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Edited by Professor S.P. Pasiechnikov

National textbook for students of higher medical educational
institutions of IV accreditation level

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In preparing the textbook were combined efforts and experience of leading national experts in urology.

The main feature of this textbook consists in the fact that it is the first textbook for basic discipline "Urology", which was prepared in accordance with the approved MoH Ukraine of modern credit-modular system of the within the 90-hour program of teaching on 4-th year in specialty "General medicine", "Pediatrics", "Medical prophylaxis" and 45-hour - on specialty "Medical Psychology".

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List of Abbreviations

- AAST - American Association for the Surgery of Trauma
- BPSA - Benign prostate specific antigen
- SD44 - cell surface polypeptide
- DOTS - Directly Observed Treatment-Short-course
- E -Cadherin Epithelial cadherin
- NIF - Hypoxia-inducible factor
- HIFU - High-intensity focused ultrasound
- HU - Hounsfield units
- ILC - Interstitial laser coagulation
- IRSS - International prostate symptom score
- ISUP - International Society of Urologic Pathology
- Ki67 - cell proliferation factor
- MIN - Minimum Intensity Projection
- MIP - Maximum Intensity Projection
- NIH-CPSI - The National Institutes of Health-chronic prostatitis symptom index
- NKF - National Kidney Foundation
- p53 - protein 53
- PCNA - Proliferating Cell Nuclear Antigen
- pH - acid-alkaline equilibrium
- proPSA - Proprostate-Specific Antigen
- PTEN - Phosphatase and tensin homolog
- SIOP (WT) - International Society of Pediatric Oncology (Wilms tumor)
- TNM - Tumor-nodules-metastases

TUMT - Transurethral microwave therapy

TUNA - Transurethral needle ablation

TUV - Transurethral vaporization

VEGF - Vascular Endothelial Growth Factor

VLAP - Visual laser ablation of the prostate

WHO - World Health Organization

WT1, WT2 - Wilms tumor protein

XMRV - Xenotropic murine leukemia virus

^{99m}Tc - drug labeled with radioactive technetium

Introduction

Urology is the section of clinical medicine, particularly surgical, which studies diseases of the urinary and male reproductive systems. At the time of Hippocrates (400-460 years BC), when doctors used a quality assessment of urine in order to identify any disease, said Felix Guyon (1831-1920), urology became an independent discipline only after two millennia. Urology has evolved into one of the most progressive high-tech branches of modern clinical medicine over the last century, especially over the last decade. In turn, this requires from doctors to study medicine more detail. Also it requires the improving of teaching skills from the faculty of medical schools.

The first book of urology in Ukrainian language was issued in 1993 by well-known Soviet scientists and educators that directly related to the creation of the Academy of Medical Sciences of Ukraine, by academician O.F. Voziyanov and corresponding member O.V. Lyulko in the same year. General acceptance of this tutorial was confirmed by the State Prize of Ukraine (2001).

The student of IV accreditation level medical universities uses a number of books that have written by different authors besides the first Ukrainian edition. These authors are the heads of departments and courses of Urology who made a lot of efforts to keep the teaching of subjects in the mainstream of fleeting changes of the theory and practice in the modern medicine.

The system of teaching in medical schools of Ukraine has undergone major changes in recent times. The main feature of this book is that it is the first national textbook on the scientific discipline of "Urology". The experience and efforts of Urology Department in the National Medical University of O.O. Bogomoletz were put to prepare this textbook. Also in the creation of the textbook the main part has token by urologists from Institute of NAMS of Ukraine, National Medical Academy of Postgraduate Education, National Medical University of Kharkov, National Medical University of Odessa, National Medical University of Lvov, Bukovina State Medical University, Dnepropetrovsk Medical Academy of the Ministry of Health, Ukrainian Medical Dental Academy, Zaporozhe Medical Academy of Postgraduate Education of Ministry of Health, Scientific and Practical Centre of Preventive and Clinical Medicine. The aim of authors was creation of the textbook, designed to train the wide profile doctors like family doctors. In their practice will certainly meet the patients with the most common diseases and primary pathological conditions of the urinary and male reproductive systems. The aim of authors was a difficult task to train the future professionals of different specialties in basic knowledge's of urology. In a rather narrow program it will properly assess how to evaluate the patient's condition in practice and how to provide the necessary assistance in their capacity, without any mistakes. We hope that the new textbook will satisfy expectations of readers - students, interns, novice doctors and teachers. We can't rely on the perfection of the first

experience with such a large group of authors and editor. All comments, tips and suggestions for improving the publication will be taken into consideration and appreciated.

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Chapter 1

Clinical anatomy and

physiology of the urinary

and male reproductive systems

1.1. The anatomical structure of the urinary system

Kidney, *ren*

Kidney is a bean-shaped paired organ. Kidneys are located on both sides of the spine in the lumbar region, in the retroperitoneal space of abdomen (Fig. 1.1). Each kidney reaches 10-12 cm in length, 5-6 cm in width and 4 cm in thickness. The weight of kidney is 120-200 grams. Left kidney is longer than right and sometimes

heavier than right. Kidneys usually have a dark brown color.

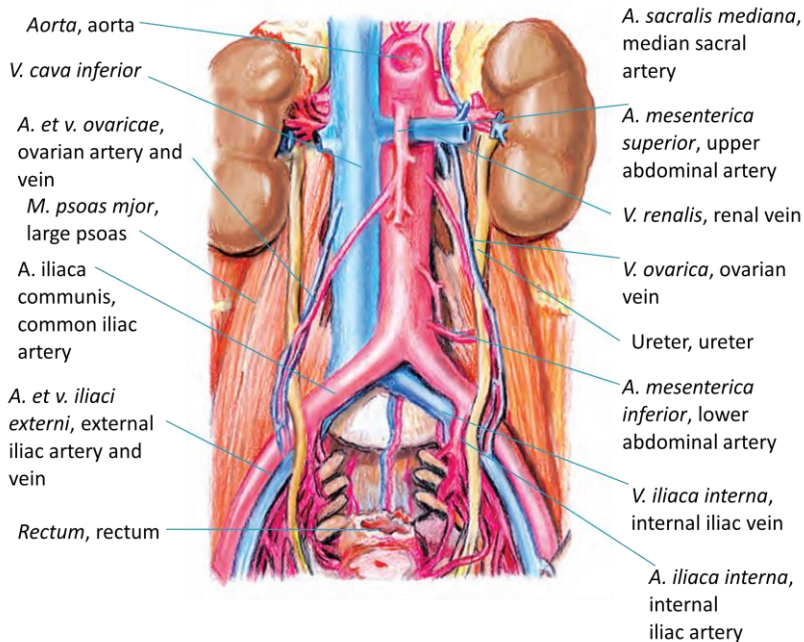


Figure. 1.1.
Organs of retroperitoneal space

Topography of kidneys

The both kidneys are located under XII rib, which extends on their axis bias upwardly and outwardly. Right kidney intersects with XII rib at its

upper and middle thirds. Upper surface of it reaches only XI rib. Left kidney intersects with XII rib almost in the middle of its length. Upper outer area of it, is above the XI rib (**Fig. 1.2, 1.3**). Upper part of the right kidney is adjacent to the right adrenal gland. The right-hand side of the liver is adjacent to the 1/4 part of front surface of kidney. Below the liver locates the right bend of the colon that is adjacent to the anterior surface of the right kidney. Descending part of the duodenum is adjacent to the medial part of the kidney, and to the gate. Front surface of the right kidney is covered by the peritoneum only in the area of contact with

liver. Upper part of left kidney is adjacent to the left adrenal gland. The upper-third front surface of the left kidney is contacted with the posterior wall of the stomach. At the middle-third it is contacted with the tail of the pancreas that intersects the gate in the lateral direction. Spleen is adjacent to top of lateral margin of left kidney.

Lower-third of the anterior medial part of left kidney is turned to the left mesenteric sinus. It contacts with the hinges of the small intestine. On the anterolateral part of the left kidney is located the left colic flexure. Front surface of the left kidney is contacted with the stomach, spleen and covered by peritoneum.

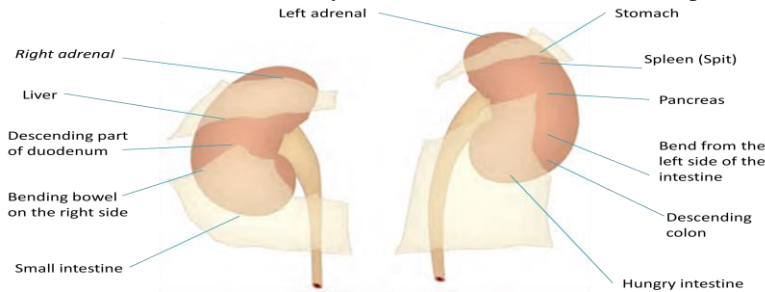


Figure. 1.2. Syntopy anterior surfaces of the kidneys

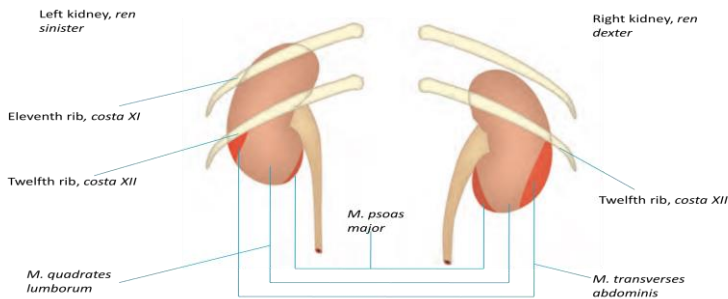


Figure. 1.3. Syntopy rear surfaces of the kidneys

The structure of the kidneys

Each kidney has anterior and posterior border, lateral and medial edges, superior and inferior border. The anterior border, *facies anterior*, is convex and slightly rotated laterally. The posterior border, *facies posterior*, is concave. Lateral part of both kidneys is adjacent to the square muscle on back. The lateral edge, *margo medialis*, is convex and slightly turned to the back wall of the abdomen. The medial edge, *margo medialis*, is concave and faces down, forward and medially. There is recess in the middle of the medial margin of kidney – gates of kidney, *hilus renalis*, which passes into the renal sinus, *sinus renalis*. Gates of kidneys form a narrower front lip in front and a wider back lip, behind. As a result, the back surface of the kidney is wider than front and renal sinus is more turned forward.

There are renal pelvis, *pelvis renalis*, renal calyces, *calyces renalis*, branches of renal vessels and nerves, lymph nodes and adipose tissue in the renal sinus. Interposition of all these entities which are

included in renal gates is: veins (V) are placed in front, arteries (A) and nerves are behind them, and renal pelvis (P) and ureter are located behind arteries and nerves (for better remembering - VAP). The superior border of kidneys, *extremitas superior*, is wider and thinner than the inferior border, *extremitas inferior*. The superior border of kidneys is located closer to the midline of the body than the inferior border. Inferior border is more distant from the spine.

The internal structure of the kidneys

At the longitudinal cut that is conducted through the kidney, we can see that kidney consists of the cavity, *sinus renalis*. There are located the renal pelvis bowls, the top of the renal pelvis and renal layer covering the cavity by all sides, except the gate. The kidney consists of the cortical substance, *cortex renis*, and renal medulla, *medulla renis*.(Figure 1.4.)

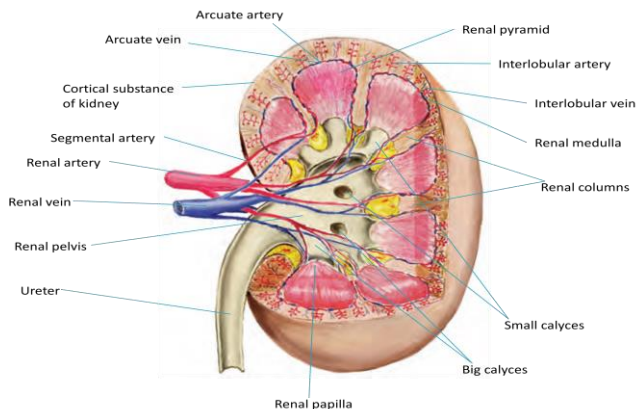


Figure 1.4. The internal structure of the kidney (front section)

The cortical substance surrounds the peripheral part of the body. Its thickness is 4 cm. The renal medulla consists of conical structures called pyramids, *pyramides renalis*. A broad basis of the pyramid is turned to body surface. The tops of pyramid are turned toward the sinus. The tops are connected with each other by two or more. They form rounded elevations that are called papillae, *papillae*

renales. In rare cases, one papilla relates to the one top. The papillae total average of about 12. Each papilla is dotted with small openings, *foramina papillaria*. Through them, the urine excels in the initial part of the urinary tract (small calyces). Cortical substance passes between the pyramids and separates them from each other. These parts are called cortical columns (*columnae renales*). The pyramids have a striped appearance due to their parallel location in the vessels and urinary tubules. The presence of the pyramids shows the lobular structure of the kidney that is typical for the most of animals. In newborn are saved traces of the former division even on the outer surface, on which are defined the furrow. The kidney of adult person is smooth outside, but in the middle it is divided into segments- pyramids. The several pyramids are merged into a single papilla.

Strips of renal medullar are moved in the cortical substance, although they are less clearly visible on it and called *pars radiata*. The spacing between it is called *pars convoluta*. *Pars radiata* and *pars convoluta* are united by one name - *lobulus corticalis*. Kidney is a complicated excretory organ. It contains tubules which are called renal tubules, *tubuli renales*. The blind ends of the tubules in the form of double-walled capsule cover the tangles of blood capillaries. Each *glomerulus* is in the cup-shaped capsule, *capsula glomeruli*. The space between the two sheets of capsule forms the cavity which is the start of urinary tubule. *Glomerulus* with its covering capsule amounts to renal corpuscle, *corpusculum renis*.(Figure 1.5.)

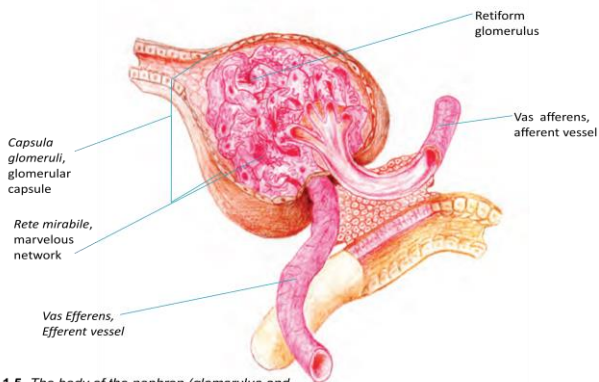


Figure. 1.5. The body of the nephron (glomerulus and capsule)

The cells of kidney are located in the *pars convoluta* of cortical substance, where they can be seen by own eye (with eyes that are not aided by microscope) as red dots. From the renal corpuscles departs convoluted tubule- *tubulus renalis controtus* that is located in *pars radiata* of cortical substance. Then the tubule lowers into the pyramid and turns back by forming a loop of the nephron, and returns to the cortical substance. The end part of the renal tubule (insert section) flows into the collecting

tubules, which are taken a few tubules and go in the parallel direction (*tubulus renalis rectus*) through *pars radiata* of cortical substance and through pyramid.

Straight tubules are gradually merge into each other in the form of short 15-20 ducts, *ductus papillaries* and open into foramina papillaria, in the *area cribrosa* on the top of papilla. Renal corpuscle and tubules which include it is the structural and functional unit of the kidney - the nephron, *nephron*. The urine is formed in the nephron.

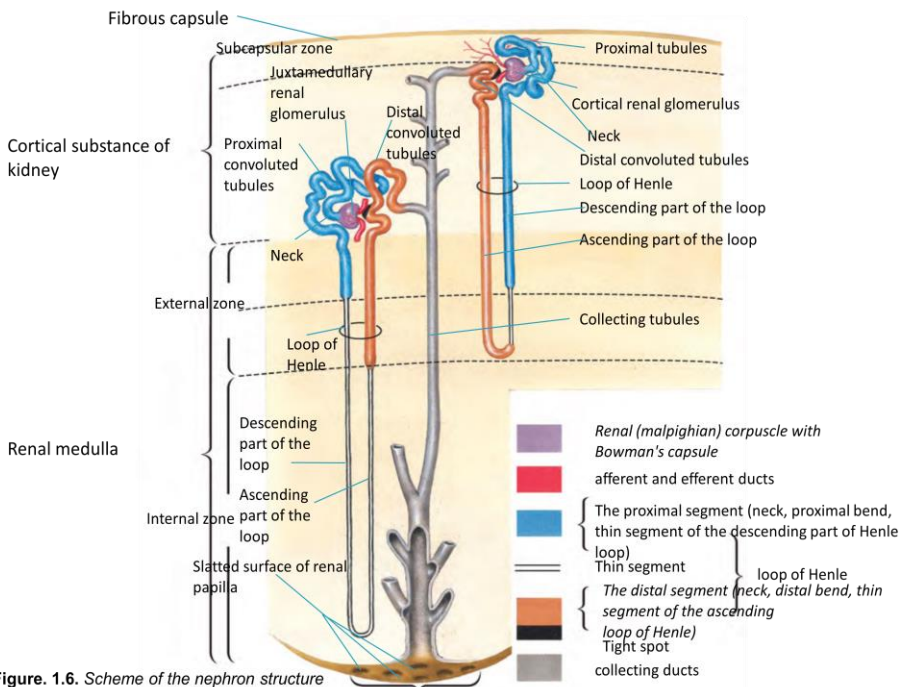


Figure. 1.6. Scheme of the nephron structure

This process is carried out in two stages: in the renal corpuscle from the capillary tubules, into the cavity of the capsule the filtered liquid part of the blood creates the primary urine. In the renal tubular is carried out the reabsorption – reabsorption of the water, glucose, amino acids and certain salts, and as result forming of residual urine. Each kidney contains about one million nephrons, the set of which is

the bulk of the renal substance.

Blood supply of kidneys

Renal artery comes from the aorta and has a large caliber. It is corresponded to the function of urinary organ which is associated with the "filtering" of blood. Near the gate of kidney renal artery is divided into sections: renal artery of the upper pole, *aa. polares superiores*, lower pole, *aa. polares inferiores*, and central part of kidney, *aa. centrales*. (Figure. 1.7).

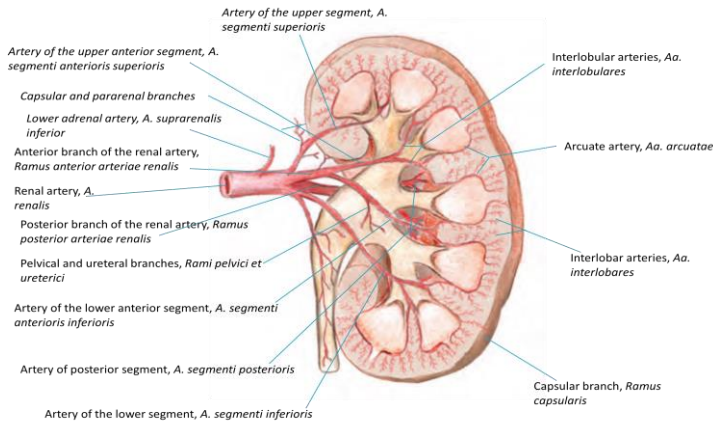


Figure. 1.7. Blood supply of the kidneys.

rectae. To the cortical substance they are sent the interlobular arteries, *aa. interlobulares*. From them depart the arterioles that are called adductor branch, *vas. afferens*. It is divided into plexiform glomerulus capillaries which are surrounded by a capsule. The glomerulus capsule, *capsula glomeruli*, is the beginning of the urinary tract. The glomerular capsule of the urinary tubules and renal glomerulus form a renal corpuscle. Glomerular capillary network is purely arterial (like the marvelous network- *rete mirabile*). At the exit of glomerulus arteriole which is located outside the capsule is called a remote vessel, *vas efferens*. It is secondary divided into the network of capillaries that serve the urinary tubules and give start to the venous system. Veins are basically repeated the course of the arteries in the parenchyma of kidney. From the renal medulla, the straight venules, *venulae rectae*, are collected the blood that flows into the arcuate veins, *vv. arcuatae*. In the cortical substance, concordantly the course of interlobular arteries are gone the interlobular veins, *vv. interlobulares*. These veins are formed of small blood vessels of superficial layer of cortical substance, called stellate veins, *vv. stellatae*, and to accept the veins from secondary capillary network that are entwined the renal tubules. The interlobular vein is infused into the arcuate veins. Arcuate veins of two neighboring particles merge and form the interlobular veins, *vv. interlobulares*, which are passed through the renal columns along with interlobular arteries. Then, around the papillae, *vv. interlobulares* are coming out of renal parenchyma in the renal sinus, where, mingling with each other, they form the renal vein, *v. renalis*, which is flowed into the vena cava inferior, *v. cava inferior*. Thus there are the two capillary systems in kidneys. The first system connects the artery and vein. The second has a special purpose in the form of vascular glomeruli where the blood is separated from cavity of capsule with only two layers of flat cells: the capillary endothelium and epithelium of the capsule. It makes favorable condition for separation of water and metabolic products from the blood.

Blood vessels are closely related to the renal tubules. Renal artery branches, *a. renalis*, penetrating from the renal sinus, *sinus renalis*, in the cortical substance are located radially between the pyramids in the form of renal interlobular arteries, *aa. interlobares renis*. Approaching to the border of the cortical substance and renal medulla, each interlobular artery is divided into two arcuate arteries, *aa. arcuate*, which are fall into adjacent particles and settle here above the base of the pyramid. They send to the renal medulla the straight arterioles, *arteriolarae*

Segmentary structure of kidneys

Each kidney contains the following renal segments, *segmenta renales*. (**Figure. 1.8**): The superior segment, *segmenta superius*, corresponds to the medial and anterior border of the superior part at the top of kidney. The supra-anterior segment, *segmentum anterius superius*, is located in front of renal pelvis and includes a front border of the top, the superior middle part of the kidney, lateral border and partially posterior border.

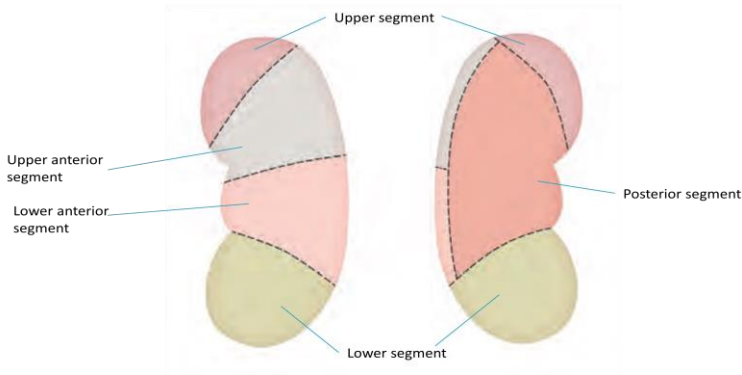


Figure. 1.8. Segments of kidney

The infra-anterior segment, *segmentum anterius inferius*, is located in front of kidney bowl too. It is opened onto the anterior surface of the kidney in the inferior section of the central part and partially on the posterior surface of it. The inferior segment, *segmentum inferius*, is located on the inferior part of the kidney. The posterior segment, *segmentum*

posterius, is located behind the renal pelvis and coincides with the rear surface of the kidney between the upper segment at the upper and the lower segment in the inferior part of kidney. The upper and lower anterior segments are located laterally.

Forniceal unit of kidney

Each cup includes a cone-shaped renal papilla. The proximal part of cup that surrounds the base of the papilla rises on its top in the form of *fornix*. In the wall of the forniceal cups are stacked smooth muscle fibers, *m.sphincter fornicis*. It is laid down with connective tissue, adjacent nerves and blood vessels (blood and lymph) and creates the forniceal unit of kidney. It plays an important role in the excretion of urine from the renal parenchyma in the calyx. It also prevents the reverse flow of urine from the calyces into the calyceal tubules. In the wall of the renal calyces are four muscles that are located above the arches (*m. levator fornicis*), around it (*m.sphincter fornicis*), along the calyces (*m. longitudinalis calycis*) and around the calyces (*m. spiralis calycis*). *M. levator fornicis* and *m. longitudinalis fornicis* are expanded the cavity of calyces, and contribute to the accumulation of urine. *M. sphincter fornicis* and *m. spiralis calycis* are narrowed the calyces by emptying of it.

Ureter

Ureter is a paired organ that connects the renal pelvis with the bladder. The length of ureter is 30-35 cm. The diameter is uneven. It is 3.4 mm in place of the discharge from pelvis (pelvic -ureteral segment) at the entrance of the pelvis (the iliac vessels crossing), passing through the wall of the bladder and the ureteral orifice. Between these places the diameter is 9 mm. (**Figure. 1.9**).

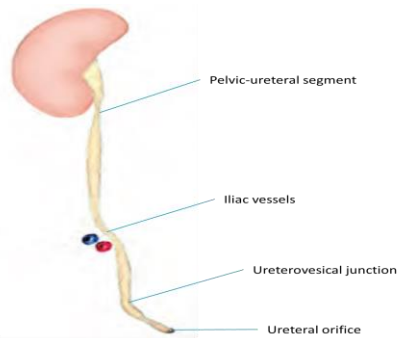


Figure. 1.9. Physiological narrowing of the ureter

There are three parts of ureter: abdominal, pelvic and intramural. Abdominal part, *pars abdominalis*, forms a bend in the place of discharge from the pelvis. The ureter extends through the front surface of the large lumbar muscle down to the pelvis terminal line, rotating downward and medially. The pelvic part falls under the pelvic peritoneum, turns medially forward

and down. By the reaching of bladder bottom, the ureter penetrates its wall in an oblique direction and opens into the cavity of the bladder by slit-like opening.

The structure of ureter

The wall of the ureter consists of three layers: the connective tissue (adventive) membrane, muscular tunic and mucous membrane. Adventive membrane, *tunica adventitia*, is composed of fibrous connective tissue mixed with elastic fibers. In the thickness of fiber periurethral tissue are located nerves and blood vessels of the ureter. The ureter is surrounded by underdeveloped fascia that is a continuation of the renal fascia. Muscular coat, *tunica muscularis*, is composed of three layers: inner longitudinal, middle circular and outer longitudinal. Thus latter is not solid and represented by separate bundles, which is more in the lower part of ureter. Mucosa, *tunica mucosa*, forms longitudinal folds, whereby the ureteral lumen has stellate shape. Closer to the lower part of ureter the folds are became smooth and ureteral lumen loses the specified form. In the thickness of mucous membrane, preferably in the upper part of the ureter, are placed a few small tubulo-alveolar glands. The topographical relation of abdominal part of the right and left ureter is different. The right ureter in the initial part is located behind the descending part of the duodenum. The lower part of the abdomen crosses the root of mesentery of the ileum. At the level of the terminal line it passes in front of common iliac vessels. The left ureter at the initial part is located behind *flexura duodenojejunalis*, and by the moving into the pelvis it crosses the external iliac vessels. The right and left ureter crisscross the testicular or ovarian vessels in the region of the middle or upper third of their length. Topographical relations of the intrapelvic part at right and left sides are the same but different in men and women. Ureter crosses the vas deferens before it enters the bladder, which is located medial to it. The place of entry into the bladder is located lower the recto-vesical depth and coincides with the top of the seminal vesicles. Women ureter crosses the initial part of the uterine artery. Then going medially, down and in front, it takes place in parauterine fiber and here at the cervix, it crosses uterine artery, locating below it. Ureter crosses the anterolateral wall of the vagina and enters the bladder.

Innervation The nerves of ureter have a sympathetic coming. To the upper part they approach from *plexus renalis*. To the lower part, *pars abdominalis*, they approach from the *plexus uretericus*. To *pars pelvina* they approach from *plexus hypogastricus inferior*. The ureters (at the lower part) receive the parasympathetic innervation from *nn. splanchnici pelvini*.

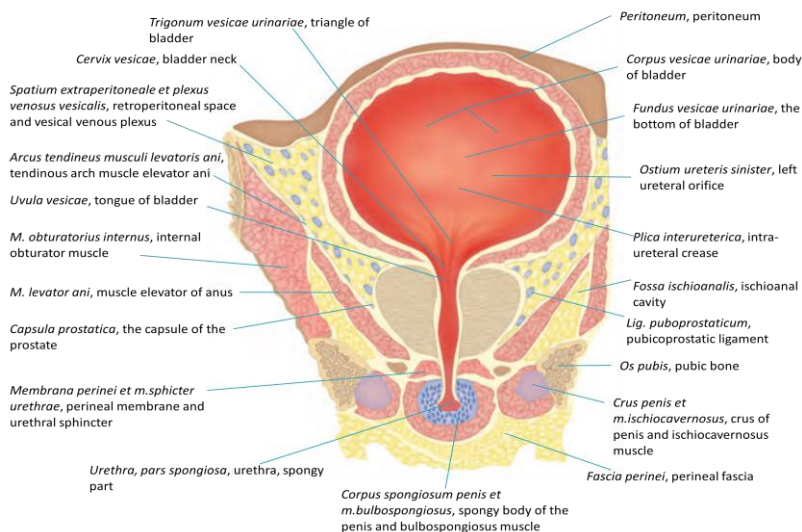
Blood supply Ureter receives the blood from several sources. The branches of, *a. renalis*, approach to the wall of *pelvis renalis* and upper part of ureter. To the walls of *pelvis renalis* and upper ureter are suitable the branches of *a. renalis*. To the middle part of the ureter are suitable rr. *ureterici* (from the aorta, *a. iliaca*

communis or *a. iliaca interna*). *Pars pelvina* of the ureter is powered from *a. rectalis media* and *aa. vesicales inferiores*. The venous blood flows in *v. testicularis* (or *v. ovarica*) and *v. ilica interna*.

Bladder, *vesica urinaria*

The bladder is a hollow flat-round muscular organ, which is located in the pelvic cavity, directly behind the pubic symphysis. The size and shape of the bladder is changed depending of its urine content. The filled bladder has a pear-shaped form. The wide part faces upwards and back, and is narrowed downward and in front. The bladder is emptied when the walls falls down and has a saucer shape. The volume of bladder is 250-300 ml. (Figure. 1.10).

Figure. 1.10. The structure of the bladder



The bladder is composed of several parts which pass into each one. The main part of a bladder is a body, *corpus vesicae*. Upper front of the bladder forms its apex, *apex vesicae*, clearly visible when the bladder is filled. It goes over towards the umbilicus at the median umbilical connection, *ligamentum*

umbilicale medianum that connects the bladder with the umbilicus. This ligament is an overgrown *urachus*. The posteroventral part of bladder that directs toward the rectum at man, and toward the vagina at woman, is the bottom of the bladder, *fundus vesicae*. It is the less moving part of the bladder. In the body of the bladder are distinguished the front, rear and side walls. The front wall is corresponded to area between the top and the bladder neck. It is turned to the pubic symphysis, and when the bladder filled, it is located behind the front abdominal muscles - pyramidal and straight. The rear wall, facing up into the abdominal cavity and makes the section that is covered with peritoneum.

The structure of the bladder

The wall of the bladder is composed of smooth muscle tissue. The cavity of it is lined with mucous membrane. It is partially covered by connective tissue sheath, partly serous and peritoneum. Muscular layer, *tunica muscularis*, is rather thick and consists of three layers which are passed into each one: the outer, middle and inner. The outer longitudinal layer, *stratum externum*, is started on the each side of the pubic fusion from the lower branches of the pubic bone pubic-vesical muscle, *m. pubovesicalis*. It goes back to the bladder neck and by lower and then rear surface it reaches the top of the bladder. Passing through the posterior wall of the bladder, muscle gives in men to the muscle layer of the rectum, rectal cystic paired muscle, *m. rectovesicalis*. The same muscle in woman goes to the cervix, and on the rear surface it goes to the rectum and buttocks - rectouterinus muscle, *m. rectouterinus*. The next is located deeper. It is the most

powerful muscle layer of the bladder. The middle layer is the basic structure of the muscle wall. It is formed by circularly (in horizontal plane) arranged bundles. In the area of the bladder neck it forms a muscle pulp of bladder. The deepest inner layer is the weakest. It consists of longitudinal muscle bundles, partly oblique direction and develops only in the area of the bottom of the bladder. All three muscle layers are not equally developed in all areas of the bladder. Due to the presence of muscle bundles that pass obliquely from one layer to another, the boundaries between them are not expressed. The uneven development of muscle layers determines that under strong stretching of the bladder wall some parts of it may be thin, and located beneath it mucous membrane is stretched. Mucosa, *tunica mucosa*, consists of multilayered transitional epithelium. Mucous membrane, *tunica mucosa*, consists of multilayered transitional epithelium, has a submucous basis, *tela submucosa* that is rich by fibrous connective tissue and pierced by thinner and thicker elastic fibers, and in result forms numerous folds that are followed the contour of the muscle layer; In a filled bladder these folds are stretched. There are three openings located in the anterior bottom section of bladder: two - ureteral orifices, *ostium ureteris*, and one - the internal urethral orifice. The holes are located at the corners of urinary cystic triangle, *trigonum vesicae*. It is the most fixed section of bladder that moves the least. Within this triangle mucous membrane is devoid of submucosal base and grows into the muscular layer tightly and without folds. The openings of the ureters, *ostium ureteris*, are formed the right and left upper corners of the triangle. Both holes are connected by periurethral fold, *plica interureterica*. It is formed by bundles of muscles from both ureters. Near the top of the triangle that is located in front and lower, places the internal orifice of urethra, *ostium urethrae internum* with half-moon shape. Behind the orifice of urethra the mucous membrane forms a protrusion - tongue bladder, *uvula vesicae*, which goes into urethra crest, *crista urethralis*. Suproposterior and partially lateral surface of the bladder are covered by peritoneum. By the transition of peritoneum from bladder to the posterior surface of the anterior abdominal wall forms the transverse fold of bladder, *plica vesicalis transversa*. Behind the level of the confluence of the ureters, peritoneum passes from the bladder to the rectum. To the uterus at woman. By its front retroperitoneal surface, bladder is adjacent to the pubic symphysis and upper branches of the pubic bone and separates from them by piece of prostatic fascia. In the filled state, bladder comes out back to top of pubic symphysis, which is situated behind the straight abdominal muscles. The seminal vesicles, vas deferens and partially prostate gland are adjacent to the bottom of bladder in men. In the interval between the seminal vesicles to the bottom of the bladder is adjacent the front wall of the rectal ampulla. The perineal aponeurosis is contained between the rectum and bladder. To the bottom of bladder are adjacent the cervix and anterior vaginal wall at woman. Anteroinferior part of the bladder and its neck, are adjacent to posterior part of the upper anterior surface of the prostate gland - in men, and urogenital diaphragm - in women. The lower parts of the bladder side walls are located under peritoneal, partially adjacent to the pelvic and at full bladder condition- to locking muscle. The vas deferens is adjacent to them- in men, and to the round ligament of the uterus-in woman.

Circulation of the bladder is carried out from the system of *a. iliaca interna*. One or two *a. vesicalis superior* frequently depart from no obliterated part of *a. umbilicalis*. *A. vesicalis inferior* is directly departed from the front trunk of the *a. iliaca interna* or the locking artery. The veins of the bladder form a network in visceral cellular space of bladder. From there, the blood is directed in venous plexus of the bladder and prostate that is located in retropubic area. Then blood flows in *v. iliaca interna*.

Innervation of the bladder is provided by upper and lower hypogastric nerve plexus, pelvic visceral nerves and genital nerves that form the walls of the bladder and especially near the confluence of ureter with it and around *plexus vesicalis*. The outflow of lymph from the bladder is carried out in *nodi lymphoidei iliaci*, located along the external iliac arteries and veins, and in *nodi lymphoidei iliaci interni* and *sacrales*.

Urethra

Male urethra, *urethra masculina*, is a tube with length of about 18 cm, which goes from the bladder to the outside opening of the urethra, *ostium urethrae externum*, at the head of the penis. The urethra passes through various formations. There are three parts of urethra: *pars prostatica*, *pars membranacea* and *pars spongiosa*. *Pars prostatica*, prostate part which is closest to the bladder through the prostate gland. Length of this section is about 2.5 cm. The prostate, especially the middle section is the most extensive and tensile portion of the urethra. On its rear wall is located a small median elevation - *colliculus seminalis*, spermatic tubercle with length of about 1.5 cm. At the top of the spermatic tubercle the slit opening leads into a small blind pocket that is located deep in the prostate, called *utricleus prostaticus* (Weber's organ). In the *colliculus seminalis* on either side of the entrance to *utricleus prostaticus* are contained small holes of seminiferous canal (one on the right and left sides). There are numerous holes of prostatic glands which are opened on both sides laterally to the spermatic tubercle. The wall in this part of the urethra is consisted of mucous membrane and muscle layer. The mucous membrane in the no stretched longitudinal channel forms folds. Around the circumference of the prostatic urethra is located a ring of muscle fibers which are the part of smooth muscle tissue in the prostate. They enhance the sphincter of the bladder, *sphincter vesicae urinariae* (smooth, spontaneous). *Pars membranacea*, membranous part of the urethra that is located away from the top of the prostate to the *bulbus penis*. The length of it is about 1 cm. Thus, this section of channel is the shortest and simultaneously the narrowest of the other three. It is located behind and below the *lig. arcuatum pubis*, and penetrates *diaphragma urogenitale* on its way with its upper and lower fascia. The lower end of the membranous part in place of breakthrough of the lower fascia is the narrowest and least lingering part of channel. It must be considered for preventing the rupture of the channel when we use catheter. The prostate and membranous parts form a fortified part of urethra, spongy – forms the moving part. *Pars spongiosa*, spongy part with a length of about 15 cm. It is surrounded by a tissue of *corpus spongiosum penis*. The part of the channel according to the bulbus is slightly extended. On the rest distance to the head, the diameter of channel is even. The channel expands again in the head with length about 1 cm and forms navicular fossa, *fossa navicularis urethrae*. The external hole is a little tensile part of the urethra. It should be considered in determining the probe. The anatomical division of the urethra consists of 3 parts. In the urological clinic (according to the course of inflammatory processes) it consists of 2 divisions: the anterior urethra, *pars spongiosa*, and rear – *pars membranacea et pars prostatica*. The boundary between them is *m. urethrae sphincter*. It prevents the penetration of infection from the anterior urethra to the rear part. Throughout the mucosa, except for the closest to outer hole of area, the channel opens numerous glands - *glandulae urethrales*. In addition, on the upper wall of the urethra, especially in front of the bulbs contained hollow - *lacunae urethrales*, holes which are aimed forward and covered by valve-shape baffles. Outside of the submucosal base is a layer of no separated muscle fibers (longitudinal-inside, circular-outside). Urethra in men on its entire length has S-shaped bend and forms two curvatures: first, is bent down, bends around the pubic symphysis, and second, is bent upward and to the root of the penis. *Pars spongiosa* in lifted up state has the straight anterior curvature and remains one of the concavity curve, which is turned to the symphysis pubica. The great fixation of posterior curvature is provided by *ligg. puboprostatica*, coming from the symphysis to the prostate, *diaphragma urogenitale* (through it passes *pars membranacea urethrae*), and *lig. suspensorium penis*, connecting penis with symphysis. Caliber of the urethral lumen is not always the same: the place of the *pars spongiosa* and *pars membranacea* is an average of 4.5 mm, outer hole - 6 mm, the middle *pars prostatica* - 11 mm, in the field of the bulb - 17 mm.

Blood supply comes from branches of *a. pudenda interna*. Different parts of the channel are powered from different sources: *pars prostatica* - from the branches of *a. rectalis media* and *a. vesicalis inferior*; *pars membranacea* - from *a. rectalis inferior* and *a. perineals*; *pars spongiosa* - from *a. pudenda interna*. In the vascularization of channel walls are also involved *a. dorsalis penis* and *a. profunda penis*. Venous blood flows to the penis veins and the veins of the bladder.

Innervation goes from *nn. perinei* and *n. dorsalis penis* (with *n. pudendus*) and from the vegetative plexus, *plexus prostaticus*.

The outflow of lymph comes from *pars prostatica* to the lymphatic vessels of the prostate, from *pars membranacea* and *pars spongiosa* - to the inguinal nodes.

Female urethra, *urethra feminina*, is significantly different from the male. Starting as a male, from the inner hole of bladder (*ostium urethrae internum*) and having rounded from below and behind the bottom edge of the pubic symphysis, it finishes already at 3-3.5 cm, that is in 5-6 times smaller length than of men. The external hole of the channel, *ostium urethrae externum*, opens in vaginal vestibule in front and higher its hole and is the narrow place of channel. The rear wall of the channel is closely connected to the front wall of the vagina. Outside the period of the passage of urine through the urethra the front and back wall of it, come into contact, but due to their significant stretch clearance, female urethra may increase to 7-8 mm. The wall of the female urethra is composed of muscle, submucosa and mucous membranes. The mucous membrane (*tunica mucosa*) has longitudinal folds on its surface and recesses - urethral lacunae (*lacunae urethrales*); deep in the mucosal are located urethra glands (*glandulae urethrales*). Groups of these glands are opened on both sides of the external opening of the urethra general lacunar ducts. The fold of mucous membrane at the back of the urethra is developed particularly strongly; it looks like a urethral crest (*crista urethralis*). In friable *tela submucosa*, penetrating also in tunica muscularis, is located the vascular plexus that in cut reminds the cavernous tissue. *Tunica muscularis* is contained outside of the mucous membrane, in which distinguish the inner circular and outer longitudinal layers. The circular layer is adherent to the muscle layer of the bladder, that covers the inside hole of the female urethra, and forms an involuntary sphincter. In the bottom part, in place of passage through the urogenital diaphragm, the female urethra is surrounds the bundles of muscle fibers, which form an arbitrary sphincter (*m.sphincter urethrae*).

Blood supply of the female is powered from *a. vesicalis inferior* and *a. pudenda interna*. Veins are flowing through venous plexus, *plexus venosus vesicalis* in *v. iliaca interna*.

Innervation is carried out from the *plexus hypogastricus inferior*, *nn. splanchnici pelvini* and *n. pudendus*.

1.2. Physiology of the Urinary System

The assessment of the regulatory systems is important characteristic of the kidney activity that adapts the work of the kidneys to needs of the whole organism. Therefore, should to differentiate two concepts - kidney functions and processes that provide them.

The kidneys involved in human body:

- 1) Maintaining constancy of body fluid volume, concentration of osmotic and ionic composition;
- 2) Regulation of acid-base balance;
- 3) Excretion of nitrogen metabolism products;
- 4) Economy or excretion of various organic substances (glucose, amino acids, etc.);
- 5) The metabolism of carbohydrates and proteins;
- 6) Secretion of biologically active substances (endocrine function of the kidney);

- 7) The regulation of blood pressure;
- 8) The regulation of erythropoiesis;
- 9) Blood coagulation.

The basic structural unit of the kidney is the nephron that is presented in its original department renal glomeruli, where occurs the filtration of blood capillaries. Received fluid is called the primary or provisionally urine. The norm of primary urine is around 180 liters per day. *Primary urine*, passes through the tubules into final urine, the daily amount of which is less than 1.5-2.0 liters. There are 85% of water and sodium, protein, glucose, amino acids, phosphorus reabsorbed in the proximal tubules of the nephron. Terminal part of the nephron determines the concentration kidney fraction. In these parts of the nephron by complex biochemical processes take place mechanisms of acid-base and water-electrolyte balance and ensure acido- and amino genesis support. The participation kidney in regulation of blood pressure and erythropoiesis is carried out by juxtaglomerular apparatus. Thus, the kidney is an important organ, whose multiple functions are aimed at achieving a common goal - to maintain homeostasis, the constancy of internal environment. There are filling and emptying phases of isolated renal pelvis activity. The frequency of rhythmic contraction depends on the volume of urine that comes from the calyces. The filling phase lasts 10-15 seconds and emptying phase lasts 2-3 seconds, on average. At the time of emptying pelvis under the influence of contractile activity of its smooth muscle wall the intra-pelvic pressure is increased that activates localized in it baroreceptors. Their excitation expands the proximal ureter and thus provides midstream urine flow in its lumen. The function of the ureter is consisted in transportation of urine from the cavity of kidney into the bladder through consistent active dilatation and reduction of its functional departments - cystoids. The last are separated by a sphincter-like entities, dilatation of which coinciding with a reduction in proximal cystoids, provides the passage of urine in the distal parts and then - in the bladder. The function of the bladder is collection of urine, maintenance of it and evacuation in the urethra outside (the act of urination). An essential condition of the urine accumulation in the orifice of bladder is closed internal opening of the urethra, which is determined by the function of smooth muscle sphincter – a complex locking unit of the bladder, which is anatomically represented by its neck, as well as the reduction of striated urethral sphincter. It is known that smooth muscle sphincter of the bladder is under control of the autonomic nervous system, whereas the urethral sphincter has somatic innervation and controlled by consciousness. The adult bladder can hold up to 400-500 ml of urine in normal. Whereas it's physiological capacity is 200-250 ml. The act of urination occurs 4-6 times a day, but depending on the amount consumed and its fluid loss through sweating and breathing may be less often or more often. The function of male and female urethra varies. The urethra takes only urine from the bladder in women, whereas it also participates in the reproductive function, providing transportation ejaculate seminal tubercle of the male urethra to the female vagina, in men.

1.3. The anatomical structure of the male reproductive system

Prostate

Prostate - is unpaired body with smooth muscle and glandular tissue which is located in the lower pelvic cavity below the bladder and surrounded by the pubic symphysis, anterior wall of the rectum and anterior urogenital diaphragm.

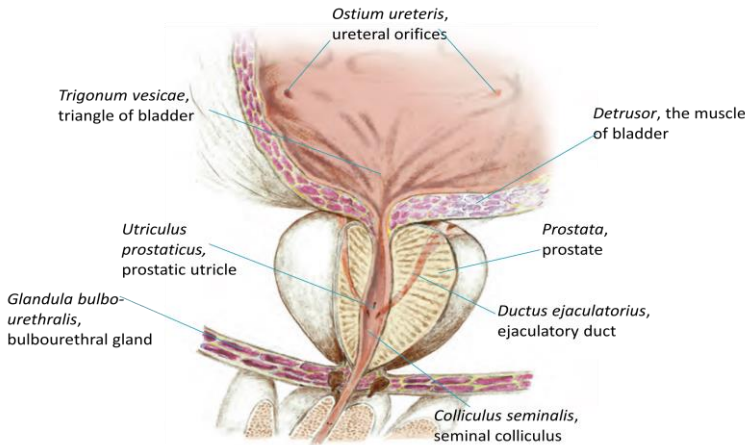


Figure. 1.11. Prostate, urethra

The prostate gland has the shape of a chestnut; it is distinguished on the downward to the urogenital diaphragm narrower apex of the prostate, *apex prostatae*, and wide with a concave surface directed to the bladder base of the prostate, *basis prostatae*. (Figure. 1.12). The front surface of the gland, *facies anterior*, is faced to the pubic symphysis, its rear surface, *facies posterior* – is faced to the rectal ampulla. Besides front and rear surfaces, the prostate gland can be distinguished also on the lower-rounded lateral surface, *facies inferiolateralis*, which is addressed respectively in the right and left sides to the muscle that raises the anus, *m. levator ani*. The prostate is composed of 30-50 glands that form the *substantia glandularis*, and muscle substance, *substantia muscularis* that forms stroma of gland. The glands of *ductuli prostatici* are opened into the prostatic part of the urethra.

The prostate gland has the shape of a chestnut; it is distinguished on the downward to the urogenital diaphragm narrower apex of the prostate, *apex prostatae*, and wide with a concave surface directed to the bladder base of the prostate, *basis prostatae*. (Figure. 1.12). The front surface of the gland, *facies anterior*, is faced to the pubic symphysis, its rear surface, *facies posterior* – is faced to the rectal ampulla. Besides front and rear surfaces, the prostate gland

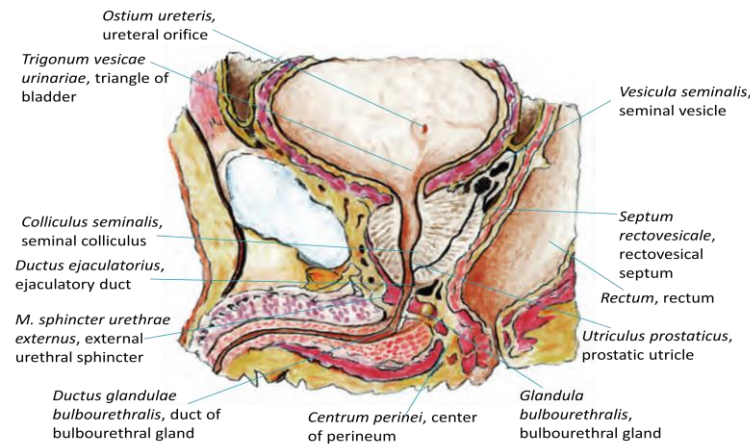


Figure. 1.12. Prostate, urethra (sagittal cut)

The bulk and slightly longer glandular ducts are contained in rear and lateral parts of the gland, and only a small amount of shorter strokes, locates in front; the anterior median area is free of them itself and has a muscular substance. The gland is surrounded by a capsule, from which penetrates the connective tissue elastic fibers and smooth muscle – the stromal gland components. Stroma is located between the ducts by separating glandular substance into lobes. (Figure. 1.13). Muscle fibers pass into the gland from the wall of adjacent to the base of the bladder.

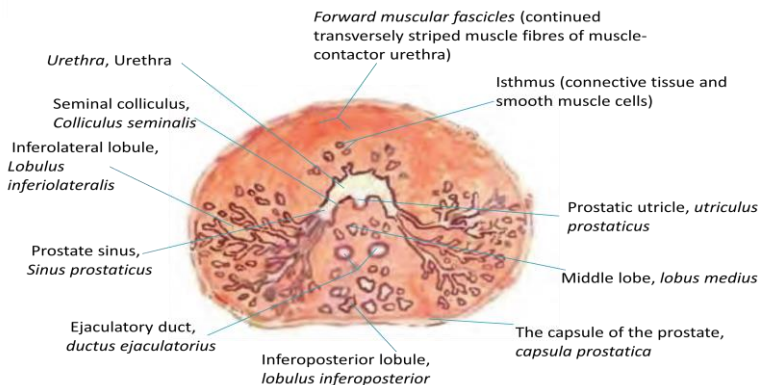


Fig. 1.13. Prostate (horizontal cut)

Above glands that occur in the urogenital diaphragm, contains

transitional from diaphragm striated muscle fibers, which form part of an arbitrary muscle - urethral sphincter, *m. sphincter urethrae*. The prostate gland is located in the middle subperitoneal floor of small basin. It has a conical shape and directed the top down to the urogenital diaphragm. The base of prostate that is located upper, almost below the bottom of bladder. There are two parts of prostate: the lobe and isthmus. It covers the initial portion of the urethra partially that comes from the bladder. The prostate gland is well-defined from all sides except the base, visceral fascial capsule, *capsula prostatica* (Pirogov - Rettsa) from which goes to pubic bones *mm. (ligg.) puboprostatici*.

The syntopy of prostate

Over the prostate gland is located the bottom of the bladder, seminal vesicles and ampulla of vas deferens. Below is urogenital diaphragm, in front is rear surface of the pubic symphysis, and on back are located fascia *rectoprostatica* and ampulla of the rectum. The prostate is easily palpated through the rectum. (Figure. 1.11, 1.12, 1.14).

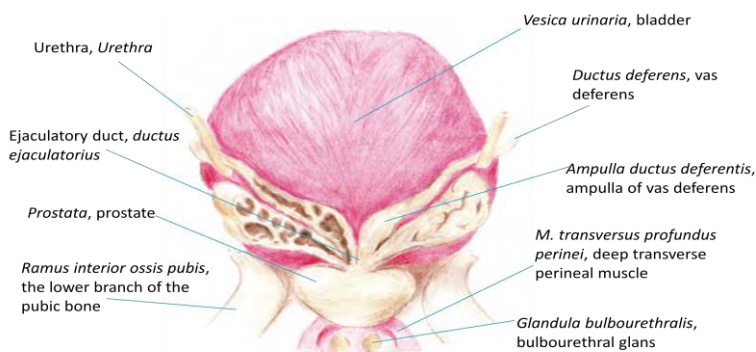


Fig. 1.14. Topography of the prostate

Blood supply of the prostate is carried out by branches of *aa. vesicales inferiores* and *aa. rectales mediae* (with *a. iliaca interna*). The veins form venous plexus, *plexus prostaticus*, that merges with the *plexus vesicalis*; then the blood flows in *v. iliaca interna*.

Innervation of the prostate

provides by lower branches subperitoneal plexus, *plexus hypogastricus*.

The outflow of lymph from the prostate is carried out to the lymph nodes which are located along *a. iliaca interna*, *a. iliaca externa* and the pelvic surface of the sacrum. The lymphatic system is associated with the lymphatic system of the urethra, bladder and rectum.

Scrotum

Skinny muscular formation is the repository of testicular appendages and the lower part of the spermatic cord. It occupies the anterior perineum area between it and the penis, and consists of a skin and a few layers. The skin of scrotum amounts to direct continuation of the penis skin, it is thin, without fat, wrinkled, more pigmented than the skin of the abdomen or thighs which is covered by rare hair. In the skin are located a large number of sweat and sebaceous glands in the middle of the surface, in the anteroposterior direction, starting from the root of the penis and ending at the perineum, located stitch scrotum, *raphe scrotum*, which looks like a low skin ridge.

Under the skin contains a fleshy membrane, *tunica dartos* that consists of smooth muscle fibers network. It is spliced to the skin by large number of jumpers. This membrane forms the multiple skin folds on the scrotum.

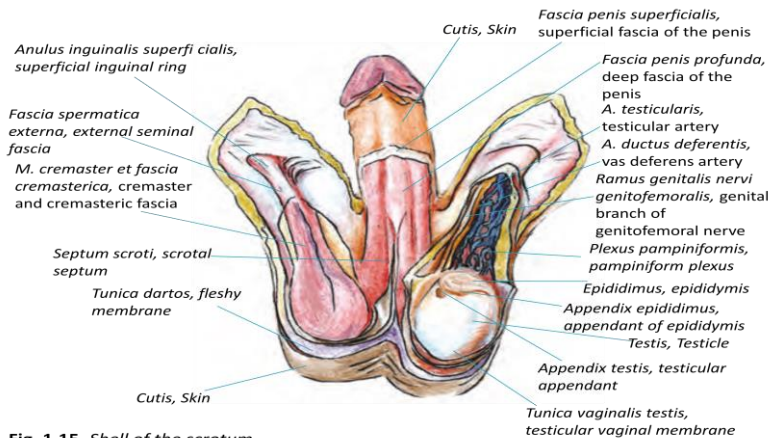


Fig. 1.15. Shell of the scrotum

parietalis, visceral plate, *lamina visceralis*, and finally albuginea of testis, *tunica albuginea*. The scrotum cavity divided into two halves - the right and left, the membrane scrotum goes sagittally, *septum scroti*, which corresponds to the surface of the skin to suture of scrotum.

Blood supply: *aa. scrotales anteriores et posteriores (aa. femoralis, pudenda interna, obturatoria)*.

Innervation: *plexus hypogastricus, nn. pudendi, ilioinguinales, genitofemorales*.

Vas deferens, ductus deferens

A pair organ, with form of thick tube with length of 50 cm, diameter 3 mm with clearance of 0.5 mm, which starts from the lower end of the tail of the epididymis and offers a total duct in the prostate seminal vesicles of the urethra. Vas deferens is consisted of several departments. Primary plot is situated in the epididymis and submit's by sharply twisted cylindrical tube. Its second piece that goes as part of spermatic cord in the scrotum and then into the inguinal canal, in the peritoneum, the bladder floor, looks like equal cylindrical tube of white color. The final section - ampoule of vas deferens, *ampulla ductus deferentis*, is expanded; its wall is provided by cavity; diverticula capsules, *diverticula ampullae*, visible externally as a tuberosity. Connecting to excretory ducts, *ductus excretorius*, of seminal vesicles, it forms a vas deferens duct, *ductus ejaculatorius*. In the wall of the vas deferens membranes are distinguished: external (adventive), middle (muscle) and inner (mucous). Adventive membrane, *tunica adventitia*, is a connective tissue with a touch of elastic fibers; shell that carries nourishing blood vessels and nerve elements of the ducts. Muscular coat, *tunica muscularis*, is the thickest part of the wall and consists of outer and inner longitudinal layers and a middle, circular, smooth muscle layer. Mucous membrane, *tunica mucosa*, forms longitudinal folds. It is covered by bifariamous prismatic epithelium that covers its own connective tissue plate, which also has a large number of elastic fibers.

Spermatic cord, *funiculus spermaticus*

Is the paired organ, rounded cord with length of 18-20 cm. Spermatic cords are directed from deep inguinal ring to the rear-upper part of the testicle. It hung's a testicle, and by the fact of that it contains a muscle that

Loose connective tissue locates deeper, without fat that connects it with the underlying external spermatic fascia, *fascia spermatica externa*, which is a continuation between of interpediculi aponevrosis fibers of external oblique muscle of abdomen and covers both muscle that raises the testicle, *m. cremaster* and its fascia, *fascia cremasterica*. Next layers are inner seminal fascia, *fascia spermatica interna*; *tunica vaginalis testis* which distinguish on parietal plate, *lamina*

raises the testicle, *m. cremaster*, cord lifts the testis to the inguinal canal. In the spermatic cord are located: vas deferens, ductus deferens, testicular artery, pampiniform venous plexus, testicular lymph vessels, nerves, arteries and veins of vas deferens. The elements of spermatic cord are located in the general membrane of spermatic cord and testicles, *tunica funiculi spermatici et testis*. The inner leaf of corresponding transverse abdominal fascia, *fascia transversalis*, is called the internal spermatic fascia, *fascia spermatica interna*. On its common shell is located the muscle lifting testicle, *m. cremaster*. The muscle bundles of it are connected by connective tissue fibers that make up the muscle fascia, which lifts the testicle, *fascia cremasterica*. *Fascia cremasterica* is connected with specified muscle and adjacent tissues, are surrounded by the external spermatic fascia, *fascia spermatica externa* that is a continuation of interpediculi fibers, *fibrae intercrurales*, of external oblique muscle aponeurosis of abdomen.

Seminal vesicles, *vesicula seminalis*

Is the paired organ that locates behind and on both sides of the bottom of bladder in front of the rectum.

Seminal vesicle is a saccular tube with a blind end a length of 12 cm and a thickness of 6.7 mm, which forms

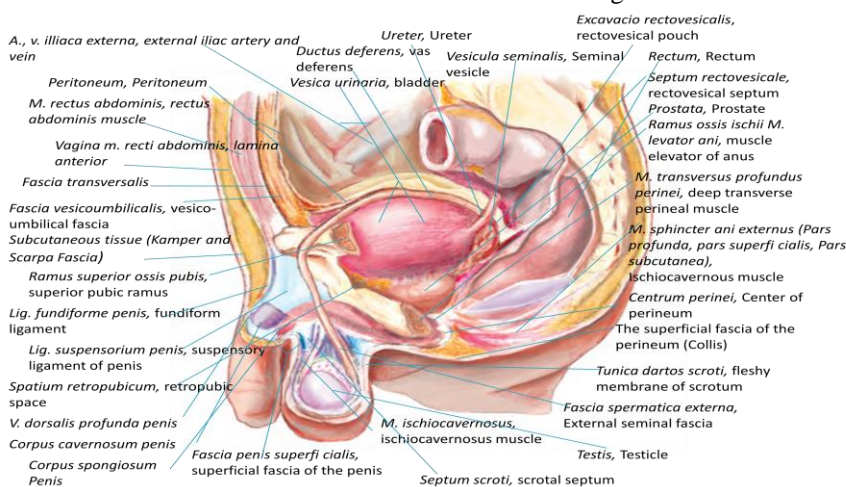


Fig. 1.16. Sagittal section of the male pelvis

a series of curves, drawn to each other and connects by connective tissue; in unstraightened (not disconnected) form of seminal vesicle, it has the form of an oblong slightly flattened in the anteroposterior direction body, with length up to 5 cm, width up to 2 cm and 1 cm thick, in which distinguish upwardly and laterally faced wide part and turned downward and medially faced narrow part - excretory ducts, *ductus*

excretorius. (Figure. 1.14, 1.16).

The wall of the vesicle, is directed toward the duct, medial, slightly thicker than the lateral. The cavity of seminal vesicle is a tortuous channel with side pockets which forms on the cut a labyrinth. The wall of the seminal vesicles is formed by elastic, collagen fibers and smooth muscle membrane, *tunica muscularis*. The cavity of vesicle is lined with mucous membrane, *tunica mucosa*. It is represented by different form of elevations that sometimes fill the lumen of the vesicle. Each spermatic vesicle membrane is enveloped by outside adventive, *tunica adventitia*. Seminal vesicles are adjacent by its front surface to the bottom of the bladder and posterior surface adjacent to the rectal ampulla being separated from it rectal-cystic wall. Medially to the ampulla of vas deferens locates, *ampulla ductus deferentis*. Near the base of the prostate excretory duct vesicle fuses with the distal end of the ampoule into the overall ejaculatory duct, *ductus ejaculatorius*, which after passing through the body of the prostate, called slit-like opening in the mucosal surface of the prostate part of urethra, side of the spermatic tubercle, *colliculus seminalis*.

Blood supply: *aa. rectales superior et media, vesicalis inferior, ductus deferentis*.

Innervation: *plexus hypogastrici superior et inferior*.

Testicles

Testicles, *testes* (Greek - *orchis* s. *Didymis*), are a pair of oval slightly flattened on the sides bodies that are located in the scrotum. Length of testicles on average 4 cm, width - 3 cm, weight - 15 to 25 g. The left testicle usually locates a bit lower than right. There are two surfaces distinguished in the testis- *facies medialis* and *lateralis*, two edges - *margo anterior* and *posterior*, and two ends - *extremitas superior* and *inferior*. The normal position of testicles in scrotum is: upper edge of it rotated upward, forward and laterally, whereby a lower edge returned not only downward, but also backward and medially. To the rear edge of testicles is suitable spermatic cord, *funiculus spermaticus*, and the appendage of the testicles, *epididymis*; the last is located along the rear edge. Epididymis has the form of long, narrow body, in which distinguish upper, slightly thickened part - the head of the epididymis, *caput epididymidis*, and lower, more pointed end - tail, *cauda epididymidis*; intermediate section is a body, *corpus epididymidis*. In the body between the front concave surface of the epididymis and testis is sinus, *sinus epididymidis*, lined with a serous membrane and opened to the lateral side. At the upper end of the testicles quite often places a little appendage - appendant testicles, *appendix testis* which in cut consists of thin tubules. At the head of the epididymis occurs *appendix epididymidis*, located usually on the leg (balance mesonephros). Testicle surrounded by dense fibrous membrane of whitish color, *tunica albuginea*, which lies directly on the matter, or parenchyma of testicles, *parenchyma testis*. At the posterior edge the fibrous tissue membrane penetrate for a short distance into the glandular tissue of testicles as incomplete vertical partitions or thickening, called *mediastinum testis*; from the mediastinum gleam like goes fibrous septum - *septula testis* that attached by their outer ends to inner surface of the *tunica albuginea* and, thus, divide the whole testicles parenchyma into lobes, *lobuli testis*. The number of testicle lobes reaches 250-300. Tops of particles turned to *mediastinum*, and foundations - to the *tunica albuginea*, testicle appendage also has a *tunica albuginea*, but thinner. (Figure. 1.17, 1.18).

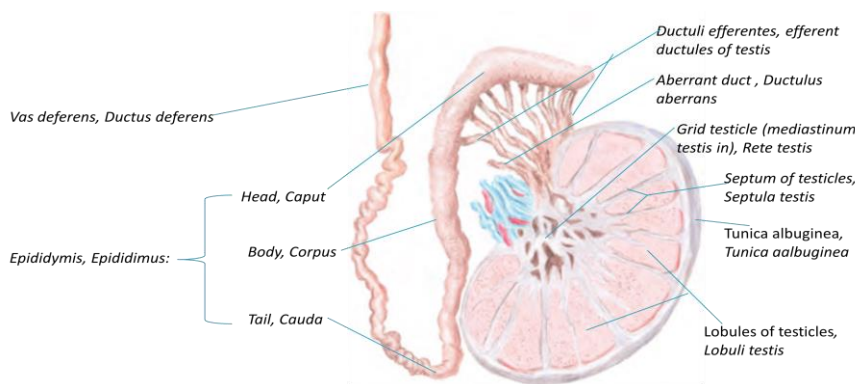


Fig. 1.17. The structure of testis

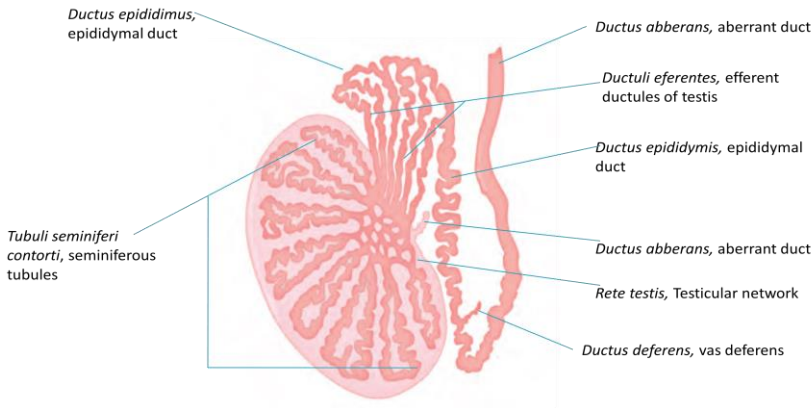


Figure. 1.18. Channels of testicles

Parenchyma of testicles consists of seminiferous tubules in which are two divisions - *tubuli seminiferi contorti* and *tubuli seminiferi recti*. Each lobule has 2-3 or more tubules. Straight tubules open into a network of passages - rete testis, located deep in the mediastinum. From network of testicles opened 12-15 remote tubules - *ductuli efferentes testis*, directed to the head of epididymis. After leaving of testicles the remote tubules become convoluted and forms a series of conical appendage particles, *lobuli s. coni epididymidis*. Ductuli efferentes open in single channel of epididymis, *ductus epididymidis* that creates numerous bends and continues in the ductus deferens. Being straightened, the channel appendage reaches 3-4 meters. *Ductuli efferentes*, *lobuli epididymidis* and the initial division of the channel form together a head appendage of epididymis. There are ducts in the epididymis that deviate, *ductuli aberrantes*. Above the head of the epididymis, in front of the spermatic cord, located a small body, *paradidymis*, - vestigial remnant of the primary buds. The formation place of spermatozoa, *spermium*, the part of the male seed - is only *tubuli seminiferi contorti*. *Tubuli recti* network of tubules and testicles belong to the excretory tract. *Tubuli recti* and tubules network testicles belong already to the excretory tract.

Blood supply: *a. testicularis*, *a. ductus deferentis* and partly *a. cremasterica*. Venous blood flows from the testis and epididymis in *plexus pampiniformis* and then into *v. testicularis*. Testicular artery waste high in the lumbar region: *a. testicularis* - from the abdominal aorta and renal arteries, *v. testicularis* flows into vena cava inferior.

Innervation: sympathetic plexus - *plexus testicularis* and *plexus deferentialis* - around the arteries with the same names.

Lymphatic vessels go from the testicles in the spermatic cord and bypassing the inguinal nodes terminate in *noduli lymphatici lumbales*. This fact, as well as a high position of *a.* and *v. testiculares*, is in connection with the laying of testicles in the lumbar region.

Penis

The penis, *penis*, constitutes with scrotum the external genitals. It consists of three bodies: paired cavernous, *corpus cavernosum penis*, and the odd sponge, *corpus spongiosum penis*. The name of these bodies is determined by the fact that they consist of multiple rungs, fibro-elastic strands mixed with unstripped muscle fibers, among dense plexus of which are intervals, caves, covered by endothelium and filled by blood. *Corpora cavernosa penis* has the form of two long cylindrical bodies with pointed ends, the rear part of which scatters and form the *crura penis*, attached to the lower branches of the pubic bone. These two bodies covered by general albuginea, *tunica albuginea corporum cavernosorum*, which in the interval between them forms a septum penis. According to the walls on the upper surface locates sulcus for *v. dorsalis penis*, and on the lower surface - for the *corpus spongiosum penis*. *Corpus spongiosum penis* is covered by tunica albuginea corporis spongiosi, lies below the cavernous bodies of the penis and penetrates the entire length of the urethra. It is smaller than the other two cavernous bodies, the diameter (1 cm), but it thickens at both ends forming in front of penis, *glans penis*, and the rear bulb - *bulbus penis* (Fig. 1.19).

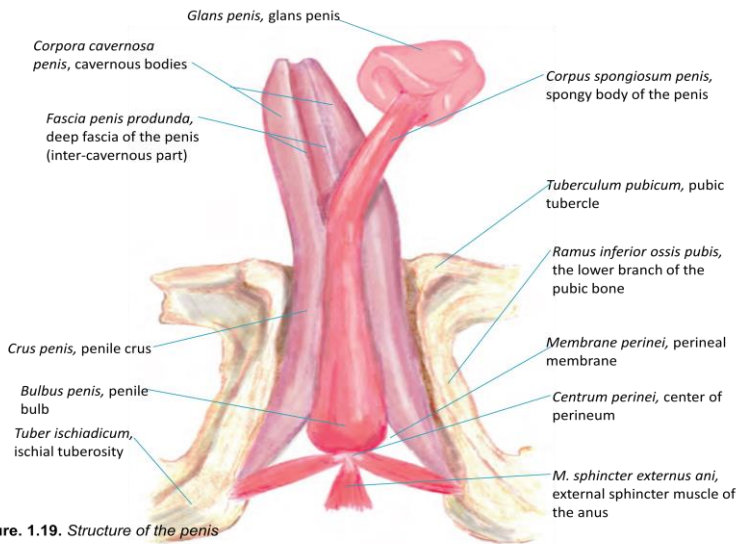


Figure. 1.19. Structure of the penis

The rear part of the penis is attached to the pubic bone and called the root, *radix penis*. The penis ends in front by head, *glans penis*. The intermediate part between the head and root is called the body, *corpus penis*. The upper surface is wider than lower surface of body and called backrest, *dorsum penis*. To the lower surface is adjacent *corpus spongiosum penis*. At the head of penis locates a vertical slit - the external urethral orifice, *ostium urethrae externum*

; the head with dorsal and lateral sides stands out a little above the *corpora cavernosa*; this region of head called *corona glandis*, and constriction behind it - *collum glandis*. The skin of the penis forms at the base of the head a loose fold, which called the foreskin, *preputium*. On the underside of the penis head the foreskin is connected with skin of head by bridle, *frenulum preputii*. Around the corona glandis and on the inner layer of the foreskin are located different size sebaceous glands, *glandulae preputiales*. The secret of these glands is part of preputial grease, *smegma preputii* that collects in the gutter between the *glans penis* and *preputium*. Between the head and the foreskin remains the space - a cavity of foreskin that opens in front of aperture which transmits the head at moving backwards the foreskin. At the surface of penis, on the line from frenulum preputii, seen the seam at the bottom, *raphe* that shows the first fusion of two distinct halves. The seam extends from the penis to scrotum and perineum. The bodies of penis are combined into one surrounding fascia, *fascia penis*, which lies under the loose subcutaneous tissue. Furthermore, the root of penis strengthens by bonds. Penis size varies depending on the number of blood cells in the cavernous and spongy bodies. Blood is brought to the penis through *aa. profundae et dorsalis penis*. Arterial branches, passing in the connective tissue septa, fall into the thin convoluted arteries, which open directly into the cavernous spaces. Veins, *venae cavernosae*, start in the central part of the cavernous body sections, some more peripheral and flowing into *vv. profundae penis* and *v. dorsalis penis*. Due to the special device of

pennial blood vessels, the blood in the cavernous bodies may be suspended that leads to their compaction during erection.

Blood supply. The arteries of penis are branches of *a. femoralis (aa. pudendae externae)* and *a. pudenda interna*. Venous outflow occurs in *vv. dorsales penis superficialis et profundae* in *v. femoralis* and *plexus venosus vesicalis*. Lymph flow carries out in *nodi lymphatici inguinales* and in the pelvic cavity nodes.

Innervation. Afferent innervation is conducted with *n. pudendus*, efferent sympathetic conducted with *plexus hypogastricus inferior*, parasympathetic with *nn. erigentes*.

1.4. Physiology of the male reproductive system

Prostate

The prostate gland has several functions: producing secret which is a component of seminal plasma that is involved in the process of urination, ejaculation and metabolism of androgens. In the prostatic cells occurs the metabolism of testosterone. Under the influence of 5-alpha-reductase, testosterone transforms into more active metabolite – dihydrotestosterone. Diseases of the prostate are the most common of all reproductive system diseases of man and can greatly disrupt the process of urinary, reproductive, and sometimes copulative function. Therefore the prostate gland of each adult patient requires a careful examination.

The penis

The main function of penis is participating in urinating, copulative and reproductive processions. The last two are implemented by the occurrence of erection. An erection of penis is a complex neurovascular process that involves the interaction of several physiological systems: central nervous system (CNS), peripheral nervous system and the smooth muscles of arteries and trabeculae penis. Erection can be seen as a cycle of penis (phases) conditions, succeeding one another.

Phase 1 - the phase of relaxation or rest. In this phase, the smooth muscle tissue and helicine arteries are reduced; the blood flow of the cavernous sinus is low and it is only for trophic needs.

Phase 2 - the phase of filling and tumescence is caused by the action of the parasympathetic nervous system and characterized by enlargement of the arteries penile usually helicine, and relaxation of smooth muscle tissues of cavernous sinuses. Filled with blood the cavernous sinuses expand and press subcutaneous venules to the tunica albuginea, and in result it reduces venous outflow and leads the penis to full erection phase.

Phase 3 - phase of full erection. In this phase, the venous outflow is virtually stopped. The pressure in the cavernous bodies is close to the systolic blood pressure. Inflow and outflow of blood in the cavernous sinus is about 3-5 ml / min.

Phase 4 - phase of rigid erection - characterized by complete cessation of blood circulation in the cavernous sinus. This is caused by a reflex contraction or arbitrary ischiocavernosus and bulbocavernosus muscles around the crus of penis.

Phase 5 - the phase of detumescence - comes after termination of orgasm or sexual stimulation. Arteries and the smooth muscle tissue of cavernous sinus reduce, restoring the flow of venous blood. The penis returns into a phase of rest. There are two basic mechanisms of erection: psychogenic and reflexogenic. Psychogenic

erections is caused by the mechanism of erotic stimulation action, which may be visual, acoustic, tactile, olfaction, imaginary. Under the influence of the stimulus in the hypothalamus, allocate neurotransmitters (dopamine, oxytocin) that activate the parasympathetic nervous system, and through erectile sacral center (S2-S4), pelvic plexus and cavernous nerve signal transmitted from the brain to the penis. Reflexogenic mechanism of erection is in its occurrence without the participation of CNS. An erection is caused by transmission of *n. dorsalis penis* stimulation of afferent impulses in erectile sacral center. The signal handles and transforms into efferent impulse for returning in the penis. Confirmations of this mechanism are the cases of erectile dysfunction in men with spinal cord injury above the erectile center (**Fig. 1.20.**)

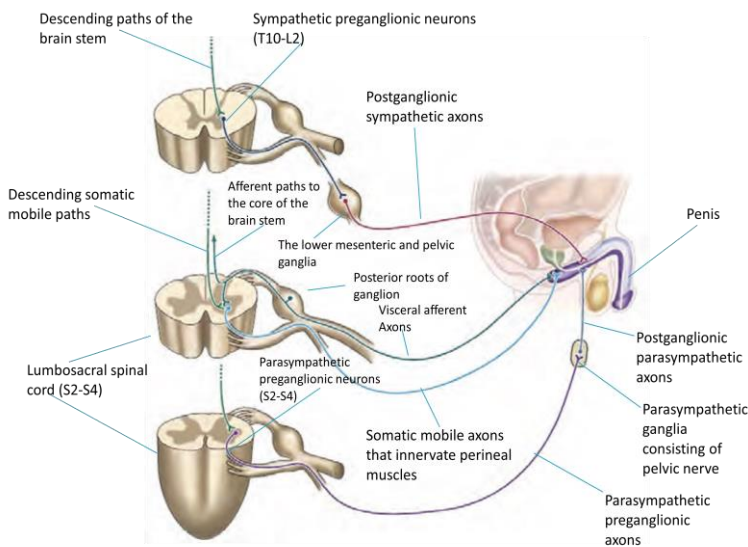


Figure. 1.20. Providing innervation of the penis

testicle volume. Steroidogenesis occurs in its turn, in Leydig cells, which constitute only 10-20% of testicular interstitial.

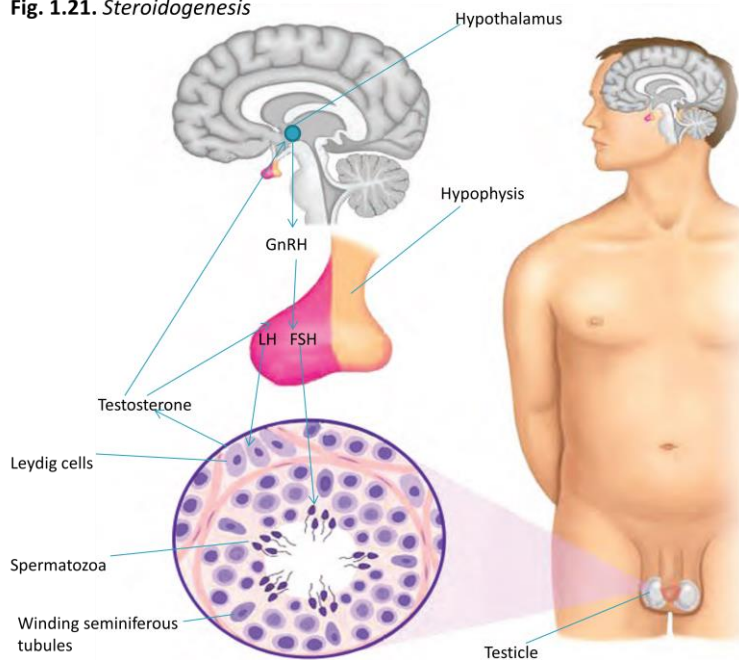
Steroidogenesis

In testicles is produced and secreted testosterone which is the main male hormone, and weaker androgens dehydroepiandrosterone and androstenedione, as well as small amounts of female hormones - estrogen and progesterin (**Fig. 1.21.**). Testosterone is the major male sex hormone that plays an important role in the maintenance of body functions at man. The main functions of testosterone and its metabolites are: development of genitals, appearance of secondary sexual characteristics according to masculine type, erectile function, libido, sexual behavior stereotype formation, formation and development of male gametes (sperm), maintaining muscle mass and bone density, stimulation of protein organospecific synthesis, inhibition of gonadotropin secretion.

Testicle

The testicles of a healthy male perform two basic functions: 1) the formation and maturation of male gametes (spermatogenesis) 2) the synthesis and secretion of male sex hormones (steroidogenesis). Both processes are closely related, but they occurred in different morphological and functional structures of testicles. Spermatogenesis occurs in the seminiferous tubules which occupy the bulk of the total

Fig. 1.21. Steroidogenesis



Spermatogenesis

The winding germinal seminiferous tubules are lined by epithelium and the Sertoli cells (see Fig. 1.22.). At the periphery of the tubule near the basement membrane are located the two types of spermatogonia - A and B. Spermatogonia of type A in its turn divided into subtypes: AD - dark (dark). Spermatogonia with no proliferative activity and may enter into mitosis with complete destruction of the entire population of sperm that can be caused, for example, exposure to high doses of radiation. Ar - pale. Cells that differentiate and share on two of spermatogonia type B. In type B spermatogonia occurs DNA

replication, resulting in each spermatogonia contains diploid set of chromosomes (2×46). Then they share by mitotic division, and form spermatocytes of first order (2×46). Then occur the two meiotic divisions whereby each of the first order spermatocytes, which, in turn, are divided into two spermatids. At meiotic division in cells the number of chromosomes is halved, so each spermatid contains 22 autosomes and one X or one Y.

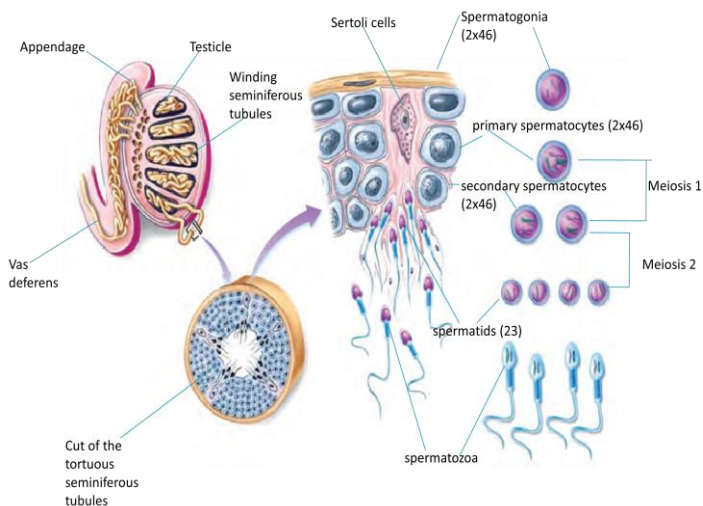


Fig. 1.22. Spermatogenesis

After all divisions, the spermatids associates with Sertoli cells, where carries the transformation process (Fig. 1.22). As a result of this process and the spermatids ripen and turn into mature gametes. After that the last of them fall into testicular appendage where it accumulates and matures. Overall testicle produces an average 123×10^6 (21 to 374×10^6) of sperm daily. The germ and secretory functions

of testicles have a complex neurohumoral regulation. The central nervous system affects on the hypothalamus through the neurotransmitters that can inhibit or stimulate the production of all GnRH and gonadotropin-releasing hormone (GnRH) directly (Fig. 1.21). GnRH secreted by the neurosecretory cells of the hypothalamus and via portal vessels of pituitary controls the secretion of gonadotropin (GT). In the front

lobe of the pituitary gland synthesize and stand out gonadotrophic hormones: luteinizing hormone (LH) and follicle-stimulating (FSH). LH effect on Leydig cells and stimulates the production of testosterone. FSH stimulates spermatogenesis through influence on the germinal epithelium and Sertoli cells. On all levels of regulation operates feedback. Testosterone and its metabolites affect the hypothalamus and pituitary gland, regulating the secretion of GnRH and GT. Increasing testosterone levels in the blood reduces the excretion of LH, thereby regulating the cells of Leydig.

Epididymis

Epididymis performs important functions such as maturation of spermatozoa, their accumulation and transportation. Gametes transports into the spermatic tubule getting into the epididymis. This process is caused by rhythmic peristaltic movements of the contractile cells that surround the duct of the epididymis, and on average lasts from 2 to 12 days. After passing through the head and body of the epididymis, sperm accumulates in the tail of the epididymis. The healthy men of reproductive age have in the caudal part of the epididymis from 209 to 155 million of gametes. Being in the epididymis, spermatozoa undergo a series of metabolic transformations and acquire their main characteristics: mobility and ability to fertilize. In particular, the tail of the epididymis rate of sperm movements is higher and the amplitude is smaller than in the head, causing them to move fast. Furthermore, it is known that sperm isolated from the testis and unable to fertilize the testicle by itself.

Vas deferens

Vas deferens is the organ which promotes transport of sperm from the tail of the epididymis to the ampulla of vas deferens, where they accumulate. Gametes during ejaculation push out from vas deferens, by contraction of muscular layer in the wall of the duct. This is the strongest muscle layer compared to other hollow organs, as evidenced by the speed and power of contractions.

Seminal vesicles

The most important function of the seminal vesicle is secretion 50-60% semen with a high content of fructose which serves as the primary source of energy and metabolism of sperm, which provides mobility. The secret of seminal vesicles is composed of a jelly-like substance that becomes liquid in a few minutes after ejaculation. In the seminal vesicles also occurs resorption of liquid components and lysis of sperm by macrophages.

Control tasks

1. Describe the topography and syntopy kidneys.
2. Describe the structure of the nephron.
3. List the main functions of the kidneys.
4. Structure, topography and function of the bladder.
5. Structure and function of testis.
6. Structure, syntopy and function of the prostate.
7. Name the anatomical and functional characteristics of male and female urethra.
8. Structure and function of the penis? Mechanisms and erection phases.

9. Syntopy elements renal crus from front to back:

- a) artery, vein, bowl;
- b) vein, artery, bowl;
- c) bowl, vein, artery.

Answer: b.

10. Number of testicular sheath (except leather purse):

- a) 4;
- b) 5;
- c) 6.

Answer: c.

11. Testosterone is produced in the testes cells:

- a) Sertoli;
- b) Leydig;
- c) Langerhans

Chapter 2

The symptoms of urological disease

The symptoms of urological disease conditionally choose up on 4 groups.

1. Pain
2. Disorders of urination
3. Quantitative and Qualitative changes urine
4. Pathological changes of sperm and discharge from the urethra

2.1. Pain.

Pain - an important symptom of urological diseases. The pain may be dull and sharp, aching and attacks, localized in the lower back, side and iliac parts of the abdomen, above the pubic, the perineum and genital area. For kidney disease is characterized the pain in the lumbar region, which can occur suddenly, attacks or enhanced gradually. Most manifesting sign of kidney disease is renal colic - pain syndrome that occurs as a result of acute disorders of urine outflow from the cavity of the kidney. The reason for this obstruction often become kidney and ureteral stones, rare - blood clots, bending of ureter, and so on. The source of pain is the baroreceptors of pelvis and kidney capsule, that irritate due to increased intrapelvic and intrarenal pressure. There renal colic suddenly appears, often after physical strain, application of over fluid, sometimes - during sleeping. The attack is characterized by acute pain in back with possible irradiation along the ureter, the genitals and the inside surface of femur, accompanied by dry mouth, nausea, vomiting, muscle tension anterior abdominal wall, bowel reflex paresis, impaired hemodynamics, dysuria, appearance of blood in the urine. In patients with renal colic the position continuously change, they loud cry or shout. Sometimes may be kollaps condition. When kidney disease involving permanent stasis in the upper urinary tract, swelling of the parenchyma or the appearance of bulk process in the kidney, is observed a constant dull pain that does not depend on the position and movements of the patient's body. Any damage to the ureter pain localized in the lateral abdomen with irradiation from hypochondrium and lumbar region down into the iliac area, external genitals. For diseases of the bladder is characterized by aching pain that is localized above the pubis or deep pelvis, sometimes - in the perineum to the head of the penis or clitoris area. It can be constant or increase with urinary emission.

If the cause of the pain can not explain the pathological process in the bladder, we must assume that it is reflected in nature and is caused by disease, of pelvic part of the ureter, prostate, urethra, the internal genital organs and rectum.

For prostate diseases characterized the constant aching pain in the perineum and anus, which increases during urination or defecation radiating to the testicles, penis head, pubic area, buttocks.

The testicular disease is characterized by pain in the scrotum that is intense, irradiating to the lumbar and pubic area, along the spermatic cord. In chronic genital disease, the pain is non intensive, accompanied by a feeling of heaviness in the scrotum. Pain in the penis may occur when it is due to disease or irradiation upstream of the urinary tract, prostate and seminal vesicles, which necessary to consider in the differential diagnosis.

2.2. Disorders of urination.

Urination - a physiological act, which is controlled by the central nervous system. Normally urine should be timely, free and painless, complete and bring relief. Any act of urination disorders are united in the concept of "dysuria". Almost all diseases of the bladder, urethra, prostate and seminal vesicles accompanied one or more symptoms of dysuria.

Acute urinary retention or ishuriya - is the inability to urinate at sufficient filling of the bladder. This situation often arises because of the obstacles to the flow of urine from the bladder (tumor or abscess of prostate gland, bladder or urethral stone etc.) and is usually accompanied by a frequent urination and a sharp pain in the abdomen. The pain and urge patients do not feel when acute urinary retention is caused by lesion of the central nervous system and directly after surgery in the pelvic and abdominal organs. In acute urinary retention patients need urgent help, which is a catheterization or suprapubic bladder puncture with evacuation of urine.

Chronic urinary retention - incomplete bladder emptying during urination with the advent of so-called "residual urine". Chronic urine retention delay is caused by obstructions to the flow of urine in the bladder neck lowering the tone of the muscle that pushes urine. In children, chronic urinary retention is also narrowing of the foreskin - phimosis.

Paradoxical delay urination, or paradoxical ishuriya is a combination of delay and incontinence of urine, which arises due to dilatation of urine bladder and reflex paralysis of its internal sphincter. Under these conditions, the urine bladder is full, the independent urination is impossible, the urination is spontaneously drops, or small portions.

Urinary incontinence is the involuntary leakage of urine without the urge to urinate. We share several species of this pathology: the present and the fake, stress (voltage) and night (during sleep) urine incontinence.

True incontinence occurs due to the insufficient function of the sphincter of the bladder with their anatomic integrity.

Fake urinary incontinence due to congenital or acquired defects of the urinary tract. This type of incontinence occurs in case of extrophia of bladder (the absence of the front wall), total epispadia (defect in the wall of the urethra), ectopia holes urethra (the opening of the holes of one or both ureters into sexual crack, into the vagina, the urethra and etc). Incontinence may be the result of injury to the bladder with the formation of vesico-vaginal or uretero-vaginal fistulas, for example, after the labor injury.

Enuresis nocturnal incontinence of urine, mainly observed in children with functional disorders of the nervous centers of urination (organic changes in urinary and nervous systems are not available).

Stress incontinence is observed in the physical loading, even minor ones - during coughing, laughing. This state is typical for women with the weakness of the pelvic diaphragm, omission, interruption of the vaginal walls and cervix, most often as a result the labor trauma, heavy physical work.

Irretention of urine is involuntary urination in the presence of imperative call. This urine disorder is caused by pathological processes in the urinary bladder or the prostate, where even a small amount of urine causes such a strong urge that the patient cannot keep it.

Stranguria is a difficult and painful urination.

Pollakiuria - frequent urination small portions with normal urinary diuresis.

Pollakiuria may be physiological (stress, hypothermia, pregnancy) or pathological (inflammation or tumor diseases of the bladder, prostate, disorders of innervation of the bladder). Sometimes it is accompanied by pain during urination. In some patients, the urge to urinate are so strong that they cannot be restrained. Such desires are called imperative or mandatory.

Nocturia (night pollakiuria) - need to wake up at night more than once to urination.

Oligaciuria - urination, which occurs abnormally infrequently, observed in violation of innervation of the bladder at the level of the spinal cord.

Recently a range of symptoms that occur as a result of the development of the pathological process in the urinary bladder, urethra and prostate gland, define the term symptoms of lower urinary tract (SLUT). SLUT comprise three groups of symptoms: accumulation, emptying (obstructive) and after emptying. The symptoms of accumulation include shortness of daytime and nighttime urination, urgent, imperative) urination, sometimes accompanied by mild pain in the lower parts of the abdominal area vaught and urgent incontinence. The symptoms of emptying include shortness of urine - release, urination thin, weak stream, straining to urinate and a long period of time from the appearance of the appeal before the beginning of urination. Symptoms after emptying the bladder note immediately after urination. Last including exclusive feeling of incomplete emptying of the bladder and leak urine immediately after the urination. There is an opinion that SLUT occur in approximately 20-30 % of the population. While there is a clear trend of increasing prevalence of SLUT with age.

2.3. Quantitative changes in urine

Diuresis amount of urine that is allocated for a certain period of time. Daily diuresis is paid on the day and night. The usually daily diuresis to the night in a healthy person usually is 3 : 1

or 4: 1.

In a healthy adult, daily urine is 65-75 % of the amount of volume of drinking water. The minimum amount of urine required for the allocation of kidney all products of metabolism, 500 ml In the conditions of standard water regime (the consumption of 1-2 litres) size of daily diuresis is 800-1500 ml, respectively the value of the minutes of diuresis 0,55-1 ml

Anuria - lack of urine in the urinary bladder due to bloc of renal function or urinary tract. When anuria daily diuresis is less than 100 ml

Types of anuria:

- arenal (renoprive) - a condition observed in the absence of kidneys;
- prerenal- occurs due to sudden changes in renal blood flow (duplex embolia of renal arteries, bilateral pulmonary renal veins, lesion of the main vessels, acute vascular failure, shock state and state, accompanied by a signature and prolonged decrease in blood pressure);
- renal - occurs when lesions of the renal parenchyma (bilateral infectional - inflamating diseases, acute glomerulonephritis, poisoning, allergic reactions, crush syndrome, transfusion of blood incompatible, sepsis etc).
- postrenal(excretory) - occurs because of the diseases that lead to violation of patency of the urinary tract: dual obstruction of renal pelvis or the urethers, compression of ureters by tumor, demeges of ureters and other.

Prerenal and renal form combined in the concept of “Secretoral anuria”.

Polyuria - the increase of daily diuresis more than 2 liters.

Polyuria may be a physiological (when receiving a large amount of liquid, after taking diuretics) or pathological (in diabetes and nonsugary diabetes, after taking the diuretics, when the descent of edema in acute and chronic renal failure).

Oliguria - reduction of daily diuresis to 500 ml Oliguria is renal and extra renal origin. The reasons of extrarenal oliguria: sweating, diarrhea, vomiting, edema formation in heart failure, miksedeme, diffuse liver damage, defeat autonomic centers of water-electrolyte metabolism, neuroendocrine violations. Renal oliguria occurs in acute renal insufficiency of any etiology: in acute glomerulonephritis, nephrotic syndrome, sometimes with acute pyelonephritis.

Nocturia is the predominance of the night diurezis over the day.

In normal conditions the vast majority of urine excreted in the daytime as at night organism not received food and liquid, reduced metabolic processes, blood pressure.

Nocturia observed in heart failure, nonsugary diabetes, cirrhosis of the liver, pernicious anemia, diseases of the thyroid gland, chronic pyelonephritis, nephrosclerosis.

In case of heart failure appearance of nocturia is that at night the conditions for the heart of economic activity improved, thereby decreasing venous congestion and swelling in the lower extremities, tissue fluid enters the blood and diuresis increases.

2.4. Qualitative changes urine

The urine of healthy person transparent, light-yellow color. The reaction of urine normally weak acid, its pH ranges from 5.0 to 7.0 and depends on the time of feeding.

Specific weight (relative density) of urine varies in different periods of days on average from 1,010 to 1,025.

The increase of the share (more 1,025) - hypersthenuria, decrease (less 1,010) - hypostenuria, urine during the day with the same specific weight - isostenuria.

Normal daily diuresis should be about 1.5 l, daily diuresis should be 3 times more than night, the value of the specific weight of at least one of the pieces should not be less than 1022, the difference between minimum and maximum specific weight should be significant (not less 10).

Proteinuria - high content of protein in the urine (more 0,033 g/l).

Proteinuria is observed in violation of the permeability of cluster filter (glomerular proteinuria), or in violation reabsorption epithelium tubules (tubular proteinuria).

Leukocyturia - excretion increased number of white blood cells (over 10 - microscopy sludge, more than 2000 in 1 ml, method Nechiporenko). Leukocyturia is characteristic for almost all of inflammatory diseases of kidneys, urinary tract and genital organs.

Clinically there are three types of leucocyturia: initial, a terminal and total. Define view pyuria by sampling two or three glasses.

On the presence of pyuria only in the first glass (initial leukocyturia) indicates inflammation of the urethra, in the third (terminal leukocyturia) - in the prostate gland, seminal wasels or neck of the bladder, in all glasses (total leukocyturia) - in the urinary bladder and the upper urinary tract.

Pyuria - the presence of pus in the urine. Sometimes pyuria possible to determine visually. In these cases, urine cloudy, gray, when standing forms a precipitate. Microscopically such Deposit urine contains white blood cells, fibrin, scraps of necrotic tissue, desquamation cells of urotely, bacteria. Pyuria always indicates the presence of inflammation in the urinary tract, most expressed it in pyonefrosis and infected hydronephrosis. A large number of pus in the urine is characteristic also for kidney abscess, tuberculosis caverns or purulent cysts, if they are combined with cavity system of the kidneys. Pyuria often noted at cystitis and urethritis, especially a lot of pus in the presence of the diverticulum of the bladder.

Bacteriuria is the presence of bacteria in the urine. About bacteriuria shows the contents in 1 ml of urine is >10⁵ colonies of bacteria. Observed in inflammatory diseases of urogenital system.

Hematuria is the presence of blood in the urine is one of the most important symptoms, which indeed happened when most of urological diseases. In the sediment urine healthy person the erythrocytes are absent or are not more than 2 cells in the field of view.

Microhematuria determined only when microscopic examination,

Macrohematuria determined visually.

Macrohematuria is mainly observed in malignant tumors of the kidneys, ureters, and urinary bladder, urolithiasis, traumatic lesions of the kidneys and urinary tract, nephroptosis, etc...

When the initial hematuria blood appears in the first portion of urine, total - all portions, terminally - in the end of urination.

Initial hematuria is typical for traumatic injury or tumor of ureter. Total hematuria may be called by the kidney, and bladder. Terminal hematuria is a characteristic symptom of a bladder neck, and in men with prostate cancer and prostatic part of the urethra.

In case of total hematuria can form blood clots. If the source of blood leak is in the kidney or ureter - blood clots are long, (repeat the form of the ureter). In diseases of the urinary bladder the clots are formless.

erithrocituria- presence in the urine of erythrocytes (more than two in the field of view).

Hemoglobinuria - availability of free hemoglobin in the urine. Urine transparent, color from red up to dark-cherry. Microscopically erythrocytes are absent in it. Observe by transfusion of blood incompatible, extensive burns, poisonings and other pathological hundred - nah, involving intravascular hemolysis.

Mioglobinuria presence in the urine myoglobin. Urine transparent, red-brown color. Marked by a significant loss of intravascular fluid (blood, lymph) of that observe traumatic toxicosis (syndrome of prolonged crushing, or crash - syndrome).

Uraturia - hour presence in the urine of excessive amounts of uric acid salts - urate (in norm - up to 250 mg / day).

Carbonaturia presence in the urine acid salts of carbonic acid - carbonate.

Phosphaturia - presence in the urine of increased amounts of salts of phosphoric acid - fosfats. Distinguish true (primary) and imaginary (secondary) phosphaturia. True phosphaturia - symptom of the disorder of metabolism, the function of thyroid glands, etc... False phosphaturia observed in inflammatory processes of kidneys and urinary tract under the influence of the characteristic of the last alkaline urine.

Oxaluria - excessive content in the urine of salts of oxalic acid - oxalate (in norm - 20 - 40 mg / day).

Cylindruria - availability of cylinders in the urine. Distinguish between true and false cylindruria. In a true cylindruria are hyaline, grainy and waxy cylinders; if not real – cylinder - consisting of salts of uric acid, myoglobin and bacteria.

Pnevmaturia - excretion of air or gas. Occurs as a result of the penetration of air into the urinary tract during cystoscopy or catheterization of the ureter, when you enter oxygen for contrasting bladder, renal pelvis, at episcistic, eyelash- bladder fistulas of the gastrointestinal and gallbladder fistulas or with formation of gases due to the fermentation process in the urinary bladder inflammation, decay of bladder tumors, diabetes due to decay of sugar into alcohol and carbon dioxide.

Lipiduria - the presence in the urine of lipids. Is usually when the venous embolism of renal capillaries due to massive fractures of the tubular bones, diabetes, nephrotic syndrome.

Glucosuria - presence in urine of glucose. Observed in diabetes, renal and steroid diabetes, nephrotic syndrome. A healthy person may arise alimentary glucosuria associated with excessive consumption of carbohydrates.

Xilyria impurities lymph in the urine, which predetermines the milky color of the last. Occurs when the message appears between the major lymphatic vessels and urinary tract as a result of the inflammatory process, trauma, tumor, causing compression of the thoracic lymphatic tract, when filariasis that leads to the formation of lymphourinary messages.

Fermenturia - the presence of enzymes in the urine. To signs of kidney disease include the increased activity of urine, and the emergence of new enzymes (aminotransferase and others)

Gidaturia (exinococuria) - the presence in the urine of a small exinococ foliculs, gidatids that get into the urinary tract from gidatid bladder and kidneys.

Spermaturia - existence of elements of semen (sperm cells spermatogenesis) in the sediments of urine. Is observed in the deformation of the posterior urethra and seed tubercle, atony of internal genital organs (congestive vesiculitis, calculitis), retrograde ejaculation after taking alpha-blockers.

2.5. Pathological changes of sperm and discharge from the urethra

Reference values of indicators ejaculate according recommendations WHO (2010) are as follows:

- quantity of 1.5 ml or more
- pH - 7,2-8,0
- viscosity up to 2 cm
- period of rarefaction - 60 min
- sperm count is not less than 15 million / ml
- the total number of sperm in the ejaculate - not less than 40 million
- total sperm motility - 40 % and more
- the percentage of sperm cells with the progressive movement - 32 % and more
- morphologically normal sperm - 4 % or more
- viable sperm - 58 % and more.
- agglutination is missing
- white blood cells – 10^6 in 1 ml
- red blood cells do not.

Aspermia- absence of sperm in the ejaculate and cells of spermatogenesis.

The reason of aspermia - obstruction of the vas deferens due to malformations or trauma

of the genitals and inflammatory processes in the genital organs (orchitis, epididymitis, fongiculitis and others).

Azoospermia – absence of spermatozooids no in the ejaculate and the presence of other cells of spermatogenesis. Distinguish true, an unreal and idiopathic azoospermia.

This azoospermia causes congenital malformations (testicular hypoplasia, bilateral cryptorchidism), traumas of both testicles or acquired diseases of genital - vines (varicocele, orchitis), metabolic disorders (obesity, diabetes), alcoholism, poisoning of phosphorus, arsenic and other

False azoospermia occurs due to obstruction of the vas deferens. Idiopathic azoospermia is observed in the absence of visible changes in the genital organs.

Aspermatizm - absence of ejaculate during intercourse while maintaining sex - craving and potency.

Distinguish between real and fake aspermatizm.

At real aspermatizm violated the processes of formation of sperm and move it to the urethra. At real aspermatizm always absent orgasm.

In case of unreal aspermatizm sperm is not allocated in the urethra, and gets into the urine bladder, and presented with urine. It happens when neurogenic atony of sphincter of urine bladder, obturation of the vas deferens, congenital obstacles or scarring in the urine bladder at the level of seed tubercle and prostate gland, ectopia of the vas deferens. When an unreal aspermatizm - orgasm is usually saved.

Mechanical aspermatizm due to congenital acquired anomalies of the urinary canal.

Oligospermia (gipospermia) - insufficient volume of ejaculate. Occurs in case of whipping testicles and their epididymis, prostate gland, seminal vesicles, glands Cooper and Littre, as well as at frequent coitus.

Oligozoospermia - reducing the number of spermatozooids in the ejaculate during an unmodified its entirety.

Astenozoospermia - decrease in the concentration of motile spermatozooids.

Terratozoospermia - decrease in the concentration of morphologically normal sperm.

Gemospermia - presence of blood in the ejaculate.

Distinguish between micro - and macrogemospermia, real and fake gemospermia.

In case of a real gemospermia blood gets into the ejaculate a result of pathological process in the testicles, the seminal ducts and prostate gland. When a fake gemospermia admixture of blood in ejaculate caused by defeat of the urethra.

Piospermia - the presence of pus in the ejaculate (more than 6-8 leukocytes in the field of view).

Characterized by inflammatory processes in the sex organs.

Necrospermia - admixture with the sperm of the only non-viable spermatozooids.

Polizoospermia increasing concentrations of spermatozooids in the ejaculate.

Microzoospermia - prevalence in the ejaculate of spermatozoons with a small head.

Macrozoospermia - prevalence in the ejaculate spermatozoons with the big head.

Urethroragia - bleeding from the urethra. Observed with injuries or tumors of urethra, urethritis.

Prostatorea - allocation of prostatic secretion from the urethra after defecation, tasion. Observed in chronic prostatitis, calculitis, vesiculitis.

Spermatorea - allocation of sperm from the urethra outside a sexual act without the presence of erection and ejaculation. It happens in chronic prostatitis, calculitis, vesiculitis and with the defeat of the spin of the brain, where is the centre of the ejaculation.

Assignments

- 1 What localization of pain in the pathological changes in the kidney?
- 2 Differential diagnosis acute retention of urine with postrenal anuria.
- 3 What information can be received at carrying out of three glass test?
- 4 Differences paradoxical ishuria of urge incontinence.
- 5 Main reasons of pnevmaturia.
- 6 Differences of hematuria and urethroragia.
- 7 Upper normal limit in the urine test on Nechiporenko is:
 - a. leucocytes - 1-2, erythrocytes - 0-1 in 1 ml;
 - b. leucocytes - 100-500, erythrocytes-50-100 per 1 ml;
 - c. leucocytes - 2000, erythrocytes -1000 in 1 ml;
 - d. leucocytes - no, erythrocytes -1000 in 1 ml

Answer: C.

8 The presence of a number of bacteria in 1 ml of urine indicates inflammatory process in the kidneys or urinary tract?

- a) 10-20;
- b) 50-100;
- c) 1000-2000;
- d) 500 000-1 000 000.

Answer: d

9 The most likely source of bleeding in the presence of shapeless blood clots in the urine:

- a. kidney;
- b. the urethra;
- c. ureter;
- d. bladder.

Answer: d.

Chapter 3

Examination methods of urological patients

3.1. Physical methods

Physical examination of the urinary system

In modern urology, the physical methods, even without the decisive diagnostic value, in most cases, are an integral part of general clinical examination of the patient. Anamnesis data, examination, palpation, percussion and auscultation are helped the doctor to consider a plan for further action, before the formulation of final diagnosis. In particular - to determine the direction and assess the examination capabilities of the patient and providing of necessary medical care, that has particular importance in the practice of family physicians and patients in urgent situations.

Anamnesis. Before the examination of the patient, it is necessary to collect a detailed medical history, to study the causes that led the patient to ask for urological care. Along with information about the conditions of life and work, carried on in the past diseases, is necessary to establish: when were the first signs of the disease and how it was developed in the future. Particular attention should be paid to the primary urological symptoms disease, which are - pain, dysuria, urinary changes.

Examination. At examination of the patient, is necessary to look at the position of patient in bed, condition, behavior. For example, the typical behavior of the patient with renal colic: the patient is restless, he always moves, unable to find a comfortable position in which the pain either disappears or decreasing. Sometimes the patient is in bed in forced position - lies on side of the patient with reduced to the abdomen bent at the hip and knee joints of the lower extremities, which may indicate the presence of inflammation in pararenal area. Patient with complete chronic urinary retention lies quiet with lower extremities bent at the knee, whereas the drops of urine are excreted from the external opening of the urethra. At examination of the anterior abdominal wall diverticulum, sometimes is defined in area of hypochondrium due to enlarged kidneys with hydronephrosis, pyonephrosis, tumor. At large tumors of kidney the subcutaneous veins corresponding part of the abdomen may be extended. Examination detects the scars in the lumbar area after past surgeries, and urinary fistulas. In acute urinary retention the diverticulum of the anterior abdominal wall can be determined directly above the pubis. Patient is usually hold on the underbelly, every few minutes trying to empty the bladder. At concrements of urethra and bladder - sometimes pulls and squeezes the penis. In severe kidney disease it may be noted earthy gray color, puffiness of face, swelling of the extremities, ascites. At uremia - confusion, shallow clonic convulsions, muscle twitching, noisy breathing, smell of ammonia breath. In children, there may be a lag in development, and in severe forms of kidney damage - even renal dwarfism. At examination of the lower anterior abdominal wall defect can be detected in the anterior abdominal wall vesical extrofia in malnourished patients - overflowing bladder. The external opening of the urethra to examine the man urination, to pull back the glans penis of the patient. Normally it is located at the top of the glans of the penis has the form of slit and should be dry. It is necessary to note the presence of discharge from the urethra, which normally do not, and their transparency, color, texture and smell. Slightly compressing the external opening of the urethra in the anterior-posterior direction, examine the scaphoid fossa and the mucous membrane of the distal urethra. In acute inflammation is marked swelling, hyperemia, discharge of pus. Bleeding from the urethra (urethrorrhagia) is typical for traumatic damage. In female can be observed polyps external opening of the urethra, the underside of the

mucous membrane of the urethra (ureterocele), its jamming. Overview of the urethra allows to identify hypospadias - its ventral wall defect at which external opening of the urethra can be opened at the glans of the penis, on the penis, near the root of the scrotum, the perineum. At epispadias the external opening of the urethra opens on the dorsal surface of the penis, the front wall of the urethra in a greater or less absent at all surface. At examination is established the presence of other abnormalities of the genitals or hypoplasia, such as hermaphroditism or hipogenitalism.

Palpation. The simplest method of examination that allows information about the size, consistency, mobility, tenderness of the kidney is palpation (Fig. 3.1). The normal sized kidneys and location are not usually palpable, with the exception of thin patients with thin abdominal wall and the absence of flatulence. It should be remembered that the kidney is not always palpable, and kidney, which is palpable, not always ill. To kidney, especially to right is specific the mobility.



Figure 3.1. *Palpation of the right kidney*

Palpation of the kidneys is performed bimanual in the patient on his back on the side or standing. The most acceptable is considered the palpation of kidney in the patient on the back with bent at the hip and knee joints and feet slightly diluted that it is necessary to relax the muscles of the anterior abdominal wall. In a standing position for this purpose of the patient is asked to bend slightly forward. Patient relaxes the muscles of the abdomen, breathes evenly and deeply. The doctor sits

down in front the kidneys, which are palpated and slips under the lower back of the patient wrist of his hand (left - palpation of the right kidney, right - palpation of left kidney). The tips of the fingers abut to the angle formed by XII edge and long muscles of the back. Half-bent fingers of the other hand penetrate to the front upper quadrant along the edge of the *rectus abdominis* muscle and outside of it. Palpation is performed by the convergence of both hands as the height of inspiration and during expiration, thereby assessing respiratory mobility of the kidney. Renal colic, acute inflammation, traumatic injury of kidneys on palpation of the affected organ are characterized by increased pain and muscle tension of the anterior abdominal wall and waist. At pyonephrosis, hydronephrosis, nephroptosis either kidney tumor the last is possible to palpate, determine the nature of its surface, texture, mobility, vote, pain. Great importance has determination of sensitivity in projection of the kidneys. Pain at pressing on XII rib or corner of costovertebral angle can point to acute or neglected chronic renal disease or retroperitoneal fat. In some cases, short tapping in these areas by the edge of hand either fist, causes concussion of the affected organ, causing the appearance of instant sharp pain that many doctors mistakenly defined as symptom Pasternatsky. In fact, the latter has been described by the author as a phenomenon

appearance of blood in the urine when tapped on the twelfth rib, which indicates the presence of stones in the kidney. Palpation of the ureter is usually almost impossible, even with a significant increase, because they are located deep in the retroperitoneal space. Palpation of the distal ureter is facilitated by examination *per vaginum* in women and in men *per rectum* bimanual when the second hand of doctor is located in suprapubic area of the anterior abdominal wall. Under these conditions commonly is possible to palpate the concretions in the intramural ureter department, and sometimes - tuberculous-infiltrated of its pelvic area in the form thick dense formation.

Some importance for the diagnosis of ureteral diseases have three hot points Torne, pushing on which causes increased pain. The upper point Torne is located at the navel about 4-6 cm lateral to it and matches

the first narrowing of the ureter - pelvis, ureter segment. The second point is located on the intersection of the line billiaca with line drawn from the top of the Torne to the tuberculum pubicum, and the second corresponds to the narrowing of the ureter - the crossroads place of its iliac vessels. The third point corresponds to third narrowing of the ureter - the confluence of its bladder - is determined by bimanual vaginal either rectal examination. The bladder is palpated through the anterior abdominal wall either bimanual: women - through the vagina, men - through the rectum. Empty bladder normally is not palpable, painless. In acute and chronic urinary retention urinary bladder at palpation over the pubis is defined as immovable, painful tumor formation of elastic consistency, which disappears after evacuation of its contents, for example by a catheter. Palpation in the suprapubic area can be identified as inflammatory infiltrates in para-vesical tissue, cancer infiltration the upper part of the bladder with wall with tumor invasion in para-vesical fiber. In such cases, a dense infiltrate above the pubis after emptying the bladder does not disappear. Palpation is a painful inflammation in the bladder and para-vesical fiber, and in the case of suppuration last (para-cystitis) can also detect fluctuations in the deep tissues. During palpation of the male urethra occurs palpation of the penis, which requires differentiation of lesions in the cavernous bodies, glans and foreskin from those in the wall of the urethra. Female urethra is palpated through the anterior wall of the vagina. In both male and female the examination is facilitated after previous input of urethral orifice catheter or metal bougie. Normally palpation of the urethra is painless. Pain or presence of seals indicates the existence of pathological changes in its wall. State of regional lymph nodes of the urinary and male reproductive systems is evaluated by palpation of the inguinal regions in the area and scarpa's triangle. Iliac, and para-aortal para-caval lymph nodes are determined by palpation of the abdomen with a significant increasing of them.

Percussion

Normal located kidneys are not defined by percussion. This method is important for conducting a differential diagnosis between tumors of the abdomen and retroperitoneum diagnosed by percussion over the tumor. If the tumor is localized in the abdominal cavity, percussion sound over it - dull, and if the tumor affected the kidney, then intestine that it covers the makes tympanitis (symptom Roberts). However, the method is ineffective for tumors with larger sizes. Blunting of percussion sound in renal traumas indicates that uro-hematoma is in the retroperitoneal space. Percussion of the bladder is carried out in the midline of the abdomen starting from epigastric area in the direction to the pubis. At full bladder - above the pubis is determined dull percussion sound.

Auscultation

In all forms of hypertension is necessary to carry auscultation of patient: in front - in the upper quadrant of the abdomen, behind - at the level of costovertebral angles. Depending on the cause of renovascular hypertension forms of noise are different. Easy systolic murmur is characteristic for renal artery stenosis. Robust and durable systolic murmur is characteristic for arteriovenous fistula, for atheromatosis of abdominal aorta. At the fibrous and fibro-muscular stenosis of the renal artery in the upper abdomen is determined extended high-frequency noise with late systolic amplification.

Physical examination of the male reproductive system

At the pathology of external male genitalia examination of patient is particularly informative, which already at this stage can allow the physician to establish a preliminary diagnosis of diseases such as hematocele, hydrocele, testicular tumor, orchiepididymitis, varicocele,

cryptorchidism and testicular ectopia, foreign bodies foreskin, damage, distortion or abnormalities of the penis (doubling) and the urethra (epispadias, hypospadias).

External genitalia of man must be examined from considering of pubic area. It is worth noting the type of body hair, color and cleanliness of the skin, the presence of certain pathological changes due to injury, deferred operations infections and more.

The penis is examined, taking into account the topography of the anatomical parts of the organ in relation to each other. It is necessary to estimate the location of the external opening of the urethra, which normally opens on the apical side of the glans. It is important to examine the foreskin; to shift it's proximally, pulling back the glans penis. Difficulties during this manipulation may indicate congenital, inflammatory or scar narrowing of the foreskin (phimosis). On the glans, sheets of the foreskin and on the skin of penis can be observed formations and rashes of different nature: syphilitic chancre, herpes papules, genital warts, squamous cell carcinoma and others. It is also important to palpate penis and glans for the presence of seals, asymmetry or distortion. Pathological changes detected by palpation may indicate inflammatory disease (cavernitis) or fibroplastic induration of the penis (Peyronie's disease).

Organs of scrotum are examined in the vertical and horizontal position of the patient in a warm room, as comfortable temperature provides muscle relaxation of scrotal meaty muscles, making it easier to palpate the testicles and their appendages through smoothing skin of scrotum. Normally, the skin of scrotum is wrinkled, hyperpigmented and elastic. Is often seen that on the skin of scrotum benign tumors, such as angiokeratoma or epidermoid cysts. Angiokeratomas are capillary hemangiomas of dark red and purple color, size 1-2 mm. Epidermoid cyst - a tight-elastic formation in size 1-2 cm, painted slightly lighter than the entire surface of the scrotal skin. These formations do not require treatment, except as treatment for patients with cosmetic concerns. If scrotum asymmetrically enlarged on the one hand, this may indicate the presence of a hydrocele, varicocele, oblique inguinal hernia, inflammation or tumor of the testicle. In inflammatory diseases of the testes or epididymis (orchitis, epididymitis, orchiepididymitis), scrotal is not only swollen, but also hyperemic. Also quite common disease are varicose expansion of veins spermatic cord (varicocele), where available enlargement, sagging, often left half of scrotum, and visualization writhing varicose veins pampiniform plexus. Testicle must be palpated carefully, bimanual by placing it between 1 and 2 or 3 fingers of each hand. In this case, should be assessed size, shape, texture testis and its epididymis. Normally testis has ovoid shape, tight elastic consistency; size about 4 cm in length and 2.5 cm wide. Appendage is usually located on the upper posterior surface of the testis, somewhat softer consistency and significantly more sensitive than testicle, and this examination should be conducted with the utmost care. Testicle with appendage should be free to move within their half of the scrotum. In the absence of it can be suspected inflammatory, cicatricial or oncological process. If the testicle is not palpable in the scrotum, it indicates cryptorchidism (undescended) or ectopic testis. In this case it is necessary to examine the inguinal canal and the surrounding areas. Testicle size looks increased in the presence of free fluid between the sheets of vaginal membrane (hydrocele). Growth and consolidation can be determined by orchiepididymitis. In addition to the inflammatory process testicles and especially epididymis are characterized by a sharp pain on palpation. At varicocele the nearby testis is palpated pampiniform plexus as packages writhing varicose veins. Venous plexus can change its size by changing the position of the patient, which is used in determining the degree of disease. On the surface of the testicle or epididymis may be defined dense formation of different forms that is usually show the cyst or tumor of organ.

On palpation of vas deferens attention is needed to the presence of beads-shaped seals that are indicative of tuberculous lesions of the testicle. At the end of the scrotal examination it should be assess the condition of the outer ring of the inguinal canal. For this we need to move little finger along the spermatic cord up to the outer ring of the inguinal canal, after which the patient asked to cough or strain the abdominal muscles. The feeling of pressure or protrusion of the outer ring indicates the presence of an inguinal hernia. Thus, the

palpation of the scrotum consistently defined and evaluated pathological changes of testis, epididymis, spermatic cord and external inguinal ring.

Prostate and seminal vesicles can be evaluated only through digital rectal examination (Figure 3.2).

It can be performed in different positions of the patient:

- in Bozeman;
- on the side with bent knees to the chest;
- on the back with bent legs at the knee and hip joints;
- standing and relying with his elbows on a table or chair;
- sitting on a couch or chair in an attitude of "bird."

At digital rectal examination is necessary to determine the size, texture, shape, middle furrow of the prostate, and the presence of structures on its surface, the mobility of the mucosa of the rectum and the presence of pain in the performance of manipulation.

The average size of prostate in young men reaches 3.5 cm across and 2.5 cm in longitudinal size. With age, the prostate gland is increased due to the growth of transition zones (prostatic hyperplasia). A slight increase can also observed in inflammation (prostatitis). Consistency of healthy prostate is comparable to the consistency *thenar*, when thumb is adjusted to little finger. At congestion, inflammation gland is slightly compacted. Wooden or stone density indicates the malignancy. In acute prostatitis and abscess formation can be felt foci of softening and fluctuation.

The shape and configuration of the prostate resembles chestnut. It should be draw attention to symmetry of both particles and the severity of the median furrow, which is smoothed in benign prostatic hyperplasia (BPH). Feature of the prostate in BPH is symmetric enlargement. Asymmetric enlargement may evidence in favor of a malignant neoplasm. Rectal mucosa, which is above the prostate, should be easy to move. Restriction or lack of mobility mucosa is typical for prostate cancer.

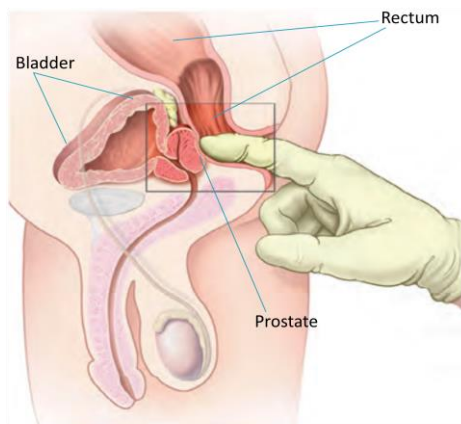


Figure 3.2. Digital rectal examination of the prostate

In normal prostate smooth surface, uniform density. At the sense of formations or irregularities must be suspected cancer, although often such changes may be the result of chronic inflammation. Digital rectal examination can be rather unpleasant for the patient, but with the proper carrying out painful sensations should not cause. Pain on palpation is observed in inflammatory processes and may be indicative of disease even at the absence of clinical symptoms. Seminal vesicles in normal are usually inaccessible to palpation, so a big role during their examination plays a position of the patient. The most suitable position for the patient is sitting on a couch or a chair squat (in position "bird"). At inflammatory, congestive processes seminal vesicles are grown in size and become tense and painful. In that case, palpation is much easier. In the diagnosis of prostate diseases

equally important role plays the study of its secretion. To isolate the secret of the prostate gland is performed massage. Carefully pressing finger stroking the prostate with the lateral part of each particle to the center, then moves continue in the anteroposterior direction, thereby displacing the secret to the urethra. According to some authors, successful massage is considered in the allocation of at least 3 drops of secretion. In concluding digital rectal examination is necessary to make a circular motion with your finger to determine pathological changes in the rectum if available.

3.2. Laboratory Diagnostics

Investigation of urine

Urinalysis is important to diagnose the absolute majority of urological diseases. For the analysis it is desirable to collect the secondary portion of the first morning urine in compliance with sanitation requirements are as careful toilet of the external genitalia, using a clean container. In the presence of gynecological pathology or menstruation, information content of urine is greatly reduced due to the high probability of hitting to it the impurities from genitals. In such cases, if necessary, resort to sampling of urine through the bladder catheterization. To prevent fermentation and destruction of formed elements of the urine should be delivered to the laboratory as soon as possible. General analysis of urine is the most common of research. It is pretty simple, rapid and inexpensive test, including physical, chemical and microscopic characteristics. To the physical include color, clarity, smell, share. Normal urine may have color according to the concentration of pigment substances (urohrom, urobilin, etc.) from straw yellow to amber. Various shades of red from pink and up to brown are lead to the presence of blood, hemoglobin or myoglobin. In addition, in pink-red color the urine is colored after eating some natural dyes (beets, blueberries, etc.). The changing of urine color may cause liver pathology. Fresh urine should be clear. Turbidity may be due to the presence of significant amounts of impurities (salts, pus, blood, mucus, etc.). Specific density of first morning portion of urine varies, usually within 1010-1025, but much depends on the drinking regime. Decrease in the density of urine (hyposthenuria) can be a sign of chronic renal failure, and to improve it (hypersthenuria) - indicate the significant amount of protein, glucose, increased fluid loss in other ways and so on. For a more accurate diagnosis of changes in specific density and, accordingly, there is a concentration of kidney function - test of Zimnitskiy. Chemical indicators of urinalysis are determined by chemical reactions. These include the determination of the reaction (pH), protein content, glucose, acetone, urobilin, urobilinogen, indican, and more. Normally, pH of urine ranges from 5.0 to 7.0, on average 5.5-6.5. On the magnitude of the urinary reaction affects nutrition and the presence of non-specific inflammatory diseases. Protein is determined in normal urine in amounts up to 0,033 g / l. In this case, its include the daily excretion of 30 to 150 mg / day. Exceeding of these values (proteinuria) may indicate the presence of nephrological diseases (glomerulonephritis, tubulointerstitial nephritis), multiple myeloma and others (renal or kidney, proteinuria), and the presence of a large amount of impurities (blood, pus, mucus, etc.) - false or retrorenal, proteinuria. In addition, the appearance of protein in the urine may lead to significant physical activity, hypothermia. The urine of a healthy person should not contain glucose and acetone. The presence of sugar in the urine (glucosuria) observed in diabetes and renal diabetes, hyperthyroidism, syndrome of Itsenko - Cushing. At the urine sediment microscopy reveal epithelium, erythrocytes, leukocytes, bacteria, cylinders and salt crystals. Normal urine may contain squamous epithelium. The appearance of a cylindrical (cubic) and transitional epithelium indicates pathology, respectively, renal tubules and urinary tract infections. The urine of healthy human do not contain erythrocytes (no more than 2 in a field of view of the microscope). Erythrouria (appearance of red blood cells in the urine) is not a specific feature of a particular pathological process. The resulting of tumor, inflammation, trauma of kidneys and urinary tract, kidney concrements. There are changed with glomerular origin, and unchanged red blood cells in the urine. Glomerular bleeding is usually accompanied by the

presence of erythrocyte cylinders and proteinuria. Normal urine contains a small amount of white blood cells (10 - on microscopy of sediment). The increased number of white blood cells (leukocyturia) indicates inflammation in the kidney and (or) the urinary tract. In order to diagnose more subtle source of erythrouria and leukocyturia is performed **3 cup urine test** that provides consecutive collecting of urine to patients in three containers. The presence of pathological impurities in the first portion indicates urethral pathology, in the third - on diseases of the prostate, seminal vesicles or bladder neck. If there are changes in all portions, it means that pathology is in kidney, ureter or bladder. Cylindruria - the presence of the cylinder in the urine. There are cylinders true (hyaline, epithelial, granular, waxy) that are casts of the renal tubules, and false (erythrocytic, leukocytic, hemoglobin, etc.). Hyaline cylinders consist of mukoproteins appear after physical activities, overheating, with renal diseases. Epithelial, granular and waxy cylinders suggest about severe chronic kidney disease (nephritis). Erythrocyte cylindruria is typical for glomerulonephritis. Leukocyte cylinders appear in case of pyelonephritis, glomerulonephritis, tubulointerstitial nephritis. In doubtful cases, a finer quantitative evaluation of the content of white blood cells, red blood cells and cylinders **urinalysis by Nechyporenko**. Analysis is subject to 1 ml of centrifuged midstream first morning urine. Normally it contains up to 1000 erythrocytes, 2000 leukocytes, 1-3 hyaline cylinders. Widespread use of this technique for the diagnosis of acquired latent inflammation. Other methods of quantitative evaluation of leukocyturia (Adiss - Kakovsky, Amburzhe, Rofe, Stansfield - Eba) have historical significance, as well as search for active leukocytes and cells Sternheimer - Malbin. In order to detect hidden inflammation can be held **prednisolone and pirogenal** tests. Intravenous injection of 10-15 mg of prednisolone or intramuscular injection of 50 mg pyrogenal lead to an increase in the number of leukocytes in 1 ml of urine, the emergence of active leukocytes and cells Sternheimer - Malbin in the presence of inflammation in the kidney. General analysis of urine may simply note the existence of bacteria in the urine (bacteriuria). To assess bacteriuria is conducted **bacteriological examination** of urine. Detection of 100 000 cfu / ml testifies to urinary tract infection - true bacteriuria. A smaller number of bacteria testifies to contamination (external contamination) urine - false bacteriuria. In practice, the bacteriological examination of urine, in addition to determining the type of microflora, always combined with the assessment of the sensitivity of bacteria to antibiotics (antibioticogram). Pathogens of specific infections require specialized research methods for their detection. Mycobacterium tuberculosis can be detected by microscopy of specifically colored urine sediment (by Ciel - Nilsson), bacteriological method (using special media), polymerase chain reaction (PCR).

Crystalluria - the presence of salt crystals in the urine. For quick urine test there are strips to assess the reaction of urine, the presence of blood (hemoglobin), protein, leukocytes, nitrite urine. The sensitivity of this reaction on the quality of hematuria is more than 90% but specificity lower false-positive results associated with a higher concentration of urine. The test for the presence of leukocytes may be false negative in the presence of concentrated urine, glycosuria, urobilinogen, the result from taking large amounts of ascorbic acid. Positive reaction to nitrites may indicate the presence of bacteriuria because many strains of gram-negative bacteria transform nitrates into nitrites. Thus, this test has a high specificity but low sensitivity. Cytological examination of urine is used for the diagnosis of the urinary tract tumors. Collection of urine is conducted directly from the urinary tract catheterization or cysto(uretero)scopy due to the rapid destruction of cells while in the bladder. The positive is considered cytology, in which are found urothelial atypical cells. It is possible for cancer of the urinary tract (transitional cell carcinoma, squamous cell carcinoma, adenocarcinoma) after radiotherapy (especially for 12 months), the use of cytotoxic drugs (cyclophosphamide, cyclosporine, etc.) in the presence of urinary tract concrements. Adenocarcinoma cells are very rarely detected in the urine. No difficulties arise in the study of cells by detecting poorly differentiated urothelial carcinoma unlike its highly differentiated variant because of the similarity of the last cell in normal urothelium.

Investigation of blood

Most urological diseases require the **general analysis of the blood**. Decrease in hemoglobin, erythropenia accompanied by traumatic injury, tumor, are accompanied by hematuria, chronic pyelonephritis, chronic renal failure. Anemia is also characteristic of renal tuberculosis. Erythrocytosis may lead to the cancer of the renal parenchyma. Leukocytosis is often with a shift in leukocyte formula accompanied by acute inflammation of the kidneys, prostate, scrotum organs. Thrombocytopenia may lead to hematuria. Acceleration sedimentation rate of erythrocytes (ESR) typical for inflammatory and neoplastic processes. Renal disease, anemia.

Biochemical research may include determination creatinine level, urea, blood serum electrolytes, which is especially important for patients with renal insufficiency. In order to estimate glomerular filtration rate in patients with creatinine clearance is determined by comparing values of blood creatinine and subsequent portions of urine. Isolated increase of creatinine in the blood may indicate a urinary reflux in venous bed under acute obstruction of the upper urinary tract. Isolated increasing of urea may indicate liver disease, lung, intestine. May be useful to determine the level of glucose, uric acid, bilirubin, total protein, serum alkaline phosphatase levels. Widespread in the diagnosis of prostate cancer has gained serological diagnosis (chemiluminescence) - a blood test for **prostate specific antigen (PSA)**. This substance has an enzyme glycopeptide nature produced by prostate epithelial cells and serves to liquefy the ejaculate. Most of the enzyme are released into the acinus, but small amounts are found in the blood and urine. The value of serum PSA is incomprehensible. The major part (75%) of it is in serum proteins stable condition and metabolized in the liver, while 25% are in the free state and excreted in the urine. Free PSA may be in two isoforms: proPSA and BPSA, which are associated respectively with cancer and benign prostatic hyperplasia. Half-life of this molecule is 2.2 days. Relatively normal blood serum PSA level is considered to <4 ng / ml. However, this value needs correction for age, and prostate volume. By the chemiluminescence analysis can be determined, and other cancer markers - alpha-fetoprotein, human chorionic gonadotropin, which is found in high amounts in tumors of the testis and blood hormones (testosterone).

Investigation of other biological fluids

Microscopic and bacteriological examination of prostate secretions which are obtained by its massage is extremely important in the diagnosis of chronic inflammation of the prostate gland. In normal secretions microscopy are determined lecithin grain in large quantities, a small amount of amyloid cells, epithelium, and up to 10 leukocytes in sight. The secret of the prostate should not contain bacteria and erythrocytes.

Microscopy of discharge from the urethra is performed in patients with urethritis. In order to identify the causative agent of inflammation is also used bacteriological examination, direct immunofluorescence (DIF) and polymerase chain reaction (PCR).

Microscopy ejaculate (spermogram) - Research of ejaculate - conducted to assess the function of fertile men.

3.3. Radiological methods of examination

Radiographic researches are basic to a large number of urological diseases. The history of their using includes over 110 years. For some time to the beginning the application of ultrasound diagnostics in the late twentieth century radiographic methods was the only non-invasive method of examination. The feature of the X-ray research is that it allows you to objectively assess not only the morphology of the urinary system, but also function. Due to this, they often take the dominant role in urological examination. Today we can bring impressive list of major radiographical researches in urology: survey picture, retrograde (ascending) ureteropyelography, excretory urography, ureteropyelography, antegrade pyelography, uro-tomography, pyeloscopy (urocimography) pnevmoren and its variants, renal angiography and its variants, renal

angiography and phlebography, pelvic phlebography and arteriography, cystography, prostatography, urethrography, vesiculography, epididymohrafiya, pnevmohrafiya purse, urocinematography, lymphography, operating radiography of kidneys, and others. It makes no sense to open the contents of each. To know them - is spetsialis task. Let us consider the most significant and widespread.

Preparation patients for radiological research

Patient may be prepared for the research with using of diet, cleansing enemas or laxatives. None of the following methods is not perfect. Moreover, such preparation does not demonstrate advantages in most patients, compared with its absence. In each case, it should approach to preparation of the patient individually. Is mandatory preparation for patients with chronic constipation. For cleaning of intestine may be administered laxatives, such as macrogol. For all patients have recommended if possible, to stay in the upright position for 1.5-2 hours. Sometimes for patient in order to prevent "hungry" gas formation is recommended a light breakfast. Classically, before performing the survey picture of the urinary system, during 2-3 days the patient excludes from the diet products that provide excessive flatulence (black bread, potatoes, cabbage, beans, sweet fruits, whole milk, etc.), limit salt. Possible administration of activated charcoal 4 times per day on the eve and morning of the research by 0.5-1.0 g. Preparation of patient for excretory urography includes the absence of contraindications (childhood and old age, diabetes, renal failure) the maintenance of fluid intake during the night and in the morning on the day of the research. Urethrography does not require the special preparation.

Survey urography

Typically, X-ray examination of urological patients always start with from survey urography. Urography (from Greek: uron - urine and graphos - write) - the study of the urinary system by using radiography.

To prevent irradiation of the testicles the external genitalia are covered in males by protective screen. In women, ovarian protection is not possible due to their location close to the urinary system. Survey urography allows to determine: a) the structure of the bone visible parts of the skeleton (the lower ribs, spine, pelvis, hip joints), b) the position, size and shape of the kidney, their contours and structure of the shadows, c) definition of the lumbar muscles contours; d) the presence of concrement shadows in kidneys and urinary tract, prostate gland, and the presence of calcified organs in the abdominal cavity and retroperitoneal space. Renal contours are determined in 60% of patients. In others it prevents the excess adipose tissue, considerable muscle development. On survey sciagram of the urinary system, the renal shadows are defined on both sides of the spine. The right kidney is usually located slightly below the left. The sizes of kidneys are approximately same, upper pole tilted towards the spine. The longitudinal axis are parallel to the edges of kidney lumbar muscles (Fig. 3.3). If the longitudinal axis of kidneys are parallel to the axis spine it must be assumed the presence of horseshoe kidney.



Fig. 3.3. Survey urogram. Picture of kidneys, lumbar muscles.

Survey urography allows to detect renal stones and urinary tract stones, except X-ray negative (urate, xanthine, cystine).

For urinary tract stones can be mistaken for foreign matters of retroperitoneal space, fecal stones phleboliths, calcified cavity, areas of tumors or lymph nodes and aneurysmatic blood vessels. On survey urogram quite often unable to see anomalies of skeletal metastases, its pathological changes that may cause dysfunction of the urinary system. The edges of the lumbar muscles normally have the form of strips with sharp contours, which goes on and lumbar vertebrae to the pelvis. Absence or blurring outlines of this muscles on one side may indicate the presence of fluid in the retroperitoneal space, conditioned by inflammation or injury. Normally in children of preschool age edges of the lumbar muscles are determined by the insufficient because this symptom at diagnosis not takes into account. If the ureters on the survey urogram normally invisible, the edges of the bladder can be determined by filling it with concentrated urine. On survey urogram in the bladder can be detected stones or foreign matters that got there through clearance of the urethra.

Excretory urography

Excretory urography is based on the ability of the kidneys to capture iodine-containing contrast agent from the blood, to accumulate them, highlight by glomerular filtration, filling calyces, pelvis, ureters, and to excrete the urine. Investigation allows to estimate renal function and to detect abnormalities of the kidney and urinary tract, localization the stones in them, tumors and certain other formations. There are ionic (high-osmotic) and nonionic (low osmotic) water soluble iodine. With the use of ionic triatomic iodine (sodium amidotrizoate) in high concentration - 60-85%. Their osmolarity is five times higher than that of blood plasma, unlike non-ionic iodine contrast agents that only twice exceed osmolarity of blood plasma. To the non-ionic contrast agents include iohexol, iodixanol. The frequency of side effects in the case of ionic contrast agents is about 5% non-ionic - 1%. It pertains to anaphylactic shock, angioedema, bronchospasm, urticaria, heart failure, lesion of CNS. More often such reactions to iodine-containing contrast agents develop in patients reacting to iodine, asthma, polyvalent allergy. Previous administration of glucocorticoids at least 12 hours before the investigation reduces the risk of side effects. Iodine containing contrast agents have nephrotoxic effects. In 10% of patients there is an increase in serum creatinine that with time is normalized independently.

The indications for excretory urography, hematuria is suspected the presence of concrements and diseases of the kidneys and urinary tract, control of treatment results.

Contraindications for excretory urography: severe renal insufficiency (level of serum creatinine is in two times higher than normal, relative density of urine lower than 1.010), hepatic, heart, blood vessels dysfunction, increased sensitivity to iodine, hyperthyroidism, the first half of pregnancy diathesis, allergy. After 1-2 min after intravenous administration is observed saturation of the entire renal parenchyma. On X-ray picture executed at this time - nephrogram - is shown the contrasted renal parenchyma. Pyelocaliceal system and upper urinary tract with satisfactory renal function begin to appear after 5-10 minutes. Therefore first picture makes 7-10 min after administration of X-ray contrast agents, the second - after 15-20 minutes, the last - after 25-30 min. With impaired renal function is a performed deferred picture - 40-60 min, 1.5-2 hours. One of the shots can be done on inhale and exhale (to clarify the degree of renal mobility). In the interpretation of X-ray urogram determine saturation of radiopaque fluid in renal parenchyma, their size, shape, position, contours, time and intensity of contrast fluid filling pyelocaliceal system, ureters, bladder dynamics, the state of the upper urinary tract. Time, clarity of picture occurrence and speed of radiopaque substance evacuation allow to identify functional disorders, deformities - organic defects (Fig. 3.4).



Fig. 3.4. Excretory urogram. Filled with contrast medium pyelocaliceal system remains cystoid function of ureters. Partially filled bladder.

especially at reduced renal function of the urinary tract picture on excretory urogram is unclear. In such cases, sometimes has resorted to compression urography. At this modification excretory urography supplementing by compression of the ureters through the anterior abdominal wall using a special device in the form X-ray negative belt and layers that are placed in the projection of the middle third of the ureter, thus achieving a stasis of urine in the upper urinary tract and increased image contrast (Fig. 3.5). However at compression urography violation of urodynamics slightly reduces the value of investigation, and therefore for diagnostic purposes must be taken pictures not only during compression, before and after to determine the natural condition of the urinary tract. Infusional urography is indicated for examination of patients in the early stages of renal failure with low information content of excretory urography.

Radiopaque fluid is diluted up to 35% concentration of 5% glucose solution or isotonic sodium chloride solution. It is injected intravenously over 5-30 min. The dose for an adult - is 60-80 ml. In children under 1 year is determined the dose rate of 5 ml per 1 kg of body weight, 3-5 years - 2.3 ml / kg, 7-14 years - 1-1.5 ml / kg. Urogram is performed after 1.10 and 20 min after injection of X-ray contrast agents, and if necessary, makes delayed pictures.

Excretory (infusional) urography is a test, and with good renal function after 3 minutes are clearly contrasted renal calyces and pelvis, and the 5-7th - bladder. Slow revenue of radiocontrast substances (or lack thereof) in any of the kidney, point to the reduction of its function. This pattern can be observed in renal colic and explained by violation of (at the moment) uro- and hemodynamics. Shadows of the ureter on excretory serial urograms are replaced normally, due to its contractility. In dyskinesia is determined spasm of calices and ureters. If at excretory urogram ureter is well detected along the entire length, it may indicate a reduction in its tone. During infusional urography as a result of permanent revenues of radiocontrast substances into the bloodstream kidney ureter is filled better and can be seen along its length. At urolithiasis on excretory or infusional urograms possible not only to see the concretions and to determine their form and size, but also to establish the degree of renal dysfunction, urodynamics. Amputation during deformation of calyces, changing contours of the renal pelvis and kidneys may indicate a tumor. Various forms of tuberculosis process are accompanied by reduction and separation of calyces, erosion of the renal papilla, single or multiple cavities, which can be combined with calyces or renal pelvis and of ureters changing the configuration and bladder.

Pictures made in the later minutes, can get picture of the bladder (descending cystogram) and to detect changes in lower urinary tract. There may be performed pictures during urination (voiding cystography), which allow to obtain picture of the urethra (urethrography). However more often to this contrast agent is injected retrograde through the external opening of the urethra.

Orthostatic excretory urography is performed in the upright position of the patient to determine the degree of renal mobility.

Compressive urography Quite often,

These methods are very informative at hydronephrosis and ureterohydronephrosis, with their help it is possible not only to establish the degree of expansion of the renal, but also to clarify the degree of dysfunction, follow the dynamics of treatment.



Fig. 3.5. Compression urogram. The picture shows a well-contrasted pelvicalyceal of kidney and upper sections of ureters.

Contraindications for using this method is the inflammation of the urinary tract, pregnancy, severe general condition of the patient.

Urethrography

Urethrography - X-ray investigation of the urethra after filling it with X-ray liquid. This investigation is the most informative, and sometimes the only method of recognition a number of pathological conditions of the urethra and prostate.



Fig. 3.6. Bilateral retrograde pyelogram, performed in order to avoid obstruction of ureters.

position throughout the investigation. Investigation is performed under radiographic control and at the time of maximum filling of the urethra performs radiography. To receive pictures of female urethra at ascending

Retrograde ureteropyelography

Retrograde (ascending) ureteropyelography allows us to determine the state of its anatomical cavity system (Fig. 3.6). Retrograde pyelography is performed with an optical device - ureterocystoscope through which the in the kidney is put ureteral catheter for introduction of liquid or X-ray - for the detection X-ray positive stones - gas (oxygen or carbon dioxide). The volume of contrast in order to prevent pyelorenal reflux and renal colic should not exceed the physiological capacity of renal cavity. Indications for retrograde pyelography may be urate urolithiasis, medullary necrosis, papillary tumor of the renal pelvis, suspected tuberculosis, and lack of kidney function on excretory urography.

Indications for urethrography serve as damage suspicion of developmental abnormalities, strictures, tumors of the urethra.

Contraindications: acute inflammatory diseases of the urethra, previous endourethral manipulations accompanied by urethrography. Ascending urethrography is performed in the patient on his back, radiographic contrast fluid is injected into the urethra using a syringe with a rubber tip Zhane or catheter that is inserted into the external opening of the urethra. Men at ascending urethrography for better visualization of the urethra in addition to provides the necessary X-ray position with bent at the knee and hip joints tightened to the body set aside outside the left foot and pull out and set aside and back right. Conductor straighten and hold in this

urethrography is technically difficult. Normally at ascending urethrography almost always filled and bladder (urethrocytography).

Descending urethrography

Through urethral catheter is injected into the bladder 150-200 ml of radiographic contrast medium. The catheter is removed during urination performed radiography (downward or voiding cystourethrography). On descending urethrogram the posterior urethra is determined better than on the ascending. Bladder neck takes the form of funnel, and the posterior urethra lumen expands on average 5 mm. However descending urethrography is not always informative enough, so it is usually complementary by ascending. On X-ray pictures in males the unchanged spongy and especially bulbous portion of the urethra (anterior urethra), stretched radiographic contrast medium give a wider shade (10-15 mm) than the narrow and membranous part of the prostate (posterior urethra), the width of the lumen which is 2-3 mm. Bulbous part slightly protrudes in the lower section, making the downward arc. Posterior urethra with anterior forms the obtuse or right angle. The lumen of posterior urethra in the direction of urethral sphincter conical narrows, the apex of the constriction is a place of transition posterior into front urethra.



Fig. 3.7. Ascending cystogram. Direct projection of the bladder. At the bottom is visible the catheter.



Fig. 3.8. Voiding cystogram. Left-sided vesico-ureteral reflux.

At the rear urethra in the ascending urethrogram is determined slight distortion turned bent advance. As part of the prostate urethra can sometimes be seen as a seminal tubercle oval filling defect. Urethrogram allows us to identify congenital urethral doubling, its diverticula, congenital valves or membrane, bladder neck sclerosis, secondary deformity of the urethra caused by ILI, detection of damage, strictures, urethral fistula, foreign matters, tumors and stones urethra. For the diagnosis of urinary stones contrasting urethrogram should be preceded survey urethrocytography.

Cystography

It is the method of radiological research of the bladder. This research is used to detect tumors of the bladder, concrements, bladder anomalies and others. Despite the fact that most of the diseases of the bladder can be detected by cystoscopy and ultrasound (sonography), cystography can sometimes play an important role in the diagnosis, when cystoscopy does not identify pathology (bladder diverticula, stones in diverticula,

vesico-ureteral refluxes, injury, etc.). Cystography is always performed using radiocontrast agents (liquid or gas).

At ascending cystography amount of administered contrast substance or gas should not exceed natural capacity of the bladder. Photos are made in the direct and lateral position (Fig. 3.7). The contraindication for performance of ascending cystography are acute inflammation of the urethra, bladder, prostate, seminal vesicles and organs of scrotum. In the presence of these diseases for resolving question of the bladder status performs the descending cystography.

Renal angiography

Angiography – is the method of contrast radiographic research of blood vessels, most of all - arteries and veins. The generally accepted and most common method of renal angiography in recent times is transfemoral aortography or its variety - selective renal arteriography. These studies provide an opportunity to get also the radiographic picture of contrasted veins of kidney in their venous phase (venography). Angiography requires the using of special equipment. Contemporary variety method - digital subtraction angiography - provides the reproduction of images by using computer technology. Contrasting fluid is injected through the puncture of femoral artery with carrying through it catheter to the level of discharge from renal artery dissection (mid body of 1 lumbar vertebra) or insertion tip of the catheter into the renal artery (selective renal arteriography).

The indications to perform renal angiography are:

- Inability to judge the type and the degree of destruction kidneys via retrograde pyelography and excretory urography;
- Renal hematuria of unknown etiology;
- Tumor of kidney;
- Complicated anomalies, tumors, tuberculosis of the kidney;
- Preoperative determination of features vascularization renal parenchyma;
- Adrenal tumors;
- Hypertension of unknown etiology.

Contraindications to renal angiography are similar to the following excretory urography. Complications of renal angiography, in addition to associated with the introduction of contrast can also be hematoma, bleeding, aneurysm, infection.

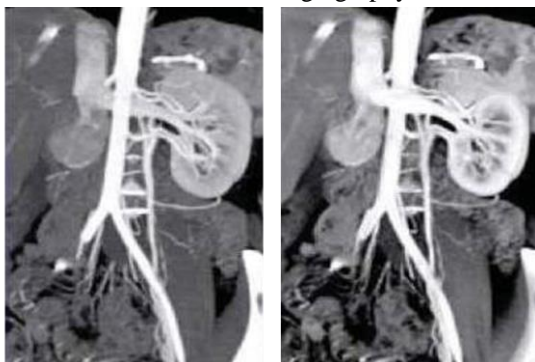


Fig. 3.9. Multislice scans of the kidneys

Computed Tomography

One of the most accurate methods of image acquisition. Computed Tomography (CT) is used to detect diseases of the abdominal cavity, liver, gallbladder, pancreas and spleen. In urology - kidney, bladder, prostate, external genitalia. With CT is

possible to determine the direction of tumor growth, metastasis to lymph nodes.

In patients with prostate cancer CT computed tomography allows you to find and to clarify the degree of metastasis tumor germination in the capsule gland, seminal vesicles and more.

The method has high sensitivity, which can detect even small tumors (0.6 cm). The irradiation during examination of the abdominal cavity is equal to dose irradiation at X-ray. CT research is contraindicated in pregnant women, in breastfed, in infants and in some diseases.

Integrated multislice tomography

The principle of spiral CT is the simultaneous performance of two actions: continuous rotation of the transmitter - X-ray tube that generates radiation around the patient's body, and continuous translational motion of the table with the patient along the axis Z of scanning through a hole in the center.



Fig. 3.10. Three-dimensional (3D) multislice CT. Using a 3D-enabled models to accurately assess early branching of the right renal artery.

In this case, the trajectory of the X-ray tube, about the axis Z - direction of movement of the table with the body of the patient - takes the form of a spiral. Unlike conventional CT, the velocity of the table with the body of a patient may vary depending on the purpose of the study. If the speed of the table is higher, than the length of the scanning is greater. It is important that path length of the table during one turn X-ray tube can be in 1,5-2 times higher than thickness of the tomographic layer

without deterioration spatial resolution of the image.

Technology of spiral scanning has significantly cut down the time CT research and significantly reduces radiation exposure to the patient. The appearance of new multislice scanners has revamped visualization of the urinary system (Figure 3.9). High axial body image, obtained with a pitch of 0.5 mm during the initial scan, with powerful graphical workstations can be quickly transformed into high-quality multiplanar construction that allow to visualize two-dimensional and without distortion an interesting areas in any plane. At intravenous contrast are available three-dimensional construction and virtual endoscopy. 3D-simulation can be performed relatively to vessels and urinary tract (Figure 3.10).

Virtual endoscopy

Virtual endoscopy of pyelocaliceal system, ureter, bladder and urethra allows non-invasive "to look" into the lumen of these organs, efficiently simulating optical study using three-dimensional computer modeling.

Multislice voiding cystourethrography

Multislice voiding cystourethrography, which is based on multidetector CT, allows to obtain picture of all urethra in cut to visualize it in three dimensions, and if necessary to perform virtual urethroscopy. The method is shown in the presence of combined reasons of infravesical obstruction.

Magnetic resonance imaging

Magnetic resonance imaging (MRI) – is a method of obtaining images of internal organs without using X-rays and radiation. MRI scanner receives an image that is composed on the basis of magnetic fields generated by the human body.

MRI in urology is less important in comparison with CT. Gradually, it is used in the diagnosis of tumors, but does not provide sufficient information to determine the stage of cancer and its prevalence. MRI in urology allows to determine the vascular lesions, to assess the rate of blood flow, to determine the diffusion processes in tissues. Performance of MRI is contraindicated in patients with a pacemaker, metal prostheses, bone implants. As the MRI is heated body, try not to carry out research in the first trimester of pregnancy unless absolutely necessary.

Dynamic MRI in urology is most often used in the diagnosis of renal tumors the bladder and prostate. The advantage of dynamic MRI is the high accuracy of the location and size of malignant renal tumors, and stage of the cancer process. Thinner assessment of kidney cancer invasion beyond the capsule of the kidney is achieved by applying an additional mode of inhibition signal from adipose tissue.

MR urography is based on a registration of the signal from static liquid without application of expensive paramagnetic contrast agent. It is associated with great potential in visualization of the upper urinary tract. MR urography is used in patients with severe chronic renal failure, radiocontrast agents and intolerance in pregnant women (Figure 3.11).

MR virtual endoscopy - another high-resolution and non-invasive method of examination of the urinary tract, which often requires the use of expensive paramagnets contrast and most used in the diagnosis of papillary tumors.

MR spectroscopy - is highly sensitive non-contrasted method of diagnosing prostate cancer. It is based on the registration of tissue concentrations of choline, creatine and citrate in the prostate gland. For accurate localization of cancer metabolism fosi is used the separation of the prostate into separate quadrants by its covering the coordinating virtual grid.

This technique is performed in the presence of a magnetic coil endorectal or by using latest generation scanners. It was established that the size and volume of tumor foci at MR spectrography depend strongly on the degree of differentiation in common Gleason scale. Thus, this method can not only diagnose prostate cancer, but also to determine its potential aggressiveness.



Fig. 3.11. MR urogram. Stenosis of the right pelvic-ureteral segment.

A significant achievement in the diagnosis of urethral stricture has become MR urethrography, which is performed at T2-weighted scan in the sagittal plane of the previous injection of hydrophilic gel in the urethra. The method allows precisely to measure the length of narrowing and to determine presence and extent of spongiofibrosis. In cancerous urethral strictures MR urethrography helps to establish the stage of the cancer process. The emergence of fundamentally new contrast agents for MRI, which contains ferumoxtran-10 allows today with almost 100% efficiency to detect cancer metastasis lesions of the urogenital system in lymph node size > 3 mm. This

substance consists of microparticles of iron oxide, which does not accumulate lymphoid tissue that is affected by the tumor.

Positron emission tomography (PET)

The basis of this method is based on possibility of using a special detecting equipment (PET scanner) to track the distribution in the body of biologically active compounds labeled with positron-emitting radioisotopes. The potential of PET is largely determined by the available arsenal of labeled compounds - radiopharmaceuticals (RFC). The choice of appropriate RFC allows to study with PET so different processes such as metabolism, transport of substances, ligand-receptor interactions, gene expression, etc. Using the RFC, which belong to different classes of biologically active compounds, makes PET pretty universal tool in modern medicine. Type of used radioligand determines the range of diagnostic possibilities of the method. For effective recognition of local and distant metastasis of renal parenchyma is used fluorodeoxyglucose - the most common biomarker. At the same time thoughts about sensitivity of this method in the diagnosis of the primary focus of renal cell carcinoma are contradictory. PET has shown feasibility of the method in the diagnosis of prostate cancer (preoperative study the state of lymph nodes and distant metastases, definition phase process by Gleason), bladder cancer and testis.

Radioisotope diagnosis

Dynamic radioisotope renography (renal scintigraphy) - the investigation of renal function using radioactive isotopes or RFC. After intravenous injection of RFC they are selectively secreted by proximal tubular epithelium of the kidney and consistently fall into lumen of the tubules, pyelocaliceal system, ureters, and bladder. The radiation emitted by RFC, penetrates through the tissue and registered gamma camera mounted next to the patient. More often for research kidney is used mercapto acetyl triglycine labeled with ^{99m}Tc half-life of 6 hours. Renoscintigraphy is shown to patients with various diseases of the kidneys. The method is particularly effective in cases where X-rays are contraindicated. Special preparation of patients does not need (Fig 3.12).

After intravenous injection RFC in the kidney appears after 15 seconds and begins to flow into the bladder for 3 minutes. Peak of radioactivity in the kidneys occurs at a time when begins excretion of RFC.

Radioactivity starts to decrease when the excretion of isotope is ahead of income.

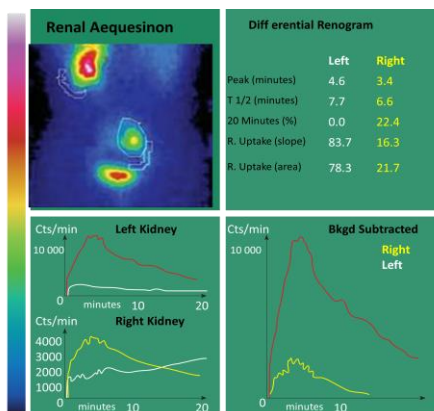


Fig. 3.12. Dynamic renal scintigraphy. Scanograms of kidneys, renograms computer and their quantitative measures.

Picture is displayed on the screen with a 30-second intervals first 3 minutes, then five-minute intervals until the end of the study, which generally lasts 20-30 minutes. The curve change in activity over time (renogram) is recorded for each kidney separately. Normal renogram has three phases:

- The first phase - the rapid rise of the curve during 20-30 sec.
- Phase II - slower rise of the curve to the peak. If the curve does not reach the top, they say that it is rising. Normally the second phase ends with a sharp peak.

- The third phase - reduction of the curve after the peak. If the curve reaches its peak, the third phase may not be.

The first phase is not subject to evaluation. The second and third - may be absent, changed or normal. Time to peak depends on the flow of urine and the level of hydration is measured by time during which RFC passes through the renal parenchyma and pelvis. Time of renogram peak is normally 2 to 4.5 minutes. If renogram continues to grow more than time in which peak should be reached, it is possible for distal obstruction (for eg., pelvis, ureter segment or below the ureter). In these situations, after 18 minutes of research is performed injection of 40 mg of furosemide: a rapid falling of the curve is no evidence of obstruction, and continuation of its rise indicates an existing obstruction. If it is planar (not rising nor coming down) it is described as a questionable result. The time of RFC by parenchyma is normally an average of 70 sec and prolonged more than 156 sec at obstruction and renal ischemia.

Static radioisotope renography (renal scintigraphy) is performed using dimercaptosuccinic acid labeled with ^{99m}Tc . RFC retracts by proximal tubules and remains there, slowly excreting in the urine. Thus is obtained a static image of the kidneys (within 3-4 hours after intravenous injection of radioisotope). It demonstrates affection of functioning nephrons and is used to evaluate resolution of renal function, identifying scars in the kidney as a defect of cortical contour in which the RFC does not accumulate.

Radioisotope bones scan (osteoscintigraphy)

Osteoscintigraphy is performed with methylene diphosphonate labeled with ^{99m}Tc . RFC is accumulated by areas of bones with increased blood supply and increased osteoblast activity. There are many causes of focal accumulation of the isotope - bone metastases places of fractures, osteomyelitis, tuberculosis, benign neoplastic lesions, such as osteoma. Prostate cancer metastases are more often to the spine and numerous (single are rare). In urology osteoscintigraphy is used for the diagnosis of bone metastases of malignant tumors, especially - prostate cancer.

Diaphanoscopy

(from the Greek. Diaphanes -clear and -skopia), transillumination – is translucence by narrow beam of light cutaneous formations. In urology diaphanoscopy is used in presence of increasing one or both halves of the scrotum. The essence of the method is that the back surface of the scrotum closer to the it's bottom or to infralateral surface rises a light source. However, if the light penetrates well through scrotum and it turns red, it means that it is caused by an increase in the accumulation of fluid (edema membranes of testis or epididymis cyst. If scrotum is impervious to light - hence its increase is caused by inflammation or tumor testis and / or epididymis. In recent years with the advent of scrotal ultrasound, diaphanoscopic value in the diagnosis of scrotal diseases scrotum is lost. Scrotum ultrasound allows making a diagnosis with much greater accuracy.

Ultrasonography

With little more than a half-century history of use in medicine, ultrasound has now become perhaps the most common method of radiation diagnostics and replaced the whole range of old diagnostic technologies. First of all, thanks to the non-invasiveness and safety along with high information and profitability. Ultrasonography - a method of study using ultra-high frequency sound waves. In medical practice, tissues displayed on the ultrasound monitor in the system of gray scale ultrasound have different density (echogenicity). Tissues of higher acoustic density (hyperechoic) are issued lighter. For example, concrements are visualized as clearly contoured structures on which define the dark path - acoustic shadow. The formation of the latter is caused by a complete reflection of ultrasonic waves from the surface of the

stone. Tissues of reduced acoustic density (hypoechoic) are issued on the screen darker and liquid formations - the most dark - echo-negative (anechoic).

Doppler ultrasound is used to visualize blood vessels and estimation of parameters of blood flow. The signals thus are registered graphically (in a color spectrum on the screen) and acoustically by recreating undulating sound of blood flow in the vessel of the heart rate of the patient. Ultrasonography of the kidneys and upper urinary tract can determine topographic features, dimensions, state of parenchyma, renal sinus, pyelocaliceal System (PCS), perirenal fat, the presence of upper urinary tract pathologic formations, as well as the degree of respiratory mobility of kidney. The normal renal parenchyma has the form of homogeneous hypoechoic structure with thickness of 15-19 mm. Its borders with inner part sinus of the kidney and has a slightly irregular contours through papillae that appear in sinus. Sometimes, especially in children and young adults in the renal parenchyma is visible pyramid triangular form directed the basis to the outer contour of the kidney, and by the tip - in the sinus, forming papillae. They have lower echogenicity than parenchyma. They have lower echogenicity than parenchyma. In the renal sinus, with echogenicity similar to the perirenal fat, can be visualized some vascular bundles in the PCS that is not detectable normally. In the study of patients with water loading or at filled bladder is visualized pelvis in the form of anechoic formation. Its anteroposterior size does not exceed 15 mm.

Providing a good visualization of kidney ultrasonography provides poor anatomical details of ureters, and the middle third of them can not be traced through the gas in the intestine (Figure 3.13).

Indications for ultrasonography of the kidneys and upper urinary tract are their developmental abnormalities, acute and chronic inflammatory diseases, trauma, hematuria, urolithiasis, differential diagnosis of space-occupying lesions, hydronephrosis, non-functioning kidney, uncorrected resistant hypertension, chronic renal failure, monitoring of kidney transplant. Under ultrasound control can also be performed percutaneous surgery - needle biopsy of the kidney and nephrostomy.

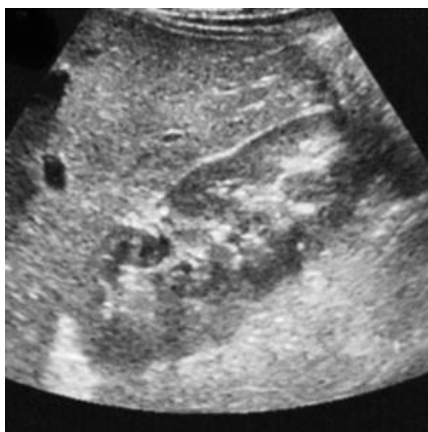


Fig. 3.13. *Ultrasound scanogram of the right kidney*

Preparation for study is needed in case of necessary visualization of renal vessels and ectopic kidneys when research is conducted by the anterior abdominal wall, and if you can not to examine kidneys due to increased amount of gas in the intestines. Are excluded products that cause increased gas formation (black bread, cabbage, beans, etc.) are assigned sorbents inside and cleansing enemas - the night before and the morning of the test.

Ultrasonography of bladder

The indications for conducting the survey is the tumor, trauma, stones and bladder diverticula, hematuria, violation of the urinary outflow from the bladder (infravesical obstruction), necessity of determination the amount of residual urine. Under ultrasound control in the bladder can be installed percutaneous suprapubic catheter. The bladder ultrasonography may be performed by the anterior abdominal wall (transabdominally), rectum (transrectal) through the urethra (transurethral) and through the vagina (transvaginal). The last three methods are more invasive because they are used to refine the information obtained via transabdominal study. Preparation for the study includes the presence of at least 100 ml of urine in the bladder. For its filling, it enough within 2-3 hours before ultrasonography to appoint the water stress research. Before transrectal research is needed to perform cleansing enema. During the

ultrasonography is evaluated volume, shape, contours of bladder, the thickness of its walls, the presence of concretions, tumors and determination of the extent of their germination outside the body. Normal bladder is rounded, with clear contours, echo-negative symmetrical formation with internal echo-structure with a wall thickness of 3-5 mm, volume 200-300 ml in an adult. At the end of study is carried out measurement amount of residual urine after self urination. The volume of residual urine similar to the volume of the bladder, is measured by special formula or using a computer program of ultrasound machine. In a healthy person in the bladder after voiding urine does not remain. The presence of residual urine indicates the detrusor hypotension, which may occur as a result of violation of the bladder innervation, infravesical obstruction or their combination. It should take into account the variability of the residual urine amount, which may vary from day to day more than 150 ml. To avoid diagnostic errors are conducted repeated measurements.

Ultrasonography of urethra (ultrasonographic urethrography) is performed only in men to determine the location, length and severity of cicatricial process in the urethra and evaluation of the degree of blood flow in the affected area. The method requires the injection in urethral lumen about 15 ml of sterile water or an isotonic solution and then clamp the external opening of the urethra at the time of the study (contraindicated in acute urethritis). Research is conducted in the patient lying down using an external linear and rectal ultrasonic sensors. These data allow us to estimate the degree of spongy body sclerosis, which provides blood supply to the urethra and thus adequately choose the surgical treatment method of urethral stricture.

Ultrasonography of the prostate and seminal vesicles

Indications for conducting research: acute and chronic inflammatory diseases of the prostate and seminal vesicles, prostate tumor, infravesical obstruction, abnormal sperm. Under ultrasonic control is carried puncture biopsy of the prostate. To assess the condition of the prostate and seminal vesicles more detail allows transrectal ultrasound (rectum). Transrectal ultrasonography is contraindicated in the presence of hemorrhoids, acute inflammatory diseases of the rectum and the skin around the anus. In such cases, and in case of failure of transrectal patient survey - is performed transabdominal.

Preparation for the study is the same as for an ultrasound of the bladder. In diseases of the prostate the volume of research usually goes beyond its visualization as it is necessary to determine the status of organs, pathogenetically-related diseases of the prostate. In particular are investigated prostate and seminal vesicles of clarifying their relationship to the surrounding organs, bladder specifying and measuring its volume amount of residual urine, under indications - the upper urinary tract, kidneys and liver to detect complications such as urostasis or metastases. At ultrasound of the prostate consistently determine its linear dimensions and the volume, evaluate the symmetry of the particles relative to the urethra, capsule expression, equality of contours, echostructure, state preputial venous plexus.

Normally, according to the ultrasound, prostate gland of a dult male symmetrical, has front size 16-23 mm, upper-lower - 24-41 mm, cross - 27-43 mm, volume - 20-25 ml homogeneous structure with smooth contours and a distinct capsule. Seminal vesicles symmetrically are located just above the top of the prostate, have a maximum upper size lower in their original departments - 8.10 mm.

Ultrasound of the scrotum and penis

Indications: any enlargement in the volume of the scrotum (acute and chronic inflammatory diseases, closed trauma, torsion, cysts, tumors of the testis and its appendages, varico- and hydrocele), trauma, tumors and fibroplastic induration of the penis (Peyronie's disease) erectile dysfunction of vascular origin. Contraindications to ultrasound may be severe inflammatory changes in the skin of the scrotum and penis. Preparation for the study include hygiene of vulva.

With the help of ultrasound evaluate the thickness of the walls of the scrotum, the size, shape, sharpness of testicular contour and appendage, and their echostructure and symmetry, state the spermatic cord. On scanograms are also determined the inguinal membrane of testicles, scrotum membrane, the presence or absence of space-occupying lesions, fluid in the cavity of the scrotum. In the application of dopplerography are distinguished arterial vessels of the testicle and scrotum, spermatic cord veins, assess the condition of blood flow in them. Normally, the thickness of the scrotum does not exceed 8 mm. The testicle is homogeneous, isoechogenic with the head of appendage, echostructure of moderate density with increased echoes from the mediastinum of testis. The body and tail of the epididymis can not be determined. Spermatic cord appears as echogenic cord. Between the sheets of inguinal membrane in the area of testicular sinus and head of appendage is determined a small amount of fluid. On the surface of the testis and epididymis may occur hydatid size 2-5 mm. Ultrasound of the penis allows us to estimate the structure of spongy and cavernous bodies, albuginea, to reveal in them fibrous inclusions to visualize vessels with the definition of their condition, the presence of atherosclerotic plaques. On doppler assess the condition of blood flow in the dorsal artery of the penis in different phases of erection, using functional and pharmacological stimulation.

The latest types of ultrasound

Ultrasound tomography (sono-CT) is based on the summation of echoes of the main plane of scanning plane with additional images obtained by non-exploring large angular deviation of ray in real time, can achieve the effect of spatial overlay twofold increases accuracy and contrast of imaging. With this technique is better differentiated liquid formations of kidneys (due to good visualization of the capsule, and improved ability to detect internal structures), small concretions (with its size from 4 mm) of the kidney, bladder, and even urethra that were previously invisible in standard ultrasound.

Harmonious echography - is based on the effect of nonlinear interaction of ultrasound waves with biological tissue. The method allows not only to increase almost three times sharpness and contrast visualization, but also to get rid of unwanted artifacts. With it manages to visualize clearly not only parenchymal tumor, but pseudocapsule of latter. Data about its prevalence have crucial significance in determining whether organ-preserving surgery for renal cell carcinoma. Papillary tumors pelvis, is difficult to diagnose with normal ultrasound, but well visualized using harmonic (USD). The possibilities of this method significantly expands in the application of ultrasound contrast agents. To a greater extent this applies to diagnose malignant lesions of the kidney and prostate. High Contrast of cancer foci in the prostate in the application of harmonic sonography with contrast enhancement provides more accurate biopsy it.

Another variety of the latest ultrasound is elastography that allows differentiate minimal differences in tissue density of the investigated organ (Fig. 3.14).

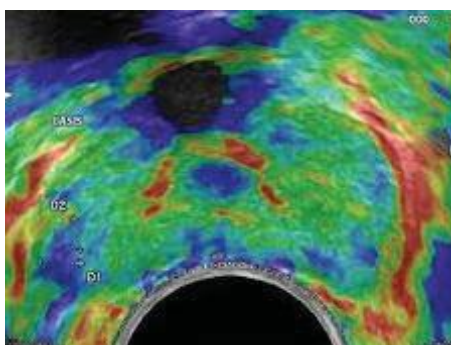


Fig. 3.14. *Elastography prostate (blue indicates the areas of dense parenchyma)*

In urology, this precision technique has been applied in the diagnosis of prostate cancer. Biopsy of the prostate under the control of transrectal elastography greatly increased verification of the disease.

Three-dimensional (3D) ultrasound in urology is most often

used to diagnose diseases of the prostate. 3D-sonography also finds the practical application in the diagnosis and staging of bladder cancer (Figure 3.15). Overall detection of tumors using this method is 96%, while two-dimensional ultrasound allows to diagnose only 81% of tumors of the bladder wall.

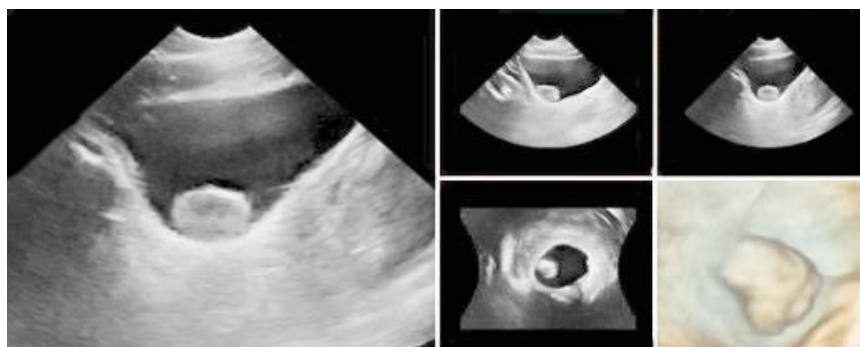


Fig. 3.15. 3D-sonogram of tumor bottom of the bladder

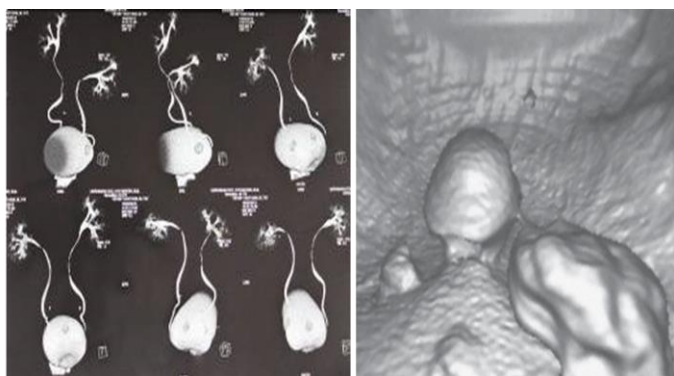


Fig. 3.16. Visualization of multiple tumors of the bladder: a) CT virtual urogram b) virtual cystoscopy.

One of the new features 3D-ultrasound of the bladder is a **virtual cystoscopy**, which allows non-invasive and detailed view inside the body, to recognize not only the tumor but also diverticulum, ureterocele, concrements and other pathological changes in the bladder (Figure 3.16).

Endoluminal ultrasonography - a modern method which is based on putting of special ultrasonic probes in hollow organs. In endourology using

intracavitary ultrasound was made possible through the development of rigid transurethral probe, which is connected to the cysto- (nephro) scopy and new types of scanning sensors that are based on long, thin and flexible catheter (similar to ureteral). In urology it is more often used for high-precision staging of papillary tumors of the urinary tract, assessment of severity and length of stricture of the urethra and ureter also to identify diverticula of the urethra.

Voiding ultrasonic cystourethroscopy - allows real-time to visualize the bladder neck and prostatic urethral department during urination at simultaneous determining the urodynamic parameters. A variety of this method - **Doppler voiding cystourethroscopy** - allows to determine the linear speed indicators of urinary flow in the posterior part of the urethra.

Echo Dopplerography - one of the informative ultrasonic methods of assessment the organ blood flow, which allows to evaluate the ability of the mechanism of erection. The method provides a quantitative assessment of veno-occlusive mechanism of erection that allows to regard it as a serious alternative high invasive pharmaco-cavernoso-tonometry. Three-dimensional echodoplerohrafiya is used in urology to detect prostate cancer and can detect cancer isoechoic foci and to assess the invasion of cancer lesions outside of

the prostate capsule. In the diagnosis of urological diseases biopsy of the affected organ is often crucial. The widespread introduction into clinical practice of the method and ultrasound are led to wider use in the practice of urology percutaneous needle biopsy as the visual control of invasive manipulation has provided significant increase in its safety and efficacy.

Invasive diagnostic of ultrasound imaging under control

Percutaneous needle biopsy of the kidney in urological practice is performed mainly to determine or clarify the morphological structure of the detected tumors. To obtain material for cytology usually resort to fine needle biopsy (using a needle with a diameter of 1.2 mm). To prevent complications of biopsy 2-3 days before is prescribed antibacterial manipulation, and day before - hemostatic agents. In stationary or outpatient basis, usually under local anesthesia, with the patient lying on the abdomen at a point on the back, which is 10-12 cm laterally midline, just below the XII rib at shallow depth in the kidney is injected trocar through which conducted the needle, coupled with a syringe. The needle are promoting deep into the kidney, while creating via syringe negative pressure aspirating into it the column kidney tissue. Needle and trocar extract without interrupting aspiration.

Contraindications to puncture: lack of contact with the patient, lack of visualization of tumors, abnormalities in decompensated blood coagulation system; violation of vessel wall permeability, high blood pressure, urosthesis in kidney; tumor localization in an area with a high risk of complications, technical difficulties in performing puncture. Fine needle biopsy under ultrasound is considered relatively safe invasive research, but during and after the procedure, there may be some complications: severe pain at the site of puncture and the progress of nerve endings, damage due to bleeding blood vessels, formation perirenal hematoma, infection of area and suppuration of puncture channel, implantation of cancer cells over the course of the puncture channel. **Puncture biopsy of the prostate** is widely used to diagnose prostate cancer. Is performed by transperineal, and most of all - access via transrectal ultrasound rectal probe.

At transrectal biopsy under control of the index finger into the rectum is injected trocar, and through it - a special device with the puncture needle. In order to improve the diagnostic value of the research tissue is taken from 6-12 areas of prostate (polyfocal biopsy). For the prevention of infectious and inflammatory complications overnight to the patient is put a cleansing enema and prescribed antibiotic therapy (fluoroquinolones), which continues three days after the manipulation. The research is performed in outpatient basis. The frequency of complications is low and amounts approximately 1%, including the presence of blood in the urine and feces, fever, acute orchiepididymitis, acute urinary retention, acute prostatitis, sepsis.

3.4. Hardware and instrumental methods of examination

Uroflowmetry - is the graphical representation of urinary speed of stream in patient's. Holding uroflowmetry is shown to diagnose diseases that are accompanied by intravesical obstruction, ie at narrowing of the urinary tract, located below the bladder. Such events shall include tumors, chronic inflammatory disease and sclerosis of the prostate, urethral stricture and valves. There are no contraindications to perform uroflowmetry. The level of urinary flow is measured in ml / s and recorded by electronic flowmeters. They are able to provide a printed record volume of urine, maximum flow rate and time of urination. The level of maximum flow (Qmax) depends on the amount of urine, detrusor contractility of patient and conductance (resistance) of the urethra. The patient must empty the bladder in the funnel of uroflowmeter. For registration optimal parameters of urine volume should be at least 150 ml and not more than 400 ml during the second after night sleep urination. If healthy person normally produces urine with a maximum volumetric rate of 20-30 ml / sec, then in obstruction infravesical the rate decreases in the early stages without special examination is not always noticeable. In men with symptoms of

infravesical obstruction with the same volume of urination level of flow is significantly different during the day (5 ml / s at four times of measurement) because most recommendations suggest at least two-fold measurement of flow, with registration of best results. Uroflowmetry does not explain why the flow of urine is abnormal. It does not differentiate the reasons of low urine flow between intravesical obstruction and reduced detrusor contractility. The main use of uroflowmetry is in the assessment of the functional status of the lower urinary tract infections in elderly men with suspected prostatic obstruction.

Cystometry or cystomanometry - definition of intravesical pressure. The research can be done either by filling the bladder and during urination. Measurement of intravesical pressure during filling of the bladder allows to assess its reservoir function. Cystomanometry thus begin after emptying of the bladder. Portions of 50 ml is injected warmed to body temperature liquid or gas at a constant volume rate.

In process filling of urinary bladder through the same catheter is measured the pressure. Observe the pressure at the first, moderate expressed and clearly expressed urge to urination. In a healthy person the first urge to urinate is recorded while filling the bladder to 100-150 ml and intravesical pressure of 7-10 cm of water column, pronounced urge - at filling up to 250-350 ml intravesical pressure of 20-35 cm of water column This kind of response to bladder filling is called normoreflexive. Under various pathological conditions, this reaction may vary. If a significant increase intravesical significantly pressure and expressed urge for urination even when there are small filling (100-150 ml) of the bladder, the bladder is called a hyperreflexive. Conversely, if the filling of the bladder 600-800 ml the pressure in the bladder increases slightly (10-15 cm of water column), and the urge to urinate is absent, then the bladder is called hyporeflexive. Cystometry during urination allows to judge the permeability of vesico-urethral segment, urethra and detrusor contractile ability. For this study, a catheter with a pressure sensor is installed in the bladder by suprapubic puncture. If simultaneously with registration of intravesical pressure uroflowmetry is performed, the study called "**pressure - flow**."

Normally maximal intravesical pressure during urination in men is 45-50 cm of water column, and in boys - 74 cm of water column, in women - 40-45 cm of water column, in girls - 64 cm water column . The increase of intravesical pressure during urination above the normal range indicates the presence of obstacles to emptying of the bladder.

Video-Cystometry - photo fluoroscopy (X-ray imaging) combined with the investigation "pressure - flow" during urination.

This study provides the most accurate measurement of the behavior of bladder and urethral sphincter during filling of the bladder during urination. Cystometry precedes to investigation "pressure - flow." The pressure of the bladder (urethral or suprapubic is measured by catheter) and of the abdominal wall the pressure (is measured by a pressure sensor inserted into the rectum) recorded during filling of the bladder (cystometry phase) and emptying (voiding phase) with the simultaneous measurement of flow during urination. Detrusor pressure can not be measured directly but can be calculated by subtracting the pressure of the abdominal cavity pressure measured in the bladder (infravesical pressure). It allows to separate the effects of increased intra-abdominal pressure caused by coughing or tension, from the general (infravesical) pressure. Thus are got the real values of detrusor pressure.

During urination the key parameters are maximal volumetric rate of urination and detrusor pressure at the moment of maximal volumetric rate of urination. This pressure, in relation to the maximum volumetric rate of urination can be used for determination of presence the infravesical obstruction.

Bladder catheterization is performed for diagnostic or therapeutic purposes: to empty the bladder, it lavage, input medicinal substances or opaque (instillation). For catheterization catheters are used - instruments in the form of tube of metal, rubber or various polymeric materials. Catheters are soft (rubber),

rigid (metal) and semirigid (elastic - from polymers). Catheters vary in diameter and under - different numbers. Number catheter, as well as other instruments is determined by scale French (Fr or F), or scale Shar'yer (Ch) and corresponds to the circumference of the tool in mm.

Most commonly is used catheters of Nelaton, Timan, Pecser, Malek, Pomerancev - Foley. There are special catheters for bladder catheterization for men, women and children. Children catheters are smaller than catheters for adult, female - shorter and have a large curvature "beak". Technique of catheter insertion into the bladder in women is simple. In position of woman on the back with his feet carefully dilute is treated a cotton ball moistened with antiseptic solution, the external opening of the urethra, and then sterile catheter to is inserted through the urethra into the bladder. With the introduction of a metal catheter should be considered curvature tool that allows you to gently pushing the back wall of the urethra, through a small arc, without effort to push it into the bladder. Insertion of soft or semi-soft catheter by using of tweezers.

Technique of catheter insertion into the male bladder is more complicated. In position of the patient on the back the the glans penis is held on coronary sulcus on the sides (not squeezing the urethra) middle and ring fingers of his left hand and pull slightly forward so that to made short folds of the mucous membrane of the urethra. The external opening of the urethra and glans penis are handled by antiseptic solution.

Index and forefinger of the same hand are gently move apart the external opening of the urethra. Catheter lubricated with sterile vaseline oil or linimentum synthomycine, by right hand is inserted through the urethra, intercepting it with sterile tweezers. Technique of introduction a metal catheter in males even more complicated and requires some skill and great care. Having processed the external opening of the urethra and lifted fingers of the left hand the glans of penis up, pulled it along the inguinal crease. The right hand in the urethra "beak" down instrument is introduced to the external sphincter of the bladder, where it finds an obstacle. Then the penis with a catheter is transferred to the midline of the abdomen at the same angle to the anterior abdominal wall (nearly horizontal) and begin to lower slowly the outer end (Pavilion) of instrument, continuing to insert deeply its internal end and pulling the urethra on it. Overcoming resistance to light, the catheter passes through the posterior part of the urethra into the bladder. Having overcome the low resistance, catheter passes through the posterior part of the urethra into the bladder. Pavilion of the catheter turns out between the legs of the patient, and the ability to freely rotate instrument on its longitudinal axis is proof that location of its inner end in the bladder. Another proof of this is excretion of urine by catheter. Violent insertion of metal instrument into the bladder is extremely dangerous, because of the possibility of perforation of the urethra or bladder neck. The risk of such complications is particularly high in the presence of obstacles along the urethra and bladder neck (tumor of the prostate, urethral stricture). Due to the traumatic complications and inflammatory indications for catheterization of the bladder in men should be extremely narrowed. Relative contraindications to catheterization of the bladder are acute inflammation of the bladder, urethra and prostate. Often it is necessary to carry out catheterization of patients suffering from benign prostatic hyperplasia or urethral stricture. It is recommended to follow the rule that if a catheter that is inserted into the urethra, met an obstacle, it is not necessary to insert with force into the bladder, because it is possible to injure the urethra. The catheter is extracted and replaced with a smaller diameter. **Bougienage of urethra** is used for diagnosis and treatment - for definition of the narrowing, its location and extent, to expand the narrowed area of the urethra. To clarify the localization of stones in the urethra or bladder is also used diagnostic probing via bougienage. Before starting of bougienage is carried the calibration of urethra by capitate elastic bougie (determine the approximate diameter of the narrowed areas), and then take a metal bougie of the corresponding number. Bougienage of urethra is performed by various in form and diameter instruments. The finer bougies (№ 1-3) are called filamentary (filiform). In order to prevent acute inflammation (urethritis, prostatitis, epididymitis) after bougienage prescribe antibiotics of short course.



Fig. 3.17.
Ureterocystoscopes in dismantled condition



Fig. 3.18. *Rigid ureteropyeloscope*



Fig. 3.19. *Nephroscope*

Endoscopy in Urology

Endoscopic methods of diagnosis in urology have their origin since 1802, when an Italian doctor F. Botstini was constructed and first used cystoscope. Since then the structure of urological endoscopes has changed significantly, with thankfulness, to visual inspection were available all urinary systems: the urethra, bladder, ureter and renal pelvis and calyx. Improvement of endoscope allows not only to visually assess the condition

of the urinary tract, but also to carry out a biopsy or other manipulation. Due to the high information content and minimally invasive endoscopy ranks high among modern diagnostic techniques in urology. Urological endoscopes are divided into types depending on which department for research of urinary system they are assigned. Among the diagnostic tools are distinguished:

- uretroscope - for a review of the urethra;
- Ureterocystoscope - for view of the urethra and bladder (Figure 3.17);
- ureteroscope - for examination of ureter;
- ureteropyeloscope - for examination of ureter, renal pelvis and calyces (Fig. 3.18);
- nephroscope - for examination of the renal pelvis and calyces (Fig. 3.19).

Despite more than a century of history perfection, modern urological endoscopes will continue to consist of the following components:

- Optical lenses that allow the image from the distal to the proximal end of the instrument;
- lighting (currently to conduct light from an external source using fiber optical fiber);
- outer shell of tool (tube) with taps to connect irrigation (flushing) system.

By its construction, they are also divided into rigid, semi-rigid and flexible (fiberscopes) (Fig. 3.20, 3.21). In the flexible tools and in small diameter rigid instruments (ureteroscopes and ureteropyeloscopes) tube as a separate component of the tool is absent and combined with an outer shell of the optical system. An important characteristic of the optical system of urological endoscopes is the viewing angle. For hard tools it is fixed and can be 0°, 5°, 12°, 30°, 70°, 120°. For the For conducting of cystoscopy is used mainly optics with viewing angle of 30-70°. Sizes of urological endoscopes are very different depending on their purpose. Thus, the outer diameter the working part of ureteropyeloscopes is 6-9 Ch, and their length is 35-60 cm. Diameter of urethrocystoscopes is 17-23 Ch, nephroscopes - 22 - 26 Ch, and their length - 15-22 cm. urethroscopy, ureteroscopy and nephroscopy uses optics with viewing angle 0-5°.



Fig. 3.20. *Fiber-urethrocystoscope*

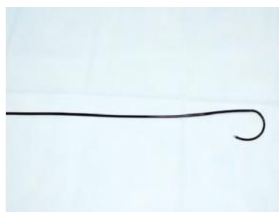


Fig. 3.21. *Fiberureteropyeloscope*

Before conducting of diagnostic procedures all endoscopes are sterilized by soaking in a special solution. In recent years, are designed the endoscopes that can be safely autoclaved. All endoscopy except percutaneous nephroscopy are spent by introducing pre-oiled tool with lubricant into the external opening of the urethra. The further insertion of tool retrograde through the urinary system is performed under visual control using irrigation for its content and creating a transparent environment for a particular examination of the mucous urinary

tract. For diagnostic procedures as an irrigation fluid is used heated to a temperature of 27-30 ° C 0,9% sodium chloride solution. The liquid serves under pressure of 50-70 cm of water column. Sometimes the purpose of hydraulic dilation of narrowed areas of the urinary system gives irrigation fluid under higher pressure. For convenience, the position of the surgeon for better visualization, and in order to documentation of obtained images during endoscopic procedures is used endotelevision cameras that transmit images from ocular optics to monitor. This image is increased tenfold and it is possible to record video-protocol procedures in digital format. The latter option except the archiving of images that allows you to broadcast diagnostic and therapeutic procedures in the online-mode for training purposes and to get advice from professionals, regardless of their location.

Urethroscopy

Urethroscopy is used to diagnose various diseases or conditions urethra most often as part of a combined procedure urethrocystoscopy. Most often is conducted in men because urethral pathology in women is rare. In the presence of chronic infection in the lower urinary tract and male genitalia for the prevention of possible exacerbation of the inflammatory process is recommended in advance of the test and assign broad-spectrum antibiotics (2-3 days on average dose). Research is contraindicated in acute inflammatory diseases of the urethra, prostate, epididymis and testes, seminal vesicles, vagina, uterus and its appendages, acute injury of the urethra.

Of course the study is performed using rigid endoscopes. On examination, the patient pre-sets the size external opening of urethra and choose the size of the urethrocystoscopes tube that corresponds to it. If it is too narrow, performs bougienage of urethra or meatotomy. Fluid that is injected during process of research for irrigation should be sterile, isotonic and apyrogenic. Indications for ureteroscopy is the diagnosis of tumors, strictures, diverticula, trauma, false passages, chronic inflammatory diseases of urethra, at some forms of sexual disorders, in patients with colliculitis, spermatorrhea, hemospermia, for injection into the urethra medications, for conduction of therapeutic manipulation, conduction the removal of foreign bodies, incision of the stricture, dissection of scar tissue, tumors, conduction of electrocoagulation at a bleeding from hemangioma with and other. Ureteroscopy is performed with the patient lying on the back with legs apart, bent at the hip and knee joints. The procedure can be performed under local, regional or general anesthesia. As a local anesthesia is used the instillation into the urethra 20 ml of a special gel containing 1-2% lidocaine. When ureteroscopy is performed as the first stage of aggressive diagnostic or therapeutic procedures - it performed under peridural, spinal or general anesthesia. Research is usually performed at slow pulling out urethroscope from the bladder after cystoscopy. According to another method starts with an overview of the distal urethra, slowly conducting instrument under the control of proximal. At the same time should pay attention to the look of the mucosa urethra and width of its lumen. Healthy urethra is lined with intact pale-pink mucosa without areas of hyperemia all through (Figure 3.22).

The lumen of it is almost uniform all throughout. The slight physiological narrowing of urethra is observed slightly distally of its prostatic department in the area of location external sphincter of the bladder. In healthy men this narrowing is overcome using a small effort. In the same area the urethra makes physiological bend in the sagittal plane anteriorly (Fig. 3.23).

The examination of urethra finishes from insertion the instrument into the bladder. During the urethroscopy can identify areas of changed mucosa (hyperemia, swelling, cicatrices), violation of its integrity (mucosal tears, tears of urethra, false passages), tumors, stones, foreign bodies, and narrowing of its lumen (stricture). In the prostatic part of urethra should pay attention to the type and location of the spermatic tubercle and the degree of protrusion into the lumen of the urethra the lateral parts of the prostate (Fig. 3.24). In some cases, especially in studying the state of the anterior the urethra, research is conducted using the "dry" urethroscopes (without stretching the urethra with liquid), while the examination of posterior urethra is better to use the irrigative urethroscope (filling the urethra with liquid). Complications of urethroscopy: mucosa injury urethral, the development of "urethral" (resorptive) fever, acute epididymitis, prostatitis, creating a false passage due to the violent insertion of the endoscope.

Cystoscopy

Cystoscopy - the method of research the bladder by examination of its inner surface using a special device - a cystoscope. The idea of examination the urinary tract by an external light source belongs to the Italian doctor Bozzini (Ph. Bozzini, 1805) German urologist Nitze (M. Nitze, 1877, 1879) has put together in one device the bright source of light and an optical system. This device was introduced into the bladder filled with fluid. The cavity of bladder is lit by electric bulb, located on the inner end of the tube. French urologist Albarran (D.J. Albarran) in 1897 was proposed to include into the system of cystoscope controlled lift for special catheter into ureteral orifice. Constructive improvements have allowed creating the modern urethroscopies that combined optical parts for conducting the survey cystoscopy, channel for catheterization of ureters and surgical interventions. Cystoscopy is one of the most frequent manipulations in urological practice. Indications for cystoscopy are diverse and cover not only most diseases of the bladder, but also the upper urinary tract and kidneys. Cystoscopy allows to determine the condition of the mucous membrane of the bladder, orifices of ureters, the presence of foreign bodies, concretions, the character of urine secreted from orifices of ureters. Cystoscopy remains the leading method of diagnostics tumors of the bladder.

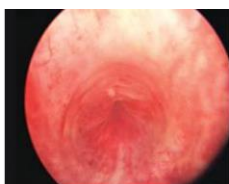


Fig. 3.22. Endoscopic image of urethra (without pathology)

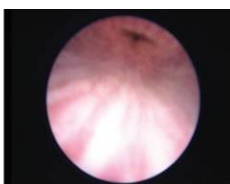


Fig. 3.23. The bending membranous urethra in part



Fig. 3.24. Prostatic part of urethra with spermatic colliculus and lateral lobes of the prostate

To identify the spread of tumor cystoscopy is performed also in cancer of the uterus and appendages, sigmoid and rectum. Indication for emergency cystoscopy is painless gross hematuria. Cystoscopy is an integral part of other diagnostic procedures, such as catheterization, ureteral retrograde ureteropyelography and ureteropyelography and surgical, diagnostic and therapeutic procedures, such as biopsy, cystolithotripsy, transurethral resection of the tumor

incision of the ureterocele and other. Cystoscopy is contraindicated in acute inflammatory diseases of urethra, prostate, testis and its epididymis, bladder, urethral injuries, bladder atony and upper urinary tract

atony, complicated vesico-ureteral-renal reflux. Acute pyelonephritis with high fever is not a contraindication for cystoscopy and ureteral catheterization. For conduction of cystoscopy should be certain conditions: urethra must be passed for the cystoscope, the bladder - quite tight, with a capacity at least 75-100 ml. During the research fluid that fills the bladder should be transparent. Research is impossible at urethral obstruction and complications of small bladder capacity or diseases involving rapid violation of transparency the optical environment as a result of hematuria, piuria and other. Therefore the bladder is washed before the research and during the procedure. For specific indications at obstruction of urethra cystoscopy may be performed through functioning suprapubic bladder fistula.

Cystoscopy is made using a special device - cystoscope (cystourethroscope), equipped with lighting and optical systems, which is injected into the bladder through the urethra. The main element of cystoscope is a thin-walled metal tube (tube) and the tube that is inserted into it, with the optical system. Depending on the cystoscope, on distal end of the cystoscope is located lighter or parallel to optical system passes channel of fiber optic lighting systems. Between the optical tube and trunk is the interval used for the input the fluid into the bladder and its output, as well as for catheters or flexible instruments. Upon designation are distinguished survey, catheterizational, operational, special-value and universal cystoscope. The survey cystoscope provides an overview and flushing of the bladder. Catheterizational cystoscope is designed for ureteral catheterization. As the number of catheters that are held simultaneously distinguish unilateral and bilateral catheterizational cystoscope. Operating cystoscope is used for conducting therapeutic or diagnostic manipulations with flexible tools. Universal cystoscope is designed for examination of bladder, ureteral catheterization, intervention by flexible instruments under the control of view, as well as electro-crushing stones in bladder cavity using special devices. Cystoscopes of special purpose are used to perform certain procedure or examination. Lithotriptoscope is intended for mechanical crushing of stones in the bladder cavity under visual control. Lithoclasty is performed by compression of stone by jagged jaws of the device. Lithotriptoscope (resectoscope) serves as transurethral electrocision the bladder neck with sclerosis, the resection of the prostate at BPH and cancer, resection under the control of papillomas and bladder tumors with high frequency. For the survey of children is used child cystoscope with small diameter. Technique cystoscopy

After providing of local regional or general anesthesia, the patient is placed in the supine on lithotomy position at urological chair with painted and bent legs. For local anesthesia is injected into the urethra 10-15 mL of special anesthetic gel and clamped the external opening of the urethra on 5-10 minutes. Children, especially pre-school and primary school children, have negative attitude to the various diagnostic and therapeutic endoscopic procedures. Fear of them, the possibility onset of pain is the reason of their active opposition. Therefore, to obtain complete information by endoscopy in children of early age, and at manipulation - and in children of school age is necessary to use anesthesia. Cystoscopy is performed in compliance with the same rules of asepsis and antisepsis as the surgery. Insertion of rigid cystoscope into the bladder conducts without violence, gently and smoothly, always with mandrin-obturator into the lumen of the tube. Penis is lifted up and in the external opening of the urethra injected end tube of the endoscope, curvature facing the front wall of the urethra. The endoscope that holds with hand at pavilion on its proximal end (to make the beak of the instrument is not turned to the side or back), with the power of its gravity easily dips into the urethra. Independent further movement of the endoscope tube is stopped as soon as it dips into the bulbous part of the urethra and stopped in front of the sphincter ring. While holding tube of the endoscope, dips strained as before, the penis downwards - thus beak tube enters in the posterior urethra. Safer method of insertion the cystoscope into the bladder is controlled by the previous performance of urethroscopy. Lubrication of urethrocystoscope before insertion of it into the urethra should be with sterile glycerol, which does not affect the transparency of the optical environment. After insertion of urethrocystoscope in the bladder the residual urine is released, urinary bladder washed by warm water with antiseptic solution and filled with saline up to urge to urinate. It allows to determine the capacity of the bladder. Usually cystoscopy is performed during injection into the bladder 150-250 ml of liquid. Examination of bladder mucosa begins from its front wall where is visualized the air sac (Figure 3.25).

Then examine the left side, right side and back walls, rotating urethrocystoscope clockwise. The most careful should be examined urinary bladder in the area of the triangle Lyeto, as in it are mostly localized pathological processes. To facilitate the orientation of the inner surface of the bladder is conventionally divided into sectors according to the clockwise. Then normally located orifices of ureters belongs to 7 (right) and 5 (left) (Figure 3.26). At examination are draw attention to the localization, symmetrical arrangement, shape and number of ureteral orifices, coloration of bladder mucosa, the presence of pathological changes (ulcers, tumors, etc.), foreign bodies and stones in the urinary bladder (Fig. 3.27-3.29). At cystoscopic examination of normal bladder picture is characterized by yellowish-pink mucosa in places approximation of optics up to bladder wall. Most distant from the optical sections acquire due to less light have dun color, which is particularly pronounced in the darkest areas of the bladder. Shiny mucosa is densely permeated by dendroid widespread smaller, then larger vessels. Delicate picture of vessels,

especially near the apex of the bladder has the form of some veins that are sometimes intertwined.

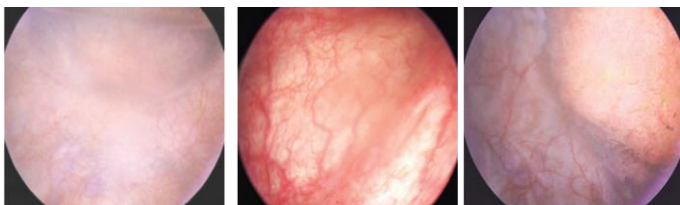


Fig. 3.25. Air sac in the bladder

Fig. 3.26. Orifice of the right ureter

Fig. 3.27. Bladder tumor

In these cases, can see how two parallel vessels that go at some distance from each other, give some smaller branches that form closed circle, in centre of which on closer examination can detect orifice of ureter. Sometimes, instead of two vessels which are passing parallel and then merge can be seen solitary vessel that goes from below obliquely

outwards and upwards. This vessel is suddenly divided dichotomously into two smaller vessels. From the last depart branches that annularly connect bending around barely noticeable ureteral orifice. Considerable assistance in searching of ureteral orifices provides inter-ureteric ligament. It is often visualized as clearly visible folds, brighter, then redder that is very different in color from the surrounding bladder mucosa. Inter-ureteral ligament is often riddled with many small blood vessels that intertwined with each other, providing a bundle of bright red color. As the approach the ureteral orifices the blood vessels are elongated and taken more correct direction. Shall take into account vessels that are located palisade behind inter-ureteral ligament that facilitate its detection. Ureteral orifices are located in two corner bases of the triangle Lyeto, have different shapes not only in different persons, but also in one person on different sides. The unifying moment is the fact that orifices are located in a slight elevation. More common orifice in the form of funnel dot deepening in the center from opening. Another, not less frequent form of orifice is deepening in the center corner folds of base and the side of triangle Lyeto, which converging. Can often to see ureteral orifice in the form of truncated crookedly "bough" in the form of a longitudinal slit. Of course, there may be all sorts of transitional forms, individual description of which is hardly necessary. In the definition of normal orifice ureteral are very important issued the absence of edema and hyperemia of the mucous membrane edges on ureteral orifice and insularity of orifice, its opening can take place only at the time of excretion of urine from the ureter. In the latter case can be seen, how edges of ureteral orifice are become thickened, orifice with fold of inter-ureteral ligament is lifted, after that happens opening that gives to ureteral orifice look of correct round opening or opened fish mouth. At the moment of opening and excretion of urine, orifice goes down again and is fed slightly ahead.

Observation of reduction ureteral orifices, by the character of excretion of urine and by urine that is excreted of ureters, makes very important moment at cystoscopic examination. Opening of ureteral orifice and excretion from it urine, is performed rhythmically at regular intervals depending on the urination, an

average of 2.3 times per minute. Reduction of ureteral orifices will be absent in excessive filling of the bladder with fluid or pronounced urge for urination which are barely held by patient during cystoscopy. Therefore, to properly assess the dynamic function of the ureters should never overflow bladder by washing fluid higher than average of its physiological or individual capacity, thus should be removed all the moments that cause irritation of the bladder or prostatic urethral part.



Fig. 3.28.
Diverticulum of bladder

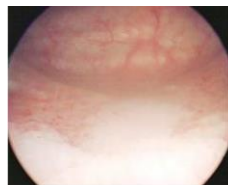


Fig. 3.29. *Leukoplakia of the bladder*



Fig. 3.30. *Concrement of right ureteral orifice*

Along with the active reduction of one ureteral orifice, reduction of other may be absent. This phenomenon is mostly observed after nephrectomy or the complete blockage of the kidney. Similarly "silent orifice" is observed at severe compression of the ureter by inflammatory infiltrate or neoplasm, predominantly in the pelvic section. Urine that is excreted from the ureters well seen by shiny slightly trembling stream that observed by mixing of two

liquids different density, such as glycerin and water, at dissolution of sugar syrup in tea and so on. Observing the excretion of the urine, may notice in certain cases in it the macroscopically visible pathologic inclusions such as crumbs of pus, salts and so on. Can also note so called "empty" contraction of ureter from which urine is not excreted that most often takes place at obstruction of upper ureteral part by stone at hydronephrosis with a distinct narrowing of ureter, etc. (Figure 3.30).

In addition to the aforementioned reasons, in some cases, the lack of one contractions orifices may be due to reflex inhibition which is caused sometimes by minor injuries ureteral orifice the beak of cystoscope at careless insertion of the tool into the bladder. Incomparably more common is "silence" of both orifices at the same time - a typical reaction to the insertion of the tool into the bladder. In such cases, further observation of the contracture of ureteral orifices should be stopped by going to examination of other parts of the bladder, then return again to examination of orifices. If after this the contraction is not renewed, cystoscopy should be postponed and repeat it after few days.

Photodynamic diagnostics urothelial tumors

At visual examination of the mucosa of the urinary tract is often difficult distinguish its changes caused by tumor process, from changes of inflammatory character. In particular, this can occur at controlling cystoscopy in patients which treated for cancer of the bladder. Photodynamic diagnostics - method of fluorescent recognition the transitional cell carcinoma that is based on the registration of exogenous glow of tissues under the influence of synthetic photosensitizer of porphyrin number (Figure 3.31). As the last is most actively used 5-aminolevulinic acid, which is injected into the urinary tract 3 hours before endoscopy in purple light. Today developed various optical tools to diagnose cancer of the bladder, ureter and pyelocaliceal system. This technique can be used not only for diagnostic but also for therapeutic procedures. In particular, during transurethral resection of the tumor with the use of this technique can precisely define the limits of tumor spread and in full value to conduct its removal.

Ureteropyeloscopy

Ureteropyeloscopy – is the visual examination of the internal surface and lumen of the ureter and renal pelvis cavity via ureteropyeloscope. The methodology conduction of ureteropyeloscopy, the position of the

patient, irrigation fluid is the same as at urethroscopy. However ureteropyeloscopy is definitely needed to be conducted under general or regional anesthesia. The patient is in lithotomy position supine position on urological chair. In the bladder is inserted the operating cystoscope that has a channel for insertion of tools. For this is usually used the conductor (over the strings of conductor) and dielectric semi-rigid metal dilators with oil at the end, with a diameter of 8 to 14 Fr; semi-rigid teflon and polyethylene bougies with diameter of 6-16 Fr, which is inserted in the ureter also in advance through the inserted conductor; Telescopic ureteral bougies with casing; conductive and non-conductive balloon dilators 3-7 Fr with diameter balloon in bloated state up to 20 Fr; fluid dilatation of the ureter applying special pump, also possible passive dilatation of the ureter through the insertion of catheter or internal stent for 2-3 days. Usually dilatation of orifice and intramural ureteral department is conducted under controlled cystoscopic over the strings-conductor to that size of dilators, which passes through the "working" channel of the endoscope (at 21-23 Fr cystoscopy it is straddling device in diameter to 10 Fr). Further, if necessary is used radiographic control.

Transurethral rigid ureteropyeloscopy

The patient is in cystoscopic position. On the opposite from the intervention side hip of patient is slightly abducted and lowered. Ureteropyeloscope with included lighting and irrigation is inserted through the urethra into the bladder. If is used a standard rigid ureteropyeloscope (diameter 10-12 Fr), is usually required to conduct preliminary dilatation of orifice; if is used miniskop (diameter <9 Fr), dilation usually not required. The tool is applied to the orifice of ureter almost in the vertical position then inserted its distal end to the upper semicircle of orifice and slowly lowered to the combination of its axis with the axis of the

ureter, while a slight movement pushing it forward and upward. During insertion of rigid ureteropyeloscope may occur some difficulties, particularly during movement at intramural department, zones of intersection with glomerular vessels and areas pelvic-ureteral segment.

Usually they are overcome as follows: a) increasing of irrigation b) turning the tool on 180 ° at passing zone of vesico-urethral anastomosis c) insertion by instrumental channel of ureteropyeloscope the ureteral

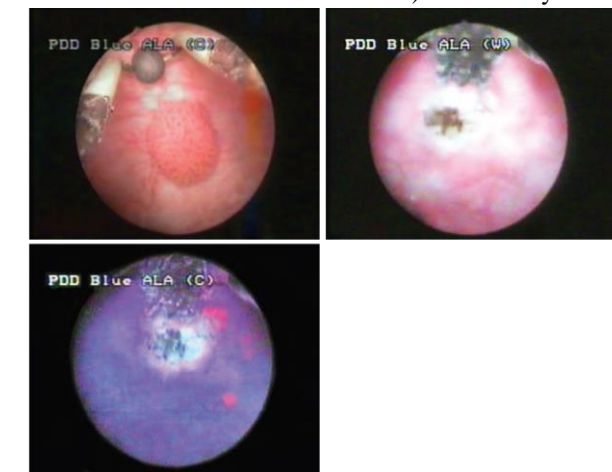


Fig. 3.31. Photodynamic diagnostics of bladder cancer: a) tumor of the bladder wall, b) electrovaporization of bladder tumors, c) at cystoscopy in purple color are observed an additional tumors (in situ).

catheter or strings of conductor (Fig. 3.32), which are passed forward, straighten the ureter and play a role of guide for ureteropyeloscope d) changing tool for endoscope with a smaller diameter; d) the use of telescopic ureteral bougies with casings in diameter 12-14 Fr, while the casing, remaining in the ureter after removal bougies creates a "tunnel" for moving the endoscope from the external opening of the urethra to the insertion site.

Transurethral fiberureteropyeloscopy

Retrograde in kidney is inserted string-conductor controlled by cystoscope and radiographic screen. Through it, if allowed "working" channel of cystoscope, a flexible ureteropyeloscope is moved in the ureter - as ureteral catheter.

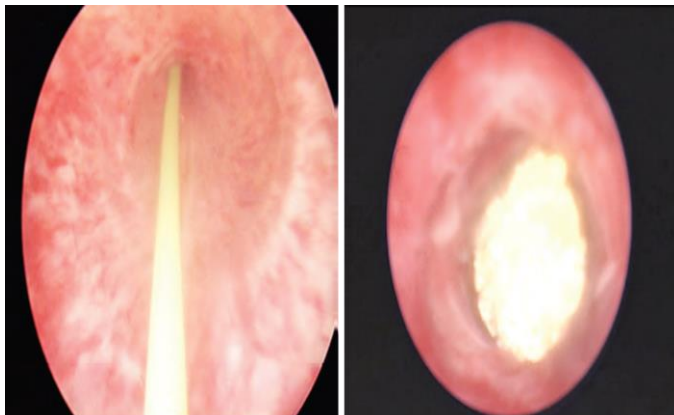


Fig. 3.32. String-conductor in the lumen of the ureter

Fig. 3.33. Ureteral stone

At passage of ureteral orifice the flexible ureteropyeloscope advisable to rotate through 180° on its axis that facilitates this stage of procedure. Typically, flexible cystoscope through ureteropyeloscope performs by two surgeons; one watches in the cystoscope, and other - in ureteropyeloscope. At controlled fiberoendoscopes one surgeon can move the tool in the ureter by string-conductor controlling the process radiologically and endoscopically.

Complications of transurethral

insertion tools in the upper urinary tract include the perforation of ureter, injury of the mucosa and even ureterodilation. In most of similar situations transurethral drainage of kidney with catheter or stent kidney in 3-30 days can eliminate these complications, but in some cases with a significant injury ureter need to perform percutaneous puncture nephrostomy followed by correction of the upper urinary tract patency of retrograde endoscopic or surgical procedure. Percutaneous pyeloscopy, nephrosopy

method of examination of abdominal and pelvic-ureteric segment of the kidney by percutaneous insertion the endoscope. Nephrosopy performs in X-ray operating room that allows using X-ray control for localization of concretions position nephrostomic drainage, and pyelographically to check the condition of renal cavity system at the end of the intervention. Most percutaneous endoscopic manipulations are made in the horizontal position of the patient on the abdomen, only sometimes has to perform percutaneous endoscopic lithoextraction in position on the side to displace concretions in field of view rigid endoscope. In order to prevent inflammatory complications before the intervention intramuscularly are injected broad-spectrum antibiotics. Rigid nephroscope with included lighting and irrigation is inserted in the kidney casing by the kidney under direct visual control. Calyces and pelvises are examined by slow displacement of the tool along its longitudinal axis, and also changing the angle inclination the endoscope relative to axis of the kidney. A sufficient mobility of the kidney and the presence of certain practices allow to examine with rigid tool most of the pyelocaliceal system and even of the ureter (up to the middle third). The main advantage of flexible fiberoendoscope (outer diameter of 15 Fr and larger) consists in the mobility of its distal end that allows you to examine the cavity system of the kidney and ureter almost all the lower thirds. The main disadvantages of flexible nephroureteroscopy - a small diameter of irrigation (instrumental) channel, less visibility, manipulation capabilities, difficulties in orientation, short lifespan of the tool and accessories. Complications of percutaneous nephroureteroscopy are associated primarily with liquid irrigation. Increased pressure in the cavities of the kidney may be accompanied regurgitation of irrigated solution and infected urine with further the appearance of an attack of pyelonephritis, until to bacterial toxic shock. Prolonged outflow of irrigation solution in the perirenal space can cause "water intoxication syndrome." The main way to prevent and eliminate such complications is to limit the time of endoscopy to 60-90 minutes, use Teflon casing (improves outflow of fluid from pyelocalyceal system), using special sterile isotonic solutions, rational antibiotic therapy before and after manipulation, forcing the diuresis during nephrosopy.

Catheterization of the ureters and installation of ureteral catheter-stents is conducted for therapeutic purposes to restore passage of urine through circumvent of the ureteral obstruction or drainage of kidney after surgery on the upper urinary tract. With the diagnostic purpose is used the unilateral ureter catheterization, using ureteral catheter to perform retrograde pyelography (establish the level of obstruction in the ureter, the definition of symptom Shevassy) or bilateral - to separate collection of urine from the kidneys at bilateral lesion of to determine the side of the operation, the differential diagnosis of anuria (renal and postrenal). Ureteral catheters and stents are the hollow tubes that are inserted via catheterisational cystoscope or ureteroscope through the bladder into the ureter and than to the renal pelvis in, and sometimes inserted intraoperatively antegrade. Ureteral catheters are made of radiopaque thermally labile biologically inert polymer. The end of of the catheter has a spherical profile, eliminating the tissue injury during his movement. Side openings provide unobstructed outflow of fluid from the organism and injection of medications. Ring marks on the catheter allow to control the depth of its movement. It have a length of 70 cm and the number 3 to 8 Ch. Ureteral catheters-stents are made of polyurethane, silicone, sylitec, C-flex, Percuflex, and with bio-absorbable materials (eliminates necessity of removal the stent). Their total length for adults is 22-28 cm and the number of 6 to 7 CH. Catheter-stent has curls at the ends, to prevent migration it downwards (with the ureter) or upwards (in the ureter). Stents saturated with barium or bismuth (containing metal salts), which makes them radiopaque. Thus, they can be visualized radiographically to ensure proper positioning.

The main indications for the use of catheters-stents:

- elimination of the obstruction caused by, for example, concrements, strictures, tumor of ureter or pelvic-ureteric segment, external compression of ureter;
- prevention of violation of the outflow urine after ureteroscopy;
- passive dilatation of the ureter before ureteroscopy;
- prevention of antegrade urinary flow after surgery or trauma of the upper urinary tract;
- visualization of the ureter at the open surgery and laparoscopic interventions through the preoperative stenting;
- splinting and drainage of the ureter and pelvic-ureteric segment after endotomy, recanalization and fistulization;
- long-term (12 months). Drainage of the urinary tract.

Control tasks

1. Is it possible to palpate the kidneys in a healthy person?
2. How to determine the third point of Tournai?
3. What means the presence of noise that auscultated in the projection of the abdomen?
4. Comparative characteristics of the prostate at digital rectal examination in patients with benign hyperplasia and prostate cancer.
5. Methods, indications and contraindications for conducting of excretory urography.

6. Diagnostic value of ultrasound examination of the kidneys.

7. Name the most common indications for the use of catheters-stents.

8. Patient N., 37 years old, complains of paroxysmal pain in the right iliac area with irradiation, which is accompanied by vomiting, frequent urination. On palpation is defined pain in the area of the right kidney. Symptom Pasternatsky is positive. In urinalysis are detected 50-60 red blood cells per field. What examination is necessary to conduct the patient?

Answer. Ultrasound of the kidneys and urinary tract, if necessary - a survey and excretory urography.

9. Patient A., 26 years. After falling on the perineum has appeared urethrorrhagia, acute urinary retention. At suprapubic area is palpated the overflowing of bladder. On the perineum is determined uro-hematoma that spreads on the external genitalia. Which radiological examination is necessary to conduct more accurate diagnosis?

Answer. Ascending urethrography.

10. Patient K., 32 years old, complains of general weakness, malaise, fever up to 39 °, chills, pain in the left half of abdomen and lower back on the left. Palpation in the region of the left kidney is painful. At the examination is determined the violation urodynamics of the upper urinary tract from the left, caused by ureter stones. What recovery methods of urodynamics are used in this situation?

Answer. Ureteral catheterization or percutaneous nephrostomy.

Abnormalities of the urinary and male reproductive system

4.1. Anomalies of the kidneys

Anomalies of development are a congenital deviation from the normal development of one or more organs at the same time. Genitourinary anomalies occur in 10-14% of newborns. Among all anomalies of development they are observed most frequently (up to 35-40%). Some of them may not be manifested throughout their lives, while others are lead to disability from an early age.

Classification

The most complete classification of renal anomalies that meets to modern requirements, the proposed by M.O Lopatkin and A.V Lyulko in 1987:

I. Anomalies of renal vessels.

1. Anomalies of the number and location (dystopia): Anomalies of renal arteries:

- a) Additional renal artery;
- b) Double renal artery;
- c) Multiple arteries.

Anomalies of renal arteries location:

- a) Lumbar dystopia;
- b) Iliac dystopia;
- c) Pelvic dystopia.

2. Anomalies of form and structure of the renal arteries:

- a) Aneurysms;
- b) Fibromuscular stenosis.

3. Congenital arteriovenous fistula.

4. Congenital anomalies of the renal vein:

- a) Abnormalities of the right renal vein (optional and multiple vein confluence testicular vein into the right renal vein);

- b) Anomalies of the left renal vein: ring, retroaortal, extracaval cavity;
- c) Anomaly patterns of renal vein (renal vein stenosis).

II. Anomalies of the kidneys:

- 1. Aplasia.
- 2. Doubling (full and partial).
- 3. Additional (third) kidney.

III. Anomalies of kidney size: hypoplasia

IV. Anomalies of the location and form of kidney

- 1. Dystopia of kidney
 - a) Unilateral (thoracic, lumbar, iliac, pelvic);
 - b) Intersectional
- 2. Fusion of kidneys
 - a) Unilateral (I-shaped kidney);
 - b) Bilateral (symmetric - horseshoe kidney, asymmetric – L- and S-shaped kidney).

V. Anomalies of renal structure:

- 1. Dysplasia: rudimentary, dwarf kidney.
- 2. Multicystic kidney
- 3. Polycystic:
 - a) Polycystosis of adults;
 - b) Polycystosis of childhood.
- 4. Parapelvic cyst, calyceal, pelvic cysts.
- 5. Caliceal-medullary anomalies:
 - a) Megacalyx, polymegacalyx;
 - b) Sponge kidney.

VI. Associated anomalies of kidneys:

- a) With vesico-ureteral reflux;
- b) With infravesical obstruction;

- c) With vesico-ureteral reflux and infravesical obstruction;
- d) With anomalies of other organs and systems - reproductive, musculoskeletal, cardiovascular, digestive.

Anomalies of renal vessels

Anomalies of renal vessels are observed most frequently among all upper urinary tract anomalies (up to 70-80%).

Additional renal artery

Additional renal artery is an anomaly of development, which is manifested in the presence of one or smaller caliber arteries. It may depart from the main renal artery, abdominal aorta, and common iliac, abdominal, diaphragmatic, adrenal arteries and supply the blood to the upper or lower segment of the kidney. They shift and mechanically cross the ureter, which violates the flow of urine from the kidney and cause the transformation of hydronephrosis. Blood supply of the kidneys is not violated, given the much higher pressure in the arteries than in the ureter. The urine stagnation in the kidney leads to the appearance of such complications like - hydronephrosis, pyelonephritis, and urolithiasis. In most cases it is asymptomatic. Most often it is manifested by signs of hydronephrosis, pyelonephritis, and urolithiasis.

The main clinical manifestations:

- A dull aching pain (from appropriate side);
- Intermittent pyrexia (associated with periodic exacerbations of chronic pyelonephritis);
- Hematuria (usually a microhematuria);
- Presence of tumor formation in the lumbar region or in the corresponding half of the abdomen (in the case of large kidney hydronephrosis).

Diagnostics

1. Physical examination:

- a) Palpation (presence of tumor formation in the region of the kidneys);
- b) Percussion (percussion dullness of the kidney).

2. Laboratory Methods:

- a) General analysis of urine (proteinuria, leukocyturia in cases of chronic pyelonephritis accession);
- b) Determination of the urea and creatinine concentration in blood plasma (increase in the presence of chronic renal insufficiency).

3. Radiographic methods:

- a) Intravenous (excretory) urography. A typical feature of this anomaly is a break in the area of contrast, ureteral-pelvic segment that is often associated with symptoms of hydronephrosis. The contour of renal pelvis in the projection of ureteral discharge has a clear rounded shape (Fig. 4.1);

- b) CT scan. Specifies the anatomical features of the arteries additional, the degree of hydronephrosis;
- c) renal angiography. Allows you to set the number and location of additional vessels, areas of blood supply to the kidney.
4. Ultrasound with Doppler effect (Fig. 4.2).

Treatment Tactics of treatment is determined in the case of associated complications.

The operation is performed on the progression of hydronephrosis, the danger of loss of kidney function. The main option is surgery antevasal ureteroanastomosis - is crossed the ureter at the site of clamping (which, if necessary, supplemented by resection of the narrowed areas), and its subsequent linking to the vessel. This movement of the ureter in most cases removes the pathological pressure on him, and normal flow of urine. With the considerable expansion of bowl is carried out simultaneously the resection of its part of wall, which also reduces the stagnation of urine. It should be noted that at first glance it is easier to cross the vessel and release the ureter from pressure without intersection.



Figure. 4.1. Additional lower-polar vessel: a - retrograde ureteropyelogram, b - excretory urogram

Such variant of interventions is performed rarely because there is a danger of circulatory disorders of the kidney lower pole. There are also several options

for moving the artery up to the level of the bowl.

Additional upper polar artery

The intrarenal artery usually passes in the area of the upper cervix of calyx. The clinical significance is in possibility of urine stasis in the upper calyx with the associated complications (chronic pyelonephritis, nephrogenic hypertension).



There are no clinical manifestations of additional upper polar artery, and it is very similar to the manifestations of additional lower polar artery. The main method of diagnosis is excretory urography. A symptom Fraley is manifested with it - a break of contrast at the level of cervix in upper calyx, with its extension (Fig. 4.3).

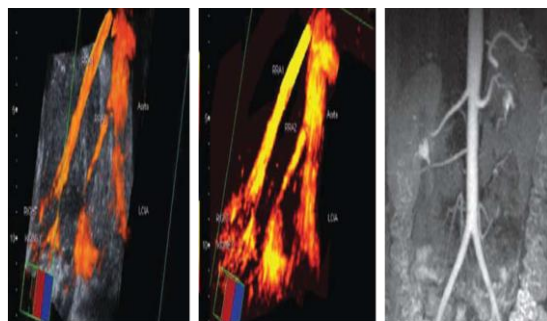


Figure. 4.2. Additional right renal artery that feeds the lower segment of the kidney with uretero-vascular conflict: a - three-dimensional ultrasound angiogram with diuretic stress in the mode MIP; b - three-dimensional ultrasound angiogram with diuretic stress (combination modes MIP and MIN); c - magnetic resonance angiogram.

Figure. 4.3. *Additional upper-polar vessel of the right kidney. Symptom Fraley.*

Treatment The main method of treatment is active observation. The surgical treatment is shown in case of complications. The operation is quite complicated. The resection of upper pole is usually performed. The plasty of vessels performs more rarely.

Anomalies of renal artery location (dystopia)

The defining is a place of renal artery discharge. Lumbar dystopia is formed at low discharge of the renal artery from the aorta in the lumbar region. The iliac dystopia is formed in place of discharge from the general iliac artery. The pelvic dystopia is formed at place of discharge from the internal iliac artery. The treatment requires only in cases of crossroads with ureter and appearance as a result of renal obstructive symptoms (plasty of ureter).

Aneurysms of the renal artery

Aneurysms are attributed to anomalies of form and structure of the renal arteries. The aneurysms are situated in the most cases in the extrarenal part of renal artery. It is associated with the absence or underdeveloped muscular layer of arterial wall. The anomaly is one reason for nephrogenic hypertension. The treatment is surgical. It consists in excision of the aneurysm.

Fibromuscular stenosis of renal artery

The fibromuscular stenosis is manifested in the form of one or more narrowing's along the renal artery. They are associated with excessive fibrosing of its walls and elevated tone of muscular layer, due to the excess of its development. This is one of reasons for nephrogenic hypertension. The operative treatment consists in excision stenosed sections of artery or prosthetic renal artery.

The congenital arteriovenous fistula

More often it is observed between segmental artery and vein - as single and multiple. In result of the formation of fistulas and venous hypertension it manifests clinically ad hypertension, varicocele, and intermittent hematuria.

The anomalies of renal veins

The anomalies of the right renal vein (additional and multiple vein) do not have clinical significance usually. The exception of testicular venous inflow into the right renal vein, which shows right-spermatic cord veins (varicocele). The anomalies of the left renal vein (annular, retroaortal, extracaval confluence) due to the compression of the aorta that is manifested by violations of venous drainage and venous hypertension. Furthermore, abnormal renal vein may overlap with the ureter by causing the certain degree of its obstruction. It disrupts the flow of urine from the kidneys and causes the hydronephrosis transformation. In these cases the treatment strategy depends on the degree of obstruction and clinical symptoms. Stenosis of the renal vein in most cases is the reason of venous stasis in the kidney, renal blood circulation and appearance of hematuria, proteinuria, and hypertension.

The number of kidneys anomaly

Anomalies of the kidneys are among the most common (10-15% of all renal anomalies).

Aplasia (agenesis) of kidney

There are 1% of all anomalies. In female it is fixed in 2 times more often than male. According to the data autopsy it is observed in 1 case for 1100 autopsy. Renal aplasia – is a complete lack of kidney and renal vessels. It is always observed like a compensatory hypertrophy of the opposite kidney. There is no clinical significance. There are no complications at the normal functioning of opposite kidney.

Doubling of kidney

It is about 10% of all kidney abnormalities. In female, the doubling occurs 2 times more often than in male. According to the autopsy it is observed in 1 case per 150 autopsies. The doubling is unilateral in 90%, and bilateral - in 10%. There are differences between the doubling of kidneys and additional kidney. In the first case, the doubled kidney is slightly bigger than normal. The two halves of it are often separated by moderate sulcus. They have individual blood supply, venous and lymphatic flow, but anatomically it is the one organ. Additional kidney is totally independent unit that can be placed at different levels and not associated with the other two kidneys. There is full and partial doubling of the kidney. There are two cavity systems at full doubling (upper underdeveloped system) that give rise to the two ureters (Fig. 4.4). The last are fall apart to the bladder (doubling of the ureters), or connecting over it (split ureter). The incomplete doubling kidney has the main pyelo-caliceal system and auxiliary that is located above it (Fig. 4.5). The latest is generally underdeveloped. It has not clearly separated large cups and it is connected to the pyelo-caliceal system. It is quite often difficult to distinguish between branching, ramified upper cup and incomplete doubling of the kidneys.

Clinical In most cases, this anomaly is not evident clinically. There is stagnation of urine at the upper part of kidney in some patients.



Figure. 4.4. *Excretory urogram 15 minutes. Full doubling of the left kidney, the splitting of the left ureter. Concrement of the upper third of right ureter. Right-sided hydronephrosis.*

This is related to constriction at the confluence of the ureter, and occurrence ureterorenal and intrarenal reflux. Such situation leads to chronic inflammation, lithogenesis, and hydronephrosis of the upper part of the kidney.

Diagnostics It is based on the clinical manifestations of the disease and data of supporting instrumental methods.

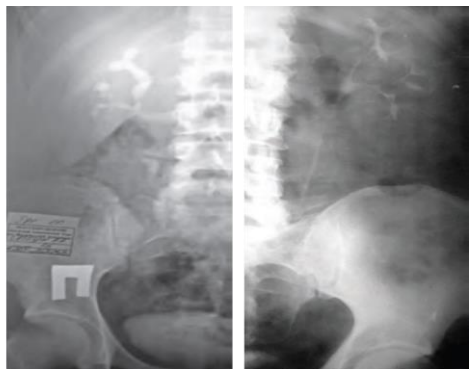
Basic methods diagnostics:

- excretory urography;
- ultrasound examination;
- CT scan;
- cystoscopy.

Additional diagnostic methods:

- MRI;
- retrograde ureteropyelography (in the absence of kidney function or uninformed of excretory urography).

Treatment The conservative treatment. It is associated with the treatment of possible complications (hydronephrosis transformation of kidneys, acute and chronic pyelonephritis, and urolithiasis).



A - infusional urogram 10 minutes;

b - excretory urography 7 minutes

The operative treatment. The operation is carried out only in the absence of effect in conservative treatment of complications. It consists of hemiresection of the upper half kidney, rear in the plasty of ureter (hydronephrosis in kidneys with frequent exacerbations of chronic pyelonephritis).

Figure. 4.5. *Partial doubling kidney:*

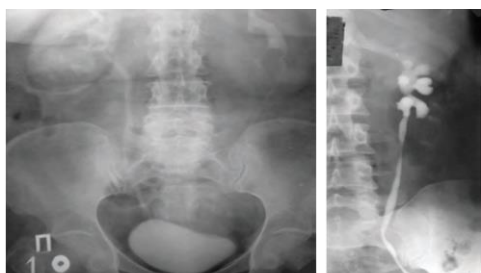


Figure. 4.6. *A - excretory urogram 10 minutes. Lumbar dystopia of both kidneys (rotation right kidney at 90°, the left kidney - 180°); b - retrograde ureteropyelogram (rotation left kidney - 90°).*

Additional kidney

It is always unilateral malformation. The additional kidney has independent blood supply, venous, lymphatic outflow and ureter, which either flows into the bladder by separate mouth below and medially from basic. It also may merge with the ureter of main kidney by the type of split ureter. It is not clinically evident and does not require treatment.

Anomaly of kidney size

Renal hypoplasia is the reduction in the size of kidneys with maintaining of morphological structure and functional capacity. It is observed in 1% of all renal anomalies. The size reduction of kidneys is accompanied by a

corresponding decrease in the number of functioning nephrons to 50% of normal kidney. It is accompanied by compensatory hypertrophy of the opposite kidney. It is not clinically evident and does not require treatment.

Anomalies of renal location

Renal dystopia is observed in 3% of all renal anomalies. It is caused by violation of renal embryogenesis at the stage of migration from pelvic area (where they are formed) and lumbar (where they are in adults). There are two major changes in the kidneys during this process:

1. Change of the kidney location.
2. Rotation of kidney (renal turn at the sagittal area in front).

Dystopia can be pelvic, iliac, lumbar, thoracic and cross according to the level of kidney location. All kinds of dystopia (except lumbar) may be accompanied or not accompanied by incomplete rotation. Lumbar dystopia has normal location of kidney, but its rotation is necessarily incomplete (Fig. 4.6). Classification of dystopia is composed on the basis of taking into account level of renal arteries discharging from the aorta. According to it are:

- Dystopia (renal artery departs from the internal iliac artery). The kidney is located in the pelvis between the bladder and the rectum (Fig. 4.7).
- Iliac dystopia (renal artery departs from the common iliac artery). The kidney is located in the iliac fossa.
- Lumbar dystopia (normal discharge of the renal arteries is accompanied by incomplete rotation of the kidney).
- Thoracic dystopia (discharge of renal arteries at the 12th thoracic vertebrae). A variation of this is a subdiaphragmatic dystopia in which the kidney is located highly under the diaphragm, but not in the thoracic cavity.
-
- Cross dystopia (the kidney is located on the opposite side near or at a distance from contralateral kidney). There is a single and bilateral (Fig. 4.8).

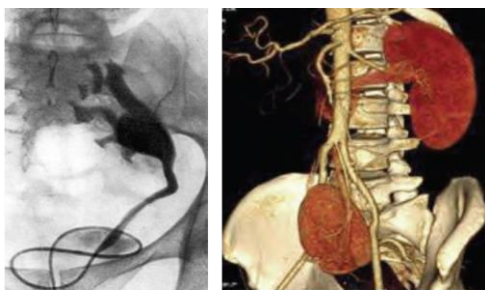


Figure. 4.7. Pelvic kidney dystopia: a - retrograde ureteropyelogram B - magnetic resonance scan of 3d-modeling.

This kidney has normal functional ability, and there are different pathological processes in it over the years. The main basis for this is a violation of the urine outflow. This is due to crossing of ureter by abnormal located vessels. The consequences of it are pyelonephritis, hydronephrosis, urolithiasis and more. Most of kidneys with dystopia have abnormal blood flow. The most clinical value has pelvic dystopia. The latter is associated with the location of kidney, compression of adjacent organs and structures and high risk of injury.

Figure. 4.7. Pelvic kidney dystopia: a - retrograde ureteropyelogram B - magnetic resonance scan of 3d-modeling.

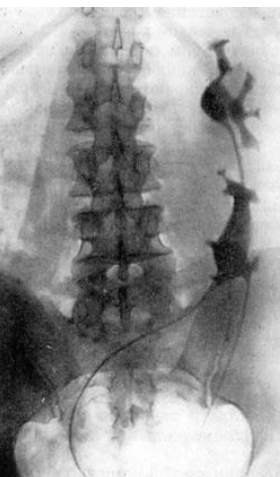


Figure. 4.8. Cross dystopia right kidney. Bilateral retrograde ureteropyelogram.

Clinical picture

It is usually associated with complications (hydronephrosis, pyelonephritis, urolithiasis). In most cases there are no clinical manifestations of dystopia.

Treatment

At the absence of clinical symptoms does not require treatment. Conservative treatment is indicated in case

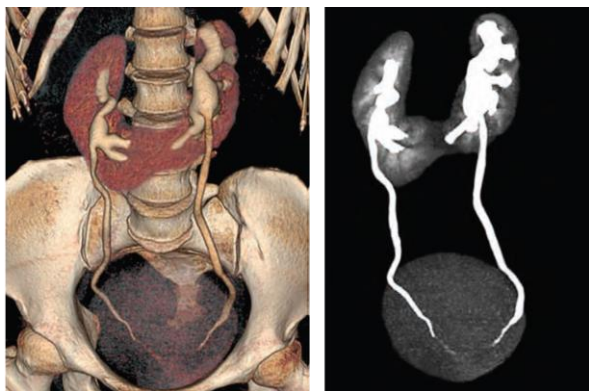


Figure. 4.10. *Horseshoe kidney: 3D-computer simulation*

of complications that described above. Surgical treatment is indicated only in severe complications and usually involves the removal of concrement or plasty of vesico-ureteral segment. Such operations are more technically complex from similar interventions on normal kidney due to violation of anatomical landmarks.

An anomaly of relative positions (Fusion of kidneys) is observed in 3-4% of all renal anomalies. It is caused by close anatomical contact between two existing kidneys. They are almost impossible to separate one from another.

Concrescence of kidneys:

- a) unilateral - and I-shaped kidney;
- b) bilateral (symmetrical - horseshoe kidney, asymmetrically – L- and S-shaped kidney) (Fig. 4.9).

There are 90% of all renal fusion fall on the horseshoe kidney (Fig. 4.10.) The 60% of patients have abnormalities of other organs, in addition. The variant of horseshoe coalescence of kidney consists in the presence of isthmus between the lower poles. Most often such kidney is located below the usual. Isthmus is located at the level of L4-L5. As in previous anomalies, the parenchyma of such kidney has normal structure, but there are certain complications in 85-90%. They are not associated only with violation of the outflow of urine from the kidney but also with the pressure of isthmus on the surrounding structures - retroperitoneal vessels, nerve plexus, intestine. This anomaly may have the abnormalities of the other systems and organs, except urological complications.

Clinical picture

There are observed a dull pain in the abdomen, dysfunction of the gastrointestinal tract, and sometimes venous and lymphatic stasis of the lower extremities. There are the general psychological disorders, as a result of long-term pain. The approach to diagnostics and treatment of this anomaly is the same as in other renal abnormalities.

Diagnostics

- a) The basic instrumental methods of diagnostics:

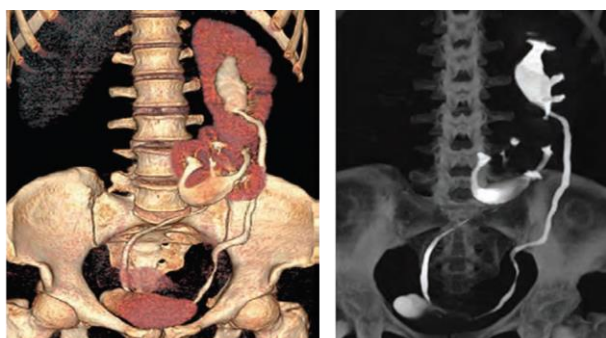


Figure. 4.9. *L-shaped kidney*

:

- excretory urography (Fig. 4.11);
- ultrasound examination;
- CT scan;
- isotope renography

b) Additional diagnostic methods:

- MRI;
- Renal angiography;
- Dynamic renal scintigraphy.

Differential diagnostics:

- a) from renal dystopia (with excretory urography or CT is fixed clear separation kidneys);
- b) the tumor of kidney (typical macrohematuria, pain, significant asymmetric increasing in size of kidney, pathological angiomatosis in the area of the tumor at angiographic study).



Figure. 4.11. Excretory urogram in 15 minutes. Horseshoe kidney.

Concrement of the upper third of the right half of the horseshoe kidney.

Right-sided hydronephrosis.

Treatment

The main treatment is conservative. It is usually associated with such complications like hydronephrosis, pyelonephritis, urolithiasis, and hypertension. Surgical treatment may include removing of concretions, plasty of ureteropelvic segment, resection of the isthmus.

Anomalies of renal structure

Polycystic kidney disease

Belongs to anomalies of the structure of the kidneys and includes 10-17% of all renal anomalies. This is a serious hereditary anomaly, which is characterized by a large number of different-sized cysts in both kidneys necessary. The reason for their formation is disrupting the formation of parenchyma, where there is no straight connection between the convoluted tubules and nephrons. The urine that is founded in glomeruli has outflow tract and accumulates in the form of a large number of cysts. At the same time, some nephrons are formed normally. Due to this is stored a partial renal function.

There are two types of polycystic kidney disease:

- polycystic of newborns;

- polycystic of adults.

A typical is the significant damage of the parenchyma both kidneys that combine with the creation of a large number of cysts in the liver, lungs, at least - pancreas and thymus. This anomaly is transmitted by an autosomal-recessive type. These children are born with signs of dysfunction not only in kidney and also in the liver, lungs.

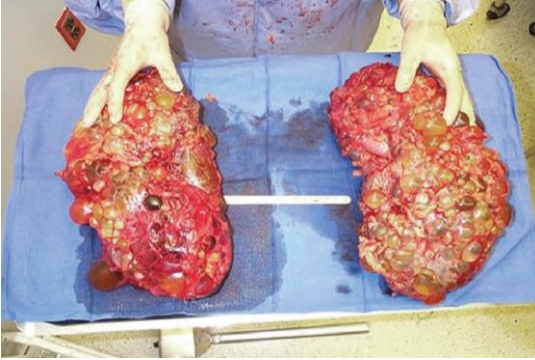


Figure. 4.12. *Polycystic kidney disease. Macropreparations.*

They usually die in the first year of life. The renal involvement is smaller with polycystosis of adults (Figure 4.12) and cysts in other organs are also rare. This anomaly is transmitted by an autosomal-dominant type. The clinical manifestations are rare in childhood. The disease is diagnosed, usually between the ages of 20-40 years, when progressive

deterioration of renal function leads to signs of chronic renal failure.

The clinical picture

It occurs in result of associated complications, which can be divided into the following groups:

1. Urologic:

- chronic renal insufficiency
- pyelonephritis;
- urolithiasis;
- nephrogenic hypertension;
- bleeding and suppuration of cyst;
- secondary anemia.

2. Lesion of cardiovascular system as a result hypertension, diseases of the vascular wall:

- thrombosis, thromboembolism;
- dyselectrolytemia

3. Neurological complications as a result of hypertension and vascular disease:

- stroke;
- polyneuropathy.

Symptoms:

- dull, aching pain in the lumbar region;
- general weakness;

Clinical disease is determined by the severity of certain groups of complications, but primarily are appeared the signs of chronic renal failure and chronic pyelonephritis. Renal function becomes significantly worse at phase of acute pyelonephritis, and then occurs chronic renal failure. In the later stages are joined neurological and cardiac complications, and level of calcium decreases.

Diagnostics

I. Changes in urine

1. Hyposthenuria (density of urine 1,002-1,008);
2. Proteinuria (up to 1 g / l);
3. Leucocyturia (exceeding 10 leucocytes in view of the general analysis, or more than 4 thousand in the urine sample by Nechyporenko).

II. Changes in blood:

1. Increasing the of urea concentration in plasma (above 8.3 mmol / l);
2. Increasing of creatinine concentration in plasma (above 110 mmol / l);
3. Hypercalcemia, hyperkalemia, hyponatremia.

III. X-Ray methods

1. Basical:

- excretory urography;
- ultrasonography (Fig. 4.13 a);
- CT scan (Fig. 4.13 b).

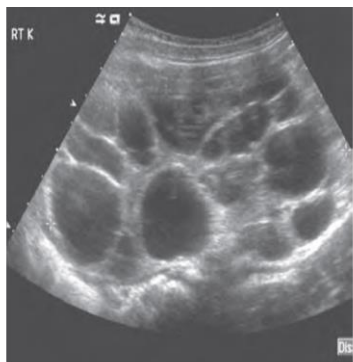
2. More:

- MRI;
- Renal angiography;
- isotope renography;
- Dynamic Nephroscintigraphy.

X-Ray signs of polycystic:

1. Increasing and tuberosity of the contours kidneys.
2. Multiple deformations of the pelvis and calyces.

3. Displacement and extension of the bowl.
4. Narrowing and lengthening of caliceal necks.



5. Multiple rounded contours of cysts in the parenchyma.

Differential diagnostics:

1. Multicystosis: multicystic kidney does not work and multicystosis always unilateral. Polycystosis is bilateral and both kidneys are affected. The opposite kidney has normal structure and function at multicystosis.

Figure 4.13. Polycystic kidney disease: a - ultrasonography, b - CT scan

2. With solitary cysts (solitary, preferably unilateral, do not cause renal dysfunction and chronic renal failure).
3. With renal tuberculosis (diagnosed single or multiple cavities in the parenchyma, ureter and bladder are affected parallel and more typical unilateral damage that clinically manifests itself).

Treatment

Conservative

General principles of treatment are based on the prevention of progression of renal insufficiency, acute pyelonephritis, treatment of other complications.

The main directions are:

1. Detoxication therapy.
2. Anti-inflammatory therapy.
3. Stimulation of the immune system and blood circulation in the kidney.

In any case, patients with polycystic kidney disease are under the supervision of a physician and require almost constant treatment for all life.

Operative treatment Is used only for the clear indications, given the high probability of intra- and postoperative complications. The main indication for surgery is the availability of concrements, large cysts that may be punctured to reduce the pressure on parenchyma and suppuration of cysts.

Puncture of cysts and resection of cystic walls in kidney are usually made. Percutaneous puncture is performed once per 4-6 months. Forecast. One of the main factors determining the duration of the compensation stage of such patients is early detection of process and active treatment. In such cases it is

possible for many years to support the kidney at a satisfactory level. If there are expressed complications during diagnostics - the prognosis is poor.

Solitary (simple) cyst of kidney

There is a variety of dysplasia (violation of structure) in renal parenchyma. Solitary cyst of the kidney occurs in 3-5% of autopsy cases and in about 10-15% of urological patients. There are two main types of cysts: congenital and acquired. At the event of the congenital type, the major role provides to wrong connection of tubular nephrons (the same principle as in polycystic kidney disease). The main factor of acquired cysts is the violation of the outflow of urine from kidneys, especially in combination with parenchymal ischemia. The renal cyst has round or oval shape. More frequently it is found above the surface of kidneys and can be localized in different parts. The content of cysts is serous usually. In rare cases it may be hemorrhagic due to bleeding in cavity of cyst.

Etiology and pathogenesis

There are several hypotheses of cyst formation at kidney. The obligatory condition for cyst is circulatory disorder in the renal parenchyma on limited area with occurrence in this area of urine flow obstructions in collecting tubules. Most researchers believe that cysts of kidney appear from unfavorable conditions for the outflow of urine in collecting tubules that are caused by obstruction of the tubule and active glomerular secretion above the place of barrier. The reason of labored urine outflow through the tubules may be peritubular sclerosis. The growth of cysts may gradually lead to atrophy of the renal parenchyma. The accession of infection develops interstitial nephritis and inflammation of cysts. Large cysts are also caused by violations of renal hemodynamics and urodynamics.

Clinical picture

In many cases (70%) the renal cysts are asymptomatic and diagnosed only in case of complications, such as violation of urodynamics, inflammation of the kidney, nephrogenic hypertension, renal failure, malignancy. Clinical manifestations may occur in large cysts or in parapelvic cysts with violation of the urine outflow from the kidneys.

Diagnostics

There are used for diagnostics of renal cysts:

- ultrasound of the kidneys (visualizes a rounded education of low echogenicity, homogeneous, with clear contours) (Fig. 4.14);
- excretory urography (defines crescent defect in bowl and calyces).
- CT scan (defines rounded formation with clear, smooth contours, low echogenicity with homogeneous content);
- MRI (picture is similar to CT scan, but more accurate and reliable);
- Renal angiography (there are renal cysts on angiogram have a characteristic picture - rounded, non-vascular area with enlightenment).

In uncomplicated cyst of kidney are no changes in laboratory test. At the inflammation of cyst in the general analysis of blood is leukocytosis, leukocyte left shift, increased erythrocyte sedimentation rate. At the renal insufficiency determines increasing of creatinine in blood plasma.



Figure. 4.14. Solitary cyst of the lower pole of the kidney. Ultrasonography

Differential diagnosis:

With tumor of the kidney (intermittent, painless hematuria, isoechogenic, heterogeneity of structure, the lack of clear contours at ultrasound, CT, abnormal vascularization at ultrasound with doppler and angiographic examination).

Treatment

The cyst with size about 5 cm, that does not violate the urodynamic - is clinically asymptomatic. Such patients need in dynamic monitoring and ultrasound once per year. The increasing of cysts more than 1 cm per year, with clinical manifestations that violates urodynamics, is need for surgical treatment. If cysts larger than 5 cm with clinical manifestations, they are need for surgical treatment. The most reliable and low-impact method of renal cysts treating is puncture (Percutaneous ignipuncture) with drainage and phased sclerosing, preferably under ultrasonographic control. If the puncture canal passes through the renal parenchyma or any adjacent organs and cavities, then such patients must be carried by traditional, open surgical intervention - the excision of the cyst wall. The resection of the kidney cyst or nephrectomy is shown at malignancy.

Multicystic kidney

Multicystic kidney is observed in 1% of all renal anomalies. At this anomaly almost all kidney is presented by cysts. It is always unilateral anomaly in adult people. Multicystic kidney does not work. It is accompanied by atresia and hypoplasia of the ureter. Bilateral multycystosis in newborn is not compatible with life.

Renal dysplasia

This anomaly lies in congenital kidney reduction in size with simultaneous malformations of kidney tissue and reduction of renal function.

There are two forms of renal dysplasia:

1. Rudimentary kidney
2. Dwarf kidney.

Rudimentary kidney - is organ that has stopped in its development early in fetal life. Instead of the kidney appears small sclerotic mass with the size of 1.3 cm or less. At research are detected in it the remains of underdeveloped glomeruli and tubules. Dwarf kidney is significantly reduced in size (2-5 cm) and has tissue with sharp decreasing in it the number of glomeruli. The number of renal vessels is also significantly reduced. The ureter may be sometimes spliced. This form of anomaly is often complicated by nephrogenic hypertension.

Calyces-medullary anomalies

To this subgroup anomalies of structure include megacalyx, polymegacalyx, and sponge kidney.

Associated anomalies of kidney

The greatest clinical significance in this group has a combination of renal anomalies with vesico-ureteral reflux and infravesical obstruction. To such combinations are accounted up to 20-30% of renal anomalies. The timely diagnosis is very important for concomitant anomalies. For these purposes is used a comprehensive urological examination: excretory urography, voiding cystography, ultrasound, radioisotope methods of examination, renal angiography. In case of vesico-ureteral reflux and absence of effect from conservative treatment usually make the reconstructive plasty surgery to correct reflux. It prevents the progression of chronic pyelonephritis and renal failure. In the presence of infravesical obstruction there is treatment that required restoring of normal urination.

4.2. Anomalies of the ureter development

Anomalies of ureter development are relatively common - about 20% of the urinary system malformations. Most of these abnormalities are diagnosed at the age of 10 years. There was adopted at the Second All-Union congress of Urology (1978) the following **classification**:

I. Anomalies of quantity:

- 1) aplasia;
- 2) complete and incomplete doubling (tripling).

II. Anomalies of structure:

- 1) hypoplasia;
- 2) neuromuscular dysplasia, achalasia, megaureter;
- 3) ureteral valves;
- 4) diverticulum of the ureter;
- 5) ureterocele.

III. Anomalies of Location:

- 1) retrocaval;
- 2) retroiliac;
- 3) ectopia of the ureteral orifice.

IV. anomalies of form:

- 1) annular;
- 2) corkscrew shaped.



Figure. 4.15. *Retrograde ureteropyelography:*
A - partial doubling of the right ureter;
B - full doubling of the right ureter

doubling of the kidneys. Doubling of ureter may be complete (ureter duplex) and incomplete (ureter fissus) (Fig. 4.15). At full doubling both of ureters follow separately to the bladder and open by two orifices (Fig. 4.16.) The lower orifice corresponds to the ureter from the upper pelvis. Incomplete doubling of ureters at different distances from the renal pelvis are merged into one.



Figure. 4.16. *Cystoscopic picture. Full doubling of right ureter*

Anomalies of the ureter structure

Hypoplasia of the ureter

This anomaly is usually combined with hypoplasia of the corresponding kidney. Hypoplasied ureter is a thin tube through the underdevelopment of muscle fibers. The orifice of it may be obliterated. Treatment consists of the

functional state of the corresponding kidney and complications.

Neuromuscular dysplasia of the ureter

It is the most frequent and severe abnormality of the upper urinary tract. It is a congenital underdevelopment of neuromuscular elements in combination with the narrowness of the prostatic, yuxtavesical or intramural sections of urethra.

Aplasia (agenesis) of ureter

Is a rare defect and occurs in 0.2% of patients with anomalies of the kidneys and urinary tract. Bilateral malformation is usually combined with bilateral renal agenesis, and incompatible with life. Unilateral defect is an integral part of renal aplasia. Sometimes it is possible to identify the ureter in a fibrous strand or rame that ends blindly. Demand for treatment occurs only in ureter that ends blindly in the development of various complications. In such a case is necessary to conduct operative treatment - removal of ureteral stump.

Doubling of ureter

The most common malformation of the ureter is usually associated with a

Classification:

Stage 1 - the expansion of the lower part urethra (achalasia);

Stage 2 - the expansion of all urethra (megaureter);

Stage 3 - ureterohydronephrosis (the extension urethra and pelvicalyceal system).

Anomaly is often bilateral, in advanced stages, and leads to chronic renal insufficiency. Recognition is based on the characteristic of X-ray picture, results of ultrasound and CT. Treatment at the initial stage may be conservative, in the following - operative (plasty surgery of the ureter).

In the complete loss of ureteral tonus - ureteral replacement of the small intestine segment, and complete loss of kidney function - nefroureterektomy.

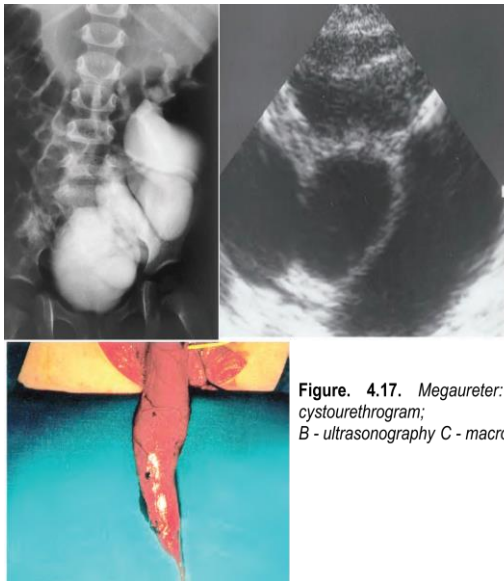


Figure. 4.17. Megaureter: A - ascending cystourethrogram; B - ultrasonography C - macro preparations

Ureterocele

Is a cystiform protrusion of the ureteric intramural part in the gallbladder lumen that has round shaped formation with dotted opening at the top. It is lined by mucous membrane of the bladder from the outside, and by mucous membrane of the ureter from the inside. It is diagnosed in 1 in 500 of births. In 2-3 times more frequently in girls than boys. Double-sided ureterocele occurs in 20% of patients.

Etiology and pathogenesis

In most cases the pathology is caused by narrowing of the ureteric orifice which leads

to the violation of the urine outflow from the ureter, hyperextension of the latter and increasing of pressure in pelvicalyceal system. The increased pressure and stagnation of urine in kidney bowl lead to circulatory disorders and the development of microbial inflammation of kidney tissue (pyelonephritis). It causes the gradual development of nephrosclerosis (replacement from normal renal tissue to sclerotic). In result of nephrosclerosis, kidney loses its basic functions. Big ureterocele causes a disturbance of urine outflow from the kidney and obligatory consequences like chronic pyelonephritis and sometimes nephrolithiasis. There are a solitary (single) and doubled ureterocele. In the latter case, it is always associated with the upper segment of the ureter kidney. At full doubling kidney in some cases there is pathology of the lower ureteric segment - vesico-ureteral reflux, unnatural throw of urine from the bladder into the ureter. Both of these conditions exacerbate the existing problem (one of them also lead to pyelonephritis and renal tissue atrophy).

Classification of ureterocele:

1. Normal - the normal ureteral orifice location.



Figure. 4.18. Vesical ultrasonography of the patient with right-ureterocele. Is visualized rounded thin-walled liquid formation on the lower right side of the bladder.

manifested itself clinically till the development of pyelonephritis. The latter has a characteristic clinical and laboratory picture (dull, aching pain in the lumbar region, fever, leukocyturia, pyuria, weakness, etc.). Big ureterocele in women may protrude outside through urethral canal (urethra). Then there is a paradoxical combination of symptoms: urinary retention due to obstruction of urethral canal and urinary incontinence that occurs as a result of spontaneous discharge of it directly with ureterocele.

2. Ectopic - in an atypical location of ureteral orifice.
3. Single or double-sided.
4. Ureterocele of doubled ureter.

Clinical picture

The anomaly is often one-sided and asymptomatic at small size. Occasionally there are complaints of difficulty in urination associated with ureterocele obstruction of the internal opening of the urethra, pain in the abdomen or lumbar region. The pathology is not

Diagnostics

1. Cystoscopy (is determined the club-shaped or rounded formation in the area of the corresponding ureteric orifice with the dotted urethral opening on the surface).
2. Ultrasound examination (defined rounded thin-walled liquid formation in the area of the vesical triangle) (Fig. 4.18.).
3. Excretory urography.

X-ray picture with ureterocele depends on the function of the affected kidney or segment of kidney. At low ureterocele the function is manifested at the intravenous urogram as the filling defect of bladder, and by stored function that is contrasted as club-shaped extension of the ureteric end.

Differential diagnosis

Is differentiated with tumor of the bladder (cystoscopy is crucial) and concrement bladder (in most cases is diagnosed by ultrasound).

Treatment

At large ureterocele and in operative complications - is necessary to conduct the excision of ureterocele and stitching the mucous membranes of ureter and bladder. An alternative is transurethral resection or excision of ureterocele that is considered to the "gold standard" treatment of this disease. During short-term inhalation or intravenous anesthesia, the resectoscope that is inserted into the lumen of the bladder, forms a

new orifice in the wall of ureterocele, the shape, size and position of which provide free flow of urine from the ureter with the lowest risk of vesico-ureteral reflux. Nephrectomy is shown by the complete loss of kidney function due to hydronephrosis or nephrosclerosis.

Anomalies of the ureteric location

Retrocaval ureter - is a defect whereby the upper third of the right ureter helically covers posteriorly the vena cava inferior. On the urogram is noted the bend of right ureter in middle section. It may be asymptomatic, but if the anomaly leads to disruption of the urine flow from the kidney, in result develops the chronic pyelonephritis, hydronephrosis, and nephrolithiasis. In these cases is necessary surgical treatment. The complete loss of kidney function is the indication to nephroureterectomy.

Retroiliac ureter is the location of the ureter behind the iliac vessels. This is a very rare malformation. The violation of the urine outflow and pyelonephritis are the indication to surgical treatment - the intersection of ureter and restoration of it, anterior to the iliac vessels. The complete loss of kidney function is the indication to the nephroureterectomy.

Syndrome of testicular veins – is compression of the right ureter by testicular veins. It is rare pathology.

Ectopic ureteral orifice - the wrong ending of the ureter when instead of the bladder the ureter may be ended in urethra, vagina or cervix, perineum, rectum, seminal vesicles. Most often incorrectly ends the ureter, which departs from the upper renal pelvis with doubling. The main symptom – is incontinence while maintaining at the same time of normal urination. Anomalies are diagnosed by examination of urethrascopy and cystoscopy, excretory urography and CT. Treatment is always surgical: To the functional conservation of kidney, ureter must be transplanted to the bladder (ureterocystoanastomosis). At the necrosis of renal parenchyma is shown nephroureterectomy or heminephroureterectomy.

4.3. Anomalies of the urinary bladder

Anomalies of the urinary bladder - is a group of congenital disorders of development and structure of the bladder.

Classification:

- extrophy of bladder;
- agenesis;
- doubling of the bladder;
- megacystis;
- anomalies of urachus;
- diverticulum of the bladder;
- congenital contracture of the bladder neck (Marion disease);
- hypertrophy of vesical triangle (perivesical folds);
- redundant mucosa of vesical triangle;

- vesico-ureteral reflux;
- neuromuscular dysfunction of the bladder.

Exstrophy of bladder

Exstrophy of bladder is the congenital absence of the anterior wall of the bladder and abdominal wall. It occurs in 1 case per 10 000 births. In boys, it is in 3 times more frequently. It occurs by improper development of the cloaca or allantois. Exstrophy of bladder – is combined anomaly, components of which are abnormalities of the urinary tract, musculoskeletal system, and sometimes the small intestine. Classic exstrophy defects makes 60% of this group. 10% - are exstrophy of cloaca, the upper gorge of bladder, pseudo-exstrophy, and exstrophy with a doubling. In 30% of patients is observed epispadias. It is typically combined with a significant divergence of pubic bones in women - with the splitting of the clitoris, epispadias, stenosis of the vaginal opening, which is displaced anteriorly, may occur the doubling of uterus. Bilateral inguinal hernia, cryptorchidism, epispadias are frequent in boys.

Clinical picture

The rear wall of the bladder, is covered by red hyperemic mucosa, protrudes outside through the defect in the skin and abdominal muscles. The ureteric orifices are gape. Navel is located above the upper edge of the defect, but most often it is absent. Exstrophy is accompanied by total epispadias. It is manifested by cystitis, urinary incontinence, pyuria.

Diagnosis

Exstrophy of bladder is diagnosed at external examination of the patient. Ultrasound and excretory urography are shown to determine the condition of upper urinary tract.

Treatment

The treatment is only operative. It is shown the plasty of bladder by local tissues or creation of isolated tissues of the bladder from part of intestine. The most important are reconstructive plasty surgery for restoration of bladder with local tissues which preferably carried out in the first days after birth.

Diverticulum of bladder

Diverticulum of the bladder - is blind saccular protrusion of the bladder wall. Anatomically diverticulum has a neck, body and bottom.

Etiology and pathogenesis

True diverticula are related to abnormalities of the urinary system but factors of this disease are still not well established. The wall of true diverticulum is consisted of all bladder layers. The false diverticulum consists only of mucosal and submucosal membranes that are protruded through the defect of cystic muscles, so there is no sphincter-shaped formation, which occurs in the primary diverticulum. True diverticula are usually solitary. Two to three diverticula occur more rarely; false diverticula, are usually multiple. True diverticula may occur in different parts of the bladder, but most of them occur at back wall and posterolateral part. Quite often they are located near the ureteral orifice, and sometimes ureteral orifices are located directly in the diverticulum. True diverticulum unlike to the false is connected to the long bladder neck, due to the presence of sphincter-shaped formation of the vesical muscular layer. Sizes of diverticula depend on degree of urodynamics violations in the lower urinary tract and morphological

changes in its wall. False diverticula, usually develop after prolonged increasing of intraluminal pressure in the bladder due to difficulty urinating (infravesical obstruction), such as benign prostatic hyperplasia, narrowing of the urethra and other reasons that violate the urodynamics of the lower urinary tract.

Classification:

- a) the original or true (congenital) that develops due to abnormalities of the urinary system (Figure 4.19);
- b) secondary (acquired), which is a complication of infravesical obstruction (Figure 4.20):
 - uncomplicated;
 - complicated.

Clinical picture

Clinical course of bladder diverticulum depends on the duration of the disease, etiological factors, location and presence of complications: infection, concrements, tumors. The clinical picture of the disease is diverse and in most cases asymptomatic.

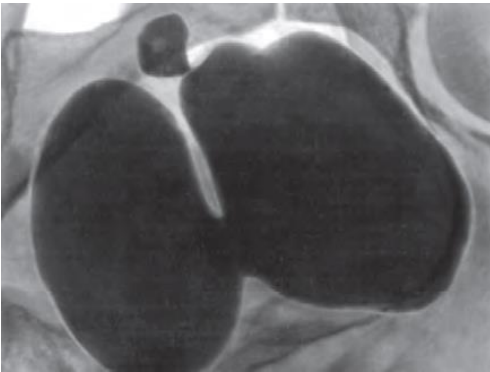


Figure. 4.19. *True diverticula of the bladder.*

Ascending cystogram.



This, in turn, leads to its late diagnosis. Diverticula can be undetected for long term. Painful manifestations occur, as a rule in patients with complications of the underlying disease. Localization of them depends on the location of the diverticulum in the bladder. In some cases, diverticula, which are located directly at the ureteral orifice, can disrupt the upper urinary tract urodynamics due to urine stasis or reflux. In the area of the kidneys they are dull, constant, and arching. At large sizes of primary diverticula are determined the violation of urination: urine stream becomes weak; part of urine is excreted outside, and gets into diverticulum.

Figure. 4.20. *Multiple acquired diverticula of the bladder. Ascending cystogram.*

After urination the content of spread diverticulum turns into the bladder, and arises a new urge and re-emptying of bladder (urinary multistage). In the conditions of urinary stagnation in the diverticulum are often formed concrements and sometimes tumors that can predetermine hematuria and inflammation of the mucosa. Joining of infection sometimes leads to pyuria and fever. Transitory or persistent pyuria is a sign

of infected diverticulum of bladder. The presence of infection in the urinary tract significantly changes the clinical picture of disease and the choice of therapeutic tactics.

Diagnosics

Examinations in patients with diverticulum of the bladder should provide for the study of anatomical and functional status of the lower and upper urinary tract, the presence of complications. Ultrasound is informative in cases where the size of diverticulum exceeds 0.5 cm. It can help to determine: the presence of diverticulum, location, size, wall thickness and diverticulum of urinary bladder and its content. The studying of the upper urinary tract anatomy involves the identifying of complications that mostly are commonly associated with urine stasis or vesico-ureteral reflux. Considering that diverticulum of the bladder is usually located on the lateral and posterior wall of the bladder, ultrasound scan is desirable to perform by using a rectal probe. Radiographic methods of research are help to establish the anatomical and functional changes in the urinary tract, the presence of radio-opaque concrements and remaining of urine after urination. Survey urography provides to determine the shade of concrements and changes in osteomuscular system. Excretory (infusional) urography enables to get the objective information about secretory-excretory function of kidneys, urodynamic and anatomical features of the upper urinary tract. Cystoscopy is used in all women with suspicion on the diverticulum of bladder. In men, this method of examination is used for specific indications. This is associated with invasiveness of research and probability of infection of the lower urinary tract. The cystoscopy is contraindicated for male patients with infravesical obstruction. At cystoscopy examination of bladder we can see the entrance to the diverticulum in the form of dark hole, where around of it is plicate mucous membrane. This plicating and the periodic closing of neck are distinguished to the true from the false diverticulum. At primary diverticulum is possible to observe the reduction of its "sphincter". Cystoscopy with using of modern endoscope allows to make the revision of mucosal diverticulum and, if necessary, the biopsy of abnormal areas. Clear understanding of the shape and size of diverticulum can be obtained only through a comprehensive study of the lower urinary tract. Urodynamic examination of patients with the diverticulum of bladder allows you to set urodynamic violation of the lower urinary tract. The simplest method for studying the flow of urine is uroflowmetry. Cystometry allows us to study the contractile function of detrusor muscle of bladder. The intraluminal pressure depends of the urine amount.

There are basic laboratory tests: general urine analysis, hidden leukocyturia in urine, level of microflora and its sensitivity to antibiotics, level of creatinine in blood serum. An integrated approach to diagnostics of bladder diverticulum allows to establish the accurate diagnosis, complications of the disease and to determine the treatment policy in line with anatomo-functional and morphological changes of the urinary tract.

Treatment

Medical tactic in patients with bladder diverticulum can be expectant (dynamic observation or conservative therapy) and surgical. Conservative treatment allows to reduce the risk or to avoid the probable complications of the underlying disease and to improve the quality of life without removing the diverticulum and its etiological factors. The timely surgical treatment should provide the removing of etiological factors of underlying disease, diverticulum and to improve the urodynamics. Choice of treatment strategy depends on the functional state of the urinary tract, kidneys, and degree of violation urodynamics, presence of concomitant diseases.

Indications for selection expectant tactics:

- The presence of uncomplicated diverticulum of bladder.

Indications for surgery:

- The presence of complicated diverticulum of bladder (urine stasis in the upper urinary tract, chronic urinary retention, etc.).

Treatment of patients with primary uncomplicated diverticulum of the urinary system – is conservative. It consists in meticulously dynamic observation with the use of measures aimed at combating the urinary infection and prevention of complications. Patients are subject to the clinical supervision, which provided for control examinations 1 per year. The indications for surgery are: the progression of the disease, urodynamic disorders in urinary tract, reducing the secretory-excretory function of the kidneys in dynamics and reduced quality life of the patient. The method of surgical treatment of the bladder diverticulum is dependent on the level and depth of damage in urinary tract, functional state of renal parenchyma and the presence of comorbidities. Treatment of patients with primary, complicated diverticulum of the bladder – is operative. It involves the removal of diverticulum, restoration of urodynamic and eliminating of complications. In cases where the primary diverticulum of the bladder was led to the ureterohydronephrosis of terminal level – is shown the removing the kidney (nephrectomy). After surgical treatment is proposed dynamic monitoring that aims to determine the extent of urodynamic recovery, infection of the urinary tract and prevention of its occurrence. Patients are subject to annual inspection during 3 years.

The redundancy of mucous membrane in triangle of bladder

Redundancy of mucous membrane in triangle of bladder - is a rare malformation in which the mucous membrane hangs over the neck of the bladder, by forming a valve that prevents the flow of urine. It is accompanied by obstructive symptoms of varying degrees. Operative treatment is shown in the presence of urinary retention or complications (ureterohydronephrosis, formation of concrements, vesico-ureteral reflux).

The bladder neck contracture

Contracture of bladder neck (Marion disease) – is excessive development of connective tissue in the submucosal and muscular layers of the bladder neck area. It is accompanied by obstructive symptoms of varying degrees. Operative treatment is shown in the presence of urinary retention or complications (ureterohydronephrosis, formation of concrements, vesico-ureteral reflux).

Anomalies of urachus

Persistence of urachus (urachal fistula) is opened channel of allantois, explained by insufficient obliteration of urachus. Urachus usually closes at 4-5th month of fetal life. The persistence rate of urachus among children autopsy – is 1 of 7610, urachal cyst - 1 of 5000. Content of urachal cyst - is serous or serous-bloody fluid. The walls are presented by admixture of connective tissue with smooth muscle cells which are lined by transitional epithelium. Large cysts are lined by flattened epithelium, and do not contain the muscle cells.

Treatment

At complete fistula of urachus is shown the surgery in the first days or months of life, an incomplete fistula - from the 1st year of life.

Vesico-ureteral reflux

Congenital or acquired disease is characterized by reversible movement of urine from the bladder into the ureter and renal cavity system. This pathology occurs more often in childhood. Vesico-ureteral reflux

develops in cases where the length of intramural ureter is too short. Certainly in this case the ureter is located more laterally.

Etiology and pathogenesis

According to different authors, vesico-ureteral reflux in 30 - 60% is the cause of pyelonephritis. It happens due to a violation of the urine outflow from the upper urinary tract, which creates favorable conditions for the emergence and progression of microbial-inflammatory process. The result of this inflammation and constant of high intrapelvic pressure occurs puckering of renal parenchyma, chronic renal failure, and hypertension. Higher number of renal diseases is associated with the violation of urodynamics in the urinary tract. Upper urinary tract function provides evacuation of urine from the kidney to the bladder. In its turn the lower urinary tract accumulates holds and eliminates it out. The close relationships of upper and lower urinary tract is confirmed in many cases by the presence of disease in vesico-ureteral segment during violation of urodynamics in the ureter. The secondary nature of vesico-ureteral reflux is associated with the presence of lower urinary tract disease and acquired changes in the ureteral orifice (traumatic, inflammatory, X-ray character and others). Neurophysiological researches have proved that the cause of vesico-ureteral reflux may be neurogenic bladder changes. Typically, vesico-ureteral reflux is common in childhood and adolescence. It is the most common cause of insufficient development of locking apparatus of ureteral orifice. Vesico-ureteral reflux can also develop as a result of high pressure during urination that appears at presence of posterior urethral valves, in some cases, neurogenic bladder and detrusor sphincter dysynergia. In addition, vesico-ureteral reflux may develop at doubling urinary tract in which kidneys are drained by two ureters. In children with ectopic ureterocele may occur incorrect development of intramural ureter that leads to vesico-ureteral reflux. In children with ureteral ectopy in which the orifice is located in the neck of the bladder, may occur vesico-ureteral reflux in the upper ureter. Vesico-ureteral reflux may also occur after surgical intervention on the bladder. For example, if during the operation was dissected vesical triangle, it can promote retraction of orifice, which leads to the development of vesico-ureteral reflux. Pathological researches are proved that the cause of vesico-ureteral reflux is a malformation of vesico-ureteral segment. Normally it is a kind of valve in which the anterior wall of the intramural part is almost devoid of muscle fibers. By increasing of intravesical pressure, the anterior wall touches the posterior muscular wall that at the time of urination prevents regurgitation of urine in the ureter. The locking apparatus of orifice formed by circular muscle fibers which located in the lower part of the distal ureter and longitudinal muscles that move to the bladder wall, but do not reach the triangle. Elasticity and muscular tone help to unchanged ureteral to adapt to variable volume of bladder and pressure in it.

Pathomorphological researchers have identified number varieties of developmental congenital anomalies of vesico-ureteral segment:

- **Hypoplasia** (epithelial hypoplasia) - segmental or total hypoplasia of the ureter.
- **Hypoplasia** and aplasia of muscular layer - lack of muscle fibers.
- **Dysplasia of muscular layer** in vesico-ureteral segment is characterized by a variety length of muscle fibers and their incorrect orientation in relation to ureteric lumen.
- **Neuromuscular dysplasia** - a combined anomaly of muscle and nerve elements of the distal ureter wall with a sharp decrease in the number of last compared to the norm.
- **Collagen-fibrous hypertrophy** - excessive development of connective tissue, mucosa and submucosa of the normal or reduced lumen of vesico-ureteral segment and frequently - its muscular hypoplasia shell.

- **Fibroepithelial dysembryoplasia** is characterized by the presence of several (20) different-sized cavities - channels lined with epithelium and surrounded by the immature connective tissue.

There are also anomalies of wall at terminal part of the ureter, among which are:

- **Angiomatosis** of ureter is called the wall of the ureter, that has usually normal clearance provided by collagenous connective tissue with numerous capillaries and venules stretched by blood, that are arranged equally around the circumference of the transverse cut in ureteropelvic segment.
- **Cavernous hemangioma** - vascular formation that is localized in one of the shell wall of ureteropelvic segment and consists of the closely spaced with large diameter thin-walled vessels, separated by thin layers of mature connective tissue.
- **Valve of ureteropelvic segment** - polypous protuberance that has foot and protrudes into lumen. The valve is formed by all layers of the ureter wall.
- **Splitting of ureteropelvic segment** - is the separation of ureter in the area of ureteropelvic segment into 2 or 3 a true channels that often have a common adventitial or muscle membrane.
- **Diverticulum of ureteropelvic segment** - is focal saccular protrusion of the terminal segment wall of ureter, which is often accompanied by hypoplasia of muscle membranes.
- **Ureterocele** - is the cystoid enlargement of intravesical ureteral segment that protrudes into the cavity of the bladder and often reaches a considerable value.
- **Ectopia of ureteral orifice** - is abnormal position of the ureteral orifice with localization of it outside of the bladder or in the bladder, but in the abnormal place.

There are many etiological factors that cause the opposite leaking of urine from the bladder into the ureter, but for the occurrence of reflux they must be accompanied by the normal anatomic-physiological state of ureterovesical segment. Among the congenital anomalies are most frequently detected: the expanding of ureteral opening, lateral ectopy, significant shortening or complete absence of intramural ureter, impaired patency of vesico-ureteral segment. At doubling of ureter, ureterocele, and in cases where the ureter opens in the area of bladder diverticulum - in these cases, the confluence of the ureter into the bladder does not have normal ligamentous and muscular apparatus. Significant role in the dysfunction of muscle tissue that is located in the area of ureteral opening plays urinary tract infection. Hypertrophic changes in muscular layer of ureter were found predominantly in patients with traumatic injuries of its walls. They are characterized by the preservation of muscle membrane or a slight increasing in the size of the background proliferation the collagen bundles of couplings around it.

Classification:

- a) Primary or congenital (lateralization and gaping of orifice, short submucosa of ureter segment, at least - paraureteral diverticulum, ureterocele);
- b) Secondary or acquired (that is a complication of any disease, injury of ureteric orifice, etc.).

Vesico-ureteral reflux is divided into the reflux of low and high pressure. Reflux of low pressure (passive) - a reverse flow of urine, which is developed during the filling of the bladder. Reflux of high pressure (active) - a reverse flow of urine from the bladder into the ureter that develops during urination. Vesico-ureteral reflux may develop during the filling of the bladder, urination or in the both cases.

Classification of vesico-ureteral reflux by the X-ray features:

The most common classification of radiopaque substance throwing that is differentiated by the severity degree of vesico-ureteral reflux at present – is classification of Heukel - Parkkulaynen (1966). According to this classification there are 5 stages of vesico-ureteral reflux:

1. Throwing of radiocontrast substances in the distal part of ureter (pelvic cystoid) without changing in its diameter.
2. Filling of the ureter and pelvicalyceal system by radiocontrast substances. Pelvicalyceal system and ureter are not extended.
3. Moderate enlargement of the ureter with pyelectasis and enlargement of cups in kidney.
4. Pronounced expansion and kneed bends of ureter, deformation of cavitory system of the kidney. There is a secondary contraction of renal parenchyma.
5. Hydroureter and sharp thinning of renal parenchyma.

Clinical picture

It depends on the violation degree of urodynamics, duration of disease, single or duplex kidney disease and the presence of complications: infection, formation of concrements and other. The clinical picture is various and in most of cases at compensated stage - asymptomatic. It leads to its late diagnostics. Clinical manifestations of the vesico-ureteral reflux are often caused by the addition of a urinary tract infection and reflux uropathy. The first clinical manifestations of vesico-ureteral reflux are recurrence of chronic pyelonephritis, and enuresis. At vesico-ureteral reflux are often observed pain in the lower abdomen or in the lower back, accompanied by fever, which appears during exacerbations of chronic pyelonephritis. These clinical manifestations are typical for passive and passive-active vesico-ureteral reflux. The typical and primary features of active vesico-ureteral reflux are leukocyturia and proteinuria in urinalysis. The first symptoms often occur after an influenza, measles, pneumonia and are not accompanied by fever and abdominal pain. Much more rarely for clinical picture of vesico-ureteral reflux were only bedwetting or daily urinary incontinence with leukocyturia without fever. There are defined the following clinical manifestations of vesico-ureteral reflux as high blood pressure and retarded physical development. The data clinical symptoms are typical for severe reflux-uropathy, which are responsible for approximately 1/3 cases of chronic pyelonephritis. The data clinical manifestations talk about the deep pathological changes in the renal parenchyma. The character of pain symptoms is varied. In the area of the kidneys is dull, constant, arching pain that manifested as renal colic. Between the severity of pain and degree of anatomical changes is no direct proportion. At the height of pain may occur nausea, vomiting, fever, indicating the complexity of the disease. In case of high pressure reflux during urination patients often note similar to colic painful manifestations in the back, which are associated with increasing of intraluminal pressure in the upper urinary tract. The accession of infection in the upper urinary tract is more common in patients with reflux-hydroureter. It causes the increasing of temperature and sometimes fever. Transient or persistent pyuria is a sign of an infected hydroureter. Increasing of intraluminal pressure in the upper urinary tract causes pelvicalyceal reflux and infection of the interstitial tissue in kidney. The presence of infection in the kidney imposes specific changes in the clinical picture of the pathological process and the choice of treatment strategy. Clinical manifestations at lesions of the lower urinary tract are characterized by the presence of dysuric complaints. Vesico-ureteral reflux, directly in conjunction with urinary tract infections can lead to kidney damage, which is called "reflux uropathy." Hematuria in patients with reflux-hydroureter is arised by increasing of intrapelvic pressure and rupture of forniceal zones. In the later stages of reflux, when there are

deep structural changes in the kidney, disorders and scarring of forniceal system, hematuria may be explained by increased bleeding from veins due to stasis of urine.

Diagnosis

Examinations in patients with uropathy that are defined as vesico-ureteral reflux, should provide the study of urodynamics in upper and lower urinary tract, secretory-excretory function of the renal parenchyma, which must be assessed comprehensively for more complete understanding of the changes in the parenchyma of the affected kidney and contralateral kidney.

The main methods of diagnosis:

- 1) CBC;
- 2) urinalysis;
- 3) bacteriological examination of urine;
- 4) the level of creatinine in blood plasma;
- 5) ultrasound of the kidneys;
- 6) survey urography;
- 7) excretory urography;
- 8) ascending and voiding uretroscopy;
- 9) diuresis urography

Additional diagnostic methods:

- 1) Radioisotope renography;
- 2) Dynamic nephroscintigraphy;
- 3) analysis of urine by Nechiporenko;
- 4) analysis of urine by Zimnitsky (with two sided lesions)

The most important and informative diagnostic methods of vesico-ureteral reflux is radiographic methods. They allow you to determine the presence or absence of reflux, and reflect the impact of vesico-ureteral reflux in the renal parenchyma. Excretory urography – is the most valuable of information in terms diagnostic method that allows determining and assessing the severity and nature of renal involvement at vesico-ureteral reflux, both functional and morphological nature. Definition of infravesical obstruction and vesico-ureteral reflux is carried out by using the ascending and voiding cystourethrogram. Violation degree of urodynamics in the lower urinary tract is assessed by conducting of uroflowmetry index and determining the amount of residual urine. Retrograde pyelography is shown only in day of operation by the strict indications due to the possibility of urinary tract infection. Retrograde pyelography is performed in cases where according to the excretory urography is impossible to judge the anatomic-functional changes in the upper urinary tract. For prevention of pyelovenous reflux, the research is conducted under the control of electronic-optical converter that allows you to choose the most convenient time for radiography. Cystography is the primary method for diagnosis of vesico-ureteral reflux (Fig. 4.21.).



Figure. 4.21. *Right-sided vesico-ureteral reflux. Ascending cystogram.*

This research determines the presence of reflux and shows its degree. Cystography can be performed by ascending filling of bladder with help of contrast material through transurethral catheterization of bladder. Voiding urethrocytography – is a method that allows getting a profile picture of urethra. X-ray pictures are taken during urination and directly afterwards. The conduction of endoscopic examination at vesico-ureteral reflux involves the assessment of urethra and bladder, detection of diseases that may cause the secondary reflux, characteristics of triangle Lyeto abnormalities. Ultrasound diagnosis provides the opportunity to

observe the vesico-ureteral reflux during the filling of the urinary bladder, but this method is still screening. In the assessment of vesico-ureteral segment are taken into attention the location of ureteral orifice, its shape, and length of submucosal ureteral tunnel that are used as prognostic indicators to address the disappearance of vesico-ureteral reflux under the influence of conservative therapy. The analysis of endoscopic methods in combination with the data of X-ray radiographic studies is the reason for the selection of patients who are treated conservatively, and to determine the indications for surgical intervention.

Treatment

Treatment of vesico-ureteral reflux is a complex task. At the initial reflux of I and II degree the treatment is mainly conservative. The most important treatment of chronic pyelonephritis with observance of the regime by forced frequent urination after 1,5-2 hours in order to prevent reverse maligns of urine into the upper urinary tract. The high degree of reflux - III, IV, V - with sclerotic changes in the parenchyma of the kidney, deformation pelvicalyceal complex and development of megareuter - are subject to the operative treatment. Frequent exacerbations of chronic pyelonephritis are made the in choice of treatment tactics of reflux for surgical. Secondary vesico-ureteral reflux in the first stage of treatment involves the removing cause that is caused by disease. The removing of infravesical obstruction, treatment of neurogenic bladder dysfunction, chronic cystitis, proctology disease quite often leads to the disappearance of reflux or reduction of its degree and activity of chronic pyelonephritis. The infravesical obstruction is represented by valve or stenosis of the posterior urethra, hypertrophy of spermatic tubercle - in boys, and stenosis of the distal urethra - in girls (meatal stenosis). **The treatment of infravesical obstruction** – is endosurgical. During the general anesthesia is conducted valve destruction or electrocision of stenosed areas in urethra or meatotomy. The bladder is drained by catheter Foley to 5-7 days, the diameter of which corresponds to the diameter of the child age urethra. In case of neurogenic bladder dysfunction is conducted a comprehensive treatment that includes medication and physiotherapy treatment depending on its form. Hyporeflexive form requires the appointment of electrophoresis with 0.05% solution of proserine to the area of the bladder for 10-14 days. At the hyperreflexive form is prescribed antispasmodic drugs for 4 weeks and electrophoresis with 0.1% solution of atropine for 12 days. Treatment of patients with proctology disorders is to appoint a diet rich in fiber. At the expressed chronic constipation are used daily cleaning enema courses for 2 weeks each month, and electrical stimulation of the rectum (the device "Amplipuls") using anal electrodes within 10-14 days. There are two methods of surgical treatment: organ-removing surgery (nephrectomy) and organ-sparing operation (plasty, reconstructive, etc.). Technical options for transplantation ureter into the bladder characterized by: first, by the type of anastomosis ("side to side", "end to side" or "laterally-lateral"), and secondly, depending on the option for establishing the antireflux mechanisms of protection the upper urinary ways. At sclerotic changes that has started in the renal parenchyma, preference given to surgical treatment. The aim of surgical treatment of vesico-ureteral reflux - is the maintaining functional ability renal parenchyma and prevention of chronic renal failure by reduction of urine passage through the

urinary tract. Stages of surgery should take into account individual changes ureter, renal parenchyma. In the presence of disease in vesico-ureteral segment the restoration of urodynamics starts from the lower urinary tract. Nephrectomy of bilateral hydroureter should be justified on the basis of the functional state of kidneys and contralateral kidney used only for health reasons. At two sided pathology at first is performed the corrective surgery on the side of the kidney that functions better. The terminal infected hydroureter that is threatened to the bacteriemic condition - is an absolute indication for nephrectomy. Along with this, a careful comparison of the results during comprehensive examination and macroscopic state of kidney during the operation in some cases allow to save the kidney in spite of its extremely low functional capabilities with the expectation of excretory function, which is important in maintaining of body homeostasis in the conditions of renal failure. The available manuals, which are given a high percentage of positive results (from 95 to 97%), are antireflux surgery: Greguare, Leatbettera - Politano, Coen and Gillyes-Verneta, Vozianova - Stakhovsky (infraureteral modeling of ureter). The principle of this operation is the elongation of the submucosal ureter. In the postoperative period much attention is given to treatment of pyelonephritis, which is aimed at the elimination of microbial pathogen and increasing of reactivity. Antibacterial treatment is based on the sensitivity of microorganisms in urine to antibiotics.

Prognosis - is favorable.

Bladder dysfunction

To inorganic dysfunction of the bladder belong the urination disorders that are occurred as a result of violations in reducing of bladder wall and urethral sphincter while preserving the anatomical integrity and the absence of anatomic obstructive changes in the urinary tract. Most often occurs the hyperactive (hyper-reflexive) bladder in which is marked the excessive constant contraction of bladder wall.

Etiology and pathogenesis

The main factors of hyper-reflexive bladder are: the weakening of inhibitory control in the higher nerve centers by the reflex muscle contraction that pushes the urine and the excessive irritation of elements in the reflex arc that are located in the bladder. These disorders of urodynamic have functionally obstructive character, the essence of which is in discoordination of action between the arising spontaneous contractions of muscle that pushes urine and relaxation of locking apparatus. The impaired function of the bladder during its neurogenic weakness is also associated with the irritability of neuro-reflex arc and related primarily with the accumulative phase. The dysfunction of emptying - is the result of the low tonus of the detrusor.

Classification

There are two basic forms of these disorders:

- 1) hyper-reflexive bladder;
- 2) hypo-reflexive bladder.

Diagnosis:

1. Complaints - frequent urination with small portions, incontinence, enuresis, difficulty urinating, rare urination with big portions, feeling of incomplete emptying of the bladder.
2. History.
3. Clinical examination:

- a) Urinalysis and blood (necessarily);
 - b) Biochemical blood test (necessary)
 - c) Urine culture on the microflora (if necessary).
4. Urodynamic examination:
- a) Uroflowmetry (necessary)
 - b) Cystometry (if necessary).
5. Cystography and voiding cystography (necessary).
6. Survey and excretory urography (necessary).
7. Ultrasound of the kidneys, bladder, with researching of residual urine (necessary).
8. Cystoscopy (if necessary).
9. Conducting of urination dairy (observation of the urination amount, the amount of received fluid, volume of urination, difficulty urinating existence, the existence of imperative urgency, incontinence episodes) - necessary.

Treatment

Is directed to normalize the bladder contraction, and for treating of the complications (cystitis, pyelonephritis and renal failure).

1. at the hyperreflexive bladder - M-cholinoblockers:
 - a) Oxybutynin (children after 5 years) 1 table (5 mg) 3 times daily, individually (2 weeks or longer);
 - b) Tolterodine (patients after '18) 1 table. (2 mg) two times a day individually (2 months or longer);
 - c) Solifenacin - the most modern drug for patients older than 18 years. It is used for long term 5-10 mg / day.
2. at the hyperreflexive bladder:
 - a) α -blockers:
 - Pyroxan 1 tab. (0.015 g) 3 g per day, lasted;
 - Tamsulosin 1 tab. (0.4 mg), 1 g per day, lasted.

Electro stimulation of bladder is conducted by the "Amplipuls" device. The regime of work is 1 hour, kind of work 2, Frequency 70 Hz, modulation 100%, stimulation-pause: 4-6 sec, time - 15 minutes, electrodes: sacral and above the womb.

4. Laser therapy - is conducted by long-term courses. The course of laser therapy for starting treatment - is 5 daily sessions, then 5 sessions with an interval of 1 day, exposure time to 1 corporeal point - 30 seconds, total exposure time during the session - 4 minutes.

5. Therapeutic physical training for the strengthening of perineum muscles and pelvic floor (always).
6. Regime of urine: Adult - after 2-2.5 hours. Kids - 1.5 hours (constantly).
7. Changing of a diet (to exclude caffeine, alcoholic drinks acidic fruits and vegetables from the ration) - constantly.

At the complications - is shown antibacterial therapy, medications for improving of renal function and other.

Complications

In result the breach of urodynamics, including the functional character, may be such complications:

- Cystitis;
- Vesico-ureteral reflux;
- Ureterohydronephrosis;
- Pyelonephritis.

Prognosis – is favorable.

Prevention

For prevention of disease is shown the health education work with the population. Sending to a physician is also shown - in cases of rare urination, difficulty during urination, incontinence, and feeling of residual urine.

4.4. Anomalies of the urethra

Anomalies of the urethra occur in the form of complete (aplasia) or partial (atresia) absence of the urethra and obliteration, congenital narrowing (stricture) and extension (diverticula); doubling of the urethra, hypospadias, epispadias, congenital cysts and fistulas, hypertrophy of the urethral mucous membrane, urethral valves.

Complete absence (aplasia) of the urethra

This pathology occurs very rare. In this pathology the fetus mostly dies inside the womb of pregnant on the 6-8 months of pregnancy. It is connected with the fact that inside the womb takes place the compression by stretched bladder of umbilical vessels and severe disturbance of blood circulation, leading to non-viability of the fetus. Urethral aplasia is often associated with the absence of penis. The fate of the fetus with the absence of the urethra depends on how is the bladder connected to the outside environment through the rectum, vagina, uterus. If the flow of urine is installed on one of the aforementioned ways, the fetus may be born alive, and in the absence of other, incompatible with life anomalies, such children can grow and develop relatively well.

Clinical picture

There are symptoms of the intestinal irritation by urine, irritation of external genitals (if bladder opens into the vagina) and skin of the abdomen or perineum (where urine is excreted through the urinary ducts or perineal in form of fistula).

Treatment – is symptomatic.

Partial absence of the ureter

Belongs to anomalies in which the fetus is rarely viable. Most often is observed in the region of the glans penis and in the webbed section that is in attachment sections of different origin.

Clinical picture

The clinical picture is manifested by urinary retention. Above the pubis is observed the protrusion of overflowing bladder.

Treatment

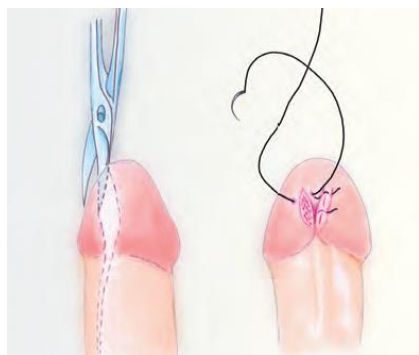
Treatment is surgical. In the absence of the external opening of the urethra is quite to cut the membrane by scalpel. In more severe abnormalities of the urethra is shown urethroscopy.

Partial congenital obliteration of the urethra

Partial congenital obliteration of the urethra may develop in any section of the urethra, but most often in the region of the glans penis. The obliteration may be also located in the area of rhomboid fossa. Very rarely are also observed the multiple obliterations with preservation of the ureteric lumen in the intervals between obliterated places. In most cases it is combined with other anomalies, including by obliteration of rectum, urethral-perineal or recto-urethral fistula.

Clinical picture

There are symptoms of the urethral partial obliteration or absence of urination naturally in the first days of life and obstruction of the urethra that was detected during catheterization. Treatment must be started at first days of life.



Obliteration of the external opening of urethra is liquidated by dissection (meatotomy) (Fig. 4.22.).

Figure. 4.22. *Technique of meatotomy.*

Obliteration in the region of the glans penis and hanging section length of 0.5 cm can be eliminated by tunnelization of urethra. At the big obliteration is necessary to impose a lip-shaped fistula proximally of obliteration area. In the satisfactory condition and

normal development of a child, is made tunelisation of capitate part of the urethra with subsequent formation on the prosthesis with nylon tube. At the age of 6-7 years urethra can be formed from the local tissues (as in hypospadias).

Congenital stricture of the urethra

Congenital urethral strictures are more common in place of the connection of urethral parts that have different origins. For example, on the border between the head of the penis and the cavernous body, between the bulb and membranous part, between the membranous and prostatic departments, at the base of the distal slope of seminal tubercle and on the verge of prostatic urethra and external sphincter. Another group includes the constriction of external opening of urethra that is often combined with phimosis and embryonic coalescence of both leaves of foreskin.

Clinical picture

The clinical picture depends on the location, extent of the constriction and duration of the disease. At the initial stages of the main complaints are reduced to the difficulty urinating. Later are joined the features of the bladder atony, ureter and pelvis, infection of urinary excretory tract and finally renal insufficiency. The nature of urination disorders depends on the shape of the constriction. In ring strictures the urination acquires sluggish nature, thin stream, not aggravated by straining the abdominale prelum.

At valve-like strictures - are typical the intermittent streams and short-term full urinary retention in the early stages of the disease.



Figure. 4.23. *Congenital stricture of the urethra. Bilateral megaureter. Retrograde cystoureteropyelogram.*

Diagnosis

Diagnosis is based on the urination disorder, observation data, instrumental and radiographic observations. Circular constriction is detected during research by bougienage with help of ascending (retrograde) urethrography (Fig. 4.23, 4.24.). At valve-like narrowing's is impossible the free passage instruments through the urethra, so for detecting them is performed the descending urethrography (taken at the time of making urination), which determine not only the place of constriction, but also extension of upward part of urethra. Urethroscopy allows you to specify the type of contraction, localization and unmodified (unlike of acquired strictures) mucous membrane in the area of narrowing. Treatment should begin as soon as possible when there are no changes and there was no infection of the bladder and kidneys. Circular constriction in the region of the external opening the urethra is dissected down to the bridle (meatotomy). Urine diversion by catheter is not required. In other localizations of strictures is shown transurethral urethrotomy (Fig. 4.25) with urinary diversion through the two-way Foley catheter for 2-3 weeks.



Figure. 4.24. *Congenital stricture*

urethra: 1 - strictured area

urethra, 2 - bladder

Congenital urethral valves

More often are localized in the posterior urethra above or below the seminal protuberance. Pathology is mostly manifested difficulty urinating, or even complete retention of it. Thus the stream of urine is flabby; children empty the bladder long and languidly. Permanent urinary retention leads to the development of chronic cystitis, pyelonephritis, and causes expansion of the upper urinary tract and contributes to chronic renal failure.

Diagnostics:

1. Urethrography.
2. Voiding cystourethrography (is determined by retention of contrast in the location of valves and supra-stenotic expansion of urethra) (Fig. 4.26.)

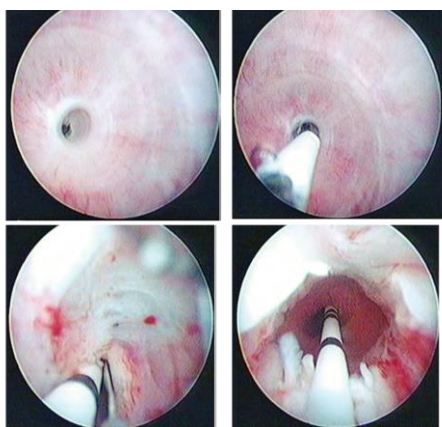


Figure. 4.25. *Congenital stricture of the bulbous part of urethra: a - urethroscopic picture, b, c, d - stages of transurethral urethrotomy "cold" knife.*

3. Urethroscopy.

Treatment

Treatment – is surgical. Is shown the transurethral incision of the urethral valves.

Prognosis

The prognosis for surgical treatment is favorable.



Fig. 4.26. *Valve of anterior urethra. Voiding cystourethrogram*

Hypospadias

Hypospadias – is the absence of posterior wall of the distal urethral part with the localization of its external opening in unusual place. It is the most common anomaly of the urinary organs.

Etiology and pathogenesis

From the position of urethral and penile embryogenesis, the occurrence of hypospadias can be represented as a violation of

circuiting on 10-14-th week of embryonic development of the urethral groove, as the segment pathology that develops from sinus urogenitalis ectodermalis. Among the causes of the delay of urethral and penis development is incorrect formation of organs, most likely single (using the female hormones, an excess excretion of them in short but strong feelings) or long (dysfunction of the ovaries, adrenal hyperplasia, etc.) endocrine, hormonal changes in the mother. Recently, the great values of hypospadias occurrence have intrauterine infection of the fetus, and other infections and intoxications in the first trimester of pregnancy. Classification (by A. R. Thompson and N. E. Savchenko):

I. hypospadias of glans (external opening opens on the lower surface of the penis glans):

1. Hidden.
2. Coronal:
 - a) With a curvature of the penis
 - b) Without curvature of the penis;
 - c) With narrowing of the external opening of the urethra
 - d) Without narrowing the external opening of the urethra.

II. Stem hypospadias (external opening is situated within the spongy body of the penis):

1. Subcoronal
2. The distal third of the penis.
3. Middle third of the penis.
4. Proximal third of the penis.

III. Penoscrotal hypospadias (external opening of the urethra is on the verge of the penis and scrotum).

IV. Scrotal hypospadias (external opening is located in the scrotal area where the spongy part of the urethra is absent):

1. The distal third of the scrotum.
2. Middle third of the scrotum.
3. Perineoscrotal hypospadias:
 - a) Curvature of the penis and lack of skin on its ventral surface;
 - b) A sharp underdevelopment or absence of free stem part of the penis on the ventral surface.

V. Perineal hypospadias (there are no spongy and membranous part of urethra and its external opening is located on the perineum).

VI. Hypospadias in women (defect in the posterior wall of the urethra and the anterior vaginal wall, in which the external opening of the urethra opens into the cavity of the vagina):

1. Partially.
2. Complete.
3. Complete with incontinence.

Separately may distinguish the hypospadias without hypospadias - a congenital underdevelopment of the urethra in length.

Hypospadias of the glans penis

Anomaly that occurs the most often and in which the external opening is situated at the place where should be fixed the bridle. The foreskin covers only the rear of the head that is slightly deflated down. In place of the normally located external opening of the urethra is fossa, and under it - a narrow opening abnormal urethra (Fig. 4.27, 4.28.).



Figure. 4.27. *Penile glans hypospadias*

Hypospadias glans does not require the surgical intervention, except when the opening of the urethra is much narrowed or penis is sharply curved. In hypospadias penile the urethral opening is located more posteriorly, at any location of lower surface of the penis up to the base of the scrotum. Part of the urethra that is located anteriorly from the opening usually has form of a flat groove that extends up to the tip of glans. In this form of hypospadias penis is almost always curved downward.

Scrotal hypospadias

In this rare form of hypospadias, the scrotum is divided by deep sulcus into two completely separate halves. On the bottom of sulcus at the distance of 4-5 cm from the opening of the anus is situated the external opening of the urethra. The part of the urethra that is located ahead may be absent or show itself as groove. Penis is usually underdeveloped, curved down and spliced. At the expressed forms of scrotal hypospadias, the gender determination of the baby at birth is difficult, especially in cases where the testes are in the inguinal canal, so the two halves of the scrotum can be mistaken for large labia, underdeveloped penis like clitoris, and the wide entrance to the urethra - rudimentary vagina. In the literature provides examples where such children are educated and grew up as girls and only later, during puberty, revealed their true gender (false hermaphroditism). In this form of hypospadias the urine spreads over the hips, perineum, except the skin irritation. However, patients are good at keeping of the urine because the bladder sphincter saved in it. Urination is possible only in a sitting position. Regardless of the severity of hypospadias may be combined with cryptorchidism. Less frequent are the combination of it with heart defects, and other internal organs, limbs and skeletal abnormalities. These situations are taken into account in appointment of treatment that requires the following tasks: straightening of the penis and simultaneously creation of skin reserves for subsequent urethroplasty, urethroplasty and saving of effect of the penile straightening; exemption of the organism from anatomically designed female reproductive organs (ovaries, uterus, mammary glands), treatment of cryptorchidism.

Treatment

It is necessary to start from 1 or 2 years old to 6-7 years up to complete rectification of the penis and urethroplasty. In the hypospadias of glans without curvature of glans, the indication for surgery serves the narrowing of the urethral external opening, which reaches occasionally considerable degree and leads to severe consequences - expansion and atony of the bladder, ureters and pelvis. Therefore, dissection of the external opening of urethra should be started as soon as possible (during the first months of life). In later age, when around the narrowed opening of the urethra is developed the scar tissue, simple dissection is not enough and it is necessary to do the plasty of meatus. The methods of urethroplasty: tunelisation and formation of the connecting urethra, urethroplasty from the local tissues (skin of the penis, scrotum, and foreskin); urethroplasty by iliac Filatov stalks that are formed along with located areas; urethroplasty with the use of free auto- and homo-transplants (skin, blood vessels, ureters, bladder mucosa, cadaverous urethra, appendix, etc.). Patients with distal stem hypospadias, middle and proximal third (in case of lack of skin on the ventral surface of the penis) is performed single-stage urethroplasty by J. Duckett. Patients with stem hypospadias of lower third with penoscrotal and scrotal forms is performed the single-stage urethroplasty by T. Broadbent. The main requirements that should be strictly observed during urethroplasty: preservation in the newly created urethra the capacity for growth and stretching, creation of channel with steady lumen that has no tendency for narrowing.

Female hypospadias

In girls hypospadias is much rarer than in boys, but in contrast to recent, in them can be observed (more or less) the incontinence. In some cases the urethra in the distal part and vagina connects into one channel with a common external opening. Some authors believe that the disease is described as female hypospadias, should be interpreted as a defect of the urethra-vaginal septum. Prevention of hypospadias should consist in rehabilitation of the mother's organism and the removal of all causes that can cause sharp fluctuations in hormone levels of the blood. According to women who have previously given birth to children with deformities in the first 4 months of pregnancy is advisable to establish a dispensary observation and to conduct the corresponding prophylactic treatment by indications.



Figure. 4.28. Types of hypospadias in males: **A - Penile hypospadias B - Stem hypospadias C - Peno-scrotal angle hypospadias D - perineal hypospadias**

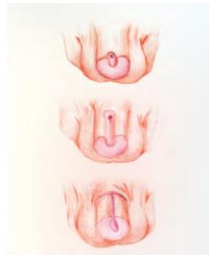


Figure. 4.29. Types of epispadias in males: **A - penile epispadias B - stem epispadias C - total epispadias**

Prognosis is favorable.

Epispadias

Epispadias is the congenital anomaly that characterized by complete or partial cleft (splitting) of urethral anterior wall. In epispadias the front wall of the urethra is absent along the entire length or partially, and the rear wall has a form of flat chute (Fig. 4.29.).

According to the statistics this anomaly appears (on the results of autopsy) in one case of 6000. It occurs much less common than hypospadias.



Figure. 4.30. *Pubico-penile epispadias with urinary incontinence.*

Etiology and pathogenesis of the disease is still unknown. It is believed that reason of epispadias is in delay of the urethra during its formation, obliteration of the external urethral opening and secondary rupture of the upper wall, delay of connection of the paired rudiments of genital tubercle and more caudal development of them.

Clinical picture

Symptoms and complaints of patients are dependent on the degree of defects. In glans epispadias is available the splitting in the region of the glans penis; subjective disorders are unobserved. Treatment is not required. In penile epispadias (splitting to penile-pubic angle) - is shortened penis that pulled up to the abdominal wall; urethral sphincter is maintained. In these two forms of epispadias patients feel discomfort probably of aesthetic character, which is associated with spraying of urine stream that gets on clothes and surrounding areas of the body. In peno-pubical epispadias is also observed a slight splitting of urethral sphincter and the associated with it partial urinary incontinence (Fig. 4.30.). Due to the shortening and deformity of penis, in this form of epispadias the sexual act is limited and sometimes impossible. The total epispadias is characterized by the splitting of the urethra, neck and anterior wall of the bladder that causes total urinary incontinence. The penis is poorly developed, short-cut, twisted and pulled to the pubis. At pulling down is visible the flattened glans, from which the upper surface of the penis goes a strip of mucous urethra. At the core of the penile root is located funnel-like cavity that conducts into the bladder from which the urine is excreted.

Classification:

I. Penile epispadias:

1. Partially
2. Total

II. Stem epispadias:

1. Partially
2. Total

III. Pubico-penile epispadias:

1. The locking apparatus normal
2. Urinary incontinence

IV. Total epispadias

V. Total epispadias with exstrophy of bladder

VI. Epispadias in woman:

1. Partially with normal closing device

2. Partially with the urinary incontinence
3. Total with absolute urinary incontinence.

Foreskin is split and hanging down in the form of apron over the glans, the prostate is absent; there are testicular atrophy, cryptorchidism, congenital hernia, rectal sphincter atony and other anomalies. In total epispadias the sexual life is frequently not possible. In all forms of epispadias there is upward curvature of the penis. However, unlike of hypospadias when it is curved due to scars in epispadias, curvature depends on the discrepancy of cavernous bodies feet's of the penis and unusual position in relation with the incompatibility of pubic and gluteal bones of pelvis. Epispadias in girls is less common than in boys. They are distinguished to clitoral, sub-pubic and total form. In the female epispadias urethra passes over the clitoris, and the front part of the urethra or the whole channel is transformed into an open chute. The upper commissure of large and small lips is absent clitoris and usually cleaved. Epispadias does not affect on the sexual life of women, pregnancy and childbirth.

Treatment

Mild forms of epispadias do not require treatment. In severe forms are indicated the operative intervention, in which the principal is to restore the urethra and to create the arbitrarily controlled sphincter of the bladder. In urinary incontinence main attention is directed to the formation of the vesical sphincter. Children should be operated at the age of 5-8 years. In epispadias of the glans penis is performed the operation Trishe, at the stem epispadias - is performed operation Dyupleya - Trishe. By the method of Dyupleya performs the plasty surgery of urethral stem, and Trishe - plasty surgery of glans.

Prognosis is favorable.

4.5. Anomalies of the penile development

Hidden penis

Hidden penis- is anomaly of development where the penis does not have a skin, while it is mostly hidden in overly-developed subcutaneous adipose tissue in the region of the pubic symphysis, rarely in the region of scrotum or perineum (Fig. 4.31.). Surgical intervention in the form of penile mobilization with subsequent plasty of penis is recommended to do at age 6 years.



Figure. 4.31. Hidden penis. Hypospadias of the glans penis

Micropenis

Micropenis – is underdeveloped male external genitalia. It is observed in infantilism and hypogenitalism associated with congenital disorders of the endocrine system. Children with this defect have a small sized scrotum and testicles, atrophied prostate, is marked not age appropriate fullness and a bit feminine look.

Treatment of gonadotropin-releasing hormone or testosterone can only lead to a temporary increase of penis.

Prognosis is favorable.

Short frenulum of the penis

It is the defect in which even at a rather wide external ring of preputial sac glans may be closed. Short frenulum prevents pulling of the foreskin, contributes to accumulation of smegma in preputial sac, and at the onset of puberty prevents the erection. The main complaint is the curvature of glans, painful erection. Due to violent sexual intercourse may occur rupture of frenulum that is accompanied by bleeding from frenular artery (sometimes massive). Treatment -is surgical (plasty of frenulum or frenuloplasty).

Phimosis

Phimosis - abnormal narrowing of the foreskin that prevents to pull it and uncover the glans penis (Fig. 4.32); the most common anomaly of the male sex organ.



Figure 4.32. Congenital phimosis:
A - Adhesions of the foreskin;
B - Hypertrophic phimosis

Etiology and pathogenesis

In newborn boys phimosis - the narrowness of external ring preputial sac - is a physiological phenomenon. Congenital phimosis is divided into hypertrophic (foreskin is extended and protrudes in the form of proboscis) and atrophic (skin tightly covers the glans). In rare cases between the foreskin and glans are formed the adhesions of connective tissue from birth or later. In congenital phimosis occurs coalescence (synechiae) of

the foreskin with the glans penis. This coalescence is more or less pronounced in almost all infants due to friable adhesions between the glans and the inner layer of the foreskin. Further at moving away the foreskin behind the glans independently liquidates the congenital phimosis and adhesions between the layers. Acquired phimosis develops primarily on the basis of inflammatory diseases of the penis that lead to cicatricial contractional rings of the foreskin, and result of its injury.

Clinical picture

The main danger of phimosis lies in its complications. At sharply expressed phimosis in infants can develop dilatation of the urinary system with the development of hydronephrosis and pyelonephritis. The significant narrowing of the foreskin hampers the urination up to acute urinary retention. Stagnation of urine and decomposition of smegma in the cavity of preputial sac cause the development of balanitis and balanoposthitis. The constant itching and irritation are provoked the masturbation in children. At the prolonged balanitis and balanoposthitis inflammation extends to the navicular fossa and the whole glans section of the urethra, leads to significant development of narrowing's, causing difficulty urinating and chronic urinary retention. Constant tension of abdominal prelum that is occurred in connection with it and promotes the development of hernias, testicular edema and loss of the rectum especially in the case of predisposition to such diseases.

Diagnostics

The diagnosis of phimosis is based on the typical complaints of patients and typical changes in the appearance of the penis.

Treatment

Physiological phimosis does not require treatment, but if before 4-year-olds are not occurred spontaneous disclosure of preputial cavity, glans penis trying to exempt from the foreskin, by gently removal it by hand in the direction of root of the penis. An absolute indication for surgery is a significant narrowing of the foreskin that leads to difficulty in urination. The proof of the latter serves as thin stream of urine and swelling of the foreskin during urination. The indication for surgery – is frequently recidivation of balanoposthitis (through a relative narrowing of the foreskin), where urination may not be difficult, but there are all conditions for the accumulation of smegma in preputial sac and an inflammatory process. The main methods of operation – is circular circumcision (circumcisio) and dissection of the foreskin by Rozer.

Technique of the foreskin dissection by Rozer:

It differentiates by that is made by incision of both layers of the foreskin in front of the surface of the penis lengthwise, not reaching of 1-1, 5 cm coronal sulcus with stitching of the wound edges with nodal catgut sutures in the transverse direction.

4.6. Developmental anomalies of the scrotal

Malformations of the scrotum, testicles, epididymis, vas deferens occurs rare. They include the congenital absence of testis (anorchism), increase in the number of testes (poliorhizm), unilateral absence of testis (monorchizm), testicular hypoplasia (hypoplasia), abnormal testicular position, twisting of the spermatic cord and testicles, congenital hydrops of testicular membranes (hydrocele) and spermatic cord (funiculocele), cysts of testicles, epididymis and spermatic cord.

Anorchia (anorchism)

Anorchism - is the absence of testes, which is accompanied by hormonal dysfunction and eunuchoidism and may combine with aplasia of the epididymis and vas deferens (Fig. 4.33.).



Figure. 4.33. *Anorchism*

It is mostly unilateral absence of testis (monorchism). Patients with anorchism are most often documented as male gender. Their "male qualities" are limited only by rudimentary penis immature and empty scrotum. In some people on the site of the scrotum is only a small bulge at the crotch and scrotal seam. Obviously anorchism occurs as a result of the male gonads destruction in early fetal life. It is caused by probably short-term secretion of fetal androgens, which have been so active, that caused fusion of genital folds with the formation of the embryonic scrotum and

stimulated the development of the penis. The main complaints of patients: genital hypoplasia and the inability for sexual life. Sometimes patients, who are educated as women, go to the doctor with complaints about lack of female sexual characteristics and abnormal development of the external genitalia. These patients usually have eunuchoid physique, height is average or slightly lower than average, mostly boyish figure, no pubic hair distribution, breast nipples are not clearly formed and widely spaced, and muscle tissue is underdeveloped. External genitalia are underdeveloped. Small or even rudimentary penis, scrotum is empty usually uncoated and covered with smooth skin. By the study through the rectum, the prostate was not palpable.

Treatment

For treatment is shown the androgen replacement therapy in order to develop male sex organs; also there are shown preparations which contain a mixture of testosterone esters with slow action and testosterone propionate, methyltestosterone. Vitamin E is also prescribed. To the anomaly of testicular provisions include cryptorchidism, torsion and ectopia.

Cryptorchidism

Cryptorchidism - is the absence of one or both testicles in scrotum due to delay of fetal movement from retroabdominal space (Fig. 4.34.). It is observed in 30% of newborns, but in 70% of these patients, testicle during the first year of life is lowered into the scrotum by itself.

Etiology and pathogenesis

The causes of cryptorchidism can be mechanical, obstacles that are prevented the lowering of testicles, hormonal and genetic factors. To mechanical factors belongs: the delayed development of the guide ligaments, short testicular vessels, the presence of fibrous barriers along the migration gonads, obliteration of the inguinal canal in any part of it, narrowing of the inguinal ring, transverse position of the testis, short hanging muscle of testis or short vas deferens, to the hormonal - androgen deficiency, human chorionic gonadotropin and luteinizing hormone mother of the fetus. The main factors are involved in the damage of detainee's testicles: violation of the testicular temperature control, trauma of testicular surrounding tissues, hypokinesia, and violation of regional circulation. Histologically is established that in the non lowered testes, the degenerative changes occur at the age of 6 months.

Classification

1. A true:

- a) Abdominal cryptorchidism (the testicle is located in the abdominal cavity),
- b) Inguinal (inguinal canal into the testicle).

2. False (the normally lowered testicle can be long term or periodically located outside the scrotum under the influence of muscle contraction that lifts the testicle).

The clinical picture. Main complaint:

- Dull, aching pain in the area of the inguinal canal, which increase when pressing;
- Absence of testis in scrotum;
- The presence of tumor formation in the inguinal canal.

Bilateral abdominal cryptorchidism is accompanied by underdevelopment of the genitals, infantilism, eunuchoidism, gynecomastia, feminization, hypospadias, epispadias and urinary incontinence. In unilateral cryptorchidism is relevant the half of the scrotum, while the bilateral - is underdeveloped in all scrotum, testicle is not descended, usually smaller in size, and easily detectable by pressing along the inguinal canal. Quite often, in this way is possible to bring it up to the external inguinal ring and the upper part of the scrotum. In abdominal cryptorchidism is usually difficult to rely on the descending of the testicles in the

scrotum. In cryptorchidism the possible complications are: hypogenitalism and infertility, hydrops of testicular membranes, inflammatory changes of non descended testes, malignant degeneration of testes and torsion of not lowered down testes.

Treatment

Optimal time for treatment of cryptorchidism – is from 2 to 8 months, maximally for 2 years. At first is shown hormonotherapy (at the 1st year of life - the use of human chorionic gonadotropin). If the course of hormone therapy is ineffective, than it is necessary to make the surgical intervention consisting in moving of the testicle into the scrotum and its fixation. In this case, testis is descended into the scrotum, falls into the favorable conditions for the development and recovery of spermatogenesis. The optimal operations are shown by Torek - Herzen, Chuhriyenko - Lyulko and Ombreden.

Testicular ectopia

It is characterized by location of testicle out way of its normal physiological movement. It can be uni- and bilateral. In paradoxical ectopia both testes are located in one half of the scrotum. The reasons of testicular ectopia consider to underdevelopment of relevant half of scrotum or Gunter ligament, and presence of adhesions. Due to possible traumatisation of ectopic testis are recommend the operation with moving it into the scrotum.

Diagnostics:

- Examination, palpation;
- Ultrasound;
- Testicular scintigraphy.

Classification

1. True testicular ectopia:

- a) Inguinal;
- b) Perineal
- c) Femoral;
- d) Pubico-penile
- e) Pelvic

2. Paradoxical testicular ectopia.

Testicular and epididymal cyst

There are congenital and acquired, uni- and multi-cysts. Congenital cyst develops from the embryonic remnants. The acquired spermatogenic cyst is caused by inflammation, injury, during which occur obliteration of the vas deferens and accumulation of serous fluid. Cyst in most cases is small. In its content - is light-yellow liquid that contains protein, and sometimes can detect in it normal and altered (degenerative) spermatozoon's.

Clinical picture

In most cases, epididymal and testicular cysts develop slowly and asymptotically. With rapid growth, it causes dull pain in the inguinal region and pain during walking. At palpation of a cyst is defined as a round tumor with a smooth surface. Sometimes there is fluctuation. The testicle and its appendage are located outside the cyst, although they are closely linked. Differential diagnosis is made with a tumor of the epididymis or spermatic cord (by ultrasound it is determined as an echogenic formation of heterogeneous content, unlike the anechogenic content of the cyst). Operative treatment – is the excision of the cyst (Figure 4-35).



Figure. 4.35. *Excision of testicular cyst.*

Diagnostics:

- Ultrasound of the scrotum;
- Diaphanoscopy (a phenomenon of translucency is positive).

Control tasks

1. In a patient during the examination about the pain in the lumbar region, was revealed the periodic rise of blood pressure: by ultrasound the right kidney is $7,3 \times 3,2$ cm, thickness is 0.6 cm, parenchymal structure of kidney is not changed. On excretory urogram the right kidney is reduced in size, pelvicalyceal system is not changed; the function of the kidney is not reduced. Pathology of the left kidney was

not found. Diagnosis? Answer. Hypoplasia of right kidney.

2. What are the main radiological signs of lumbar dystopia of kidney?
3. What anomaly of renal fusion occurs most often? Make a plan for diagnostic confirmation of this diagnosis.
4. Conduct the differential diagnostics of polycystic kidney disease with solitary renal cyst.
5. What is seen at cystoscopy with full doubling of left ureter?
6. What reason for achalasia of ureter? What are the symptoms of ureteral achalasia at ultrasound and X-ray?
7. Patient B., 16 years old. From anamnesis of patient the urination is accompanied by a dull aching pain in the lumbar region, which increases with tension. About which pathology is possible to think of? What are the x-ray signs of this disease?

Answer. Vesico-ureteral reflux.

8. In the newborn above the pubis is observed the formation of red color, round shape, during the inspection of defined rhythmic urine of two holes located in the lower part of this formation. What is the name of anomaly? At what age can be performed plastic surgery? Its options?

Answer. Extrophy of bladder. Surgical treatment at the age of 1 year or later. Plastic surgery of the bladder and anterior abdominal wall.

9. To the polyclinic addressed parents of 2-years old boy with the complaints of the testicle absence in the right scrotum. At the examination occurs hypoplasia of right half of scrotum, absence of testicle. It is reduced in size, palpated in the course of inguinal canal into the scrotum but not descended. What is the most likely diagnosis? Confirmation of the diagnosis? Tactics of treatment?

Answer. Right-sided cryptorchidism, inguinal form.

10. Conduct the differential diagnostics of hypospadias of the glans penis with scrotal hypospadias.

Chapter 5

Infectious inflammatory diseases

5.1.Nonspecific inflammatory diseases

Urinary tract infections (UTI) are among the most common infectious diseases. For example, in the United States over 7 million patients per year refer to the doctors for UTI among whom nearly one-third suffer from cystitis. In Ukraine, more than 170 patients with new-onset cystitis and more than 110 thousand with new-onset pyelonephritis are recorded yearly. The prevalence of UTI in Ukraine is respectively more than 500 and more than 1600 per 100 thousand people. According to modern outlook, it is important to distinguish uncomplicated and complicated UTI.

Uncomplicated UTI in adults include the episodes of acute cystitis or pyelonephritis in the persons (mostly women) who do not have structural and functional abnormalities of urinary tract, renal diseases and associated diseases that may result in more serious consequences and, therefore, require additional treatment.

Complicated UTI are the infections associated with the conditions increasing the risk of infection or treatment failure.

When referring to the doctor with acute onset of urinary tract symptoms, as a rule, it is impossible immediately to classify the patients having complicated or uncomplicated UTI. Several factors indicate potentially complicated UTI and help to determine it:

- Male sex
- Older persons
- Hospital infections
- Pregnancy
- Urinary catheter
- Recent interventions to urinary tract

- Functional or anatomic abnormalities of urinary tract
- Recent use of antimicrobial medications
- Symptoms for > 7 days, when referring to the doctor
- Diabetes
- Immune compromised patients.

The presence of these factors is merely a guide for a doctor who has to decide, based on limited clinical data, whether to make more diligent diagnostics or not and which tactics should be chosen for the patient.

Pyelonephritis

Pyelonephritis is nonspecific infectious and inflammatory disease predominantly affecting renal interstitial tissue and tubules, with simultaneous or sequential involvement of calix and pelvis, and at the final stage blood vessels and glomeruli.

The process may be uni- or bilateral.

There is uncomplicated pyelonephritis developing without affecting urodynamics and complicated pyelonephritis developing on the background of urine stasis with structural or functional abnormalities of urinary tract on the background of concomitant diseases affecting nocifensor of microorganism and increasing the risk of infection and treatment inefficiency, or under the conditions of external drainage of urinary tract (catheters, cyst stoma, ureter stoma, renal stoma).

Uncomplicated pyelonephritis is more common in young women.

Complicated pyelonephritis occurs in 20-40% patients with congenital abnormalities (renal cystic disease, neuromuscular ureteral dysplasia, vesicoureteral pelvic reflux, infravesical obstruction) and the diseases (urolithiasis, hydronephrosis, nephroptosis, benign hyperplasia and prostate cancer, neurogenic bladder etc.) that cause abnormal urine flow from the kidney.

Acute and chronic pyelonephritis are distinguished according to their course.

Acute pyelonephritis

Acute pyelonephritis may be independent disease, but more often it complicates the course of urolithiasis, congenital abnormalities, prostate cancer, diabetes, inflammatory diseases of female reproductive organs, pregnancy. Among the infectious diseases, acute pyelonephritis occupies second place following acute respiratory infections. Girls and women suffer more often than men due to anatomical and physiological features: due to shorter urethra, the infection easily spreads in ascending way. Owing to the fact that frequency of infravesical obstruction is increasing with age, incidence of pyelonephritis in men begins to increase after age of 60, leaving women behind. Purulent forms of acute pyelonephritis (suppurative nephritis, carbunculosis, renal abscess) are developed in 20-30% patients. Pathomorphologists find pyelonephritis in every 10th deceased, and after 60 years old in every 5th deceased.

Often, the agents of acute pyelonephritis are hospital (nosocomial) infections.

Etiology and pathogenesis

There is no specific causative agent of pyelonephritis.

Escherichia coli initiates over 80% observations of acute pyelonephritis in patients without urodynamic abnormalities, but *Pseudomonas aeruginosa*, *Proteus* spp. and *Klebsiella* spp. are more often found in patients with retention - obstructive processes in kidneys and upper urinary tract. In 60 % of patients, the same microorganisms were discharged from inflammatory nidus and urine. Often, the agents of acute pyelonephritis is hospital (nosocomial) infection.

Virulence of obligate uropathogens related to intestinal microflora - the so-called "commensals" (cohabitants) is caused by:

- ability to move against the urine flow due to flagella;
- phenomenon of bacterial adhesion;
- ability to resist opsonization and phagocytosis;
- discharge endotoxin upon their death.

In impaired patients, children, pregnant women, elderly and senile patients, bacterial translocation from the gut plays an important role in pathogenesis of pyelonephritis on dysbiosis background. In the conditions of ischemia, the causative agents of suppurative destructive forms of acute pyelonephritis may be anaerobic microflora (bacteroids), the presence of which is permitted in cases where infectious agents cannot be found in conventional nutrient medium. There are hematogenic and urinogenic routes of renal infection.

Hematogenic route is the course of systemic infectious inflammatory processes characterized by bacteremia, or as a consequence of metastatic entry of bacteria from distant septic foci. Leading role in hematogenic renal infection belongs to grampositive microflora, especially *Staphylococcus aureus*.

Urinary (ascending) route of infection is along the wall from the urinary bladder in case of vesicoureteralpelvic. The feature of fornix system structure is that increasing pressure within pelvis, epithelial cover of calix fornix transforms from multilayer to single-layer, and the fissures are created in the intercellular space through which infected urine goes outside pyelocaliceal system, saturating medullary substance which is more prone to development of inflammation than cortical one. In addition, with increasing pressure, the microorganisms are able to penetrate into general blood circulation through pelvis-venous and pelvis-lymphatic reflux and coming back with blood flow to kidney, to settle in the capillaries around convoluted tubules. Therewith, the degree of pathological changes in kidneys is conditioned by occlusion period and virulence of infection. Ascending urinary route of infection is also contributed by the phenomenon of adhesion of certain bacteria to the urinary tract epithelium and their ability to spread from the lower urinary tract (urethra, bladder) to upper one (ureter, pelvis, calix).

Pathomorphology

If acute pyelonephritis develops due to hematogenic entry of infection, the pathologic process develops mainly in cortical layer of kidney decreasing towards renal pelvis. Macroscopically, the kidney is enlarged, its surface is uneven, its color is dark red. Fibrous capsule is thickened and is tight to the cortex. Microscopically, in the interstitial tissue of peritubular area around the vessel, large number of small-cell infiltrates consisting of white blood cells, plasmocytes and multinuclear is found. Tubular epithelium is

thinned. The lumen of tubules is filled with clotted fibrin, leukocytes, erythrocytes and shelled epithelium. Atrophy or hyaline regeneration of nephrons takes place. In case of urinary route of renal infection in medulla, due to its anatomical and physiological characteristics, more favorable conditions for development of diffuse leukocyte infiltration than in cortex are formed. Major macro- and microscopic changes occur in the area of calix fornix around the neck of collector tubules. Leukocyte infiltration along the vessels is spread to cortex substance. Damages to glomerular and tubular apparatus are secondary in relation to renal interstitial tissue. In case of reverse development of inflammatory process, connective tissue is formed in place of small purulent foci.

Classification

There are several classifications of acute pyelonephritis being in force in different countries of the world and supported by various national and international associations of urologist and pathomorphologists.

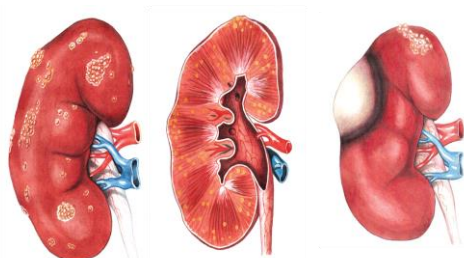


Fig. 5.1.: Forms of acute purulent pyelonephritis a, б — apostema nephritis with carbuncle formations in middle and upper renal segment; в — carbuncle of upper segment, abscess of middle renal segment

Generalizing the positive experience of existing classifications, it is expedient to determine at this stage:

- serous pyelonephritis;
- purulent pyelonephritis:
 - 1) apostema nephritis (focal bacterial nephritis);
 - 2) kidney carbuncle (multi focal bacterial nephritis);
 - 3) renal abscess;
- emphysematous pyelonephritis;
- necrotic papillitis;
- xanthogranulomatous pyelonephritis.

By peculiarities of course depending on age and condition of the patient, the following acute pyelonephritis patients are determined: 1) children; 2) pregnant, 3) elderly and senile 4) diabetic patients with renal failure, immunosuppression. **The development of infectious inflammation process from serous to purulent stage with formation of individual clinical and morphological forms of acute purulent pyelonephritis is combined uninterrupted process** (Fig. 5.1). When acute purulent pyelonephritis is transformed to purulent stage, edema, venous stasis and mucosal erosion of renal pelvis and calyces are progressing. Underlying cortical layer takes the form of continuous purulent exudate where some parts of necrotic tissue are found. The neutrophils at different stages of their dystrophic and necrobiotic changes dominate in exudate. Macrophages, lymphocytes and plasma cells are encountered. In case of failure to remove obstruction, inadequate antibiotic therapy, on the background of general and local reactivity disorder, microabscesses are formed of cellular infiltrates and apostema nephritis (focal bacterial nephritis) is developed. Thereafter, the microabscesses merge together to form **renal carbuncle (multifocal bacterial nephritis)**. The result of purulent fusing of destruction nidus with parallel formation of pyogenic abscess capsule is renal abscess formation. Often, the development of metastatic renal abscess is preceded by the disease of various locations (tonsillitis, otitis, pneumonia, appendicitis, osteomyelitis, mastitis, furunculosis, infected wounds, colitis etc.). Abscess rupture through fibrous capsule of kidney leads to the formation of paranephritis.

Common symptoms of acute pyelonephritis:

Local symptoms of acute pyelonephritis:

- | | |
|---|--|
| <ul style="list-style-type: none"> • fever (often intermittent nature); • chills ; • tachycardia ; • headache; • pain in muscles and joints ; • nausea, vomiting; • weakness | <ul style="list-style-type: none"> • pain in lumbar area spreading along the ureter; • palpation pain on the projection of kidney; • muscle tension; • enlarged, painful kidney is palpated; • painful tipping in lumbar region |
|---|--|

Clinical findings. Acute serous pyelonephritis is characterized by general and local symptoms and laboratory changes.

In case of uncomplicated acute pyelonephritis general symptoms prevail, in case of complicated (often obstructive) pyelonephritis local ones prevail. In women, the disease progresses often in the presence of symptoms of acute cystitis or when they disappear, especially if there is no treatment. The largest group of patients with obstructive forms of acute pyelonephritis suffers from urolithiasis in which the clinical symptoms are often preceded by attack of renal colic. Disease severity is determined, first of all, by general and local reactivity and does not always correspond to the degree of morphological changes in kidney. In elderly and senile patients, weakened patients, immunocompromised patients and pregnant, clinic purulent forms of acute pyelonephritis may be atypical and are accompanied by effaced clinical findings, and, vice versa, in young patients with serous pyelonephritis, pronounced clinical symptoms (acute pain syndrome, high hectic fever, chills) may be observed.

The most common clinical signs of the transition of inflammatory process to purulent stage are increased pain, repeated fever with chills, rise in body temperature up to 39-41°C, oliguria, hypotension, tachycardia, pale skin, sclera icteritiousness, weakness, dizziness. The leukocytosis grows and leukogram shifts to the left. Hypercoagulation disorders with increasing levels of serum fibrinogen, plasma tolerance to heparin are developing. Local signs of destruction and suppuration are less pronounced than general symptoms. The clinical course of acute purulent pyelonephritis, particularly of obstructive nature and when both kidneys are involved in the pathological process, often accompanied by severe septic complications.

Sepsis

Following the recommendations of conciliation conference of The American College of Chest Physicians and the Society of Critical Care Medicine (1992), the sepsis is regarded as systemic inflammatory response syndrome (SIRS) associated with the infection i.e. the chain of pathophysiological phases growing by its severity: sepsis → severe sepsis → sepsis with hypotension → septic shock.

Severe sepsis is characterized by multiple organ failure and hypoperfusion.

Sepsis with hypotension is characterized by decrease in systolic blood pressure <90 mm of mercury or more than 40 mm of mercury from original and adjusted by infusion therapy.

Septic shock is characterized by decrease in systolic blood pressure <90 mm of mercury despite adequate fluid renewal and requires vasopressure support. Microcirculation disorders play an important role in the pathogenesis of septic shock due to vascular spasm and intravascular coagulation. Increasing azotemic intoxication combined with anemia, hypoproteinemia and acidosis lead to generalized

endothelial damage and vascular wall permeability disorder in consequence of which big quantities of tissue thromboplastin enter the bloodstream. Deep hemodynamic misbalance, platelet aggregation and blood rheology disorders lead to blockage of microcirculatory flow with bright clinical manifestation of the intravascular disseminated coagulation syndrome in the form of myocardial infarction, pulmonary arteries thromboembolism and bleeding of various localizations.

Diagnostics. The diagnosis of acute pyelonephritis in the presence of typical symptoms (loin pain, fever, changes in urine) does not seem different. In the laboratory blood tests, leukocytosis, shift of leukogram, increased ESR, toxic granularity of neutrophils, possible moderate decrease in hemoglobin are observed. General urine analysis is characterized by leukocyturia, bacteriuria, moderate proteinuria, erythrocyturia. Earlier laboratory findings of primary acute pyelonephritis are bacteriuria exceeding 10^5 CFU/ml and it may appear several days earlier than leukocyturia. For practical purposes, the number of colonies of pathogenic strains 10^3 CFU / m is important.

Differential diagnostics of acute pyelonephritis is with acute respiratory diseases, including pneumonia, acute infectious inflammatory disease of abdomen, sepsis and other diseases accompanied with SIRS. The most difficult is the differential diagnostics at early stage of acute uncomplicated pyelonephritis, even when there is no pain in loin, and only signs of SIRS are available. The most important laboratory findings of acute pyelonephritis (bacteriuria, leukocyturia) during the first days of the disease may not be observed, as repeated urine analysis are required. Past renal and urinary tract diseases in anamnesis and pain in the projection of the kidney, which is most pronounced with urinary tract obstruction and purulent forms allow to suspect acute pyelonephritis.

The diagnosis "sepsis" is set if there is proved or foreseeable infection and at least two clinical and laboratory SIRS findings:

- a) body temperature is below 36 or above 38 ° C;
- b) heart rate greater than 90 beats per minute;
- c) respiratory rate more than 20 per minute or hyperventilation, evidenced by $RaSO_2$ less than 32 mm of mercury;;
- d) white blood cell count less than $4 \cdot 10^9/L$ or more than $12 \cdot 10^9/l$ or the presence of more than 10% of immature polymorphonuclear leukocytes.

During acute pneumonia, constant fever, respiratory disorders, typical physical and radiological signs.

Acute cholecystitis is characterized by pain in the right hypochondrium spreading to shoulder-blade, shoulder and the symptoms of peritoneal irritation. In case of acute appendicitis, the pain initially occurs in the epigastric area, then is localized in the right iliac region. The symptoms of peritoneal irritation appear. Body temperature in case of acute appendicitis increases gradually and is steadily kept at high numbers, whereas in case of acute pyelonephritis, it rises in the evening accompanied by chills, sweating and decreases in the morning to subnormal values (hectic nature).

Transition of infectious inflammatory process to purulent stage is accompanied by anemia growth, increased white blood cell count, followed by leukogram left shift, increased erythrocyte sedimentation rate, tendency to hypercoagulability and hypoproteinemia. Acute complicated (obstructive) pyelonephritis, especially when involved in the pathological process of both kidneys, is often accompanied by increased levels of nitrogenous toxins. Thus, reliable differences of most blood parameters allow diagnosing transition of infectious inflammatory process to purulent stage, while certain morphological forms of acute purulent pyelonephritis are first found using imaging techniques (ultrasound, MRT, CT).

Ultrasonography allows visualizing pathological changes in kidneys and urinary tract, distinguishing primary and secondary pyelonephritis, diagnosing transition of infectious inflammatory process to purulent stage. Uncomplicated acute serous pyelonephritis is characterized by increase in kidneys, moderate respiratory restriction of mobility, increased thickness of renal parenchyma, diffuse reduction of echogenicity, reduced area and reduced echogenicity of renal sinus. In a number of observations around kidney, rarefaction halo is observed caused by edema of adrenal tissue. Complicated forms of obstructive pyelonephritis are characterized by pronounced increase in kidney, enlargement of its emptying system and ureter. In most cases, ultrasound can determine the cause of urine outflow disorder, to detect concrements, including – X-ray negative.

Ultrasonic findings of inflammatory process progress include further increase in the parenchyma thickness, reduce in its echogenicity, blurring of edge-forming shadow of central echocomplex and reduce in respiratory mobility of kidney. Apostema nephritis (focal bacterial nephritis) is manifested by increase in the size of kidney, general thickening and diffuse parenchymal heterogeneity, sometimes in the form of big number of small hypoechoic areas, which subsequently are fused together to form foci of low echogenicity with irregular, indistinct outlines. Renal carbuncle (multifocal bacterial nephritis) is visualized as a local heterogeneous, hypoechoic thickening of parenchyma without clear contours, which distorts the external contour of kidney (Figure 5.2).

Renal abscess is visualized as homogeneous hypoechoic formation with hyperechoic pyogenic capsule with uneven thickness.

Doppler Ultrasonography in energy Doppler (ED) and color Doppler mapping (CDM) mode complements the possibilities of ultrasound diagnostics, allowing to trace the dynamics of pathological process and to differentiate abscess and renal tumor. The development of destruction and suppuration is accompanied by

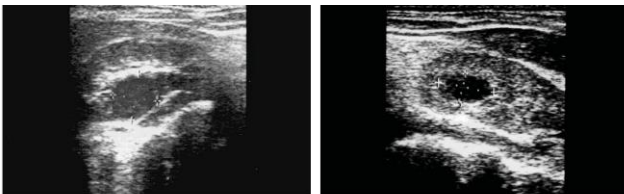


Figure 5.2. Ultrasonograms of kidney in "gray scale":
a - acute multifocal bacterial nephritis (heterogeneous hypoechoic volumetric formation without clear contours, b – renal abscess (homogeneous hypoechoic formation with hyperechoic capsule of uneven thickness).

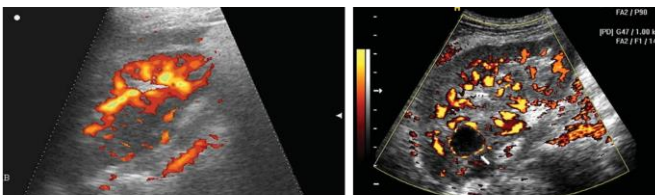


Figure 5.3. Ultrasonic Doppler of kidney in ED mode: *a - acute multifocal bacterial nephritis (acute depletion of vascular pattern in the area of inflammatory foci), b – renal abscess (anechoic formation, lack of vascular pattern in the area of inflammatory foci, perifocal increased*

blood flow in the area of formation of pyogenic capsule).

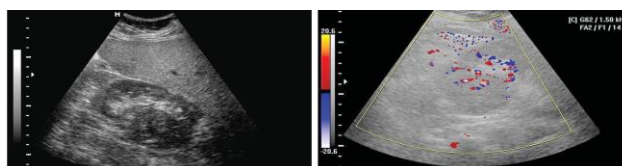


Fig. 5.4. Ultrasonograms of kidney: a — “grey scale” mode — renal cancer (non-uniform volumetric formation without clear contours), b — CDC mode - renal cancer (signs of neoangiogenesis as multiple color signals in the area of volumetric formation).

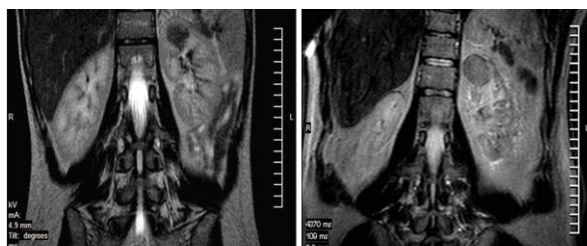


Figure 5.5. MRT of kidney: a – renal abscess (hypointensive foci on the series of T1- weighted scans), b - renal cancer (hypointensive foci with pronounced "pseudocapsule" on the series of T1- weighted scans).

gradual depletion of vascular pattern in inflammatory foci until his disappearance. Abscess formation is characterized by increased perifocal blood flow in the area of the pyogenic capsule formation (Fig. 5.3).

Kidney tumor is visualized as three-dimensional formation with increased vascular pattern in the form of "lakes" and "pools" around which deformation and breakage of vascular pattern are found (Fig. 5.4).

Radiographic studies include plain and excretory urography. On plain urogram, increase in kidney shadow, indistinct contour of lumbar muscle, scoliosis toward the affected kidney, concrement shadows in renal and bladder projection. On the series of excretory urogram, increase in size of kidney, deformation of calicopelvic system, reduce in intensity of staining, atony of upper urinary tracts are observed. If urodynamics is disturbed, delay in staining and extension of calico-pelvic and ureter are noted.

Magnetic resonance tomography (MRT) is a highly informative method of diagnostics and differential diagnosis of acute purulent pyelonephritis (Fig. 5.5).

Computed tomography (CT) is highly informative method for diagnosing apostema nephritis, carbuncle, abscess and kidney tumors. Densitometric parameters of renal parenchyma measured in conventional units under Hounsfield (HU) scale is fairly constant and the norm is 30-35 HU (X-ray coefficient of water absorption is 0).

Apostema pyelonephritis is characterized by multiple small foci of low density (10-15 HU) with irregular, indistinct outlines on the background of increased thickness of renal parenchyma. Renal

carbuncle is visualized as heterogeneous formation of low density (15-25 HU) without clear contours deforming external contour of the kidney.

In case of purulent fusion of renal tissue with abscess formation, inflammatory foci becomes more homogeneous, further reduction in its density is observed, connective tissue capsule is formed around irregular in thickness and with bigger density than renal parenchyma (Figure 5.6).

Special informative native CT has at an early stage of suppurative destructive process when sonographic pattern of renal carbuncle and renal abscess reminds tumor that looks like a formation with irregular, indistinct contours, density 5-10 HU higher or lower than parenchyma density.

A significant step ahead was the introduction of spiral Computed tomography with 3D reconstruction of X-ray picture into clinical practice which allows localizing clearly pathological changes in kidney and urinary tract, differing distinctly primary and secondary pyelonephritis, detecting concretions, regardless of their composition and density. When intravenous contrast staining is added to CT, it allows to get more contrast image of renal parenchyma and identify morphological clinical form of acute purulent pyelonephritis.

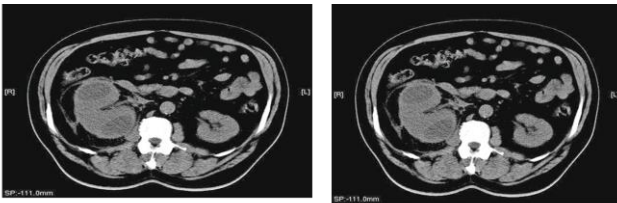


Fig. 5.6. CT of kidney: abscess of right kidney (two sites with distinct contours density in whole 18-22 HU, around which formation of pyogenic capsule is observed)

Treatment

Treatment of acute serous pyelonephritis is conservative in most cases. If urine outflow from the upper and lower urinary tract is disturbed, catheterization of kidney, endopyelovesical stenting, percutaneous puncture nephrostomy, bladder catheterization or trocar epicycstostomy should be immediately performed.

Upon restoration of urodynamics and urine sampling for bacteriological

examination, urgent empirical intravenous antibiotic therapy should be initiated. Treatment of acute uncomplicated serous pyelonephritis with minimal clinical and laboratory manifestation is possible using parenteral antibiotic administration (intramuscular) and in some cases per os. Empirical antibiotic therapy lasts 3-5 days. Later, directional or etiotropic treatment is conducted for 7-14 days. Preference is given to broad-spectrum antibiotics, which antimicrobial activity should cover at least 90-95% of possible agents: fluoroquinolones II-III generation (Ciprofloxacin 200 mg b.i.d., Levofloxacin 0.5-0.75 o.d.), cephalosporins III-IV generation (Ceftriaxone, Cefotaxime, Ceftazidime 1g b.i.d.), aminopenicillins (Amoxicillin, Amoxicillin with clavulanic acid 1.2 g b.i.d.).

In severe cases, combination therapy with two antibiotics including fluoroquinolones III-IV generation (Levofloxacin 0.75 o.d., Gatifloxacin 0.4 g o.d. or b.i.d.), cephalosporins III-IV generation (Cefepime 2.0 g t.i.d., Cefoxitin 1.0 g 2-3 b.i.d. or t.i.d.), carbapenems (ertapenem 1.0 g o.d., Imipenem, Meropenem, Dorypenem 0,5 - 1.0 g b.i.d. or t.i.d) and aminoglycosides (Amikacin 15 mg/kg o.d.), antimicrobial activity of which covers most gram-positive, gram-negative uropathogens including *Pseudomonas aeruginosa* as well as some anaerobes. Upon verification of microbial pathogens, the most reasonable is etiotropic antibacterial monotherapy Antibiotic therapy is supplemented by the infusion detoxification therapy (complex saline solutions, 5% glucose solution) and medications that improve renal hemodynamics (Aminophylline, Pentoxifylline). It should be remembered that massive antibacterial and infusion therapy until restoration of the urine flow can cause perfusion of infected urine into the blood with the development of severe septic complications due to entry of big amounts of

endotoxin.

If there is hypercoagulation syndrome, the balance of coagulative and anticoagulative blood activity should be adjusted, direct action anticoagulants (heparin), inhibitors of proteolysis (aprotinin), disaggregants are prescribed.

Upon normalization of body temperature before sanitization of inflammatory foci or normalization of urine, administration of oral antibiotics should start. Preference is given to "sequential therapy" – per os administration of the same drug taken parenterally.

A special place in the complex treatment and preventive measures for acute pyelonephritis is occupied by herbal medicine, which begins immediately upon restoration of urine passage and lasts up to 2-3 months. Herbal products which include centaury, sulfurwort, rosemary, knotweed, wild carrot, ortosiphon, horsetail, field horsetail, St. John's wort, peppermint, birch buds, black elderberry, oregano, fir, corn stigmas have anti-inflammatory and antispasmodic properties, increase diuresis, improve renal hemodynamics and urodynamics, creating the conditions for elimination of microbial pathogens.

Due to introduction of modern highly informative visualization methods that allow early detection and monitoring of purulent inflammatory process, highly efficient antibacterial drugs and minimally invasive technologies into clinical practice **in case of acute purulent pyelonephritis without urodynamics disorders, conservative waiting tactics is preferred:**

- apostema nephritis (focal bacterial nephritis), renal carbuncle (multifocal bacterial nephritis) and renal abscess diameter under 3 cm should be treated conservatively by modern highly efficient antibacterial drugs under ultrasound, CT and MRT control;
- in case of renal abscess ≥ 3 cm, percutaneous needle aspiration of pus under ultrasound or CT control and drainage of inflammatory foci should be performed to stop pus discharge;
- if suppuration spreads on adrenal adipose tissue, there is no positive dynamics of the disease within 1 day upon unlocking of kidney and drainage of purulent foci, surgery is indicated. Upon mandatory excretory urography, lumbotomy, decapsulation of kidney, crossed incision of carbuncles, abscess incision and drainage, drainage of kidney and retroperitoneal space should be performed. The issues regarding nephrectomy should be always resolved individually for organ-preserving tactics taking into account contralateral kidney function (excretory urography).

Given the risk of chronic infectious inflammatory process in kidneys, followed by the development of nephrosclerosis, chronic renal failure, hypertension, all patients upon acute pyelonephritis are subject to one year quarterly follow-up (complete blood count,

urine analysis, renal ultrasound, if necessary level of serum creatinine, with signs of relapse -

bacteriological examination of urine). Upon nephrectomy, follow-up is lifetime monitoring of dynamic function of remaining single kidney.

Prognosis. Timely recovery of impaired urodynamics and adequate antibiotic therapy of acute serous pyelonephritis allows achieving full recovery. Timely surgery in case of purulent forms of acute pyelonephritis provides favorable prognosis and satisfactory long-term results.

Acute pyelonephritis in infants often develops on the background of puerperal infection (occurring in postpartum period and may be associated with unsanitized urogenital infections in mothers, sexually transmitted diseases). Among the new-born, the ratio of girls and boys with pyelonephritis is 1: 2, among infants 5:1, children 6-10 years old 13:1. The fact that pyelonephritis is more common in girls is

due to anatomical features of female urethra - it is shorter and wider which creates favorable conditions for infection spread to urinary organs.

Underdeveloped immune system, presence of infection foci in the organism (tonsillitis, otitis, pneumonia, colitis, vulvovaginitis etc.), intestinal dysbiosis with bacterial translocation, vesico-ureteral reflux, infravesical obstruction contribute to renal infection. Children with abnormalities of kidneys and urinary tract get sick 8-10 times more than healthy ones.

The smaller is the baby, the more acute is the beginning, the more pronounced are clinical findings with prevailing general symptoms, the severer is temperature reaction (up to 39-41°C). More often, acute pyelonephritis in children under 3 years starts with cystitis on the background of acute respiratory infection. In newborns local symptoms may be moderately pronounced. Gastrointestinal disorders, vomiting, weakness, adynamy, sclera icteritiousness are observed.

In case of repeated episode of acute pyelonephritis, the complex of mandatory studies includes excretory urography, cystography to exclude vesico-ureteral reflux which requires surgical correction. When choosing reasonable antibiotic therapy step-by-step monotherapy with III generation cephalosporins (Ceftriaxone, Cefotaxime, Ceftazidime) is preferred. The fluoroquinolones are contraindicated for administration for the children under 18 years as they have adverse effect on tissue formation.

Gestational pyelonephritis is observed in 2-17% of women, ranking the first place in the structure of extragenital pathology during pregnancy. The highest incidence rate falls to 20-24 age group. Important role in the pathogenesis of gestational pyelonephritis is played by presence of unsanitized foci of infection in the body, latent urogenital infection, impaired urodynamics due to neurohumoral and hormonal influence of pregnancy on muscular system of the upper and lower urinary tract. More often, gestational pyelonephritis developed in II trimester of pregnancy in 80% of cases is right-sided due to mechanical pressure of pregnant uterus on the right ureter.

The clinical course is characterized by pronounced pain syndrome, temperature reaction, laboratory changes in blood and urine, but sometimes, with suppuration development, has atypical nature.

Differential diagnostics in young mothers should first be done with genital pathology and mastitis.

Ultrasound allows detecting violations of urodynamics, visualizing pathological changes in kidney and controlling the dynamics of pathological process.

Priority actions include restoration of impaired urodynamics: positional drainage therapy (knee-elbow position), ureteral catheterization and endopyelovesical stenting. If it is impossible to do endopyelovesical renal drainage or it is inefficient, percutaneous puncture nephrostomy should be performed.

When choosing reasonable antibiotic therapy, the drugs penetrating less through placenta barrier should be preferred - aminopenicillins (Amoxicillin, Amoxicillin with clavulanic acid, ampicillin, ampicillin with sulbactam, cephalosporins III generation). The fluoroquinolones disturbing tissue formation in children are contraindicated.

Acute pyelonephritis in elderly and senile patients often develops on the background of involutive reduction in reactivity of organism and immunosuppressive action of drugs taken by the patients to treat a variety of chronic diseases. As a result of dysfunction and intestinal microbiocenose, the translocation of enteric flora plays important role in the pathogenesis of pyelonephritis. Changes in microbial landscape of urinary tract and intestinal bacteria adhesion to urothelium on the background of decrease of local immunity contributes to the development of infectious inflammatory process in kidneys.

Hormonal misbalance, sedentary lifestyle and infravesical obstruction deepen urine stasis and promote ascending kidney infection. Characteristic feature of infectious inflammation in elderly and senile age on the background of secondary immunodeficiency is atypical clinical picture of the disease, increase in purulent forms of acute pyelonephritis and severe septic complications. Given that the mass of kidneys in humans over 70 years old is reduced by 30% and the number of nephrons by 50%, even

conditionally pathogenic microflora can lead to the development of inflammatory process and renal failure.

In elderly and senile age patients, mortality rate for complications of acute purulent pyelonephritis is 30%, ranking the first places in the structure of mortality at urological hospitals. Given slower excretion of drugs in elderly and senile age patients, the dosage of uroantiseptics should be adjusted taking into account renal function and glomerular filtration rate. Because of possible ototoxic action, this category of patients should be limited in prescription of aminoglycosides, and due to the increased risk of antibiotic-associated diarrhea and pseudomembranous colitis - beta-lactam antibiotics. During purulent destructive forms of acute pyelonephritis, treatment tactics should be more active. With development of severe septic complications, nephrectomy should be preferred. In diabetic patients, urine containing glucose is nutrient media for microorganisms.

In diabetic patients, pyelonephritis is mutually aggravating factor: renal infection complicates correction of carbohydrate metabolism, and successful treatment of pyelonephritis is impossible without normalization of blood glucose. The development of diabetic angiopathies lead to microcirculatory disorders, contributing to the progression of infectious inflammation in kidneys.

Metabolic disorders inhibit general and local resistance, creating additional conditions for the transition of acute serous pyelonephritis to purulent stage. Kidney infection by intestinal bacteria in combination with hyperglycemia even without urodynamic disorders can cause the development of purulent destructive forms of acute pyelonephritis, emphysematous pyelonephritis, necrotic papillitis and spread of suppuration outside kidneys. Similar conditions are created by other etiopathogenetical factors in the patients with renal failure upon kidney transplantation, with immunosuppression.

Acute pyelonephritis in these patients may not have pronounced clinical symptoms and characteristic laboratory findings, but more than half the cases are complicated by transition to purulent stage and septic shock, that's why surgical treatment is preferred. In some cases, only nephrectomy can save the patient's life.

Emphysematous pyelonephritis is acute infectious inflammatory process caused by the microorganisms (*Escherichia coli*, *Pseudomonas aeruginosa*, more rarely *Proteus* spp., *Klebsiella* sp.), causing necrotizing inflammation and, as a result of glucose decomposition, gas formation. More often (80%), gas formation is observed on the background of immunosuppression in patients with diabetes, elderly and senile patients, mostly in women. The process in the most cases is unilateral, often obstructive. Quite frequently, emphysematous pyelonephritis is combined with thrombosis of renal vessels and necrosis of renal papillae.

Almost in 30% of patients, the process begins acutely: body temperature rises up to 40°C, fever, tachycardia appear, motor agitation, nausea is often observed, sometimes relentless vomiting leading to dehydration, acidosis, electrolyte exchange disorder. Pneumaturia is sometimes observed. Frequently, the disease is complicated by renal and liver failure, septic shock. Local symptoms are slightly pronounced. Disorder in urine flow is accompanied by intense pain in lumbar area. The spread of inflammatory process beyond the kidney may lead to peritoneum irritation. Palpation reveals enlarged, painful kidney.

During ultrasound examination, increase in kidney and, in some cases, gas in kidney and in adrenal tissue are found.

On plain urogram, accumulation of gas in renal projection and retroperitoneum is sometimes observed. On excretory urogram, renal function is not impaired nor reduced, calix deformation may be noted. The differential diagnostics should be done with acute infectious diseases, acute appendicitis, cholecystopancreatitis, perforated gastric and duodenum ulcer.

Conservative therapy should be short and in case of its inefficiency, active surgical tactics is preferred, including lumbotomy, kidney decapsulation, nephrostomy, extensive drainage of retroperitoneum tissue. In case of unilateral nature of pathological process in elderly and senile patients, in the patients with severe diabetes and sepsis, as well as in combination of emphysematous pyelonephritis with infarct

and renal necrosis, nephrectomy should be the method of choice.

In case of conservative treatment, mortality rate is 50%. Nephrectomy allows to save 70-80% of patients. In case of bilateral nature of pathological process, prognosis is unfavorable.

Necrotizing papillitis is destructive process in renal medulla. It is observed in 2-2.5% of patients with urological disorders. The women have it 3-5 times more often than men. The factors of papillary necrosis include diabetes, nephrolithiasis, renal injury, atherosclerosis, abuse of analgesics. Urodynamics disorder, venous stasis and pyelotubular refluxes create favorable conditions for the infection penetration to renal papillae.

Necrotizing papillitis is caused by heart attack, may be focal or total and spread to renal medulla.

Bilateral renal papillary necrosis is observed in 25% of patients.

Acute disease occurs in 25% of patients. More often, the process becomes chronic. Acute renal papillary necrosis is manifested by the same symptoms as acute pyelonephritis. One of the most common signs of renal papillary necrosis is macrohematuria caused by abruption of necrotic papilla. Typical symptom is discharge of necrotic tissue with urine, often accompanied by renal colic. In case of slow abruption of necrotic papilla, a concrement may be formed out of it due to salt encrustation.

On plain urograms, concrement triangular with the rarefied area in the center, small shadows of the calcinates in papilla area and in calix fornix are reported. On excretory urograms, calix amputation due to edema in the area of their necks, "effaced" contours of the papilla, cavity in the center of renal pyramid connected with the calix are reported.

Differential diagnosis are to be done with abnormalities of kidney development (spongy kidney, kidney dysplasia), renal tuberculosis, papillary tumors of calicopelvic system.

Treatment of the patients with renal papillary necrosis is the same as with acute pyelonephritis. In addition, the complex of therapeutic measures include the elimination of the factor of the disease and haemostatic therapy. In case of upper urinary tract disorder, recovery of urine passage is indicated. In case of profuse hematuria, when it becomes life-threatening for the patient, surgical treatment is indicated. Xanthogranulomatous pyelonephritis is one of the varieties of purulent pyelonephritis process for which histological examination is characterized by presence of cellular infiltrates consisting of mononuclear macrophages loaded with lipids "foam" (xanthom) cells.

Macroscopically, the kidney is enlarged, its surface is nodular. Renal parenchyma is affected either diffusely or in certain segments which contain xanthogranulomatous nodes which section resembles a tumor. In the center of xanthogranulomatous node, necrosis areas are observed. In case of enlargement and filling of calix with thick pus, renal tuberculosis may be erroneously diagnosed in macroscopical way.

More xanthogranulomatous pyelonephritis occurs in middle-aged women. In 66% of cases, the disease complicates nephrolithiasis, in 18% - diabetes. The process is predominantly unilateral. The most frequent agents of infectious inflammatory process are *Escherichia coli* and *Proteus* spp. Clinical manifestations of xanthogranulomatous pyelonephritis are nonspecific. Often, there is pain in lumbar and hypochondrium, rise in body temperature, leukocytosis, anemia, leukocyturia. During palpation, in kidney area, slightly painful tumor-like formation may be detected. The literature describes only a few cases of correct diagnosis before surgery.

Differential diagnosis should be made with tumor and renal tuberculosis.

The only efficient treatment is surgical: enucleation of node like xanthom granulomas within healthy tissue or nephrectomy.

Chronic pyelonephritis

Etiology and pathogenesis. Chronic pyelonephritis is caused by the transition of acute infectious inflammatory process to chronic one (lasting > 3 months) due to inadequate antibiotic therapy or failure to eliminate the causes of urine passage disorder, but may be also primarily chronic. In women, it occurs 2 times more often than in men, and is more stable. The process may be unilateral or bilateral.

Microbial pathogens of chronic pyelonephritis are often *Escherichia coli*, *Pseudomonas aeruginosa*, *Proteus* spp., *Klebsiella* spp., *Enterococcus* spp., *Staphylococcus* spp. Biological feature of uropathogens is the increased intensity of metabolic processes, enzyme activity and ability to inhibit the production of secretory immunoglobulins by mucous of urinary tract. As a consequence of the prolonged coexistence of obligate autoflora with microorganism, the bacteria acquire a set of heteroantigens, similar to autoantigens of the macroorganism, providing for them a kind of "umbrella" of immunological tolerance.

The factors for chronic infectious inflammatory process in kidneys are venous and lymphostasis, metabolic disorders (sugar diabetes), chronic foci of the infections (colitis, cholecystitis, tonsillitis, sinusitis etc.), immunodeficiency, elderly and senile age and female gender.

Pathomorphology. Morphological changes during chronic pyelonephritis are characterized by polymorphism, have prevailing focal nature and chronicity of pathological process; along with unchanged or slightly changed areas, inflammation and sclerosis foci can be found.

According to the activity of infectious inflammatory process in kidneys, three stages are distinguished:

- a) stage of active inflammatory process;
- b) latent stage;
- c) remission or cyclical recovery.

According to the degree of morphological changes, four stages of chronic pyelonephritis are distinguished:

Stage I - Malpighian glomerulus are preserved, uniform atrophy of discharging tubules and interstitial lymphocytic infiltration are observed;

Stage II – a part of glomeruli is hyalinized, the tubules of nephrons partially atrophied, the infiltrates have clear boundaries, cicatricial sclerotic process begins;

Stage III - death and hyalinization of the most glomeruli are observed. Nephron tubules are lined with low undifferentiated epithelium filled with colloid mass. Microscopic structure of the kidney reminds structure of the thyroid gland and for such reason it is called "thyroid kidney";

Stage IV - cortical substance is violently thinned, it does not contain glomeruli and consists mainly of connective tissue with little cores with abundant lymphocytic infiltration. "Pyelonephritic contracted kidney" is developing with progressive replacement of all structures by cicatricial connective tissue.

Clinical findings. Chronic pyelonephritis is characterized by a variety of clinical symptoms. In some patients, pyelonephritis has long-term latent course, manifested only by mild pain in lumbar area, leukocyturia, in others it is interrupted by acute attacks that cause inflammation spread to new areas of the parenchyma, bringing renal scarring.

Sometimes pyelonephritis is found during autopsy. For a long time, the patients may not be aware of the disease or feel fatigue, weakness, malaise, loss of appetite, sometimes "groundless" fever, dull pain in lumbar area, headache, dry mouth.

Often, clinical course of chronic pyelonephritis is characterized by the alternation of active and latent phases with periodic remissions. Failure to restore urodynamics, bilateral kidney lesion, frequent attacks of infectious inflammatory process accelerate the development of chronic renal failure (CRF).

Diagnostics. The diagnosis of "chronic pyelonephritis" is set based on the patient's complaints, anamnesis, physical examination, laboratory data and radial examination methods (ultrasound, plain and excretory urography, renal scintigraphy, CT).

The most common laboratory manifestations of chronic pyelonephritis are leukocyturia and bacteriuria. Moderate, often false proteinuria is reported. Often, erythrocyturia caused by fornical

bleeding which may be triggered by increased muscular pressure owing to urine passage disorder is also observed. Later, the tendency to hyposthenuria progressing with development of sclerotic process appears. The colonies of pathogenic microorganisms strains 10^3 CFU/ml and more are important for practical purposes. During relapsing chronic pyelonephritis without urodynamics disorder and if it is impossible to find microbial agent in conventional nutrient media, it is necessary to exclude sexually transmitted infections.

Systematic examination of urine may find minor proteinuria and Nechiporenko test may find hidden leukocyturia. Three glass test allows to differentiate chronic pyelonephritis and the infections of the lower urinary tract and of male reproductive organs (cystitis, prostatitis, urethritis).

In the patients with latent course of the inflammatory process, the diagnosis of chronic pyelonephritis is evidenced by increased C-reactive protein level.

During the examination of the patient, the attention should be paid to the pale skin. Blood examination evidences anemia even if CRF signs lack. The classification of anemia is performed in conformity to the hemoglobin level: light more than 89 g/l, moderate 70-89 g/l, severe - 50-69 g/l, super severe <50 g/l. Latent course of infection inflammatory process is accompanied by ESR increase. During attack of chronic pyelonephritis, leukocytosis and leukogram left shift are reported.

Often, a sign of chronic pyelonephritis is arterial hypertension that is difficult to correct.

There are no specific ultrasound signs of chronic pyelonephritis. In the phase of active inflammatory process, increase in linear dimensions and volume of the kidney as well as reduced echogenicity of the renal parenchyma are observed. In case of obstruction of upper urinary tract, typical extension of calicopelvic system is found. Upon each attack of the process, the deformity of outer contour of the kidney is observed owing to cicatricial involvement, the echogenicity of the cicatricial altered parenchyma is increased, the boundary between cortex and medulla is effaced, the pyramids no longer differentiate. "Pyelonephritic contracted kidney" is characterized by reductions in linear dimensions and kidney, structural index and parenchyma thickness.

According to the results of Doppler ultrasonography and renal angioscintigraphy, degradation of vascular pattern of the affected kidney is observed.

Excretory urography allows to identify the existence and cause of the upper urinary tract disorders, reduced function of the kidneys. At later stages, reduction of kidney dimensions is observed, renal cortical index is increased (ratio of the area of calicopelvic system of the kidney to the kidney area), the deformation of the external contour of the kidney and calix increases.

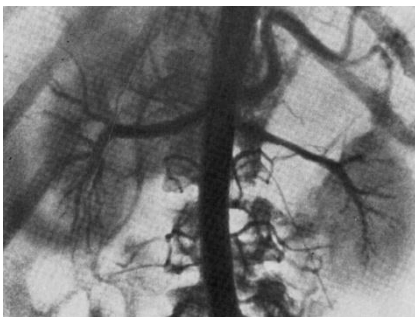


Fig. 5.7. Angiogram: chronic pyelonephritis with contracted left kidney.

Magnetic resonance and Computed tomography allow determining the shape, size and contours of the kidney parenchyma thickness, condition of calicopelvic system. Angiography allows determining vascular changes in chronic pyelonephritis from gradual reduction of small branches of segmental arteries up to their complete disappearance. Large segmental renal artery branches resemble the picture of the "burnt tree" (Fig. 5.7).

Radioisotope examinations (renography, renal scintigraphy) indicate the stage of secretory and excretory functions disorder of the affected kidney.

In nephrological practice, the terminology "chronic renal disease" (CRD) is used, indicating the stage of renal failure: *complicated* (hypertension, anemia) or *uncomplicated* pyelonephritis.

Treatment. Obligatory condition for successful treatment of chronic pyelonephritis is to eliminate the causes of urine passage disorder. Ethiotropic antibiotic therapy is started upon identification of microbial agent, having determined its sensitivity to antibiotics and functional capacity of the kidneys. If the situation requires emergency treatment, the medications are prescribed empirically for 3-5 days until the results of urine inoculation have been received. In the phase of active inflammatory process, **CRF stage is determined proceeding from the glomerular filtration rate (GFR) according to the value of endogenous creatinine clearance:**

- CRF I — GFR \geq 90 ml/min
- CRF II — GFR 60–89 ml/min
- CRF III — GFR 30–59 ml/min
- CRF IV — GFR 15–29 ml/min
- CRF V — GFR $<$ 15 ml/min.

the treatment starts with intravenous monotherapy with broad-spectrum antibiotics: fluoroquinolones II-IV generation (Ciprofloxacin 200 mg b.i.d., Levofloxacin 0.5-0.75 g o.d, Gatifloxacin 0.4 g o.d.), cephalosporins III-IV generation (Ceftriaxone, Cefotaxime, Ceftazidime, Cefepime 1 g b.i.d.), aminoglycosides (Amikacin 15 mg/kg o.d.).

Upon normalization of body temperature, there should be transition to oral medications (multistage antibiotic therapy) up to complete eradication of the pathogen. Antibacterial medications should be varied every 10-15 days. To prevent a recurrence, short course of antibiotic therapy is preferred (5 days, and in elderly patients 3 days per week with half of the dose, or 10 days per month).

The therapy is supplemented by herbs. In children and elderly persons, an important role in treatment of chronic pyelonephritis is given to prevention and treatment of intestinal dysbiosis with probiotics. For the prevention of relapse in women of reproductive age, the advantages are given to "pulse therapy" with single dose of antibiotic before sexual intercourse for 6-12 months.

The patients with chronic pyelonephritis are subject to constant clinical follow-up with monitoring of complete blood count, C-reactive protein, urea and creatinine, urine analysis, when the signs of relapse appear, bacteriological urine examination, blood pressure, renal ultrasound should be done. With CRF I-II stages, the patients are examined one per year, with CRF III stage every six months, with CRF IV stage quarterly. In case of severe hypertension under the conditions of unilateral lesion and preservation of the function of contralateral kidney, nephrectomy should be considered. With CRF V stage dialysis treatment should be applied.

The prognosis of chronic pyelonephritis depends on duration of the disease, inflammatory activity, frequency of attacks and the adequacy of treatment strategy. The prognosis is unfavorable under the conditions of arterial hypertension and chronic renal failure.

Pyonephrosis

Pyonephrosis is terminal stage of specific or nonspecific suppurative destructive inflammatory process with complete replacement of renal parenchyma by connective tissue. Pyonephrosis may be unilateral or

bilateral, closed (when the cavities containing pus are completely closed), intermittent or open. Pyonephrosis is often unilateral. In contrast to infected hydronephrosis, when renal function is partially preserved, in case of pyonephrosis it fails completely.

Etiology and pathogenesis. Pyonephrosis is often conditioned by kidney infection with mixed microflora in which coliform bacterium and blue pus bacillus, proteus, enterococcus, staphylococcus, streptococcus, mycobacterium of tuberculosis prevail. Pyonephrosis is the result of long-term and sometimes turbulent infectious-inflammatory process on the background of urine outflow disorder from kidney. More frequently, pyonephrosis is a complication of urolithiasis, development abnormalities, supra- and infravesical obstruction of any origin.

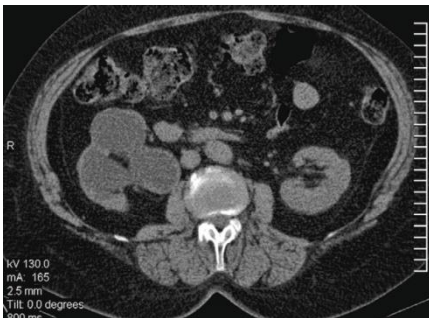
A kidney looks like a large thin-walled cavity filled with pus. If pyonephrosis progresses with urinary tract obstruction, the kidney is enlarged, if it is a result of chronic pyelonephritis with tendency to kidney contraction, the kidney is reduced.

Pyonephrosis is always accompanied by severe sclerotic pedunculitis, peri- and paranephritis resulting in formation of thick, dense fibrous structure around a kidney, often matted with surrounding tissues and organs. Caliber of renal vessels is dramatically reduced. Renal stem is thickened, as a rule, owing to inflammatory sclerotic changes of surrounding tissues.

Clinical findings depend on the degree of urinary tract patency: acute progress, latent course, intermittent course. The manifestations of closed pyonephrosis are identical to clinical findings of acute purulent pyelonephritis: hectic fever, chills, sclera icteritiousness, tachycardia, severe pain in lumbar area and so on. Pathological changes in urine may not exist. In the blood, there is leukocytosis, left shift of the leukogram, elevated ESR. Hypercoagulation disorders are developing. Palpable enlarged painful kidney. When patency of the urinary tract is restored, purulent sediment, pyuria, massive bacteriuria appear in the urine. Thus, body temperature decreases, as well as the pain. Closed tuberculous pyonephrosis is characterized by more effaced clinical manifestations.

For open pyonephrosis, fatigue, overall weakness, loss of appetite,

Fig. 5.8. *Kidney CT: right side pyonephrosis (multi chamber cavity of 18–20 HU density, remnants of thinned parenchyma of 38–40 HU density)*



weight loss are characteristic, sometimes fever up to subfebrile, dull pain on the affected side, enlarged kidney and moderate pain during palpation, leukocyturia (pyuria), bacteriuria, accelerated ESR. For bilateral pyonephrosis is

characterized by the signs of progressive renal failure.

Intermittent clinical course is typical for intermittent pyonephrosis. Slow progress of pathological process is interrupted by the periods of attacks.

Diagnostics. The diagnosis is based on patient complaints, study of anamnesis, objective data (during pyonephrosis, a kidney is enlarged, slow-moving, dense, often painful), laboratory data and additional methods (ultrasound, plain and excretory urography, CT etc.). Ultrasound examination may determine the cause and the level of urine outflow disorder. The kidney is enlarged, often with irregular contours.

Echographic image of renal cavity is hypoechoic, heterogeneous, sometimes with dense horizontal level due to the presence of purulent sediment, but always more echogenic than in case of infectious hydronephrosis due to pus content. Thinning to few millimeters and diffuse increase in echogenicity of the substituted renal parenchyma by connective tissue are reported.

On plain urogram, enlarged kidney shadow, blurred contour of lumbar muscle, often concrement

shadow (coral-like or multiple) may be revealed. When deciding the nephrectomy, compulsory examination methods include excretory urography to assess the functions of contralateral kidney. On tardive excretory urograms, sometimes accumulation of contrast medium in the dilated renal cavities is observed. Computed tomography allows to determine the cause and the level of urine outflow disorder. Renal cavity containing pus looks like heterogeneous formation of low density, around which there is remaining sharply thinned, substituted by connective tissue, dense renal parenchyma (Figure 5.8). On the angiograms, renal arteries are thinned, elongated, no nephrographic effect or it is weakly expressed in some areas. Radioisotopic examinations indicate dramatic reduction or loss of function of the affected kidney.

Surgical Treatment – nephrectomy, in complex cases subcapsular one. Thus, excision of cicatricial substituted perirenal tissue, often saturated with pus, creates favorable conditions for wound healing. In the patients with closed pyonephrosis, the indications to surgery may be emergency because catheterization of the affected kidney does not provide the desired effect. In septic patients with dysfunction of another kidney, the advantage is given to percutaneous drainage with delayed nephrectomy upon stabilization of general condition of the patient and restoration of contralateral kidney function. Antibacterial and detoxification therapy are similar to those for acute purulent pyelonephritis. In case of tuberculous pyonephrosis, anti-TB drugs are prescribed. Follow-up is lifetime monitoring of dynamic function of single kidney.

The prognosis depends on the function of single remaining kidney and the patient's age. Young patients have more favorable prognosis and satisfactory long-term results.

Paranephritis

Paranephritis is infectious inflammatory process in adrenal fat tissue. Primary and secondary paranephritis are distinguished.

Primary paranephritis develops in the absence of renal disease as a result of adrenal tissue infection in hematogenic way from distant septic foci (osteomyelitis, mastitis, furunculosis, lung abscess, infected wounds etc.).

Secondary paranephritis is observed in 80% of cases and develops as the complication of chronic inflammatory processes in kidneys (carbuncle, abscess, pyonephrosis).

The infection may spread to paranephral tissue from inflammatory foci in neighboring organs (appendicitis parakolitis, parametritis etc.).

Depending on the localization, upper paranephritis (in the area of the upper renal pole), lower paranephritis (in the area of the lower renal pole), anterior paranephritis (between kidney and colon), posterior paranephritis (between kidney and lumbar muscles) are defined, as well as total affection of adrenal tissue (total paranephritis).

Posterior paranephritis is observed more frequently as a result of more fat on the back of the kidney and renal sinus neighborhood. The process is more often unilateral.

Etiology and pathogenesis. Causative agent of primary paranephritis is often gram-positive microflora, including *Staphylococcus aureus*, gram-negative one is rarer. Secondary process is often caused by gram-negative microflora (*Escherichia coli*, *Pseudomonas aeruginosa*, *Proteus spp.* and *Klebsiella spp.*). Paranephritis course may be acute or chronic.

Acute paranephritis has exudative inflammation stage that can have reverse progress, or can go to the next purulent stage, first with diffuse infiltration, then with purulent fusing of adipose tissue and perirenal abscess formation. When interfascial partitions are fused, suppurative process spreads through the weakest places of lumbar area – Petit and Grunfeld-Lesgaft triangles, forming retroperitoneal

phlegmon. The pus may break through the skin to the intestine, abdominal and pleural cavities or spread along the lumbar muscle then through obturator foramen on the inner hip surface.

Clinical findings of paranephritis depends on the severity of inflammatory process, localization of purulent foci, virulence of the infection and reactivity of the organism.

Acute paranephritis may not have typical symptoms and begins with body temperature rise up to 39-40°C, which is often preceded by chills. Often, only 3-4 days later, local symptoms such as pain in lumbar area, in hypochondrium, protective tension of abdominal muscles and lumbar muscles are observed. Painfulness during palpation in costovertebral corner is observed. Later, the scoliosis towards affected kidney (through protective lumbar muscle contraction) is observed. If lumbar muscle is involved in inflammatory process, flexion contracture of the hip joint with characteristic position of the patient (hip brought to abdomen), increased pain when trying to straighten the lower limb, inability to take straightened lower limb from the bed (symptom of sticky heel) are observed.

When the pus spreads under the skin there is a protrusion in the lumbar area, edema and local hyperaemia. Blood findings correspond to purulent inflammatory process of any localization. In case of acute paranephritis associated with purulent inflammation in the kidney, pronounced leukocyturia (pyuria), hematuria and proteinuria are observed. However, in case of obstructive suppurative pyelonephritis, closed pyonephrosis and hematogenic nature of acute paranephritis, the changes in urine may be minimal or lack at all.

Chronic paranephritis is rarely a result of undertreated acute paranephritis. More frequently, it is a result of repeated acute obstructive (calculous) pyelonephritis and of the complication in the postoperative period as infiltration of adrenal tissue by the infected urine. Chronic paranephritis has a course of productive inflammation with substitution of perirenal tissue by connective one. If the inflammatory process seizes limited area of tissue around renal gate, such form of chronic paranephritis is called pedunculitis if sclerotic process is spread to all adrenal tissue, developing "testaceous" paranephritis with the complication as vasorenal hypertension and urodynamics disorder. Chronic paranephritis is characterized by dull pain in lumbar area, moderate fever with acute calculous pyelonephritis, increased ESR.

Diagnostics. Diagnosis is based on patient complaints, anamnesis studies, clinical and laboratory data and additional methods (ultrasound, plain and excretory urography, CT etc.). On ultrasound image, acute purulent paranephritis is manifested as heterogeneous areas of low echogenicity, with indistinct, irregular contours. The most important ultrasonographic symptom of paranephritis is limitation of respiratory renal excursion until its disappearance. Purulent fusing of adrenal adipous body with formation of perirenal abscess is visualized as hypo- and anechogenic foci in retroperitoneum, sometimes with heterogeneous content.

On plain urogram, contour of lumbar muscle is effaced. The scoliosis in the direction of lesion is observed. According to excretory urography, one can distinguish primary

and secondary paranephritis, find concrement shadow and kidney dysfunction.

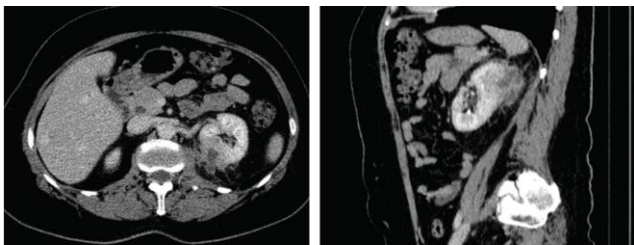


Fig. 5.9. CT of kidney and retroperitoneum with bolus intravenous staining: abscess of the upper pole of the left kidney with suppuration spread to perinefric tissue: a – transversal projection; b – lateral projection.

Excretory urography with breath in and out reveals sharp restriction or lack of respiratory excursion of kidney on the affected side.

Computed tomography allows distinguishing primary and secondary

paranephritis and localizing purulent foci (Fig. 5.9).

Treatment.

Adequate antibiotic therapy started at the stage of exudative inflammation allows recovery in the majority of patients.

In the patients with acute purulent paranephritis in phase of diffuse cellular infiltration to adipose tissue, conservative and expectant tactics is justified. Massive antibiotic therapy is complemented by infusion detoxification therapy and administration of drugs improving hemodynamics. If there is hypercoagulation syndrome, coagulative and anticoagulative blood activity should be corrected.

Treatment of the patients with perirenal abscess should be surgical: percutaneous needle aspiration of pus under ultrasound or CT control should be performed for the abscess ≥ 3 cm, percutaneous puncture drainage of inflammatory foci to stop discharge of pus is indicated for the abscess ≥ 4 cm. If there is no positive dynamics, retroperitoneal phlegmon progresses, surgical drainage of retroperitoneum is indicated.

Treatment of chronic paranephritis is conservative: it includes antibiotic therapy in the case of chronic obstructive pyelonephritis, corticosteroids, non-steroid anti-inflammatory drugs should be prescribed. If conservative treatment is inefficient, surgical treatment is indicated: remove sclerotic cell in the area of renal gate, pelvis and ureter. To prevent relapse of pedunculitis within the postoperative period anti-inflammatory and tissue therapy is prescribed.

The prognosis in case of the treatment in proper time is favorable, in chronic cases, it depends on the nature of the underlying disease.

Cystitis

Cystitis is the inflammation of urinary bladder mucous. The most common is nonspecific infectious cystitis. Its prevalence in Ukraine is 314 patients per 100 thousand people, chronic cystitis 135 per 100 thousand population. The majority of the patients is women of reproductive age. Each episode of acute cystitis in women is on average associated with the presence of symptoms for 6.1 days, limited activity for 2.4 days, failure to attend classes or job for 0.4 days.

Etiology and pathogenesis. For cystitis, pathogenic micro-organisms and degenerative congestive processes in the wall of the bladder are required. The vast majority of cystitis is caused by gram-negative bacteria, among which *Escherichia coli* is present in about 80% of cases. *Staphylococcus saprophiticus* is the second causative agent of acute cystitis (11%) by frequency. The reason of the majority of the rest of the cases is enterococci, *Klebsiella spp.*, *Proteus spp.* In the etiology of cystitis, urogenital infections (*Chlamidia trachomatis*, *Ureaplasma urealyticum*, *Trichomonas vaginalis*) are of particular importance.

In the age between 20 and 50 years old, cystitis is found about 50 times more often in women. In later age, the incidence of cystitis in both men and women increases, and the ratio of women/men decreases.

The high incidence in women is largely associated with anatomical features and the disorder of normal rate of urination. Reflex urinary retention is especially dangerous upon delivery and surgeries on abdominal cavity and pelvis. Even single catheterization may lead to urinary tract infection.

Cystitis is accompanied by a variety of pathological conditions of the urinary tract and genital organs and may be the first clinical manifestation of developmental abnormalities, pyelonephritis, urolithiasis, cancer and inflammatory lesions of these organs.

The fixation of causative agent to the mucous membrane of the bladder happens when urodynamics of the lower urinary tract is disturbed and inner bladder pressure is increased which causes venous congestion, ischemia and degenerative changes in bladder tissues. The syndrome of inner bladder hypertension occurs both in detrusor hypotension and hypertension. Hypothermia also causes ischemia of the mucous membrane of the bladder.

The infection gets into the bladder by ascending (in the urethra), descending (from kidney),

hematogenic and lymphogenous ways.

Cystitis conditions:

- presence of pathogenic microorganisms;
- urodynamics disorder;
- degeneration, disorders of local circulation (ischemia) or the integrity of the bladder walls;

urination rate disorder in women.

Women are very inclined to cystitis recurrence. Such high frequency may be explained by the following factors:

- anatomical and physiological characteristics of the female body: short and wide urether, proximity to the reservoirs of conditionally pathogenic microorganisms;
- frequent concomitant gynecological diseases associated with infectious and inflammatory hormonal component disturbing vaginal dysbiosis;
- frequency of sexual intercourse and contraception features.

Classification. According to etiology the following classification exists: infectious (nonspecific and specific), chemical, radiation, medical and thermal cystitis.

According to the course, acute and chronic cystitis (latent, recurrent) are distinguished. Depending on prevalence of inflammatory process diffuse (total) and focal cystitis are distinguished. If the pathologic process is limited only by the neck of the urinary bladder, cervical cysts (tigonitis) are diagnosed.

Depending on nature and depth of pathological changes, acute cystitis is divided into catarrhal, follicular, hemorrhagic, ulcerative and necrotizing, chronic on incrusting, polypous, cystic, ulcerative and interstitial.

Clinical findings. Main symptoms of acute cystitis is frequent and painful urination, often with imperative urge and urgent incontinence, pain in bladder area (pubic area and perineum) and urethra. Almost in 40% of women with acute cystitis macrohematuria is observed. However, this symptom is not regarded as an indicator

of the complicated infection. The intensity of pain does not always correspond to the severity of morphological changes in the mucous layer of the bladder, depending on the type of higher nervous activity and the degree of increase of detrusor tone (up to tenesmus).

Chronic cystitis is often acute complication or another disease of urinary bladder, urethra, kidneys and reproductive organs (diverticulum, tumor, concretions, foreign bodies and neuro-muscular dysplasia of the bladder, urethral stricture, cancer and benign prostatic hyperplasia, prostatitis, urethritis, chronic pyelonephritis, tuberculosis), diabetes, vagina descent, chronic inflammatory diseases of female reproductive organs.

Clinical symptoms during relapses are the same as during acute cystitis.

Hemorrhagic cystitis is characterized by the presence of urine mixed with blood (possible clots), necrotic cystitis by the fragments of necrotic mucosal layer of the bladder. Iatrogenic origin of chemical and thermal cystitis is associated with the introduction of chemically aggressive fluids, often of alcohol iodine solution or over-heated liquid. Radiation cystitis is caused by radiation therapy of the pelvis area.

In men, the clinics of acute cystitis is almost always a part of symptomatic complex of acute prostatitis or even masks the latter, especially if it is accompanied by fever with hyperthermia of hectic nature.

Acute cystitis in women is characterized by the tendency to relapses and the possibility of complications by ascending pyelonephritis. The presence of temperature reactions and intoxication symptoms evidence the complications of acute ascending pyelonephritis or damage of the integrity of

mucosal and muscular layers of the bladder (ulcerative and necrotic cystitis).

Necrotizing cystitis is the most severe form of acute cystitis, is found relatively rare (due to the compression of the posterior wall of the bladder and blood vessels combined with the infection, introduction of concentrated chemical solutions into the bladder). It is characterized by high body temperature, severe intoxication up to bacterial shock, oliguria, anuria. Urine is turbid, with unpleasant odor, mixed with blood, fibrin, mucus fragments. When the urine bladder is perforated, the phenomena of urinary peritonitis or pelvic urine phlegmona develop.

Diagnostics. Physical examination - painfulness over vagina, in women painful palpation of the urethra through vagina, sometimes hyperemic external opening of urethra.

Laboratory examination of patients with cystitis include:

- complete blood count;
- urine analysis (leukocyturia, bacteriuria, erythrocyturia) Leukocyturia is found in all urine samples. Absence of leukocyturia is a contradiction to the diagnosis of acute cystitis and puts it into question. But in case of cervical cystitis, it may be absent;
 - bacteriological examination of urine in case of acute cystitis when causative agents and the profiles of their antimicrobial susceptibility are predictable is not mandatory, but in case of chronic one, it is required. Traditional standard for diagnostically significant bacteriuria is 10⁵ CFU/ml fixed over forty years ago. Recent studies have shown that such standard does not meet practical requirements if it is used in the cases of strictly infectious inflammation. Thus, almost one third to half of the cases of acute cystitis demonstrate bacteriuria less than 10⁵ CFU/ml. For practically purposes, the number of colonies 10³ CFU/ml should be used.

For the diagnostics of cystitis, the following is also applied:

- ultrasound of kidneys, ureters, urine bladder and prostate;
- excretory urography should be performed only in cases of chronic cystitis and atypical course of acute cystitis;
 - cystoscopy is performed only in case of chronic cystitis. Instrumental examinations for acute cystitis are generally contraindicated and performed only in case of protracted course of inflammation (more than 2-3 weeks). Cystoscopy is also indicated upon regression of acute hemorrhagic cystitis symptoms.

For women with chronic cystitis, the consultation of gynecologist and examination for sexually transmitted disease is obligatory. In case of acute cystitis in women, examination of external opening of the urethra and vaginal examination is mandatory. If vaginal and urethral discharges, herpetic erosions, peculiar smell, hyperemy are present, the patients are subject to examination for STD by gynecologist. Differential diagnosis of acute cystitis is performed with tuberculosis, especially in case of aseptic pyuria, with bladder cancer, benign prostate hyperplasia and cancer, stone of intramural part of ureter, urethra diseases, vesico-urethral segment, bladder diverticulum, neurogenic dysfunction of bladder, other diseases of the pelvis.

The course of acute appendicitis may be accompanied with the elements of symptomatic complex of acute cystitis with pelvic position of the appendix. Dysuria, microhematuria, small leukocyturia are observed. However, acute cystitis is not accompanied by the changes in the blood formula, leukocytosis.

- **Treatment.** Treatment of acute cystitis may be both outpatient and inpatient (for severe or protracted

course), aimed at elimination of a number of etiologic and pathogenetic factors.

Rest, milk and vegetable diet excluding hot spices, canned goods, meat broths, enough liquid (diuretic herbs, green tea, berry drinks, kissels) are prescribed to the patients. The heat procedures - sitting baths, dry heat, microclysters and sheath herbal irrigation are also indicated except for hemorrhagic cystitis.

In most cases, analgesic and antispasmodic drugs are applied. Among the analgesics, non-steroid anti-inflammatory aids and antispasmodics, the following is used: Ketorolac, Diklofenak, Dexametoprolen, Drotaverin, belladonna extract candles inserted to the rectum.

Given the etiologic structure of acute cystitis agents, oral antibiotic monotherapy shall be conducted. Highly efficient antibiotic is Phosphomycin. Treatment with such drug for 1-2 days may eliminate the symptoms in most patients. Daily dose of 3.0 g taken in the evening before sleep. Reliable and time-tested for their efficiency are the fluoroquinolones, if they are taken for 3 days. There are no evidences of more efficient long-term administration of the fluoroquinolones, but in clinical practice, 5-14-days scheme is used more frequently for all groups of antibiotics. Among the fluoroquinolones, the following is used: Norfloxacin and Pephloxacin 0.4 g, b.i.d, Ofloxacin 0.2 - 0.4 g b.i.d, Ciprofloxacin 0.25-0.5 g b.i.d, Llevofloxacin 0.25 - 0.5 g o.d. Amoxicillin 0.5 g t.i.d., Amoxicillin/clavulanic acid 0.375 g t.i.d. or 1.0 g, b.i.d. is also efficient.

In case of no recourse of acute cystitis within 3-8 days, the antibiotics are replaced or combined antibacterial therapy is prescribed.

Macrohematuria in case of acute hemorrhagic cystitis is treated by the hemostatics: etamsylate sodium 12.5% 2.0 ml i.v. 2-3 times per day, Aminocaproic acid 0.5 g t.i.d., or 5% solution of 30 ml 3-4 times per day by internal administration.

Treatment of acute radiation, thermal and chemical cystitis has its own features. Hormonal drugs (Hydrocortisone, Prednisolone, Dexamethasone), the drugs enhancing reactivity (Methyluracilum 0.5-1.0 g 4 times per day by internal administration for 2-3 weeks), antisensitizers are used. For instillation, a mixture consisting of 0.9% methyluracil solution, 0.5% novocaine, hydrocortisone, antibiotics and vitamin B12 is used.

Bladder instillation are indicated only in case of prolonged cystitis, elimination of residual effects of acute cystitis, chronic cystitis, for regeneration of the bladder mucous in case of chemical, thermal and radiation cystitis. 2% colloidal solution of Collargolum (for analgesic effect mixed with 0.5% novocaine), therapeutic oils of rosehip, sea-buckthorn, mixture of Ectericidum with hydrocortisone, mixture of 2 ml hydrocortisone with Dimexidum 10-20% - 10 ml and 10-20 ml of 0.5% novocaine are used for the instillations.

In case of necrotizing cystitis, early surgery - cystostomy, removal of necrotic tissue, drainage of paravesical space are indicated. During postoperative period, constant irrigation of the bladder with antiseptic solutions should be done.

On average, with rational and timely therapy, the manifestations of acute catarrhal cystitis regress within 2-3 days, severer form up to 2 weeks. Longer course of the disease should be considered as protracted and require careful X-ray, instrumental examination, gynecological examination, prostate examination.

To prevent a possible recurrence, it is recommended to exclude hypothermia, intense physical activity, in-tiem treatment of sexually transmitted disease and inflammatory illnesses of female genitals, kidneys and urinary tract. Treatment at the resorts is recommended. Furthermore, preventive treatment is prescribed to the patients with frequent recurrences of cystitis (more than 2 acute conditions within 6 months or 3 within one year). There are several approaches to such therapy.

1. Long-term prophylactic administration of low doses of fluoroquinolones, 10 days per month for 3 months.
2. The patients whose acute condition is associated with sexual intercourse, the antibiotics are recommended immediately after coitus with gradual reduction in dose.
3. Women in menopausal period, if they have no contraindications (presence of hormone-dependent

tumors) periuretral or intravaginal administration of hormonal creams or suppositories containing estrogen is recommended.

Drug therapy of acute conditions of chronic cystitis does not differ from that in acute cystitis, but takes more time: a course of 7-14 days. Given the etiological structure of chronic cystitis pathogens, oral antibiotic monotherapy which may begin empirically upon urine culture sampling. Analgesics, antispasmodics, antibiotics are used.

Physiotherapy of chronic cystitis upon regression of symptoms includes the following procedures:

1. UHF on the bladder area projection № 6-8 daily.
2. Diadynamic therapy according to abdominal- sacral technique – in case of pronounced cystalgia № 6-8 daily.
3. Ultraton rectal therapy № 6-10 daily.
4. Paraffin ozokerite applications on the bladder projection № 8-10 daily.
5. Ultrasound therapy of urinary bladder neck projection № 8-10 daily.
6. Neodiathermy of urinary bladder area № 6-8 daily.

Interstitial Cystitis

Interstitial cystitis occurs in case of the inflammatory reaction expansion to stroma of submucous layer and muscle layer of the bladder. In the literature, this form of cystitis is called simple or solitary ulcer of the bladder. Interstitial cystitis is non-infectious, non-specific inflammation of the bladder, resulting in case of glycosaminoglycan deficiency covering and protecting transitional epithelium from urine penetration into the wall of the urinary bladder. Activation of mast cells and autoimmunity play an important role in the development of interstitial cystitis. Interstitial cystitis is found in women 10 times more often than in men and its spread varies in European countries from 16 per 100 thousand (Netherlands) to 450 per 100 thousand (Finland).

According to cystoscopic pattern, two forms of interstitial cystitis are identified: ulcerative (development of ulcers), which occurs in 6-20% of cases, and non-ulcerative which is observed much more frequently.

Clinical findings. Constant, urgent needs to urinate, frequent urination up to 60 or more times per day, with small amount of urine during day and night.

There is chronic pelvic pain in the perineum or suprapubic area, pain during intercourse and ejaculation.

Diagnosics.

The diagnosis of interstitial cystitis is set considering the following criteria:

- very frequent urination (60 times or more per day), pain when the urinary bladder is filling, a relief upon emptying ;
- negative results of urine culture examination;
- the results of cystoscopic and histological examinations;
- urodynamic examination (cystometry) : the ability of the urinary bladder to fill and its stability (intermittent involuntary contractions of the bladder with filling rate of 30 ml/min).

National Institute of Arthritis, diabetes, intestinal and renal diseases of the United States proposed the following exclusion criteria for the diagnosis of interstitial cystitis:

1. The patients under 18 years, duration of symptoms less than 9 months.

2. Tumors of urinary bladder, cancer of uterus, vagina or urethra, urethral diverticulum
3. Tuberculosis, radiation cystitis, vaginitis, active genital herpes infection, chemical cystitis (cyclophosphamide treatment).
4. Concrements in urinary bladder or in the lower ureter.
5. Pollakisuria <8 times a day, nocturia <2 times, symptoms relieving by antibiotics, analgesics, antispasmodics, anticholinergics.
6. The ability of urinary bladder to hold 350 ml of urine and more during cystometry (standing. No compelling urge when the bladder is filled with 100 ml of gas or 150 ml of liquids (filling rate during cystometry is 30-100 ml per minute).
7. Diagnosed bacterial cystitis or prostatitis for the last 3 months.

Treatment of interstitial cystitis is empirical and aimed on restoring of impermeability (tightness) of mucosal layer of the bladder, mast cell inactivation and relieving regional pain.

Conservative treatment of interstitial cystitis is based on three principles:

1. Recovery of mucosal layer (glycosaminoglycans).
2. Inhibition of neurological hyperactivity.
3. Administration of antihistamines.

Restoration of mucous layer

Satisfactory results during administration of heparin which is a glycosaminoglycan 5000 IU b.i.d. subcutaneously for 7-10 days or 5000-20 000 IU in 1000 ml of 5% glucose o.d. intravenously for 4 days (2 courses with 4 days interval) have been recorder. It is recommended to repeat heparin therapy courses in 1-1,5 years. Also, heparin is used for urinary bladder instillations: 20000 IU are dissolved in 20 ml of sterile water.

Pentosanpolysulphate is polysaccharide, semisynthetic "heparinoid" that adjusts the deficit of glycosaminoglycans layer, is administered orally 100 mg t.i.d. (or 150 mg b.i.d.) for 6-24 months.

Hyaluronic acid for intravesical instillation, dose 40 mg o.d. weekly for 1 month, thereafter one per month.

Local treatment includes instillation of silver nitrate solution in growing concentrations 0.1 to 1% solution (1:5000 1:2000 1:1000) for 2-10 minutes during 6-8 weeks (2-3 times per week).

Dimethylsulfoxide is administered intravesically as 10% solution for inhibition (degranulation) of mast cells (50 ml of solution once per week for 2-3 months).

Inhibition of neurological hyperactivity

Amitriptyline is tricyclic antidepressant, it has three affecting points: a) central and peripheral anticholinergic affect; b) blockade of active transport of serotonin and norepinephrine in presynaptic nerve endings; c) sedative action explained by antihistamine effect. It should be administered 25 mg t.i.d.

Hydroxyzine (H-receptor antagonist) is administered internally 25 mg t. i. d., reduces the release of mast cells, vasodilation, hyperemy, pain.

Nifedipine (calcium channel blocker) inhibits the contractile ability of urinary bladder and reduces the activity of the immune system.

Antihistamine administration

Classical antihistamines in conventional doses and modes are prescribed. Endovesical interferemces should be performed in formation of bladder ulcers. Electrocoagulation of ulcer edges is performed,

permanent catheter remains for 2-3 days and medicinal oils (sea-buckthorn, rosehip) are administered.

For the treatment of severe forms of the disease, cystolysis operation should be performed - release of upper, back and side walls of the bladder from adjacent tissues by means of diathermy. Urinary bladder is drained through cystostoma for 10 days. Another surgical technique involves selective denervation of bladder with epicycstostomy.

In case of progress, despite long-term conservative and organ preserving surgical treatment, cystectomy with simultaneous formation of artificial urinary bladder from isolated intestinal segment is recommended as terminal measure.

Prostatitis

Prostatitis is inflammation of prostate. Prostatitis should be distinguished from chronic pelvic pain syndrome (CPPS) – symptomatic complex characterized by clinical picture similar to prostatitis, but without infection or inflammation factor in the prostate. Chronic prostatitis is often prolongation of acute one, but it occurs initially much more frequently, progressing with mild symptoms, becoming acute from time to time.

Epidemiology. The urgency of prostatitis is due to its high prevalence, unsatisfactory treatment results, frequent relapses and socially aspects caused by sexual disharmony and infertility. According to the data of national and foreign authors, 8 to 14% of men have the manifestations of prostatitis.

Among the patients with urologic profile, prostatitis occurs in 25% of men. Quality of life of a patient suffering from prostatitis is unsatisfactory. It is comparable to the state of the patients who have just suffered an acute myocardial infarction, suffer from angina, Crohn's disease, heart failure or diabetes.

Classification of prostatitis recommended by European urologist association:

Category I, Acute bacterial prostatitis

- Category II, Chronic bacterial prostatitis
- Category III, Chronic abacterial prostatitis / chronic pelvic pain syndrome
- Category IIIA, Inflammatory
- Category IIIB, Non-inflammatory
- Category IV, Asymptomatic prostatitis

Category I, or acute bacterial prostatitis is acute infectious inflammatory process of prostate. Category II is chronic bacterial prostatitis, this diagnosis is set when pathogenic bacteria are found in microbiological examination of prostate secretion, urine after prostatic massage or ejaculation. Chronic prostatitis is may be frequently continuation of acute one, but more often it occurs without prior phases for acute inflammation.

Category III is called chronic pelvic pain syndrome, as main clinical criterion of the disease is pain for more than 3 months. It includes the patients with no pathogenic bacteria in the genital excretas (prostate secretion, urine received upon prostate massage or ejaculation). This category is further divided into inflammatory chronic pelvic pain syndrome (IIIA) and non-inflammatory chronic pelvic pain (IIIB), which are defined by the leukocytes count in samples received from prostate (prostate secretion, urine received upon prostate massage or ejaculation). The majority of patients with prostatitis belong to these categories.

The classification includes a new category (IV) - asymptomatic inflammatory prostatitis. This form of prostatitis is characterized by lack of clinical manifestations. The disease is found by clinical examination made by different reasons (palpation pain, leukocyturia, pyospermia, infertility of the

couple etc.) or histological examination of the prostate tissues.

Etiology and pathogenesis. The most common etiological factor of acute prostatitis is *Escherichia coli* which is found in 65-80% of cases. Other gram-negative enterobacteria (*Proteus spp.*, *Klebsiella spp.*, *Pseudomonas aeruginosa*) and often found in the patients with acute inflammation of prostate. Gram-positive bacteria (staphylococci, including *Staphylococcus saprophyticus*, streptococci, enterococci etc.) play less significant role. Often, acute prostatitis is caused by *T.T. vaginalis*, *N. gonorrhoeae* and their association with one or classical bacterial pathogens.

Favorable factors for development of acute prostatitis are:

1. Surgeries for congenital diseases of penis and urethra.
2. Meatus stenosis, urethra stricture.
3. Cystoscopy, bladder catheterization or other instrumental intervention in urethra
4. Obstructive urination caused by prostatic hyperplasia.
5. Change in virulence properties of the microorganism.

Acute bacterial infection of the prostate usually results from ascending urethral infection or reflux of infected urine into the prostate ducts opening in posterior urethra. Other possible routes of infection include penetration of bacteria from rectum and other organs through lymph and blood vessels.

Chronic bacterial prostatitis

This disease is characterized by periodic recurrences of urinary tract infection and prolonged persistence of bacteria in the prostate secretory system, despite numerous courses of antibiotics therapy. The frequency of chronic bacterial prostatitis does not exceed 5-10%. The most common etiological factors of bacterial prostatitis, as in the case of acute one, are Gram-negative bacteria, especially *Escherichia coli*. Typically, the infectious process caused by one microorganism, although there are reported cases of inflammatory process caused by several microorganisms.

The cases of chronic bacterial prostatitis caused by *Mycobacterium tuberculosis*, *Trichomonas vaginalis*, *Neisseria gonorrhoeae*, *Clostridia*, *Salmonella*, mollicutes, fungal microorganisms and obligate anaerobes have been reported. The ways of penetration of bacterial infection to the prostate are the same as for acute prostatitis.

Microbial virulence factors play an important role in the pathogenesis of bacterial inflammation of the prostate gland.

There are several theories of pathogenesis of bacterial prostatitis, each of which or their combination may lead to development and maintenance of the course of chronic bacterial prostatitis:

- Intraprostatic reflux.
- Formation of fibrosis areas and concrements.
- Secretory dysfunction.
- Immunological deficiency.

Intraprostatic urine reflux is an important mechanism for the development of all types of prostatitis, especially bacterial one.

Draining ducts of peripheral glands have horizontal or oblique directions against the urine flow axis. Because of this anatomical feature, prostatic infection is often detected in peripheral area.

Formation of fibrosis areas and concrements. Prolonged stasis of the infected prostate secretion caused by the occlusion of efferent ducts as a result of inflammatory edema may lead to duct fibrosis and formation of stones. Prostatic stones as renal stones, as well as fibrosis areas may be impregnated with pathogenic bacteria, which excludes the impact of antimicrobial agents on them and thus leads to recurrence of prostatitis and urinary tract infection.

Secretory dysfunction is violation of prostatic secretion characterized by reduction of fructose

concentration, acid phosphatase, lysozyme, citric acid cations (zinc, magnesium, calcium), and increasing pH. These changes precede the inflammatory process or is its consequence. Secretory dysfunction underlies the reduction of antibacterial characteristics of prostate secretion.

Immunological theory. Bacteria, being antigenic stimulus, initiate immune reaction, resulting in prostatitis.

Chronic abacterial, inflammatory prostatitis

Its synonym is a syndrome of chronic inflammatory pelvic pain - a disease, with no microorganisms that may be found using standard methods of microbiological examination.

The most probable theories to explain the origin and development of the disease are:

- Infection theory.
- Theory of chemical inflammation.
- Immune Theory.

The arguments in favor of the infection theory is the studies that revealed the presence of bacterial DNA in prostate samples (tissue and secretion) that were considered as culturally negative in conventional clinical microbiological tests.

The following microorganisms are revealed in case of abacterial chronic prostatitis:

- *Ureaplasma urealyticum*
- *Mycoplasma hominis*
- *Chlamydia trachomatis*
- *Trichomonas vaginalis*.

Much rarer: *Neisseria gonorrhoeae*, fungus, viruses.

Chemical inflammation of the prostate is realized by means of intraprostatic urinary reflux - one of the main mechanisms for the development of any form of prostate inflammation, but unlike bacterial prostatitis, damaging factors is urine components, such as urate which trigger a complex of inflammatory tissue reactions. Possible reason of abacterial prostatitis may be immune response to the entry of unknown antigen or autoimmune processes.

Typically, the disease is caused not only by single factor but by the complex of synergizing factors.

Prostatitis clinics

Acute bacterial prostatitis is manifested by severe local and general symptoms. Among them, severe pain over groin and perineum, dysuria, in the majority of cases, fever with chills, aches throughout the body, weakness, sweating. Pain syndrome may manifest or increase only during defecation or pressure in rectum, perineum while sitting. In some patients, rise in body temperature is sometimes the only manifestation of the disease. The presence of venous and lymphatic outflow favors resorption of inflammatory exudate causing severe chills at the fever height. The features of clinical symptoms also depend on anatomical and topographical location of inflammatory foci in the prostate in relation to urethra, bladder neck and rectum. Because of pronounced prostate edema and urination disorders, its acute retention is rarely observed. Overall condition becomes more difficult, intoxication signs are growing. Late diagnostics leads to abscess formation and burst (mostly in urethra, rarer in rectum, urinary bladder or perineum area).

Bursting to the urethra leads to the formation of a cavity not sufficiently drained. If the abscess bursts into the rectum, urethral-rectal fistula may form.

Manifestations of chronic bacterial prostatitis are diverse. They may vary from lack of symptoms to sudden exacerbation. Most patients feel pain of various intensity in perineum, rectum resounding to

penis, scrotum, sacrum, loin, hips. In rare cases, the pain becomes of recurrent neuralgic attacks nature. Typically, the patients complain of discomfort in urethra, frequent urination, occasionally the discharges from urethra happen in the daytime under the influence of gland automassage during walking, exercises or defecation. Paresthesias in perineum and rectum (sense of pressure, heaviness, overflow) are felt and in some patients these phenomena become stronger in case of prolonged sitting. This disease is also characterized by recurrent infections of the urinary tract, usually caused by the same microorganism.

Chronic pelvic pain syndrome is a syndrome diagnosed based on the set of symptoms peculiar to it. Therefore, the diagnosis of chronic pelvic pain syndrome (abacterial chronic prostatitis / prostatodynia) is based on clinical data, in case of negative results of microbiological tests. Clinically, these patients have long anamnesis (3 months or more) of urogenital and pelvic pain, irritative and obstructive urination disorders, some symptoms of sexual dysfunction are also possible, often, the patients complain of general manifestation of weakness, fatigue, aches throughout the body, paresthesias.

Diagnosics

All diagnostic procedures can be divided into three groups: mandatory examination, recommended and sampling.

Obligatory examination:

- Anamnesis.
- Physical examination, including digital rectal investigation
- Analysis of prostate secretion.

Recommended examination:

- Assessment of symptoms or NIH-CPSI index.
- Topical diagnostics of inflammation of lower urinary tract under Meares - Stamey.
- Uroflowmetry.
- US with finding of residual urine and prostate volume.

Sampling:

- Bacterioscopic examination of urethra scrape.
- Ejaculate examination, including cultures.
- Prostatic specific antigen (PSA).
- Video- urodynamic examinations (including flow - EMG).
- TRUS.
- CT.

The main complaints are pain (Table 5.1), dysuria, optional complaints or complications include sexual, reproductive functions disorders and psychological and emotional changes.

Table 5.1. *Pain localization with prostatitis or CPPS*

Pain localization	Patients percentage
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Prostate/perineum	46 %
Scrotum and /or testicles	39 %
Penis	6 %
Urinary bladder	6 %
Sacrum	2 %

Symptoms of the lower urinary tract are:

- Frequent urination.
- Difficult urination (weak flow, necessity to make efforts).
- Painful urination.

National Institutes of Health (1999) developed a questionnaire to objectify the symptoms of chronic prostatitis - chronic prostatitis symptom index (CPSI). It should be noted that the questionnaire does not replace careful collection of anamnesis. However, it allows to assess quickly clinical situation and to focus on the most important issues for the patient. Besides clear description of the symptoms, carefully collected anamnesis plays an important role. Except for classical anamnesis items on duration of the diseases, sequence of symptoms, probable causes and provoking factors, course of the disease (relapse rate, season nature), prior testing and treatment, its efficiency and duration of remission, previous diseases, it is necessary to assess:

- presence of sexually transmitted diseases and sexually transmitted in anamnesis;
- presence of everyday and professional negative factors - physical inactivity, overcooling, chronic fatigue, stress, dietary preferences (spicy, pickled food, coffee), addictions (alcohol, smoking, drugs abuse);
- information about sexual life of the patient - regularity of sexual activity, full- value of intercourse, number of partners, use of prolonged intercourse, practice of abandoned intercourses;
- Information about the treatment of sexual partners.

Physical examination

State of the prostate is evaluated by digital rectal study. The most characteristic feature is the pain of varying intensity. In case of acute prostatitis, the gland is considerably enlarged, painful, often dense and homogeneous. In case of abscess, focal area is found, and upon abscess burst, there is retraction, to the contrary. Chronic inflammation with acute condition or chronic pelvic syndrome pain are marked by slight pain or its lack. Consistency is homogeneous or heterogeneous, elastic or slightly dense, sometimes atonic.

Microscopic examination of prostate secretion can confirm inflammation in the prostate gland, and allows to judge its functional state. During microscopy of prostate secretion the key indicators are registered

- number of leukocytes;
- number of lecithin grains;
- presence and type of microflora.

Before the procedure, the patient urinates in part to clear the urethra. Then, prostate massage should be done. If prostate secretion cannot be obtained, then urine sediment obtained immediately upon prostate massage (up to 30 min.) is examined.

The most objective information about the state of the lower urinary tract provides 4 glass test described by *E. M. Meares* i *T. A. Stamey* in 1968. It is one of the main methods which allows not only to diagnose but also to determine therapeutic approach. The test consists of microscopic and bacteriological study of urine samples obtained from various sections of urinary tract and prostate secretion that allows to determine the source of inflammation.

Medication of the patient:

- full bladder;
- prior the examination, the patient is recommended to refrain for one day from sexual contacts for facilitate the reception of prostate secretion;
- penis head should be clean and treated with 70 % spirit solution.

The samples for examination are taken in 4 stages:

1. Having prepared the patient, the first 10 ml of urine are collected in sterile container (I - urethral portion).
2. Having partially emptied the bladder in volume of 150-200 ml, 10 ml of urine are collected in the same way (II - bladder portion).
3. The next step is prostate massage for prostate secretion (III - prostate portion).
4. The first 10 ml of urine are collected after prostatic massage (IV – post massage portion).

Interpretation of the results:

- The first portion of urine (I) displays the status of the urethra. Urethritis is characterized by increased number of leukocytes and bacteria in 1 ml versus bladder portion (II)
- The presence of leukocytes in the first and second urine samples (II) allows to diagnose cystitis or pyelonephritis. Finding leukocytes and uropathogen bacteria in prostate secretion (III) or urine sample (IV) obtained after prostate massage allows to set the diagnosis of bacterial prostatitis when bacteria are not present (or are found in lower concentration) in the first (I) and second urine samples (II). Lack or presence of non-pathogenic bacteria, presence of more than 10 leukocytes in prostatic secretion (III) or urine obtained after prostatic massage (IV) implies inflammatory chronic pelvic pain syndrome (Nonbacterial prostatitis) in the patients.

Lack of inflammatory changes during microscopy in all portions of urine and prostate secretion and sterility of the prostate excretion is the basis for the diagnosis of non- inflammatory chronic pelvic pain syndrome (prostatodynia).

Ejaculate studies allow:

- in some cases to provide differential diagnostics between inflammatory and non-inflammatory chronic pelvic pain syndrome;
- determine the inclusion of the reproductive system in the inflammatory process (vesiculitis).

US examination of prostate using rectal sensor (TRUS) has significantly increased the urologists' diagnostic capabilities. Indications for its use :

- acute bacterial prostatitis – exclusion of prostate abscess if no positive dynamics is observed on the background of antibiotic therapy;
- finding pathological changes in the prostate gland that may affect treatment strategy (cysts, stones etc.);
- suspicion of prostate cancer with digital rectal examination or after study of prostate specific antigen;
- if there is pain associated with ejaculation, to exclude obstruction or cysts of spermaduct and pathogenic changes in seminal vesicles.

If clinically significant disease (abscess of prostate, prostate and bladder cancer, benign prostatic hyperplasia, lesions of musculoskeletal system simulating prostatitis symptoms etc.) are suspected, Computed tomography and magnetic resonance tomography should be used.

Treatment of prostatitis

Antibiotic therapy is currently generally accepted treatment for chronic prostatitis. One of the factors complicating considerably the choice of antibiotics for the treatment of chronic prostatitis is limited number of drugs that can penetrate through hematoprostatic barrier and accumulate in the prostate at the concentrations sufficient for eradication of the pathogen. In this respect, the drugs of fluoroquinolones group are preferable.

We recommend optimal treatment pattern of acute prostatitis:

- I stage — empiric peroral prescription of 3rd generation cephalosporins or fluoroquinolones
- II stage — correction of antibiotic therapy according to inoculation data and the patient's response to therapy.

Treatment of acute prostatitis.

In case of acute prostatitis, in contrast to chronic inflammation, betalactam antibiotics and aminoglycosides are able to accumulate in the tissue of the prostate gland in the concentration sufficient to inhibit most pathogens, due to enlarged prostate perfusion and high permeability of hematoprostatic barrier. One should remember that the ability of antimicrobial drugs of these groups to penetrate into the prostate decreases as long as inflammation reduces. Therefore, when clinical effect is achieved, you should shift to peroral administration of fluoroquinolones

When clinical symptoms becom less acute, the patient should be treated with peroral drugs:

- fluoroquinolones;
- Doxycycline.

Treatment of chronic bacterial prostatitis. At present, the drugs of choice are fluoroquinolones (Norfloxacin, Levofloxacin, Ciprofloxacin). For the patients with allergic reactions to fluoroquinolones, Doxycycline is recommended. The urologists in Europe and the United States generally recognize that antibacterial therapy of chronic prostatitis requires long period of time, and, unlike to the prevailing practice in this country, the therapy usually uses one drug. The tradition to change antibiotics every 7-10 days has no scientific justification and in the majority of clinical situations is unacceptable. Nowadays, 2-4- week course of treatment is considered optimal. Therefore, special attention should be drawn to medicines prescribed o.d., e.g. fluoroquinolones such as Levofloxacin.

Treatment of chronic nonbacterial prostatitis. Despite the lack of cultured bacteria, antibiotic therapy of inflammatory chronic pelvic pain syndrome is the most frequently recommended treatment. *The basis for prescription of antibacterial medicines is:*

- probable role of cryptogenic (hardly cultured) microorganisms in the etiology of chronic nonbacterial prostatitis and high frequency of finding in this category of patients;
 - antibacterial therapy brings relief to the patients with chronic pelvic pain syndrome.
- Antibacterial therapy of chronic nonbacterial prostatitis (inflammatory chronic pelvic pain syndrome) is prescribed as follows:*

- antibiotic therapy by fluoroquinolones, Doxycycline for 2 weeks;
 - then reexamination, and if positive dynamics (reduction of pain syndrome) is observed - continuation of antibiotics administration up to 4 weeks.
- Non-inflammatory chronic pelvic pain syndrome.** There is still no consensus on the role of antibiotic therapy in the treatment of patients with this form of prostatitis.

Asymptomatic prostatitis. These patients do not require treatment despite laboratory, cytological or histological signs of inflammation.

The patients in this category should be treated for some reasons:

- infertility;
- finding pathogenic microorganisms in microbiological examination;
- elevated PSA level and positive results of microbiological examination (before defining the indications for prostate biopsy)
- before surgical treatment of prostate.

The same antibacterial drugs are used as for the treatment of chronic bacterial prostatitis.

In addition to antibiotics, the medicines of other groups are used for the treatment of patients with prostatitis. Moreover, in the case of abacterial prostatitis forms, these drugs are of particular importance in comparison with antibiotics.

Alpha-adrenoceptor blocking drug

For the patients with prostatitis symptoms, considerable urodynamics disorders are peculiar: increase in urethral closure pressure, lower maximum and average urinary flow rate, partial opening of the bladder neck during urination with increased urethra tone, its narrowing at the level of external sphincter. This gives reasons for the use of Alpha-adrenoceptor blocking drugs (Tamsulosin, Silodosin, Alfuzosin, Doxazosin, Terazosin) in the treatment of all forms of chronic prostatitis. Prolonged administration of alpha-adrenoceptor blocking drugs for at least 3 months is recommended even upon clinical effect has been achieved.

Nonsteroidal anti-inflammatory drugs

Owing to inhibition of inflammation and analgesic and anti-edematous effect. The treatment of chronic pelvic pain syndrome (inflammatory and non-inflammatory) may be useful as a symptomatic and pathogenic therapy. Given potential for side effects, the duration of treatment should not exceed 4 weeks.

Phytotherapy

This type of medicamental treatment is widely used in the treatment of chronic prostatitis. Fruit extract of saw palmetto (*Serenoa repens*), in addition to inhibition of the activity of 5-alpha-reductase and aromatase, reduces the formation of inflammatory mediators: leukotrienes and prostaglandins due to reducing the activity of phospholipase A2, lipoxygenase and cyclooxygenase. At the level of target organs – prostate, it has anti-inflammatory and vessel protecting effect, reducing swelling due to increased inhibition of capillary penetrability. Medication of African plum bark (*Rugenum africanum*) in clinical application provides anti-inflammatory and anti-edema effect and reduces prostate cell proliferation. One more medication derived from natural raw materials is Prostatilen (made of cattle prostate tissue), which has anti-inflammatory, anti-edema action, improves microcirculation in the gland.

Physiotherapy

Physiotherapy methods are widely used in the treatment of chronic prostatitis. Many physical factors in the different methods are part of comprehensive therapy. Both traditional methods of physiotherapy (digital prostate massage, microclysters with medicines or herbal decoctions, warm sitting baths) and apparatus physiotherapy: magnetic, electric stimulation of prostate, low-intensive laser radiation are

widely used with anti-inflammatory, anticongestive effect to correct immune disorders, as well as to improve the efficiency of antibiotic therapy.

Each factor usually affects locally on the prostate (in urethral, rectal, transcutaneous way), has prevailing effect on individual links in the pathogenesis of chronic prostatitis, and therefore, it can be used simultaneously with several physiotherapy factors.

Magnetic therapy has anti-inflammatory and analgesic effect, restores blood circulation, normalizes the course of redox and tissue enzymatic processes, creates the conditions for efficient antibiotics action on inflammation. It is used both transcutaneously and rectally.

Electrical stimulation. This type of physiotherapy improves microcirculation, increases the tone of smooth muscles of prostate, restores its evacuatory, secretory function and improves sexual function in the patients with chronic prostatitis.

Low-intensity laser radiation has pronounced anti-inflammatory effect, stimulates general and local immunity, improves microcirculation in inflammation foci that affects vascular grid permeability, provides analgesic and bacteriostatic effect. Perineal and transrectal exposure is used.

Prostate massage is used to treat chronic prostatitis since the XIX century, but there is still no common view on the place of such treatment. As massage is showing high clinical efficiency, it reduces edema, causes discharge of secretion from prostate glands, increases microcirculation, tones muscle structure of the prostate, this method is widely recommended. It is desirable to make prostate massage 3 times per week along with dynamic microbiological studies and administration of broad-spectrum antibiotics.

Massage indications:	Massage contraindications:
<ul style="list-style-type: none"> • chronic prostatitis; • chronic pelvic pain syndrome; • asymptomatic prostatitis (in case of treatment); • necessity to get prostate secretion for diagnostic purposes. 	<ul style="list-style-type: none"> • acute bacterial prostatitis; • chronic prostatitis combined with prostate cancer or prostatic hyperplasia; • prostate stones; • real cysts of prostate; • urination difficulties with residual urine

Medicamental or apparatus methods also used in the treatment but providing less effect include analgesics, muscle relaxants, adjuvants, psychotherapy, autotraining, α -reductase inhibitors, instrumental methods (TUMT, TUNA, Laser), allopurinol (to reduce uric acid in urine), anticholinergic and spasmolytic drugs. During sanatorium-and-spa treatment of the patients with chronic prostatitis, rectal mud wads and mud and ozocerite "briefs", microclysters with mineral water, mineral baths etc. are desirable. Introduction of therapeutic mud in rectal ampulla causes acute hyperemia not only of mucosa, but also of prostate tissue and seminal vesicles. This increases the microcirculation of tissues and their secretory activity. Popular resorts for the treatment of chronic prostatitis is Saki, Kuyalnik, Truskavets, Morshin, Solonyi Lyman and others.

Both treatment and prevention of exacerbations which may include lifestyle changes, including reduction of hipodynamia, exercises for perineum muscles, timely urination, regular sexual life are of great importance in the correction of chronic prostatitis.

Urethritis

Urethritis is inflammation of urethra mucous membrane.

Etiology and pathogenesis. The emergence of the disease is caused by infectious factors. Urethritis pathogens are *N. gonorrhoeae*, *Ch. trachomatis*, *Mycoplasma genitalium*, *T. vaginalis* and other microorganisms. The frequency of certain microorganism finding varies in different patients' populations. *Mycoplasma hominis*, does not probably cause urethritis, and *Ureaplasma urealyticum* is uncommon reason of the disease. In most cases, the presence of mycoplasmas or ureaplasmas is asymptomatic. In men, the risk of being infected by gonorrhea during one episode of intercourse with an infected partner is around 17-20 %. This risk increases with the number of sexual intercourse with an infected partner. Uncircumcised men may be more prone to gonorrhea infection.

Gonococci are transmitted not only by vaginal way, but also during oral sex. Incubation period ranges 3 to 10 days, but the exceptions are very common. For example, certain strains of microorganisms cause symptoms in a period shorter than 12 hours (including gonococci), other strains may be evident 3 months later. In the pathogenesis of non-specific urethritis, microorganism condition plays significant role. The reasons of non-specific urethritis may be traumatic injuries, including catheterization, bouginage, endoscopic manipulation. In addition, it may develop on the background of general infectious diseases, metabolic disorders, congestive events, and may be caused by allergic factors.

The pathogen being outside the cells on the epithelium surface or within epithelial cells (*N. gonorrhoeae*, *Ch. Trachomatis*) cause the development of pyogenic infection.

Then, chlamydia and gonococci penetrate the upstream parts of the urinary tract and cause epididymitis in men and cervicitis, endometritis and salpingitis in women. Recent data suggest that *M. genitalium* can also cause inflammatory processes of pelvis minor in women.

Bacterial urethritis is caused by various bacteria - staphylococci, streptococci, E. coli, enterococci and other opportunistic pathogenic microorganisms. The pathogens penetrate into mucous membrane of urethra by hematogenic or urogenous route in case of renal, bladder diseases, balanoposthitis etc. Banal microflora, in its turn, may contribute to the beginning of specific urethritis.

Infectious:		Non-infectious:	Classification. All urethritis can be divided into two broad groups: infectious and non-infectious. The urethritis are also divided on gonococcal and non-gonococcal
<i>Specific:</i> <ul style="list-style-type: none"> • gonorrheal; • tubercular; • trichomonal 	<i>Non-specific:</i> <ul style="list-style-type: none"> • bacterial; • chlamydial; • virus; • micotic (candidal) 	<ul style="list-style-type: none"> • allergic; • metabolic; • traumatic; • congestive 	

(non-specific) urethritis. In Central Europe, non-specific urethritis is found much more frequently than gonococcal one. There is a correlation between frequency of promiscuity, low socio-economic quality of life and frequency of STDs.

Acute urethritis is characterized by muco-purulent or abundant purulent discharge from urethra, hyperemia and edema of urethral lips. Pronounced complaint are burning, itching, colics along the urethra, especially during urination, dysuria. In case of non-specific non-gonorrheal urethritis, urethral

discharge may often be scarce, even in the acute stage, or only itching of urethra is noted. Clinical picture of latent and chronic urethritis is similar, but less pronounced. The discharge may be insignificant or lack at all.

Diagnostics. To diagnose urethritis, the following is used:

1. Microscopic and bacterioscopic examinations of urethra scrape (native and painted under Gram or Romanowsky - Giemsa), which allow quantitative and qualitative assessment of cellular components (leukocytes, epithelial), and detect the presence of microorganisms. Finding in Gram stained smear or urethral discharge > 5 WBC in the field of vision during microscopy indicates urethritis and finding intracellular located gonococci (as gram-negative diplococci), trichomonads or other microorganisms indicates etiological factor.

1. Bacteriological study (nutrient media inoculation) can identify microbial organisms, assess their sensitivity to antibiotics.

2. ELISA, PCR and Immunofluorescence (to exclude chlamydia, ureaplasma, viral and other infections).

3. Three-glass urine test, analysis of prostatic juice.

Three-glass urine test detects changes in the first portion characterized by increased number of leukocytes. In case urethritis is complicated by prostatitis, peculiar changes in the prostate juice test are detected. All diagnostics procedures may be divided into mandatory and optional.

Treatment of

acute gonococcal urethritis.

Main method of treatment is prescription of antibiotics.

As a result of continuous growth in the number of strains of

N. gonorrhoeae, resistant to fluoroquinolones, this class of antibiotics is no longer recommended to treat gonorrhea in the United States. Since gonorrhea is often associated with chlamydial infection, it is advisable to treat actively simultaneous chlamydial infection.

Mandatory measures:

- Collection of complaints and anamnesis;
- Three-glass urine test;
- Microscopic and bacteriological studies;
- Bacteriological studies;
- PCR

Optional measures:

- ELISA or Immunofluorescence ;
- Prostate juice test

First line medicines:

- cefixime per os 400 mg single dose or 400 mg as suspension (200 mg/5ml);
- Ceftriaxone im (with local anesthetic) 1 g single dose

Alternative medicines:

- Ciprofloxacin per os 500 mg single dose ;
- ofloxacin per os 400 mg single dose ;
- levofloxacin per os dose 250 mg single dose

Complications. More frequent are the following complications such as balanoposthitis, cavernitis, epididymitis, orchitis, prostatitis, vesiculitis, coliculitis, Reiter's syndrome. Late complications of urethritis include urethra stricture.

Treatment of acute nonspecific urethritis. For treatment of non-specific urethritis, it is better to use other therapy regimes. It is believed that Doxycycline (100 mg b.i.d.7 days) and Azithromycin (1 g

once or every 7 days in chronic cases) are the most efficient in the treatment of nonbacterial infections, but *M. genitalium* infection is better treated with Azithromycin. Erythromycin is less efficient and is often accompanied by adverse reactions.

Another medication from Macrolide group - Josamycin (500 mg t.i.d. for 7 days) provides good clinical results. Prescription of fluoroquinolones is also efficient especially in the case of bacterial flora addition. As pregnant women are contraindicated Doxycycline and fluoroquinolones, in addition to Erythromycin and Azithromycin they may receive Amoxicillin 500 mg t.i.d. for 7 days. For the infections caused by *T. vaginalis*, Metronidazole is prescribed (orally single 2 g dose or 500 mg 2-3 times per day, for 5 days). As with other STDs, it is necessary to treat simultaneously both sexual partners. The patients should be informed about the necessity of sexual abstinence for one week after beginning of therapy, this will provide the disappearance of symptoms and appropriate treatment of their sexual partners.

Common approaches to treatment of chronic non-specific urethritis. In treatment of chronic nonspecific urethritis, antibacterial drugs are combined with medicines potentiating their action. Biostimulators, anti-inflammatory medicines, immunomodulators, multivitamins and others are prescribed.

Local treatment: instillations and irrigation of urethra which are contraindicated in acute inflammation in urethra are possible in the case of chronic inflammation. Follow-up treatment: examination, microscopy of urethra scrape or bacteriological study of the first urine sample 7-10 days later.

Epididymitis, orchiepididymitis

Epididymitis is inflammation of the epididymis classified as acute or chronic process.

Acute epididymitis is clinical syndrome including pain, edema and inflammation of epididymis which lasts less than 6 weeks. It should be differentiated from chronic epididymitis which includes long-term pain in the epididymis and usually without edema.

Complications of acute epididymitis include abscess formation, testicular infarction, chronic pain and infertility. Often, testicle is involved in the inflammatory process, orchiepididymitis occurs.

Epididymitis is more often unilateral and progresses with relatively acute onset.

In 15 % of patients with acute epididymitis, chronic inflammation which may cause epididymis permeability blockage develops, and if testicle is affected, to its atrophy and impaired spermatogenesis.

Etiology and pathogenesis. Common pathogen is infection that gets into epididymis from urethra, prostate or bladder. In young men, it is associated with sexual activity and STD in his partner. All men with epididymitis caused by sexually transmitted infection, have in their anamnesis sexual contact, which could even be a few months before the onset of symptoms. The most cases in sexually active men aged under 35 are caused by sexually transmitted infection, in particular (*C. trachomatis*, *T. vaginalis*, *N. gonorrhoeae*), whereas in older patients epididymitis is usually caused by uropathogens. In homosexual men who practice anal sex, the pathogen of epididymitis is often Coliform bacteria.

In 10 % of cases, injury of epididymis causes its inflammation. The factors that contribute to the disease include sexual excesses, masturbation, prolonged unrealized excitement, interrupted intercourse, overcooling, persistent constipation, hemorrhoids, i.e. those factors that cause stagnation of blood in the veins of pelvis and scrotum.

Orchiepididymitis is also observed in some systemic infections such as tuberculosis, syphilis, brucellosis, cryptococcosis. This is especially peculiar for the patients with immune deficiency. The most common type of orchitis is parotiditis orchitis, which occurs in 20-30 % of patients in postpubertal period as a complication of mumps.

Often, the infection enters the epididymis through spermaduct canal due to antiperistaltic contractions in the presence of inflammation in the prostate gland, urethra, its bouginage, prolonged catheterization, damage during instrumental studies, abnormalities of development.

Clinical findings. The patient complains of acute pain in the respective part of the scrotum, fever up to 38-40 ° C, chills. The pain is radiating to the groin, sometimes to lumbar area and buttocks, acutely increases with movement, forcing the patients to stay in bed. Acute epididymitis begins suddenly, with rapid epididymis increase.

During objective examination, increase in the affected side of the scrotum, redness and edema of the skin are observed, scrotum skin is stretched, loses folds, and reactive dropsy of testicular membranes may appear (Fig. 5.10.)



Fig. 5.10. Scrotum during acute orchiepididymitis



Fig. 5.11. Ultrasonography of acute epididymitis (enlarged epididymis and fluid in testicle membranes are seen)

At the onset of the disease, inflammation and edema are found in the epididymis tail, but may quickly spread to the epididymis and testicle.

Palpating the spermatic cord, thickened and painful ejaculatory duct is detected. If inflammatory process spreads to the testicle, the testicle is enlarged and painful during palpation, (as its epididymis), dense, its surface is hilly. The boundary between it and epididymis is not determined. If the inflammation shifts to abscess formation stage, fluctuation area appears. The abscess may burst out and as a result epididymis is welded to scrotum skin. Echographic picture of acute epididymitis is characterized by enlarged

epididymis or its parts. The structure of the latter is homogeneous or heterogeneous, and echogenicity is decreased. On color Doppler mapping and energy Doppler study, acute inflammation of epididymis is characterized by its hypervascularization (Fig. 5.11).

Acute period of the disease lasts 5-7 days, thereafter the pain decreases, body temperature normalizes, edema of the scrotum and the size of inflammatory infiltrate decrease. However, epididymis remains enlarged, dense and painful on palpation for a period of several weeks.

Diagnostics. Bacterial etiology of epididymitis is usually set by microscopy of Gram stained urethra scrape and detection of gram-negative bacteria. The presence in smear of phagocytized gram-negative diplococci situated inside the cells is peculiar to the infection caused by *N. gonorrhoeae*. The presence of leukocytes in smear only indicates non-gonococcal urethritis. In most of these patients *Ch. Trachomatis* is found. In many cases, transient decrease in sperm count and their antegrade motility can be detected.

Note that the ejaculate analysis should be conducted only when process becomes less acute.

Azoospermia due to complete obstruction of both epididymis is not so rare complication, too. If you suspect parotitis orchitis, diagnosis evidence is the presence of parotitis in anamnesis and detection of specific *IgM* in blood serum. Approximately 20% of cases of parotitis orchitis in men in postpubertal period are bilateral and accompanied by the risk of testicular atrophy and azoospermia.

Differential diagnostics. Acute orchiepididymitis must be differentiated from suppuration of spermatic cord cyst, entrapment of inguinal hernia, torsion of spermatic cord. Elevated scrotum position during orchiepididymitis reduces pain and during torsion of spermatic cord, the pain does not decrease, but vice versa increases (Pren symptom).

Nonspecific epididymitis by its clinical signs and physical examination data is sometimes difficult to distinguish from epididymis tuberculosis. Increased organ, focal density, tuberosity may occur in both

types of epididymitis. Bead-like changes of spermaduct, appearance of purulent scrotal fistulas with simultaneous presence of other tuberculous focus in the body, detection of *Mycobacterium tuberculosis* in urine or purulent discharge from scrotum fistula evidence in favor of tuberculous nature of the lesion. Isolated increase in testicular arises during tumors as well as in case of brucellosis lesion which is often characterized by dropsy of testicular membranes. Sometimes differential diagnostics with tumor is only possible during surgery using urgent biopsy and histological examination.

Treatment. First, tranquility, bed rest, suspensory application should be prescribed to the patients with acute epididymitis. The most efficient drugs are antibiotics. Their selection depends on the degree of penetration of antimicrobial agents into testicle and epididymis tissue and possible sensitivity to these microorganisms. The choice of antibiotic should be done based on empirical awareness that in young sexually active men a cause of the disease is usually *Ch. trachomatis*, and in older men, traditional uropathogens are found more often. Before antibiotic therapy, urethral smear and urine after digital rectal examination for prostate cultural studies and PCR diagnostics could be got. While waiting for the result, the drugs of choice are fluoroquinolones, mainly affecting *Ch. trachomatis*, *N. gonorrhoeae* (eg Ciprofloxacin, Ofloxacin, Levofloxacin), due to their broad range of activity and high degree of urogenital tissue penetration. If *Ch. trachomatis* is established as pathogen, the therapy should be continued with Doxycycline 200 mg per day. Total duration of treatment should be at least 2 weeks. As an alternative drugs of the second stage and alternative drugs, macrolides are used. In severe general condition, detoxification therapy may be applied. Supportive therapy includes bed rest, elevated testicles position (suspensory on scrotum), analgesics and anti-inflammatory drugs. When inflammatory process becomes less intense, hot compress, physiotherapy methods (antibiotics, electrophoresis, procedures with anti-inflammatory effect) are used. In case of epididymitis caused by sexually transmitted disease, sexual partner should also be treated. If the agent is uropathogen, for prevention of infection recurrence, thorough examination should be conducted to detect urination disorders. Chronic epididymitis develops mainly after acute or recurrent epididymitis manifestations. It is characterized by scarring and hardening of epididymis. Epididymis is palpated as solid, enlarged, painless aqueous formation. Often, these residual phenomena of acute epididymitis cause no complaints and do not require further treatment. Complicated sperm outflow from epididymis may lead to the formation of cysts. In case of bilateral chronic epididymitis, resulting in diffuse scarring and occlusion of epididymis tubules, infertility may develop.

Surgical treatment is often used not only in cases of neglected disease with the development of abscess formation and destruction of testicular tissue. When the fluctuation appears, the abscess should be dissected. Complex treatment of patients with acute nonspecific epididymitis and epididymoorchitis with early surgery and simultaneous prescription of modern anti-inflammatory drugs and immune stimulants leads to rapid extinction of inflammatory process in the majority of patients, compared with conservative treatment.

The most acceptable should be "active and expectant" tactic consisting in the attempts to preserve an organ, even a small part of viable parenchyma, especially in young people, and bilateral process, with active and radical tactics in elderly and senile age patients and concomitant aggravating diseases (diabetes, severe cardio-vascular disorders, renal failure etc.). This tactic should be differentiated: at serous stage conservative therapy, at diffuse purulent one - organ preserving surgery (section of epididymis protein membrane for decompression and drainage) and at suppurative destructive one - epididymectomy or hemicastration.

Prognosis. The course of nonspecific acute epididymitis is usually favorable. Body temperature decreases, pain disappears within a few days. However, sometimes upon inflammation, tight knot remains - scar blocking sperm outflow which may lead to infertility.

Cavernitis

Cavernitis is inflammation of the cavernous bodies of the penis. It occurs as complication of prostatitis, gonorrhea, closed penile injury, acute urethritis and infectious diseases. Cavernitis may be uni- or bilateral. During cavernitis, inflammatory infiltrate manifested as painful compression in penis

is formed in one of the cavernous bodies.

Etiology and pathogenesis. Cavernitis often develops upon prostatectomy, when permanent catheter or drainage tubes stay for long in urethra. Except for cavernitis, these patients may have epididymitis, orchiepididymitis, urethritis. Acute and chronic, limited and diffused cavernitis are differentiated.

Acute cavernitis is manifested by pain in penis, fever, chills, urination difficulties due to permanent erection not associated with arousal.

Clinical picture. Disease begins acutely, suddenly. Penis is swollen, hyperemic, in the cavernous bodies infiltration is palpable, sometimes with areas of softening. In case of delayed or inadequate treatment, infiltration transforms into abscess. Simultaneously, the patient has common symptoms of inflammatory disease: headache, chills, fatigue, fever. Limited cavernitis is localized mainly in the cavernous bodies of urethra. Sometimes urination gets difficult. During palpation, painful infiltration is determined in cavernous bodies.

If no medical measures are undertaken, infiltration may suppurate. In this case, an abscess which quickly bursts into urethra lumen is formed in cavernous body. Later, scar tissue grows in place of abscess, and this leads to penis bend during erection which can cause severe discomfort or even make sexual intercourse impossible.

Treatment. Treatment is compulsory at in-patient ward because there is a risk of development of described complications. Treatment of the underlying disease which led to cavernitis, course of antibiotic therapy which is combined during the first day with cold compresses and then with thermal procedures, UHF, electrophoresis, ultrasound, diadynamophoresis of potassium iodide or hydrocortisone and resorption means should be conducted. If an abscess of cavernous body has developed, it should be opened and drained. Good effect is possible with timely treatment.

Antisclerotic therapy should be used when acute process has subsided.

Prognosis in case of timely intensive care is favorable, in case of abscess formation sexual function is impaired. Chronic cavernitis may be a complication of chronic urethritis or a result of improper or inadequate treatment of acute cavernitis. The disease manifests by mild pain in penis, replacement elastic tissue by fibrous as evidenced in presence of penis local compression and erectile dysfunction. When the density of the formation increases, fibrous induration of penis (Peyronie's disease) is observed. Treatment of chronic cavernitis is of essence as well as acute one, but without antibiotics, treatment of erectile dysfunction or Peyronie's disease.

5.2 Tuberculosis of urinary and male reproductive system

Tuberculosis is specific infectious disease caused by inflammation induced by *Mycobacterium tuberculosis* (tubercle bacillus). All tissues and organs without exception may be exposed to tuberculosis. Since tuberculosis infection is transmitted in droplet way through lungs, the disease is divided into pulmonary and extrapulmonary forms. The latter include tuberculosis of any localisation, with the exception of lungs, including tuberculosis of urogenital system. Tuberculosis of urogenital system prevails in the structure of extrapulmonary tuberculosis. Real incidence of urogenital tuberculosis significantly exceeds the registered one, because of the diagnostic complexity, existence of oligosymptomatic effaced forms.

Etiology and pathogenesis. The causative agent of tuberculosis belongs to the order *Actinomycetales*, family *Mycobacteriaceae*, species *Mycobacterium*. These polymorphic bacilli are stable to acids, alkalis and alcohol. Tuberculosis in humans is often caused by *M. tuberculosis* species. Humans are infected by *Mycobacterium* of bovine type (*M. bovis*) mainly when eating raw milk from infected animals. Variability of tuberculosis pathogen has been found long ago, but especially important this issue has become now due to the significant increase in resistance to anti-TB treatment, broad and long-term use of antibacterial drugs. Variability of parasitism media leads to adaptive responses in mycobacteria, changes in their metabolism, increase in mutation and genetic recombination frequency,

role of selective factors. Special importance is attributed to L-variants of mycobacteria in connection with their possibility of long persistence in humans.

The occurrence of resistance to all applicable antibiotics and chemotherapeutic drugs is observed in mycobacterium tuberculosis. Primary drug resistance to the cultures existing in 3-15% of strains, and the secondary one emerging during antibiotic therapy are possible. The mechanisms of resistance occurrence are different and not well studied. Simultaneous existence of sensitive and resistant bacteria is possible in the patient. The occurrence of drug resistance is a major cause of treatment failure. Even formation of drug resistance in mycobacterium leading to progress of the disease is possible.

Tuberculosis lesion of urogenital system is secondary. Mycobacteria enter kidneys, prostate or epididymis in hematogenic way from primary foci, usually located in the lung. Most likely period of kidney infection should be considered the period of "initial complex" formation, followed by latent course of the process, not as complication of pulmonary process spread in hematogenic way.

The development of tuberculous inflammation in the urinary tract before kidneys is impossible.

Tuberculosis infection brought with blood may cause early specific changes only in the bodies with sufficient blood supply, parenchymal ones, i.e. kidney, prostate, epididymis. Today, the theory of lymphogenous, contact tuberculosis spread is rejected. As for urogenital way of infection, it was proved that specific disorder of the urinary tract may occur only towards urine flow from sick kidney, and ascending infection of contralateral kidney from urinary bladder is impossible.

Renal tuberculosis is unilateral process, i.e. only one kidney is affected. Even if bilateral pathological changes are recorded, on the one side they are always more pronounced than from the other one.

Immunity to tuberculosis is acquired and formed in response to the penetration of mycobacteria to the body during infection or vaccination. It manifests in 4-8 weeks upon penetration of microbes.

The key factors in tuberculosis pathogenesis are considered adverse conditions of external environment which reduce the body resistance forces and make tuberculosis one of social diseases. These conditions include starvation, hard physical labor, poor living conditions.

The most significant pathogenetic factor is microcirculation disorders occurring upon bacterial embolus obstruction of small renal vessels. Mycobacteria penetrated to inner part of renal medulla receive favorable conditions for fixation in tissues and their reproduction.

Unlike primary metastatic lesions in cortical area which are subject to cicatrization in case of efficient functioning of immune system, specific inflammatory infiltrates in the area of pyramids apex progress. These changes are consistent with the initial form of renal tuberculosis defined as renal parenchyma tuberculosis. Further development of specific inflammatory process depends on many factors, first of all, virulence of mycobacteria trapped in the parenchyma.

An important stage in development of specific inflammatory renal lesion is transition of tuberculosis process to the urinary tract. Appearing initially in the submucosa of ureter and calix, the tubercles are covered with ulcers and scars. Ureteral strictures, bullous edema of its mucosal, pedunculitis and periureteritis and lead to urodynamics disorders. In the conditions of high intracaliceal pressure, favorable conditions for TB infection spread are created by renal pelvis reflux.

Tuberculosis of urinary bladder is always secondary in relation to kidneys and ureter lesion.

Tuberculous infectious organism is spread to submucous of bladder wall through lymphogenous route. At the initial stages of tuberculous lesion, tubercle rash is localized around the ureter on the side of the affected kidney. In future, the tubercles are covered with ulcers. In case of inflammation spread, ulcerative lesions of the upper and lateral walls of the bladder appear, its capacity decreases it is initially caused by chronic detrusor hypertonicity, and then by its sclerotic degeneration. Logical consequence of these changes is occurrence of bilateral vesico-uretral reflux leading to progress of pyelonephritis and renal failure.

Pathomorphology. Tuberculosis, like other mycobacteriosis, refers to the group of granulomatous diseases, primary tissue manifestation is granuloma progress. Tuberculous inflammation is not referred to chronic forms and is prolonged response to pathogenic agent. Main granuloma cell is macrophage.

In granuloma, accumulating macrophages transform into epithelioid cells. Merging of the latter leads to giant polynuclear Pirogov - Langhans cells with peripheral horseshoe location of nuclei. Different types of cells are part of granulomas.

The following pathological forms of hematogenic *renal tuberculosis* are known: miliary, focal, cavernous tuberculosis and tuberculous pyonephrosis and tuberculous infarctus. "Long-term consequences of urinary tuberculosis" include dissociated tubercular foci that have lost their activity, calcified focus, postoperational conditions, changes associated with excessive fibrosis and its consequences, nonspecific disease on the background of "cured" tuberculosis (pyelonephritis, urolithiasis and others) proliferative changes in the epithelium of the urinary tract. The rare form of renal tuberculosis includes their miliary lesions with excessive fibrosis - tuberculous nephritis.

Tuberculous lesion of ureter found in half of the patients with cavernous renal tuberculosis may be miliary, infiltrative-ulcerative and tyroid. Depending on involvement of ureter walls, endo-, meso-, peri- and panurethritis may be distinguished.

Tuberculosis of urinary bladder is similar to ureter lesions. Specific lesion of the ureter and bladder may complicate by secondary infection, resulting in the development of irreversible sclerotic changes with organ dysfunction. Thus, ureteral stenosis leads to urine stasis in calico-pelvic system of kidney, increase in intracaliceal pressure and as a result, atrophy of renal parenchyma with renal failure progress. The consequence is a loss of kidneys from hydronephrotic transformation, pyonephrosis or nephrosclerosis.

Tuberculosis of male genital organs is found in miliary, focal or focal destructive and fistula forms.

Tuberculous orchitis is associated with epididymis lesion. Morphologically, depending on the predominant localization of tuberculous granulomas, interstitial and intracanalicular are distinguished. The progress may lead to total caseous necrosis of testicular tissue, lesion of its membranes and tissues of scrotum, formation of fistulas. As a result of tubercular inflammation of the testicles, the cicatricial changes macroscopically similar to gummatous ones are observed.

In case of tuberculous epididymitis, the organ is enlarged and dense, dry, whitish-yellowish foci in its tissue with typical histological picture are found. The progress of inflammatory process often goes on testicle membranes (periorchitis), scrotum tissue with fistula formation and development of verruciform skin tuberculosis, spermaduct.

Tuberculous prostatitis is often combined with tuberculous epididymitis, deferentitis or renal tuberculosis, but may be one of the direct manifestations of hematogenic tuberculosis.

Histologically, in tissue of the organ, the groups of confluent granulomas and foci or at the stage of decay, the formation of cavities is possible. Massive caseification may lead to formation of fistula to urethra, urinary bladder, rectum and perineum.

Classification. Since 2006 in Ukraine, according to the Ministry of Health dd. 09.06.2006 № 385, clinical classification of tuberculosis, adapted to the classification of diseases and other problems related to health 10 WHO edition 1993 has been valid taking into account organizational and tactical and dispensary characteristics of the disease.

Clinical classification of tuberculosis.

I. Type of tuberculosis:

- First diagnosed tuberculosis - FDTB (date of diagnosis).
- Relapse of tuberculosis - RTB (date of diagnosis).
- Chronic tuberculosis - CTB (date of diagnosis).

II. Clinical forms of tuberculosis:

Localization and prevalence

Renal tuberculosis:

1. tuberculosis of renal parenchyma;
2. tuberculosis of renal papilla (papillitis);
3. cavernous tuberculosis;
4. fibro-cavernous tuberculosis;
5. tuberculous pyonephrosis.

Tuberculosis of ureter:

6. infiltrative (paraurethritis);
7. ulcerative. Tuberculosis of the bladder: 8. focal; 9. ulcer.

Tuberculosis of urethra (rare form):

1. ulcerative.

Tuberculosis of male genital organs:

2. Tuberculosis of prostate;
3. focal;
4. cavernous;
5. tuberculosis of seminal vesicles (vesiculitis);
6. Tuberculosis of epididymis (epididymitis);
7. caseous-cavernous;
8. testicles tuberculosis (orchitis);
9. focal;
- 4 cavernous;
- 5 spermatic duct tuberculosis (deferentitis);
- 6 penis tuberculosis (rare form).

Phases of the process:

- 7 infiltration;
- 8 degradation;
- 9 ulceration;
- 10 resolution;
- 11 scarring;
- 12 calcification.

Bacteriarelease

- 13 Mycobacterium tuberculosis (MBT +)
- 14 without Mycobacterium tuberculosis (MBT-).

Clinical findings. Tuberculosis of urogenital system is considered the most common "hoaxer" among renal and urinary tract diseases, because its clinical manifestations are extremely multifaceted and have no pathognomonic signs. In many patients, renal tuberculosis imitates for long any chronic renal disease - chronic pyelonephritis, urolithiasis, renal cystic disease, tumors etc. - and some patients have no subjective symptoms.

Classical symptoms for urotuberculosis are the following: frequent and painful urination, dull pain in the area of affected kidney, aseptic pyuria, stable acidic urine. In recent years, more and more often, pthisiurologic patients have no some and sometimes any of the above symptoms. Common signs are also rarer - fatigue and exhaustion.

Clinics of urogenital tuberculosis is closely related to anatomical and functional changes in kidneys and urinary tract.

There are general and local symptoms of urinary system tuberculosis. General symptoms include changes in general condition of patients, fever and arterial hypertension. Local symptoms are divided into subjective symptoms (pains and urination disorders) and objective (physical signs, changes in urine). Modern clinics of urinary system tuberculosis is characterized by the dominance of local over general ones.

The most permanent changes are observed in urine - leucocyturia, erythrocyturia, proteinuria, hyposthenuria, TBC-micobacteriuria, nonspecific bacteriuria. TB micobacteriuria is most probable and specific among these features. Finding of *Mycobacterium tuberculosis* in urine always means urinary system tuberculosis. *Mycobacterium tuberculosis* is possible to find in urine not in all patients with renal tuberculosis, even with all modern means of bacteriological examination. On average, *Mycobacterium tuberculosis* is found in 50-70% of patients with renal tuberculosis.

With renal tuberculosis as with chronic pyelonephritis, there are three phases of inflammatory process: active, latent and remission (or clinical recovery).

In case of prostate and seminal vesicles lesion, the disease may progress for a long time without symptoms or with symptoms of prostatitis, hemospermia, dysuria, painful ejaculation, pain in anus during defecation, infertility. According to prevailing localization of specific process, so-called rectal forms (pain in perineum during defecation, in the sacrum), cytouretral form (dysuria, painful ejaculation, hemospermia, infertility) are found.

When scrotum organs are affected, at early stage of the disease, the symptoms are similar to those of acute epididymitis or orchiepididymitis: acute pain in the scrotum. Scrotum is hyperemic, swollen.

Testicle and epididymis are enlarged, acutely painful during palpation.

Subsequently, fluctuation area appears on scrotum skin, where cutaneous fistula with purulent discharge is formed, testicle and its epididymis are transformed into single dense, tuberiferous, painless conglomerate or tuberiferous indurations remain in epididymis.

Casuistic localizations of sexual tuberculosis also include specific lesion of penis, spermatic cord and Cowper's glands.

Diagnostics. Diagnostics of renal tuberculosis is difficult due to lack of pathognomonic clinical manifestations of the disease, often hidden or concealed course. So targeted special examination focused on tuberculosis is necessary for the patients complaining of urological symptoms if there is no conclusive data for nonspecific urological disease.

Clinical examination methods. Clinical examination of the patient begins with their interview: explanations of complaints, anamnesis of this and other diseases.

Physical examination methods may have some importance at the beginning. If the findings of palpation of kidneys and urinary tract are not pathognomonic for tuberculosis, the changes in male genitals may be found (density and tuberosity of epididymis or testicle with epididymis, purulent fistula in scrotum, induration of spermaduct, prostate) indicating tuberculous etiology of genital diseases and possibility of concomitant pathological process in kidney. Thus, clinical examination methods do not allow setting the diagnosis of tuberculosis of urogenital system, but may suspect this disease.

Laboratory diagnostics

Laboratory diagnostics is the most important for recognition of renal tuberculosis.

In so far as clinical symptoms are not pathognomonic for renal tuberculosis so its manifestations found in laboratory examinations are typical.

Blood count. General blood tests may be used to assess the activity of specific inflammation. In case of renal tuberculosis, increased erythrocytes sedimentation rate, lymphopenia, monocytosis, eosinophilia are found. In case of renal tuberculosis, leukocytosis is rare, regardless of the prevalence of specific process. Lymphocytopenia is observed in 15-20% of patients - monocytosis, which to some extent may reflect the activity of tuberculosis process. More and more importance is paid to the studies of nonspecific and specific immune resistance parameters. For such purpose, the content of sialic acid and C-reactive protein (CRP), serum protein fractions, neutrophil damage index (NDI), protuberulosis antibodies titre, lymphocyte blast transformation reaction (LBTR).

Renal tuberculosis is characterized by reduction in albumin level and increase in serum globulins,

especially α and γ - fractions.

Urine tests is basic laboratory diagnostic method of renal tuberculosis. Stable acidic urine reaction, proteinuria, leukocyturia, erythrocyturia are considered to be classical signs of renal tuberculosis. Formerly, one of the classic signs of renal tuberculosis was considered "aseptic pyuria." Recently, specific ratio of non-specific urinary infection increases for renal tuberculosis.

Bacterial diagnostics of renal tuberculosis

Since the most reliable and early symptom of renal tuberculosis is the presence of tuberculous mikobacteria, to set the diagnosis of this disease, search of *Mycobacterium tuberculosis* in urine is extremely important.

Today, the concept of "physiological" tuberculous bacteriuria has been finally rejected. Inoculation rate of *Mycobacterium tuberculosis* with proven renal tuberculosis varies from 26% to 73 % of cases. The presence of tuberculosis pathogen in urine, without being the most common sign of renal tuberculosis, can be considered the most specific, early and reliable its manifestation. Finding of *Mycobacterium tuberculosis* in urine is the basis to set the diagnosis even if there is no radiographic and laboratory data indicating specific inflammatory lesion of urinary organs.

Mycobacterium tuberculosis in urine are found by bacterioscopy (microscopy of sediment), biological study and biological sampling.

Resolving power of bacterioscopic examination is rather low. Main advantage of culture method to find *Mycobacterium tuberculosis* is its high sensitivity up to 73 %. Significant drawback of culture method is that the duration of culture growth ranges 15 to 53 days, and another 1.5-2 months are required to determine drug sensitivity. Biological test - introduction of native urine in Guinea pigs in order to infect it with TB and its subsequent finding – has been recently applied rarer due to lack of significant advantages in comparison with culture method.

Recently, qualitatively new ways of tuberculosis diagnostics have appeared at the molecular level. These are amplification methods for finding of DNA and RNA *Mycobacterium tuberculosis* in biological substrates. The most common in clinical practice is Polymerase chain reaction (diagnostic sensitivity and specificity are estimated at 90-100%).

Tuberculin diagnostics. Skin tuberculin test is classic example for finding of delayed hypersensitivity and is widely used in complex diagnostics of renal tuberculosis (intradermal Mantoux test). Tuberculin challenge tests based on assessment of skin, general and focal reaction upon parenteral tuberculin injection are of great value for diagnostics of renal tuberculosis.

Pathomorphological examinations. Finding in the tissues of kidney and urinary tract or genitals under examination of histological changes corresponding to renal tuberculosis findings is one of the most reliable diagnostic sign.

Endoscopic methods. This group includes cystoscopy, chromo cystoscopy, ureteral catheterization for examination of urine obtained from renal pelvis, or for retrograde ureteropyelography, endovesical biopsy of urinary bladder, uretero and pyeloscopy during which you have the opportunity to perform diagnostic and therapeutic manipulations (biopsy, lithotripsy, stricturotomy etc.).



Fig. 5.12. Excretory urogram. Cavernous tuberculosis of the left kidney. Tuberculous microcyst



Fig. 5.13. Excretory urogram. Polycavernous tuberculosis of single functioning right kidney. Strictures of middle and lower thirds of urethra

Radiological examinations.

Radiological diagnostics of urinary tuberculosis is currently one of the main methods. Current range of radiological methods for renal tuberculosis diagnostics includes radiography and tomography, excretory urography (Fig. 5.12, 5.13), retrograde or percutaneous antegrade

pyelography, descending and ascending cystography, renal angiography, radiocinetography, radionuclide renography, computed tomography (Fig. 5.14, 5.15), nuclear magnetic resonance imaging. These methods are used comprehensively in various combinations according to strict indications and complement each other.

Depending on the location and severity of the process, there are three radiological forms of renal parenchyma tuberculosis.

Tuberculosis of renal parenchyma with localization of single tuberculous foci mainly in cortical layer of kidney. In this situation, no radiological signs are observed.

Tuberculosis of renal parenchyma with localization of multiple foci in cortical layer. X-ray picture in these patients may imitate tumors and cysts, sometimes compressions and extensions of some calix with slower evacuation.

When specific changes are located in juxtamedullar section of renal parenchyma, certain calix or their groups deform, elongate or become beadlike. In these patients, false exclusion of one or more calix may be observed.

In the case of calcification of cortical tuberculous foci, characteristic pyelographic tuberculoma picture appears.

In case of cavernose form, radiological changes are polymorphic, characterized by calix deformation and presence of cavities in pericaliceal area. *Ultrasound examination.* Ultrasound scanning of kidneys allows to judge the state of pelvicalyceal system to promptly identify renal stones, calcification foci, sclerotic changes, cavities and cystic formations concomitant to tuberculosis and to determine the contents of cavities and the thickness of their walls. Ultrasound in phthisiurological practice should be used as screening for finding clinically non-manifested forms of the disease in persons being in risk group concerning renal tuberculosis.

Differential diagnostics. Tuberculosis of urinary system is often differentiated from its nonspecific inflammatory diseases (pyelonephritis, cystitis etc.) and neoplasms. Features of clinical course of modern renal tuberculosis, representative specific changes in male genitals, radiographic changes, inefficiency of previous therapy, dynamic factor, results of comprehensive examination, and what is the most important- positive results of bacteriological urine examination for MBT – allow to make proper differential diagnostics. In case of oncological alertness, except for the specified methods, angiography, biopsy and identification of atypical cells in urine are important; in severe cases, diagnostic surgery should be done.

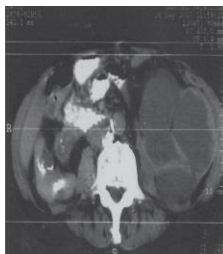


Fig. 5.14. Computed tomogram – left-side tuberculous pyonephrosis



Fig. 5.15. Computed tomogram – image of wrinkled calcified right kidney

Treatment. Medication Among complex therapeutic measures aimed on treatment of the patients with tuberculosis, etiotherapeutic chemotherapy occupies leading position.

There are two groups of anti-TB drugs: Group 1 - the most efficient drugs (Rifampicin, Isoniazid), Group 2 - high efficient drugs (Streptomycin, Kanamycin, Amikacin, Florymicin, Pyrazinamide, Ethambutol, Protionamid, fluoroquinolones). The efficiency of chemotherapy depends on its duration. In the period of occurrence of the first anti-TB drugs, treatment

duration was relatively short (1-3 months). As the experience was gained, it has gradually increased and reached 12-18 months.

Recently, in many countries, the Directly Observed Treatment Short Course (DOTS) has been tested, which has shown to be highly efficient and allowed to reduce significantly the duration of treatment (6-9 months) due to the use of rational chemotherapy regimens. Because of various state of bacterial populations at different stages of the disease during chemotherapy, recently, it has been decided to divide the whole period of chemotherapy treatment in 2 stages.

At the first phase of chemotherapy when there is rapid MBT reproduction, for the bacillary patients found for the first time, 4 anti-TB drugs are prescribed (Isoniazid, Rifampicin, Pyrazinamide or Streptomycin, Ethambutol). Such intensive chemotherapy lasts 2 months, and if bacteria discharge is preserved, that is evidenced by smear microscopy, 3 months. In newly diagnosed patients at the second stage of chemotherapy, when the majority of mycobacterial population is suppressed, 2 drugs (Isoniazid and Rifampicin) are taken for 4 months every day or every other day. For newly diagnosed patients treated irregularly or who interrupted treatment, and for the patients with tuberculosis relapse, in intensive phase, five drugs (Isoniazid, Rifampicin, Pirazynamyd, Streptomycin, Ethambutol) are recommended for 2 months, then for 1 month, 4 drugs (Streptomycin is canceled) should be used. The second phase of chemotherapy in these patients is recommended with 3 anti-TB drugs for the next 5 months every day or every other day.

In the patients, in whom at the initial examination MBT were not found, intensive part of chemotherapy may include 3 drugs (Isoniazid, Rifampicin, Pyrazinamide) for 2 months, then intake of 2 drugs (Isoniazid and Rifampicin or Ethambutol) should be continued for 4 months. The patients with chronic forms of tuberculosis should be treated under individual chemotherapy patterns based on resistance of Mycobacterium tuberculosis to the medicines and subsequent modification of chemotherapy regimen in case of secondary resistance to used drugs. Often, for such patients as well as for the patients in whom MBT polyresistance has been found, reserve drugs should be used - Kanamycin, Amikacin, Protionamid, Ethambutol and fluoroquinolones (Ofloxacin, Lomefloxacin, Ciprofloxacin).

Surgical treatment. Conservative treatment as an independent method is used at early stages of renal tuberculosis. In case of cavernous forms, especially complicated by urinary tract lesions, the main method is surgery.

Specific chemotherapy is done in pre-and postoperative periods (including functional capacity of kidneys or kidney). In case of renal tuberculosis, the following surgeries are used: 1) organ removing - nephrectomy, nephruretectomy; 2) organ preserving - cavernotomy, cavernectomy, resection of kidney, 3) reconstructive - ureterocystoneoanastomosis, ureteropyeloanastomosis, ureterocalicoanastomosis; 4) plastic (intestinal plastic) – ureterointestocystoplastic; 5) palliative - nephropylotomy, ureterocutaneostomy.

In case of tuberculosis of external genitalis, main treatment method remains surgery, however, the use of specific drugs allows to reduce surgical activity up to 50% and affect the nature and extent of surgery. Types of surgeries: cavernotomy of epididymis and testicle, epididymis resection, epididymectomy with resection of testicle, orchiectomy, castration, vasoresection, spermaduct surgery.

Prognosis. The prognosis depends on the stage of the disease and prevalence of urinary system lesion.

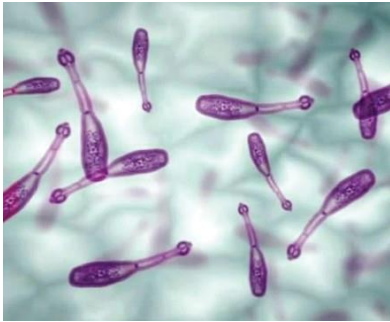
At the early stages of renal tuberculosis, recovery of almost all patients may be achieved. In case of pronounced destructive forms of renal tuberculosis, especially complicated by urinary tract lesions, despite the surgeries (often repeated), more than 30% of patients remain permanently disabled.

Life prognosis for the patients with tuberculosis of favorable reproductive system. In case of bilateral lesion of epididymis, in most cases, infertility is recorded. Disability occurs only in the patients with severe urogenital tuberculosis.

5.3. Parasitic diseases of urinary and male reproductive systems

Renal echinococcosis

Renal echinococcosis is very rare form of the disease: among all cases of echinococcosis, renal lesion is 1.5 to 5%. It occurs mainly in rural areas in the patients 20 to



40 years old. The process is usually unilateral.

Fig. 5.16. *TeniaTaenia*

Etiology and pathogenesis.

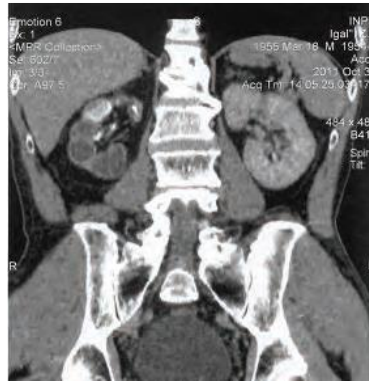
The disease is caused by the hydatid stage of tenia *Taenia* kidney. The germs of echinococcus through hematogenic and develop mainly in cortical layer. in pets. It takes several years from clinical symptoms.

During echinococcosis, single-or chitinous shell is formed in the kidney, from the inner layer of which embryonic scoleces are growing providing its endogenous growth. The cyst causes parenchyma atrophy and can grow into adjacent organs (liver, spleen, intestine). When a cyst is perforated in calix or pelvis, echinococcus fluid enters urinary tract. Suppuration of a cyst is complicated by development of pyelonephritis and pyonephrosis.

Clinical findings. Clinical course and symptoms of renal echinococcosis are conditioned by number, size and cyst location, nature of morphological changes, presence or absence of complications. There are two periods of helminthiasis course- latent and with clinical manifestations. Latent period is from the time of parasite entry till the first clinical manifestations. Patients do not complain for a long time and do not seek medical aid. During the period of clinical manifestations, dull aching pain in lumbar region is observed, painful enlarged kidney may be determined by palpation. If there is an open cyst, renal colic, dysuria is observed, pyuria and hematuria are possible

Diagnostics. The basic method is intradermal allergy test with echinococcus antigen (Kaconi test), the probability of which is 90. In case of open form of echinococcosis (cyst) during cystoscopy it is possible to see how from the ureter opening of affected kidney, filial vesicles are separated. On the observation image, it is possible to find enlarged shadow of a kidney with irregular contours. Sometimes, annular shadow of calcified wall of echinococcus cyst is fixed.

Fig. 5.17. Schematic representation of different types of pyelograms in case of renal echinococcosis.



echinococcus

development of pustule and *echinococcus* (Fig. 5.16.) in penetrate the kidney lymphogenous route and The source of infection is infection until the first

multi-chamber cyst with

When performing excretory urography or retrograde pyelography in cases of closed renal echinococcosis, the following options may be observed:

1. Large thin crescent shadow (Fig. 5.17 a), located mainly unilaterally in kidney, sometimes this shadow is deformed, contains spots (Fig. 5.17, b);
2. compression of one or two calix by a parasitic cyst, whereupon there is crescent shadow around one of the cyst poles on X-ray picture (Fig. 5.17, c);
3. Pelvis takes the form of "fingers of squeezed hand" (Fig. 5.17, d) in case the cyst localization in the lower kidney pole.

Open form of echinococcosis kidneys is characterized by the following two types of X-ray picture:

- a) on the background of the lower shadow, there are small dense rounded shapes resembling a bunch of grapes and caused by penetration of contrast fluid around filial vesicles (Fig. 5.17, d);
- b) presence of contrast fluid shadow in the cyst cavity with horizontal level and dense shadows on the top - gas presence (Fig. 5.17, e).

Ultrasonography and computed tomography allow to differentiate the cysts from tumors and to establish the prevalence of pathological process.

Differential diagnostics is carried with solitary cyst and renal tumors.

Treatment of the patients with renal echinococcosis is surgical. The method of surgery depends on the size, condition and location of parasitic cyst, its dependence on surrounding organs and tissues. When the cyst is located in one segment of the kidney, organ preserving surgery is recommended (resection of kidney with parasitic cyst).

The cyst is removed, its content is evacuated. 2% formaldehyde solution (to destroy filial vesicles) is injected into the cyst cavity. The cyst is excised and its content is removed together with chitinous shell and filial vesicles. The surgery is completed by excision of excess fibrous renal capsule and laying of knotty catgut sutures. If the cyst suppurates, it should be stripped, its content should be sucked, chitinous shell and filial vesicles should be removed. The formed cavity should be treated with 2% formaldehyde solution and drained. In case of massive destruction of renal parenchyma and intact function of contralateral kidney, nephrectomy is indicated. **Echinococcosis of retroperitoneal cellular tissue** is one of the rare localizations. Treatment consists in open echinococcectomy with excision of cyst wall together with surrounding tissues upon prior cleaning of its cavity and treatment of the wall with 3% formaldehyde solution. The surgery is finished by retroperitoneal drainage.

Echinococcosis of paravesical tissue and urinary bladder. Primary lesion of paravesical tissue and urinary bladder is very rare and occurs as a result of dissemination of abdomen organs or hematogenic contamination by helminthic larvae from pelvic vessels. The main features of pathology is presence of fragments chitinous membrane, filial vesicles and echinococcus hamulus in urine and positive intracutaneous allergic test with echinococcus antigen. During cystoscopy, rounded protrusion of its walls is found in the bladder cavity. Mucous membrane is red, blood vessels are dilated. Sometimes, edema of mucosa with bruise areas and fibrous tumors with dark red films or erosion are observed. When a cyst is calcified, annular shadow is found on plain picture. Deformation of urinary bladder, defect in its content are found on cystograms.

Treatment of echinococcosis of paravesical tissue and urinary bladder is surgical: removal of a cyst with resection of bladder wall or echinococcectomy.

Echinococcus cysts of prostate are extremely rare and always secondary. Clinical manifestations of prostate echinococcosis are caused by number and size of cysts, nature of morphological changes, presence or absence of suppuration. Main element of the disease clinics is gradually increasing dysuria. Often, such patients are treated for a long time for chronic cystitis or prostatitis. When the cysts increase

and suppurate, difficulties in urination and defecation (acute retention of urine is possible), pain in underbelly and perineum appear.

Diagnostics. Cystoscopy has limited diagnostic capacity. With the help of cystography, deformation or filling defect is found. The most valuable method in recognizing prostatic echinococcosis is ultrasonography and computed tomography.

Treatment is only surgical. Transvesical access is often used. Bladder wall is opened over protrusion, the cyst is opened and its content is carefully removed. The cavity is treated with 3-5% formaldehyde solution, wall cysts are maximally cut, and the cavity is tightly caught up with the remnants.. The surgery is completed by cystostomy.

The **prognosis** of the disease in case of timely treatment is favorable.

Urogenital schistosomiasis (bilharziasis)

Urogenital schistosomiasis is a parasitic disease typical for a number of tropical countries in Africa, America and Middle East.

Etiology and pathogenesis. Pathogens are trematodes of *Schistosomatidae* family (Fig. 5.18).

Intermediate hosts of these trematodes are gastropods, final host is a man, mammals and birds. When blood flukes eggs penetrate into the water, miracidium leave them and penetrate mussel's tissue where they further develop. Human beings are infected while swimming in waters where Cercariae are present.

As a result of active movement and tissue lysis, blood flukes penetrate to



Fig. 5.18. *Schistosoma mansoni* egg

vascular bed and migrate into venous plexus of gastrointestinal tract or urinary bladder where females begin to lay eggs which through vascular wall penetrate to submucous membrane of the bladder and sexual organs. Thus, schistosomiasis infiltration - bilharzioma is formed. In consequence of urinary bladder contraction, the eggs are perforated through epy mucosa and are discharged with

urine. Trophic disorders of mucusous membrane lead to ulceration, during the scarring of which ureter is involved and bilateral ureterohydronephrosis and chronic renal failure are developing. Except for urinary bladder, migrating parasites can penetrate along the anastomosis of venous plexus to prostate, seminal vesicle, epididymis, spermaduct.

Clinical findings. 10-15 minutes later at the place of Cercariae penetration, urticaria appears, and within a day there is a transient macular rash with severe itching, preserved for 5 days. 1-2 months upon infection by blood flukes, acute schistosomiasis or Katayama fever develops. The disease is characterized by sudden onset, fever for 2 weeks or more, dry cough, appearance of urticary rash, hepatomegaly, splenomegaly, leukocytosis, eosinophilia, increased erythrocyte sedimentation rate.

Diagnostics. Absolute sign of the disease is finding schistosoma eggs in urine. An important role is played by cystoscopy, in which schistosoma warts appear looking like yellow hemispherical transparent formations without signs of inflammation of the surrounding mucosa. At the later stages of the disease, schistosoma infiltrates (hyperemic irregular formations in urinary bladder mucosa) and bladder ulcers are found. In case of chronic invasion, the mucosa of urinary bladder is pale yellow, with poor vascular pattern and presence of "sand" spots : calcified eggs of helminthes are seen through the mucosa.

The outlines of calcification areas are observed on plain urogram, their intensity depends on the degree of concentration of layed eggs and fibrosis of the bladder wall.

The diagnosis is confirmed by indirect immunofluorescence with schistosoma antigens.

Treatment is conservative (trivalent stibic medicines and thioxanthenes compounds). Treatment course includes 12 i.v. injections of 1% solution of antimonyl-sodium tartrate every other day for 4 weeks. Surgical treatment in case of narrowing of ureter (ureterocystoneoanastomosis).

Prognosis is favorable in case of timely specific therapy

Prevention is total prohibition on swimming in natural waters of tropical countries, boiling of drinking water.

Filariasis

Filariasis is helminth invasion of humans and animals caused by filaria- nematodes of the family *Onchocercidae* (Fig. 5.19.). Filariasis is common in tropical countries of Africa, Asia, South America, the Pacific Islands. Today over 120 million people are infected and about 40 million are crippled and became disabled owing to this disease.

Etiology and pathogenesis. Filaria is viviparous helminthes. Man, vertebrate animals are its final hosts, blood-sucking Dipteran insects of various kinds are intermediate hosts, and they are the carriers of the parasite. In humans, mature helminthes parasitize in lymphatic vessels and nodes, in the mesentery, retroperitoneal tissue, in various body cavities, skin and subcutaneous tissue. During blood suction by an insect, microfilaria penetrate with blood into its stomach, then migrate to the muscles, which become invasive larvae. By hemolymph, they are carried to an insect proboscis and during blood suction through the skin penetrate to the body of final host. The concentration of larvae of some filaria species circulating in blood can vary during the day. In this regard, three invasion types are distinguished: periodic - pronounced peak of population falls on certain time period - day or night, subperiodic - larvae reside in blood, but during some hours of the day, their concentration increases; aperiodic (permanent) - microfilaria are found in blood at any time in the same amount. The frequency of microfilariasis is conditioned by the time of maximal activity of insect transmitter.



Fig. 5.19. Nematode *Filarioidea*

In humans, adult filaria parasites in lymph vessels and nodes, larvae (microfilaria) in blood vessels. The most affected are lymphatics in pelvis and lumbar region.

Filaria leads to partial or complete blockage of lymph vessels and as a result of toxic allergenic effect cause inflammation of their walls and the development of sclerotic changed. Progression leads to lymph flow disorder from external genitalia and lower extremities, subsequently causing elephantiasis.



Clinical findings. Filariasis with lesion of male genitals is characterized by the development of: 1) lymphadenitis - lesion of inguinal lymph nodes (the earliest, and sometimes the only symptom of the disease), 2) lymphangitis of scrotum organs manifesting in intense pain in groin and testicles,

Fig. 5.20. A patient with Elephantiasis of scrotum and lower extremities

fever, edema of scrotal skin, funiculitis, lymphangitis of penis, epididymitis, orchitis, with acute or chronic course, and 3) hydrocoel, 4) elephantiasis of scrotum (Fig. 5.20, 5.21).



Fig. 5.21. A child with Elephantiasis of scrotum

Diagnostics is based on clinical findings of the disease. Finding larvae of a parasite – microfilaria - in blood, urine, etc. are of particular importance. Diagnosis is set on the basis of clinical, epidemiological anamnesis (stay in endemic areas) and finding of microfilaria in smear and thick drop of blood stained by Romanowsky - Giemsa, biopsy of skin, lymphatic nodes, hydrocoele content. Immunological methods (reaction of passive hemagglutination, complement fixation, immunofluorescence analysis etc.) are also used. During cystoscopy, sometimes it is possible to find varicose lymphatic vessels. Lymphography allows to find

where the lymph penetrates urinary system.

Treatment is conservative. Such drugs as Diethylcarbamazine (Ditrasin, Banocidum, Notesin, Hetrazan) are prescribed. 2% solution of silver nitrate is locally injected into the bladder or electrocoagulation in the location of lymph leakage is performed. In case of massive lymph loss, urinary bladder should be removed. Surgical treatment of acute filarial epididymitis, orchitis and hydrocele does not differ from that in case of non-parasitosis similar diseases. In case of significant chyluria from affected kidney and satisfactory function of contralateral kidney, nephrectomy is used.

Forecast is serious because of the possibility of elephantiasis, which can lead to disability. The cause of deaths could be purulent-septic complications.

Prevention is protection of people from insects-transmitters bites.

Control questions

- What factors complicate the course of urinary tract infection?
- Make a plan to treat a woman patient with gestational pyelonephritis.
- Perform differential diagnosis of acute pyelonephritis with acute pneumonia and acute appendicitis.
- Clinical and laboratory manifestations of systemic inflammatory response syndrome.
- A patient 55 years old complains of pain in the right half of the scrotum, increased body temperature up to 38 ° C, fever. A week ago, bladder catheterization was performed. **OBJECTIVE:** during palpation, pain, edema of the right half of the scrotum, lack of differentiation between testicle and epididymis. **Diagnosis?**

Answer. Acute right-orchepididymitis.

- Are there pathognomonic symptoms of renal tuberculosis?
- Describe three radiological forms of renal parenchyma tuberculosis.
- The state of a patient 67 years old, who for many years suffered from chronic cystitis, has worsened, it manifests in urination every 10-15 minutes with pronounced pain. During radiological examination, right-sided pyelectasia with contrast of lower pelvis, reduced bladder volume to 40 ml were found. What is the most likely diagnosis?

Answer. Cavernous tuberculosis of right kidney, urinary stricture of the right ureter, tuberculous microcyst.

- Identify the characteristics of renal echinococcosis on excretory urograms.
- Bilateral inguinal lymphadenitis and hydrocele are observed in a 19 years old patient, residing in one of the Central African countries. Diagnosis? Examination plan?

Answer. The patient has filariasis features. It is necessary to make microscopy of blood smear to find microfilariae, as well as an immunological tests

Chapter 6

UROLITHIASIS

Urolithiasis is a polyetiological disease associated with metabolic disorders and accompanied by stone formation in the urinary tract.

Epidemiology

The prevalence of urolithiasis in Ukraine takes the second place after the urinary tract infection among all urological diseases. In the USA, the prevalence of urolithiasis is 10-15%. Male morbidity with urolithiasis is 2-3 times more frequent than in the females. The average risk of stone formation is 5-10% during the lifetime. Annually urolithiasis incidence increases. The urolithiasis morbidity is 0.16 - 0.22 and rate of development is 30-45% of all urological pathology. The people of young working age fall ill more frequently, the disease has symptoms of acute and chronic pyelonephritis with frequent relapses of urolithiasis (3-80%). In its turn, it results in development of renal failure, disability and patient's mortality. In 2010 death from urolithiasis was 0.869 in Ukraine.

Classification. Stones of the urinary tract are classified depending on their size, localization, X-ray contrast (Tabl.6.1), etiology of their formation, composition (mineralogy), risk group of development of urolithiasis recurrence. According to the size, the stones can be of up to 5 mm, 6-10mm, 11-20mm, >20 mm. Depending on the anatomic localization there are stones (Fig. 6.1) of the upper, middle or lower pelvis, upper, middle or lower third of the ureter, bladder and urethra. As to the number, there are single or numerous stones. According to the frequency of development there are primary, recurrent (residual) stones. As to the presence of infection, there are infected and noninfected stones.

Table 6.1. Classification of the urinary stones depending on their X-ray contrast and chemical composition.

X-ray contrast positive	Slightly contrast	Noncontrast
Dehydrate of calcium oxalate	Phosphate of magnesium-ammonium	Uric acid
Monohydrate of calcium oxalate	Appatite	Ammonium urate
Calcium phosphate	Cystine	Xanthine 2,8, dehydroxidenine Indavir

Fig. 6.1. a) stones of the renal calyx; b) a stone of the renal pelvis; c) a stone of the upper third of the ureter; d) a stone of the middle third of the ureter; e) a stone of the lower third of the ureter; f) a stone of the bladder; g) a stone of the urethra

X-ray contrast of the stones

X-ray contrast of the stones during inspection urography depends on their chemical composition. When the patient is made CT without using a contrast substance, it is necessary to determine contrast of the stone in the Hounsfield units (HU), as this index characterizes density and composition of the stone.

Risk groups as to the stone formation

Approximately 50% of patients with urolithiasis have only one recurrence during their lifetime but in 10% of patients recurrences of the stone formation are quite frequent.

Recurrence of the urinary stones is based on two main risk factors:

1. Insufficiency of urine proteolysis resulting in formation of the protein matrix of the renal stone.
2. Optimal range of pH for crystallization of the uric acid in the oversaturated solution of the urine that causes precipitation of the stone-forming acids and formation of the crystalline (mineral) part of the stone.

Separately, there are coral-like renal stones that occupy the pelvis and at least one pelvic system forming as though imprint of the cavitory system of the kidney. Most of such stones consist of struvite and calcium phosphate. The most frequent cause of their formation is alkalization of the urine under the

Classification of coral-like stones
I degree: a stone is almost completely localized in the renal pelvis but having appendages towards the pelvis.
II degree: appendages of the stone occupy the pelvis and large calyces.
III degree: the stone completely fills the pelvis and all calyces forming branches at the level of the small calyces. (Fig.6.2).

influence of chronic infection (urease-producing microorganisms).

Fig. 6.2 Classification of the coral-like renal stones;

- a) I degree; b) II degree; c) III degree

6.1. Renal and ureteral concrements***Epidemiology***

The prevalence of the renal and ureter stones was 754 cases in adults per 100,000 of the population in Ukraine in 2010.

Pathogenesis of the stone-formation

At present there are a number of theories as to the stone-formatio

- *Matrix theory*: the stone nucleus is formed on the basis of desquamative epithelium due to development of the inflammatory process of the urinary tracts.
- *Colloid theory*: transition of the protective colloids from the lyophobic form into lipophilic that causes pathological crystallization.
- *Ion theory*: insufficiency of urine proteolysis under the condition of changed pH of the urine.
- *The theory of precipitation and crystallization*: the stones are formed in the oversaturated urine during the intensive process of crystallization.
- *Inhibition theory*: the stones are formed due to imbalance between inhibitors and promoters, which supports metastability of the urine.

The main cause of the stone-formation is metastability disorder in urine and oversaturation of urine with stone-forming substances.

Clinical picture

The main symptoms of urolithiasis are pain, hematuria, disuria, discharge of crystals of uric acids or concrements. At the height of the attack 50% of patients have nausea and vomiting. Fever may be in development of pyelonephritis.

Pain syndrome

The leading clinical symptom of urolithiasis is pain. Depending on the size, form, localization and degree of the stone mobility pain may be of different character. When the renal stone is big, immovable and doesn't disturb the urine outflow pain may be absent ("dumb stone"). As a rule, the renal or ureter stone causes pain, not infrequently as a renal colic. In nephrolithiasis its frequency is 70% and it is even more frequent – up to 90% and higher in the ureter stones. Acute stretching of the renal cavity and fibrous capsule is manifested as a pain syndrome. The renal colic develops suddenly, without visible causes in the daytime or at night, at rest or on movement. The pain is unbearable and localized in the left or right lumbar area spreading downwards along the ureter into the glomerular, inguinal area, inner surface of the thigh and external genitals. The colic duration lasts from several minutes to 24 hours and longer. The renal colic caused by obstruction of the ureter lumen by the stone is especially difficult to tolerate. It may be accompanied by nausea, vomiting, sometimes anuria. Infection may be manifested by elevation of the body temperature, chills. There may be distention of the abdomen due to delay of excretion and flatulence. The phenomena of intestinal paresis, irradiation of pain especially in the inguinal area and external genitals are explained by bonds between ganglia of the kidneys and abdominal cavity as well as nervous bonds of the ureters. The upper part of the ureter gets innervation from the ganglia of the renal sinus area, the middle one – from the seminal and the pelvic area – from hypogastral plexus.

Hematuria is microscopically revealed in 75-90% of cases. It is predominantly caused by mechanic factors associated with damage of the mucous membrane of the pelvis or ureter by the stones.

Disuria. Polakiuria, nocturia and disuria may develop in patients with low localized stones of the ureters, especially in juxtevesical and intramural sections. Disuria in the bladder stones is caused by mechanic irritation of the mucous membrane or secondary cystitis.

The concrement passing with urine is an absolute sign of urolithiasis. Usually it occurs soon after the attack of the renal colic. Some patients may have painless passing of the concrement.

Diagnosis

The diagnosis of urolithiasis is made on the basis of specific symptoms, objective examination, ultrasound investigation, X-ray and laboratory data.

Physical examination

During examination attention should be paid to such factors: Duration, character and localization of pain;

- Presence of urolithiasis in anamnesis;
- Previous complications associated with removal of the kidneys;
- Infections of the urinary tracts; family anamnesis complicated with urolithiasis;
- Presence of single or transplanted kidney

Palpation of the kidney is made bimanually in three positions according to Guillon. Usually the kidneys are not palpated. The lower pole of the kidney, especially of the right one, may be palpated in large coral-like stones. In pyelonephritis the kidney is enlarged, of elastic consistency, with irregular surface. The kidneys are palpated in nephroptosis, malformations. Not infrequently tenderness is determined on palpation of the kidney area and on percussion of the lumbar area.

The ureter is painless even in presence of the stone in it. In ureteritis and periureteritis tenderness to palpation can be at the site of physiological narrowing of the ureters – at the Tournet points. The upper painful point that corresponds to the pyeloureteral segment is determined at the umbilical level by 3-4 cm to the right or left on palpation of the abdominal wall. The middle Tournet point is on the intersection of the **a.billica** with the line made from the upper painful point to the tuberculum pubicum. While pressing this point on the abdominal wall tenderness is caused in localization of the stone in the projection of the middle physiological narrowing – above the glomerular vessels. The lower painful point of Tournet that corresponds to the third physiological narrowing of the ureter - before the intramural section – is determined only by bimanual rectal or vaginal palpation.

Palpation and percussion of the bladder is obligatory in urolithiasis as there may be possibility of chronic retention of urine due to the presence of the bladder stones or in diseases that cause their formation (hyperplasia or cancer of the prostate gland, stricture of the ureter). Examination of the patient with urolithiasis as of any urologic patient should be completed by rectal palpation of the prostate gland that allows to reveal concomitant hyperplasia, cancer, prostatitis, prostate stones, etc.

Visual methods of examination*Obligatory methods:*

- Ultrasound investigation (USI): echo-positive shadow of the definite form and size (Fig.6.3, 6.6) is visualized in the renal cavity. In disturbance of the urine outflow from the pelvis there is dilatation of the kidney cavity or some groups of calyces.
- Inspection urography: in X-ray positive stones in the kidney projection there is a clear shadow of one or several concretions of the definite form and size (Fig.6.4).
- Excretory urography determines functional state of the kidney, changes in the pelvis and calyces, their dilatation, deformation and defects of filling.

Additional methods:

- Retrograde ureteropyelography (with oxygen or contrast liquid): it is made in X-ray – negative stones of the kidneys. The pneumopyelogram shows shadows of the stones, defects of filling are seen in using contrast liquid.
- Radioisotope roentgenography determines the functional state of the kidneys – secretory and excretory function.
- Renal angiography is made in possible variants of partial renal resection, anatomic nephrolithotomy.

Lately spiral CT without using contrast substances has become a standard examination for acute pain in the flank and substituted excretory urography. It can help to establish the presence of the stone, its

Inspection urography
<ul style="list-style-type: none"> • Allows to visualize X-ray- contrast stones, thus to estimate partially their composition; • Helps to compare the stone size in further treatment; • Requires preparation of the patient’s intestines ; • Sensitivity is 44-77% and specificity is 80-87%; • Inspection urography should not be made when CT is planned; • Computer tomography (CT) is made in case of noncontrast stones or in presence of urolithiasis or kidney tumor (Fig.6.5).

diameter and density. When there is no stone it may determine the etiology of pain. Urate and cysteine stones, invisible during inspection urography are visualized by CT. Roentgenologic methods of examination with introduction of the contrast substance (excretory urography or CT with contrast) are indicated when removal of the stone is planned and anatomy of the excretory renal system is unknown. Besides, it allows to estimate the renal function. At present CT with contrast is preferable as this method allows to make 3D-reconstruction of the excretory system to determine density of the stone and distance to the skin. The latter parameters allow to predict efficacy of ESWL.

Laboratory studies. The following laboratory methods of diagnosis are used;

- Urinalysis (micro- or macrohematuria, crystalluria, possible leucocyturia, bacteriuria, change of pH of the urine);
- Blood count (in inflammation: leucocytosis, shift to the left, accelerated ESR);
- Creatinine, urea of the blood serum (in renal failure their level is increased);
- pH of the urine – three times, salt transport (uric acid of the blood serum);
- urinalysis by Nechiporenko;
- culture for sterility with antibioticogram.

Treatment

One of the important stages of urolithiasis treatment is removal of the stones – transition of the patient’s condition from the “stone having” into “prestone having”. The following stage of urolithiasis treatment is correction of the stone and main and secondary risk factors of urolithiasis to the norm with the follow-up for 3 -5 years.

Differential diagnosis of urolithiasis	
Abscess of the abdominal cavity	General diseases of the large intestine
Acute glomerulonephritis	Abscess of the liver
Extrauterine pregnancy	Pancreatitis
Disease of the spine	Necrotic papilitis

Appendicitis	Inflammatory process of the small pelvis
Hepatic colic	Pyonephrosis
Cholecystitis	Arteriovenous fistula of the kidney
Cholelithiasis	Tumor of the kidney
Diverticulitis	Thrombosis of the renal vein
Ulcer of the stomach and duodenum	Abscess of the spleen
Epididimitis	Torsion of the testis
Gastritis	Infection of the urinary tracts
Foreign bodies of the GIT	Obstruction of the urinary tracts of other etiology
Intestinal obstruction	Viral gastroenteritis

Principles of pharmacotherapy can be found in the section “General approaches to management of the patients with urolithiasis.

General recommendations as to the surgical removal of the stones

All patients are planned to remove the stone should be made a bacteriological test of the urine. When there was revealed a growth of

bacteria or there is a suspicion of the infectious process, antibiotic therapy should be started immediately.

The following methods are used for active removal of the stones: endoscopic (extracorporeal shock-wave lithotripsy (ESWL), intracutaneous nephrolithotripsy (INL), ureteroscopy (URS) and open surgical intervention.

Any surgical interventions are contraindicated to the patients with coagulopathy. ESWL, INL and URS are contraindicated to pregnant women. The best method of treatment of the pregnant women is drainage by using percutaneous nephrostomic drainage, internal stent (Fig.6.7, 66.8) or urinary catheter. The patients with pace maker are recommended to consult a cardiologist before making ESWL.

When endoscopic surgery is impossible due to technical or medical causes, open surgery is performed:

- Pyelolithotomy;
- Pyelonephrolithotomy;
- Anatomic nephrolithotomy;
- Ureterolithotomy; nephrectomy (in purulent complications of urolithiasis- pyonephrosis, abscess of the kidney, paranephritis and absence of the renal function).

Fig. 6.7. The stone of pyeloureteral segment and inserted stent

Fig. 6.8.Nephroscopy Generally accepted measures are taken in the postoperative period – infusion, antibacterial, symptomatic therapy and (in some cases) early metaphylactic therapy. The following stage of urolithiasis treatment is metaphylactics or antirecurrent treatment.

Sometimes the patients have chronic strictures of the urethra of different origin, of the urethra (after gonorrhoea, tuberculosis, traumas of the urethra and its surgery).

Classification
Primary, which formed in the urethra; Secondary(migrating), which got into the urethra from the kidneys, ureters, bladder

The main symptoms
<ul style="list-style-type: none"> • Difficult urination; • Pain in the urethra and in the perineum; • Hematuria; • Pyuria

6.2. Concrements of the urinary bladder

Etiology and pathogenesis

Pathogenesis of the bladder stones is similar to that of urolithiasis. The stones of the kidneys and ureters descend in the bladder and in their nondischarge they grow in it (Fig. 6.9). One of the conditions of the stone-formation and stone growth is urine stasis in the bladder. Congenital and acquired strictures of the urethra, adenoma and cancer of the prostate gland (15%), diverticula, tumors, traumas and foreign bodies of the bladder, its neurogenic dysfunction especially in spinal patients and after multiple traumas of the bones – these are factors that cause formation of stones in the bladder. Stone-formation is observed in women in pathology of the bladder cervix due to radiation cystites; in vesico-vaginal fistulas, on ligatures of the vesical walls after gynecological operations. The nucleus for stone-formation may be foreign bodies that were introduced into the bladder or penetrated into it.

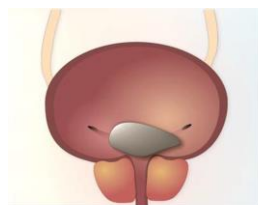


Figure. 6.9 Concrement of urinary bladder

Clinical picture

The main symptoms of the stone presence in the bladder are:

- Pain;
- Disuria;
- Hematuria.

Pain is slightly marked in the bladder at rest but significantly increases in urination, active movements, harsh riding. The pain irradiates to the balanus, perineum, and testes. There is characteristic frequent vesical tenesmus in the daytime in their insignificant amount or absence at night. During urination there is often observed a symptom of closing of the urine stream and the urination act is possible only in the horizontal position lying on one of the flanks. Infection additionally results in development of cystitis, which considerably increases disuria (“alkaline cystitis”). Sometimes there may

be complete disorder of the urine outflow as a result of the stone intrusion into the vesical cervix or phenomenon of urine incontinence against the background of imperative vesical tenesmus.

Diagnosis

To make a diagnosis of the bladder stones the following is used:

- *Inspection urography*, which may reveal a shadow of the stone in the projection of the bladder (Fig.6.10);
 - *US* of the filled bladder when a dense structure is found in its cavity. It may also estimate the size, configuration and inflammatory changes of the prostate gland;
 - *Contrast cystography* (ascending and descending) and pneumocystography, in which defects of filling are revealed in the bladder;
- *Cystoscopy*, which gives a possibility to differentiate the bladder stone with other diseases that are accompanied by hematuria and disuria.

Laboratory methods of examination:

- *Blood count;*
- *Urolysis;*
- *Urine culture;*
- *Urea and creatinine of the blood.*

CLASSIFICATION:
<ul style="list-style-type: none"> • Primary (that are formed in the bladder, they are mainly encountered in children that reside in the dry and hot climate and have unbalanced diet) • Secondary (chronic retention of urine or recurrent infections caused by obstruction of the lower urinary tracts (benign hyperplasia or prostate cancer, urethra structure or stricture?) or neurogenic bladder, rarely – by foreign bodies. • Migrating (from the upper urinary tracts).

In absence of inflammatory processes the blood count is without changes. The urine may contain erythrocyturia and leucocyturia. There is frequent bacteriuria. In case of renal failure there is elevation of the creatinine level and urea in the blood serum.

Treatment

There are two main methods of treatment of patients with bladder stones:

- Cystolithotripsy;
- Cystolithotomy.
- Cystolithotripsy may be mechanic and electrohydraulic. The conditions necessary for performing cystolithotripsy are sufficient passage of the urethra for introduction of the instrument into the bladder, absence of acute inflammatory diseases of the urinary tracts and sufficient size of the bladder. Complications of cystolithotripsy include urethral fever, acute prostatitis, orchiepididimitis, and acute retention of urine.

- Therefore, the patients need prophylactic intake of antibiotics before surgery. When cystolithotripsy is impossible (marked strictures of the urethra, large size of the stone, acute inflammatory processes in the urogenital organs or there is a necessity to correct surgically the infravesical obstruction, excision of diverticula and neoplasms of the bladder), cystolithotomy is performed in combination with other operations.

6.3. Urethral concrements

Epidemiology

- Stones of the urethra make 2 % of all cases of urolithiasis.

Etiology and pathogenesis

- Primary concrements of the urethra are formed in the diverticula, in strictures, fistula of the urethra, foreign bodies, chronic infection, schistosomiasis after urethroplasty. They are caused by accumulation of pus, mucus, alkaline reaction of the urine.

- Secondary stones stop mainly in patients with narrow external urethral opening at the level of boat-like fossa, rarely in the prostatic or membranous part.

Clinical picture

Not infrequently the symptoms develop after renal colic or suddenly, sometimes with development of acute retention of the urine. In retention of the stone in the posterior part of the urethra there may be observed incontinence of urine.

Diagnosis

To make a diagnosis of the urethral stones the following is used:

- Palpation (including rectal) of the urethra, which reveals the stone, its localization, size, the condition of the surrounding tissues;
- Introduction of the metallic bougie into the urethra allows to diagnose the stricture level, Inspection urogram in the lateral projection, which determines the site of the stone localization and its size.
- Ascending urethrocystogram, which helps to reveal presence of the urethral stricture, its diverticules or size, and localization of the stone is determined by the shadow or defect of filling.

The laboratory methods include all generally accepted methods for examination of the patient:

- Blood count;
- Urinalysis;
- Culture of the urine;
- Urea and creatinine of the blood.

In absence of the inflammatory processes the blood count is without changes. The urine may contain erythrocyturia and leucocyturia. There is frequent bacteriuria. In case of renal failure there is elevation of the creatinine level and urea in the blood serum.

Treatment

The stones of the anterior part of the urethra are removed by special forceps, clamps and tweezers. If necessary, meatotomy is performed. This manipulation may be performed in the polyclinic. In case of the stone localization in the proximal part of the urethra, it may be moved into the bladder by a metallic

bougie to perform cystolithotripsy later on. Under the conditions of the urological department the stone may be removed by the loops of Pashkovskiy or Dormia under the intravenous anesthesia. In case of acute inflammatory condition and impossibility of instrumental removal and shift of the stone into the bladder due to presence of strictures, epicycstostomy is applied and uretrolithotomy is performed.

6.4. Concrements of the prostate gland

Epidemiology

The prostate stones can be approximately in 5% of males. They are most frequently revealed in males over 50 during examination for hyperplasia of the prostate gland.

Etiology and pathogenesis

The stones can be formed in obstruction of the excretory duct in the secretory parts of the prostate gland being made of protein and calcium salts. The most common causes of the secretion passage are: chronic prostatitis or prostate hyperplasia. Besides, the prostate stones may be formed after radiation therapy, TUR of the prostate and introduction of the prostate stent. As a rule, the prostate stones are multiple.

Clinical picture

The clinical picture corresponds to symptoms of the primary diseases, though the course is more often asymptomatic.

The main symptoms are:

- Nagging pain in the perineum and sacral area;
- Frequent, painful, sometimes difficult urination; terminal disuria;
- Discomfort in the perineum during ejaculation;
- hemospermia.

Diagnosis

- digital rectal examination of the prostate gland; separate squeezings are palpated;
- USI: echo-positive structures of the prostate gland with acoustic shadow. This method allows to determine exactly the number and size of the stones;
- Inspection urography: fine concrements are visualized in the projection of the prostate gland.

Treatment and prognosis

In the asymptomatic course the treatment is not necessary. Partially the prostate stones can be removed during TUR of the prostate for hyperplasia or prostate cancer.

The prognosis is favorable.

Differential diagnosis
Chronic prostatitis;

Benign prostate hyperplasia Prostate cancer Prostate tuberculosis

GENERAL APPROACHES TO MANAGEMENT OF PATIENTS WITH UROLITHIASIS

Pharmacotherapy

Analgesia may be reached by administration of the following drugs by different ways of introduction: sodium diclofenac, indomethacin, sodium metamisol, dexcetoprofen, ketopolac together with drotaverin or other spasmolytics. It is necessary to start with nonsteroid anti-inflammatory drugs and start alternative analgesics (tramadol) in persisting of pain.

Sodium diclofenac affects negatively the glomerular filtration only in patients with decreased function of the kidneys. While expecting the independent passing of the stone from the proximal part of the ureter, it is expedient to administer sodium diclofenac in tablets (capsules) or suppositories by 50-100 mg per day (to decrease edema of the ureter) and tamsulosin in capsules by 0.4 mg once a day (to decrease spasm of the ureter) for 3-10 days ensuring risk reduction of the renal colic recurrences. The control of the stone passage and determination of the renal function should be made with the help of corresponding methods. The concrement, which passed out should be directed to the X-ray analysis. In case the satisfactory analgesia cannot be provided by medicines, one should drain the kidney with the help of the stent or intracutaneous nephrostoma or surgical removal of the stone.

Metaphylaxics (antirecurrent treatment) of urolithiasis

The recurrence of the urinary stones is based on two main risk factors:

1. Insufficiency of urine proteolysis that results in formation of the protein matrix of the renal stone.
2. Optimal range of pH for crystallization of the renal salts in the oversaturated solution of the urine causing precipitation of the stone-forming salts and formation of the crystalline (mineral) part of the stone.

Secondary risk factors of nephrolithiasis are the following: infections of the urinary tracts, presence of mucus, detrite, cast-off epithelium, salts, stone fragments after their removal, and disorder of urodynamics. Increased proteolytic activity can be achieved by intake of enzymatic drugs in acid urine with pH of up to 5.7. The oral intake of pepsin, acidin-pepsin is administered. In pH over 5.8 the enzymatic drugs are administered having the proteolytic enzyme tripsin. Enzymatic drugs are administered for 14 days of every month for 3-4 months. One of the main factors of urolithiasis risk is concentration of hydrogen ions of urine, which is expressed in pH indices. In the acid urine (pH is 4.0-5.6) and presence of urate lithiases it is necessary to use drugs containing citrate acid that makes urine alkaline (the so-called citrate mixtures). The drugs are taken according to instruction under constant control of the urine pH keeping this index within 6.2.-6.8 under doctor's follow-up. When the day profile of the urine pH is below 6.2, the dose should be increased, when it is above 6.8 it should be decreased. Simultaneously in correction of urine it is necessary to make a correction of the uric acid level in the blood serum by intake of urostatics (alopurinol) for 2-3 months. Against the background of this therapy diet-therapy is recommended with limited ingestion of meat products, phytotherapy,

antibacterial therapy, intensive water regimen It is recommended to apply citrate mixtures and phytodrugs for antirecurrent (metaphylactic) treatment of the *oxalate stones*. Alkalinization of the urine, increased excretion of the citrate and reduction in calcium excretion cause reduction of the calcium oxalate in the urine as citrate forms a chemical compound with calcium in the alkaline media. Besides, citrate-ion should be considered as the most important physiological inhibitor of the calcium oxalate crystallization (as well as calcium phosphate) and aggregation of these crystals. To dissolve urate-oxalate stones and prophylaxis of the recurrent calcium oxalate stone formation, urine pH should be kept at the level from 6.8 to 7.4 for some time. The diet should be poor in calcium. Increased liquid regimen should be followed with phyto- and antibacterial therapy (according to antibioticogram).

Microorganisms, especially all species of *Proteus* play a significant part in the formation of phosphate-acid stones in the alkaline urine in pH of 6.8-7.0 and higher at the expense of the enzyme urease that decomposes urine urea to ammonia and, thus alkalinize the media. To make a correction of phosphaturia it is necessary to differentiate true and false phosphaturia. False phosphaturia is always conditioned by presence of microorganisms, antibiotic therapy is indicated in this case. True phosphaturia is possible in neurogenic diseases or stomach diseases and treatment of these diseases is recommended. The necessary conditions in metaphylaxis of phosphates are correction of the urine proteolysis level (see above), antibacterial therapy according to the urine culture, and correction of the urine pH from the alkaline to the acidulous state. It is also recommended to use: dyer's madder, ammonium chloride, methionine (administration according to the instruction) for 2-3 months or by courses for 2 months. The above given therapy should be supplemented by diet therapy with exclusion of the citrus plants, fresh milk and dairy products and predominance of the meat products. Phytotherapy is useful to some extent and intake of cranberries, sea buckthorn, cowberries, seeds of wild carrot.

In antirecurrent treatment of cysteine stones it is recommended to take penicilinamid, citrate mixtures. In alkalinization of the urine, pH of the patients with cysteine concrements should be ranged 7.5-8.5.

Metaphylactics of urolithiasis should be made under the constant observation of the physician, controlling USI every 3 months and, if need be, roentgen-examination (Tabl.6.2).

Table 6.2. Diet depending on the kind of urolithiasis

Prohibited food products	Products which should be limited	Recommended food products
Oxalate stones		
Spinach	Boiled meat	A great amount of liquid
Sorrel	Potato	Fish
Rhubarb	Carrot	Eggs
Lemons	Red beet	Cabbage
Dried fruits	Green pea	Cucumbers
Chocolates	Tomatoes	Salad

Cocoa	Tomato paste	Onion
Natural coffee	Sauces	Fruits (except for the enumerated kinds)
Strong tea	Plums	Butter
Hot spice	Argus	Cereals
Legumes	Sugar	
	Milk	
Phosphate stones		
Legumes	Potato	A great amount of liquid
Alkaline mineral waters	Milk	Meat
	Fruits	Fish
	Eggs	Cheese
		Bread
		Porridge of different cereals of high quality
		Macaroni
		Butter
Urate stones		
Liver	Meat (except for the enumerated kinds)	A great amount of liquid
Brain	Fish	Mineral water
Mutton	Meat and fish broth	Fruits
Caviar	Cereals	Vegetables
Herring		Sugar
Sardine		Butter, oil
Chocolate		Milk
Cocoa		Non-fat cheese
Natural coffee		Potato
Strong tea		

Nuts		
Cystine stones		
Meat of the inner organs of animals (liver, kidneys, spleen, brain)	Meat and fish (it is allowed to have them 5 times a week by 200-250 g predominantly in boiled)	Oranges, water-melon, birch juice, grapes, raisin, pomegranate, plums, melons, strawberries, potato, lemons, tangerines, cornel, olives, carrot, nuts, current, apples
Gelatin	Eggs (not more than one a week)	
Smoked food products	Products of wheat flour	
Spicy food products	Legumes	

Metaphylactic treatment of patients with calcium stones should be started with conservative measures. Pharmacological treatment is administered only in cases of ineffectiveness of the conservative measures. The amount of liquid used a day should exceed 2 l for an adult patient. The specific gravity of the urine should be an index of the necessary dissolution of the urine. The diet should be chosen individually according to the biochemical deviations.

Pharmacological treatment of the patients with stones of the uric acid

One of the most important prophylactic factors of urate formations is the use of the great amount of liquid that would provide diuresis of over 2 l.

The determining pharmacological causative agent is alkalization of the patient's urine with the help of 3-7 mmol potassium citrate or 9 mmol of sodium-potassium citrate 2-3 times per 24 hours. When the level of the uric acid in the blood or urine is increased, the treatment should be added by administration of alopurilol in the daily dose of 300 mg. To dissolve the stones of the uric acid increased diuresis should be combined with administration of 6-10 mmol of potassium citrate or 9-18 mmol of sodium-potassium citrate three times a day and 300 mg/day of alopurinol even in the normal level of the uric acid in the blood serum.

Pharmacological treatment of the patients with cysteine stones

Liquid usage should provide daily diuresis of over 3 L. To achieve this, the patient should drink at least 159 ml of liquid for an hour. Alkalization of the urine should provide keeping of urine pH at the level higher than 7.5. This may be achieved by using potassium citrate in the daily dose of 3-10 mmol. Administration of ascorbic acid in 3-5 g/day may be effective in the patients with daily excretion of cysteine with urine of up to 3- 3.5 mmol. Captopril should be administered in higher level of cysteine excretion (75-150 mg/day).

Pharmacological treatment of the patients with infectious stones

Maximal surgical release of stones should, first of all, be achieved in the patients with stones of magnesium phosphate and carbonapatite whose formation is caused by ureasoproducing microorganisms. Administration of antibiotics should correspond to results of antibioticogram and continue for a long-term period to eradicate the infection.

Potential complications and prognosis*Complications of urolithiasis:*

- Acute pyelonephritis;
- Loss of the kidney function;
- Terminal hydronephrosis in the long-term obstruction;
- Stricture of the ureter;
- Perforation of the ureter or formation of the fistula;
- Urine extravasation;
- Urosepsis.

Prognosis

In timely diagnosis, treatment and metaphylaxis the prognosis is favorable.

Summary

The concrement formation in the urinary tracts is a widely spread pathological state, which develops in patients in different parts of the world. Costs of their treatment take a considerable part in the system of the health services. Taking into account the recurrent course of the disease it is important not only to remove stones from the urinary tracts or promote their independent discharge but also to diagnose and treat metabolic disorders. Thanks to noninvasive methods treatment of urolithiasis has become safe and routine.

Control tasks

1. Describe the clinical picture in the patient with pelvic stone causing obstruction.
2. Is it sufficient to make inspection urography for diagnosis of the kidney stone?
3. What kind of treatment is indicated to the patient with calcium stone of the kidney pelvis having a size of 2.8 cm and causing obstruction?
4. What part of the urinary tracts is the passage of the stone is the most difficult?
5. Name the kinds of endoscopic interventions in urolithiasis?
6. Name the factors, which contribute to stone formation in the bladder.
7. Make a differential diagnosis of the bladder stone with a tumor of the bladder.
8. Make a plan of making a diagnosis and treatment of the patient with a stone of the posterior part of the urethra.
9. Name the localization of the stone in detection of hemospermia in the patient.

Chapter 7

HYDRONEPHROSIS

Hydronephrosis is a congenital or acquired disease, which is characterized by dilatation of the pelvis and calyces, dysfunction of the kidney due to the functional or organic narrowing of the pelvic-ureter segment.

Etiology and pathogenesis

Etiology of hydronephrosis is of various characters and may be caused by:

- 1) neuromuscular dysplasia of the pelvic-ureter segment;
- 2) stricture of the pelvic-ureter segment (Fig.7.1.);
- 3) high origin of the ureter;
- 4) squeezing of the ureter by the blood vessels, embryonic strand, adhesions (Fig.7.2.)

The highest percentage (68%) is made by congenital strictures of the pelvic-ureter segment.

The cause of the urine retention is most frequently prevention of the urine outflow in the area of the pelvic-ureter segment. This typical localization is explained embryologically: the bladder, urinary tracts and kidneys originate from one fetal leaf. However, they develop and come to join from three different topographic centers. The least deviation in time or movement direction of the cellular groups results in considerable displacement of the kidneys and malformations. The most frequent of them are insufficient connection of the ureter leaf with the primary renal pelvis. Histologically, short and narrow segment below the pelvis with predominance of the longitudinal muscular fibers are found in this case instead of usual spiroid ones. This predominance of the longitudinal fibers causes anatomic obstruction for preserved systole-diastole activity of the pelvic-ureter segment. There were described cases when the muscular fibers were absent in this area. Therefore, narrowing of the pelvic-ureter segment should be considered the dominant in the etiological factors of hydronephrosis. Difficult outflow brings about estasia of the renal pelvis and calyces, and elevation of the intrapelvic pressure negatively influences the microcirculation and function of the renal parenchyma.

Other etiological factors, such as high origin of the ureter, additional lower polar vessels, and valves of the pelvic-ureter segment are encountered considerably rarer.

Classification

1. By etiology:

a) primary, or congenital, which develops due to natural obstacle in the area of the pelvic-ureter segment or along the ureter;

b) secondary, or acquired, which is a complication of some diseases (stones of the kidney or ureter, pedunculitis, renal tumor, etc).

2. By the side of affection:

a) unilateral;

b) bilateral.

3. By presence of the infection component:

- a) aseptic;
- b) infected.

4. By the course of the disease:

- a) primary;
- b) recurrent.

Clinical classification of hydronephrosis
I stage – pyeloectasia (dilatation only of the renal pelvis with moderate dysfunction of the kidney).
II stage – prehydronephrosis (dilatation only of the renal pelvis and renal calyces – hydrocalycosis, reduced thickness of the renal parenchyma with marked dysfunction).
III stage – hydronephrosis (atonia of the renal pelvis, atrophy of the parenchyma, loss of the renal function).

Clinical picture

In most cases hydronephrosis has an asymptomatic course, which is a cause of its late diagnosis with high rate of organ-removal operations. The clinical manifestations of hydronephrosis are various and depend on duration of the disease, presence of infection, concrement formation, and urine retention in the pelvis as well as presence of uni- or bilateral affection of the kidneys. The character of painful manifestations may also be various. They may be dull, permanent, bursting, attack-like in the kidney area, which are manifested by colics. There is no dependence between expression of the pain syndrome and degree of the anatomic changes. At the height of the attack there may be nausea, vomiting, elevation of the body temperature, which is indication of the complicated course of hydronephrosis.

Infection frequently causes elevation of temperature, sometimes with fever. Chronic pyuria is a sign of infected hydronephrosis. Pyelonephritis is a typical complication of hydronephrosis. Disorder of urine passage, its constant congestion in the renal pelvis, pelvic-renal refluxes contribute to infection penetration into the interstitial tissue of the kidney. Presence of infection in the kidney in hydronephrosis has an effect on the clinical picture and course of the pathological process, choice of the preoperative preparation and further treatment.

Hematuria is another frequent symptom of hydronephrosis. It results from increased intrapelvic pressure and rupture of the fornical veins at the initial stages of hydronephrosis. In the later stages of hydronephrosis when the disorder of the pelvic-ureter segment passage results in deep structural changes in the kidney, disorder and cicatrisation of the fornical apparatus, hematuria may be explained by hemorrhage from the dilated venous vessels due to urine stasis.

Diagnosis

Amnestic data and physical methods of diagnosis may give grounds for preliminary diagnosis. The renal function should be estimated in complex to reveal parenchymal changes of the affected and contralateral kidney. Investigations should not be obligatory made in the acute period, especially in complicated hydronephrosis.

The main methods of diagnosis also include ultrasound investigation and X-ray-radiological methods. Ultrasound investigation is a screening method. It helps to determine: kidney size, thickness of the parenchyma, and its characteristic structure, size of the calyces, according to the data of resistance index of the intrarenal arteries (IR) the state of the intrarenal hemodynamics is determined; the norm is at least 0.7.

Diuresis urogram is an obligatory method of examination in performing excretory urography in patients with hydronephrosis and allows to make a differential diagnosis between idiopathic dilatation of the renal pelvis without passage disorders of the pelvic-ureter segment and hydronephrosis. Diuresis urography is made by the following technique: after performing classical excretory urography 1.0 ml of furosemid is introduced intravenously on the 60th min and renal roentgenogram is made in 5 min. A complete evacuation of the roentgen-contrast substance from the calices and pelvis after diuresis loading is a sign of absence of any obstacle in the pelvic-ureter segment. Absence of evacuation or

partial evacuation of the roentgen-contrast substance is a sign of obstruction.

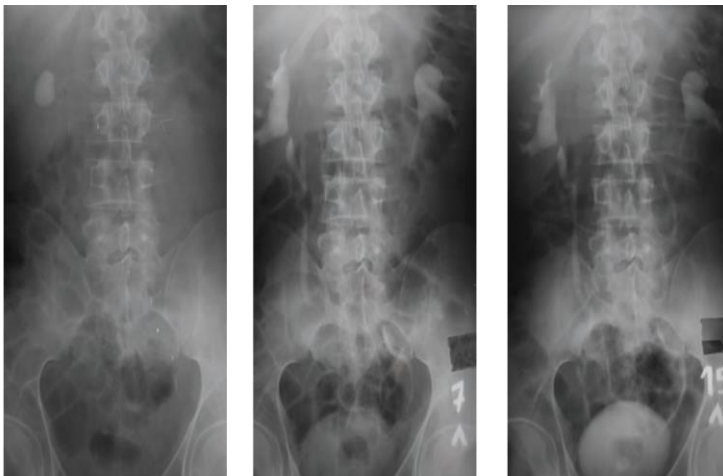


Figure. 7.3. Additional lower-polar vessel of the right kidney, right hydronephrosis, calculus right kidney bowl: a - survey urography; b - excretory urography 7 minutes; c - 15 minutes.

Retrograde pyelography is necessary to make only on the day of surgery by strict indications because of possible infection of the urinary tracts. Retrograde pyelography is made only in cases when according to the data of excretory urography we can judge about the size of the urinary cavity system, the obstruction level and diameter of the ureter lumen. For contrast study of the upper third of the ureter and

pelvic-ureter segment, a catheter is introduced into the ureter to 10-15 cm and it is filled in with the contrast substance. To prevent development of the reflux the investigation is made under the control of electronic-optic transformer that allows to find the best moment for roentgenography.

Radioisotope renography, dynamic renoscintigraphy, scanning of the kidneys are additional methods of examination that make clear the anatomic-functional state of the affected and contralateral kidney, the number of functioning parenchyma of the kidney, renal hemodynamics, secretory – excretory function of the kidney.

The main laboratory tests are general urinalysis, urine analysis for latent leucocyturia (Nechiporenko test), determination of urine microflora and its sensitivity to antibiotics, determination of creatinine concentration in the blood serum.

A complex approach to diagnosis of hydronephrosis gives a possibility to make a precise diagnosis, determine the stage of the disease, functional state of the contralateral kidney and method of treatment according to the functional and anatomic-morphological changes of the kidney.

Treatment

In I stage of hydronephrosis without marked subjective and functional disorders, the patient is followed-up with repeated complex examination at least once a year.

Conservative treatment is based on thorough taking of diet-hygienic measures in struggle against infection that are, first of all, directed at its prevention. In unsatisfactory pharmacofunction of the kidney according to the data of diuresis urography surgical intervention is performed in the pelvic-ureter segment.

Treatment of II and III stages is surgical. There are two principally different methods of surgery – nephrectomy and organ-preserving operations with excision of the narrowed area of the pelvic-ureter segment and formation of the pelvis-urinary anastomosis (Fig. 7.4.). The most common are plastics of the pelvic-ureter segment by the method of Anderson-Hains, Shwitzer, Calp-de-Kid and by the method of Albarran.

Nephrectomy in terminal hydronephrosis (III stage) should be strictly grounded taking into account the functional state of the contralateral kidney. In marked renal failure (intermittent stage) the decision as to nephrectomy should be taken individually in every patient, especially in elderly people. In such cases it is necessary at first to perform correction operation in the kidney that functions better.

In complete loss of the renal function nephrectomy is performed. Indications to nephrectomy in bilateral hydronephrosis are divided into absolute and forced. Purulent pyelonephrosis in the terminal stage threatening by postoperative hemorrhage is an absolute indication to nephrectomy.

Unsatisfactory results of repeated plastic operations, purulent and urinary fistulas that do not heal for a long time, marked hypertension are factors for removal of the kidney despite pathology of the contralateral one.

Besides, thorough comparison of the results of complex examination, macroscopic state of the kidney in some cases allows to save the kidney in spite of its rather lower functional abilities, which is significant in supporting homeostasis of the organism under the conditions of marked renal failure.

Control examination is made in 3 months after surgery, in a year and yearly in future.

Prognosis in I and II stage of hydronephrosis (in case of plastic-reconstructive operation) is favorable; in hydronephrosis of III stage (in case of nephrectomy) it is favorable under the condition of normal functioning of the contralateral kidney.

CONTROL TASKS

1. Causes of development of hydronephrosis.
2. Name the main distinctions between hydronephrosis of II and III stage.
3. How is to make a diagnosis of stricture of the pelvic-ureter segment?
4. Make a differential diagnosis of hydronephrosis with parapelvic cysts of the kidney.
5. Make up a plan of treatment of hydronephrosis of I and II stage.

Chapter 8

Traumatic injuries of the urinary and male reproductive systems

8.1. Kidney injury

Kidney injury is observed in at least 1-5% of all cases. Kidneys are organs that are most frequently injured of all genitourinary system and abdomen. Moreover, 70-80% of kidney injuries are combined with trauma of other organs and systems. The ratio for men and women for this disease is 3: 1. Kidney trauma may result in an immediate threat to life, but the majority of renal traumas should be conducted conservatively. Progress in technology of visualization and treatments methods during the last 20 years has helped to reduce the need of surgical intervention and increase the number of organsaving results. The majority of patients come to the urology department with isolated kidney trauma. Patients with associated traumas are often hospitalized to general surgery departments.

Epidemiology

Gunshot trauma (injury) of the kidney occurs mainly during wartime. According to the experience of World War II, they were 12.1% in relation to all wounds of the urinary and male reproductive organs. In future military conflicts marked increase in the number of kidney injury in 2-3 times, probably due to changes in types of firearms. Among patients urological hospitals in peacetime at a fraction of patients with closed injuries accounted for 0.2-0.3% of the kidneys. In subsequent military conflicts an increasing of the kidney trauma number in 2-3 times is marked, probably due to the changes in types of weapons. Among patients of urological

hospitals in peacetime the ratio of patients with closed kidney trauma is 0.2-0.3%.

Etiology Pathogenesis

Closed injury

In the appearance of trauma the direction, location and impact force are important, as well as the anatomical location of the kidney and its topographical relationship with XI and XII ribs, spine, kidneys physical properties, the development of muscles, subcutaneous fat layer and perirenal tissue, etc. Kidney rupture occurs either due to direct injury (bruised

back, falling to a solid object, the compression of the body), or an indirect effect (a fall from a height, jumps, slaughter the entire body). The interaction of these factors can lead to compression of the kidney between the ribs and transverse processes of the vertebrae, as well as the hydrodynamic impact of increasing pressure of the fluid (blood, urine) in the kidney.

In the presence of preceding pathological changes of the kidney (hydro-and pyonephrosis, maldevelopments) organ trauma can be caused by a small force impact - so-called "spontaneous rupture of the kidney", often caused by abdominal or lumbar trauma.

There is a special type of the closed renal injury - accidental trauma that occurs during instrumental studies: perforation of the renal pelvis, calyx; penetration by the catheter, loop or other introduced retrogradely instruments in the renal parenchyma, perirenal tissue; tears of the mucousa of the calyx

in the fornix area due to input of a large amount of the fluid under considerable pressure in the renal pelvis while performing retrograde ureteropyelography

The development and implementation of a new technologies in the clinical urological practice (extracorporeal shockwave lithotripsy (ESWL)) led to a special type of closed renal injury:

Trauma is caused by the short-term effects of a high positive (more than 1000 atm.) and low negative (-50 atm) pressure on the kidney;

Depending on the initial state of the kidney (acute pyelonephritis, contracted kidney, and other features) organ trauma can occur at low energies of the shock wave.

When using high-energy, the injury severity is directly proportional to the number of shockwave impulses on the kidney. When using the optimal parameters of the ESWL, injury severity can be equated with the kidney contusion without damaging the kidney capsule and cell structures. At the same time, under certain conditions intrarenal and perirenal subcapsular hematomas may arise.

Opened injury

The causes and conditions of the open renal trauma varied. Particularly severe trauma is observed in modern firearm injury. This is due to the complex structure of the wound channel, branching zone of tissue damage, frequent combined lesion of the interconnecting areas, and often a great number of injuries (up to 90%). High modern kinetic energy of shells, especially in mine-explosive injuries, led to an increase in the frequency of indirect trauma of the kidneys when organs located nearby are injured.

Classification

Types of the mechanical injury of the kidneys are divided into two groups: closed (blunt or subcutaneous), open (or penetrating injury): ball, missile, stabbing, cutting, etc.

-
- Depending on the nature of injury: isolated, combined.
- Depending on the number of lesions: solitary, multiple.
- Depending on the injury side: left-sided, right-sided, bilateral.
- Depending on the area of kidney injury: the upper segment, lower segment, body of the kidney, vascular pedicle..

Committee of organ lesions of the American Association for the surgery of trauma (AAST) has developed a special scale, which is widely used in the world. Damages are divided according to the degree of severity from I to V (Table 8.1, Fig. 8.1).

Clinical picture

Closed injury

Kidney injury is characterized with the triad of symptoms: pain in the lumbar region, swelling and hematuria:

- **pain** in the lumbar region is observed in 95% of patients with closed injuries and in all affected by combined trauma. The pain is caused by damage of the tissues and organs surrounding the kidney, stretching the fibrous capsule of the kidney, ischemia of parenchyma, pressure of the growing hematoma on the parietal peritoneum, ureter occlusion with blood clots.
- The pain may be dull, sharp, piercing, radiating to the groin. Nausea, vomiting, bloating, symptoms of peritoneal irritation, fever, can often cause diagnostic mistakes;
- swelling in the lumbar or subcostal area caused by hematoma or urohematoma in perirenal or

retroperitoneal fat tissue. Some clinicians have noted the presence of swelling in 40-45% of patients. Big urohematomas may spread from the diaphragm to the pelvis by a retroperitoneal tissue, and in 2-3 weeks can be detected even on the scrotum and thigh;

- hematuria - is the most important and often sign of kidney injury. Microhematuria is detected in almost all patients. The duration of hematuria and its intensity may vary. It usually takes 4-5 days, and in some cases - up to 2-3 weeks or more

- The intensity of clinical manifestations of closed renal injuries depends on the severity of morphological and functional disorders in renal parenchyma during the posttraumatic period. If there is mild damage, injured structures of the kidney recover with the loss of 1-15% of functioning parenchyma. Average severity of the kidney injury causes loss of

- 30% of functionally active parenchyma, and severe damage is accompanied by irreversible degenerative-dystrophic changes of up to 65% of the parenchyma.

- Open injuries

The main symptoms of kidney injury - pain in the wound area, hematuria, urohematoma, location of the wound and the direction of the wound channel, leakage of urine from the

wound. The last symptom, although it is most likely, is

rarely seen early after the injury (2.2% of cases). If kidney injury is suspected, one can use the Nessler's reagent method to determine the urine leakage from the wound. When kidney is injured, urohematoma is rarely observed, because of the blood and urine flow out of the wound, or (when injuries are combined) flow into the peritoneal or pleural cavity.

Diagnosics

Laboratory:

- complete blood count: anemia in severe blood loss, leukocytosis;
- clinical urinalysis: haematuria of varying degrees of severity.

Instrumental methods:

a) *excretory urography* (Figure 8.2) (if indicated – with high dose and infusion modifications); in addition to conventional radiographs at 7, 15 and 25 minutes after infusion of contrast material into a vein, it is advisable to perform (in the absence of the injured kidney function) delayed images (at 1, 3, 6 hours or more);

ultrasonography (USG): now the most of clinicians start the evaluation of patients with suspected kidney trauma, with USG. Typically, ultrasound is used for the initial evaluation of patients with polytrauma, it makes possible to detect the fluid in the abdominal cavity or retroperitoneal space, subcapsular hematoma (Figure 8.3).

Ultrasound is more effective in moderate and severe injuries. The effectiveness of the method is 60%. With the combined use of excretory urography and ultrasonography, the correct diagnosis is possible with 98% sensitivity and 99% specificity. Therefore, when trauma of the kidney is suspected, ultrasound is a primary screening method, which, in

the presence of hematuria, is supplemented with an excretory urography; if these studies do not help in the diagnosis, use of radioisotope renography or dynamic

I	Contusion or hematoma. Subcapsular, nonexpanding without parenchymal laceration
II	Nonexpanding perirenal hematoma confirmed to renal; laceration: <1.0 cm parenchymal depth of renal cortex without urinary extravagation
III	Cortex laceration >1 cm without urinary extravagation
IV	Parenchymal laceration extending through renal cortex, medulla, and collecting system, or vascular injury — of segmental arteries, veins with hematoma, partial vessel injury or vessel thrombosis
V	Completely shattered kidney or renal hilum vessels injury, avulsion of renal hilum

Nephroscintigraphy, computed tomography (CT), magnetic resonance imaging (MRI), if necessary - renal angiography as the most informative method, are indicated.

Table 8.1. *Kidney injury scoring scale (AAST*)*

* Advance one grade for bilateral injuries up to grade III

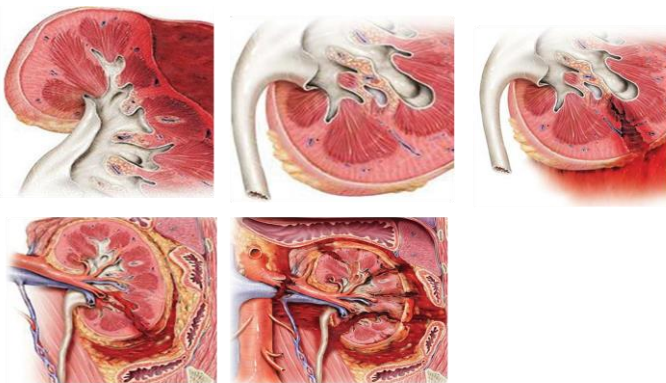


Fig. 8.1. *Grades of kidney injury, according to the AAST*

Treatment

In all cases, if kidney injury is suspected, patients should be treated in the hospital, as in the case of subcapsular laceration, secondary injury is possible, and immediate surgery is needed. Treatment can be conservative and operative.

Conservative treatment

Closed Injuries

When closed isolated kidney injury is mild to moderate grade, if hemodynamic is stable and there are no other indications for surgery, treatment can be limited as dynamic observation and conservative therapy. Conservative treatment of isolated kidney injuries is conducted when the patient's general condition is satisfactory, there is no profuse hematuria, symptoms of internal bleeding, signs of increasing hematoma and urinary infiltration. Conservative treatment includes the appointment of strict bed regime for 10-15 days; measures to stop bleeding (hemostatics), hemodynamic and hematocrit monitoring;



Fig. 8.2. Excretory urography at laceration of the right kidney (contrast leakage)

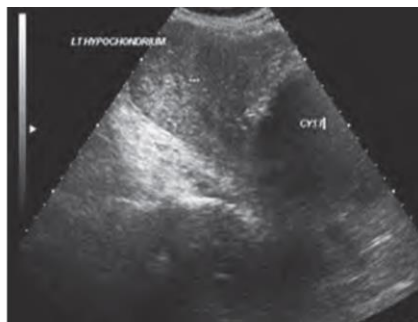


Fig. 8.3. Sonography at left kidney injury. Urohematoma

prophylactic parenteral antibiotics and uroantiseptics are used, painkillers and anti-inflammatory drugs are prescribed. Upon termination of microhematuria, disappearance of pain the patient may continue treatment as outpatients. This treatment is effective in 98% of patients. Later, after conservative treatment, the isolated closed kidney injury can be complicated with hydrocalycosis (due to sclerosis that compresses calyx necks).

Scars and sclerotic changes in pararenal tissue cause poor circulation and ultimately pyelonephritis and nephrogenic hypertension.

pararenal tissue cause poor circulation and ultimately pyelonephritis and nephrogenic hypertension.

When closed kidney injury, resulting from instrumental manipulation, initially conservative treatment is conducted:

- wall perforation of the kidney pelvis and/or calyx results stop of the further examination, antibiotic solution introduction through a catheter and catheter extraction;
- the patient is prescribed bed rest, haemostatics, antibiotics, cold on the lumbar region or stomach in the ureter projection, and the next day – heat is prescribed;
- if hematoma, urohematoma increases rapidly - surgery is indicated.
- Peryrenalne accumulation of fluid (blood) caused by remote shockwave lithotripsy may dissolve on their own within a few days or weeks, and subcapsular hematoma - in a period of 6 weeks to 6 months. Temporary decrease in renal function observed in 30% of cases after an injury, it can be prevented by assigning patients nifedipine and allopurinol.

Open injuries:

Conservative treatment is permitted only in rare cases: when stabbed injuries are isolated, without significant tissue injury, at moderate and short-term hematuria and satisfactory condition of the patient; treatment of victims is conducted on the same plan as that with closed renal injuries.

Surgical treatment

Indications for surgical treatment are: a) internal bleeding in the isolated kidney injury, accompanied by anemia, decreased blood pressure, rapid pulse; b) overnight hematuria, deterioration of the patient's general condition c) hematoma in the lumbar region, which is increasing slowly; d) the associated injury of the kidneys and the abdominal cavity or chest. In each case of the injury, it must be determined: whether the patient has second

kidney and its function. In the case of hospitalization of the patient in a state of shock, antishock measures must be taken to perform the operation under favorable conditions. If the patient's condition does not improve and the hemoglobin level decreases, surgery is performed immediately, continuing antishock therapy.

Minimally invasive intervention

Percutaneous drainage of hematoma or paranephral urohematoma is performed according to a strict indications and under ultrasound control. Objective of this manipulation: evacuation of hematoma, reduction of terms of treatment and to

reduce the risk of early and late complications. Endoscopic drainage of the kidney using an internal stent is used in injuries of moderate severity. Objective: to reduce extravasation of urine and / or elimination of violation of the urine outflow. Typically, the stent is removed after 4 weeks. Embolization of a bleeding vessel is performed under angiographic control in patients with stable hemodynamics, if segmental artery is injured and / or in the case of intensive ongoing hematuria. The best results are obtained with this technique in patients with penetrating injuries caused by knives (82%).

Open surgery

Absolute indications for surgical treatment of closed and open injuries of the kidney: unstable hemodynamic parameters, increasing or pulsating hematoma.

Relative indications: not clearly defined injury grade, extravasation of urine in large amounts, the presence of large areas of non-viable kidney tissue, severe damage (V grade) combined injuries requiring surgical treatment, premorbid disease of the injured kidney; unsatisfactory effect of the conservative treatment or low-invasive surgery.

Indications for early nephrectomy: many deep gaps kidney lacerations, that are not amenable to surgical treatment, non-viability of the most of parenchyma, shattered kidney, kidney hilum vascular injury, severe general condition of the patient and the presence of significant combined injuries that pose a direct threat to the life of the patient.

Indications for organo-sparing operations: lacerations or separation of one of the poles of the kidney, isolated lacerations of the body of the kidney and its fibrous capsule, single kidney damage, damage to one kidney with abnormal second, simultaneous damage to both kidneys.

Complications

All complications of kidney injury are divided into early and late, a term that separates them is 1 month. The probability of urological complications of varying severity of kidney injury is: mild - 0-15%, average - 38-43% and severe - 100%.

Early complications include: shock, internal bleeding, including secondary, retroperitoneal hematoma, paranephral abscess, infectious processes, peritonitis (primary or early), pneumonia, sepsis, urinary fistula, hypertension, urinoma.

Late complications include: infection, secondary hemorrhage, arteriovenous fistulae formation, hydronephrosis, hypertension, traumatic pyelo and paranephritis, urine renal fistula, urinary tract stones, ureteral compression, post-traumatic cysts of the kidney and pyonephrosis.

Further treatment . Re-examination are indicated to all hospitalized patients with significant kidney injury within 2-4 days after injury. It also recommended if fever occurs , pain in the lumbar region appears and at if hematocrit is low . Prior to discharging the patient, radionuclide study is recommended to determine the functional state of the kidneys. After considerable kidney injury surveillance include: physical examination, urinalysis, personalized radiation studies, blood pressure control, monitoring in serum creatinine levels

Prognosis

After closed kidney injury of light and medium degree, without the development of complications, prognosis is favorable. Severe injury and serious complications may require nephrectomy and lead to disability.

Prognosis after open kidney injury depends on the severity of the injury, the nature and type of injury, presence of complications, combined injury of other organs, on the timeliness and scope of the assistance provided.

Patients suffered kidney injury, regardless of the treatment methods used (conservative or operative), are at high risk of late complications. Even after nephrectomy of the injured organ, a variety of diseases (chronic pyelonephritis, stones, tuberculosis) appears after time, in the kidney that remained in half of the patients. All this necessitates a long-term observation of these patients.

8.2. Ureteral injury

Due to the location, small size, mobility of ureters, their injury, when exposed to external forces, are relatively rare. From a practical point of view, iatrogenic

ureteral injury arising during performance of therapeutic and diagnostic manipulations (cannulation of the ureters, contact ureterolithotripsy) and during surgery (usually - on pelvic organs) is of biggest interest.

Classification

- *Distinguished by the type of injury:* closed (sc) , open (wound) , which may be spherical, rolling pin , piercing , cutting , etc. .
- *By the nature of injuries:* isolated , combined.
- *Depending on the number of lesions :* solitary , multiple .
- *Depending on the damage side :* left-sided , right-sided , double-sided .
- *Damage localization :* upper third of the ureter , the middle third of the ureter , the lower third of the ureter.
- *By the damage type :* contusion , incomplete laceration of mucosa , partiall
- *rupture of the outer layers of the ureter, a complete rupture (injury) of the wall of ureter with divergence of its edges ,occasional ligation of the ureter during surgery .*
- *The severity of injury (Table 8.2*

Table 8.2. Classification of ureteral injury, developed by AAST

Gra	Injury description
I	Solely hematoma
II	Laceration, transection < 50 %
III	Laceration, transection > 50 %
IV	Complete transection, devascularization < 2 cm

V Complete transaction, devascularization > 2 cm

Clinical picture

For injuries or wounds of the abdomen, in which ureter is damaged, the first major signs are those of combined injuries of the abdomen and only later, there are signs of urinary infiltration of the retroperitoneum: fever, signs of intoxication, pain in the lumbar region, muscle tension, edema in rectal or vaginal examination. Closed injuries of ureter frequently occur as iatrogenic injury during instrumental invasion in the ureter and gynecological operations on the pelvic and retroperitoneal space (according to the literature, from 5 to 30% of surgical interventions in the pelvic area, are accompanied by ureter injury). Injury of the ureter with wall transection or avulsion leads to urine flows in paranephral fat tissue. If transection of the ureter wall is small, urine enters the retroperitoneal space gradually and in small amount, penetrates tissue and leads to the development of urinoma and urine infiltration. Retroperitoneal fat tissue, infiltrated with urine and blood often suppurates, that leads to the development of isolated septic foci, or through the significant necrosis and tissue melting, to secondary peritonitis, but more often to urosepsis.

Diagnostics

Clinical investigation. If suspected ureteral injury occurs during the operation, intravenous infusion of indigokarmin or methylene blue is recommended to identify the injured area of

the ureter, what is particularly important to identify its partial

damage. Catheterization is proposed as a method of both prevention and intraoperative diagnosis of ureteral injury

Isolated iatrogenic ureteral injury can be missed easily. In such cases, after gynecological operations, accompanied by ureteral injury, patients feel pain in the lumbar region, leakage of urine through the vagina is marked, and this condition is

septic.

Clinical diagnosis of ureteral injury simultaneous to wounds of the abdomen or lumbar region is based on the location of the wound and the wound channel direction, evaluation of urine and wound exudation.

The most effective method for diagnosis of ureteral injury is a direct visualization of the damaged area, because with pre- and intraoperative instrumental studies is usually possible only in 20% of cases. That is why during the revision of the abdominal cavity at the slightest suspicion of ureteral injury, revision of the retroperitoneal space should be performed, especially if there is a hematoma.

There are absolute and relative indications for their revision of retroperitoneum:

- absolute indications - continuing bleeding or pulsating hematoma;
- relative indications - urinary extravasation and the inability to establish the extent of injury, due to the need of urgent intervention caused by combined injury of the abdominal cavity.

Instrumental investigation:

- excretory (infusional) urography: shapeless urinoma can be defined in retroperitoneal fat, and at accidental ligation of the ureter - renal pelvis and calyces dilatation, ureter dilatation on the injury site, (Fig. 8.4);
- retrograde ureteropyelography: is used if excretory urography does not provide the necessary information;

- endoscopy: flexible ureteroscope is used (Figure 8.5).



Fig. 8.4. Iatrogenic injury of the right ureter (is observed dilatation of pyelocalyceal system and ureter up to the lower parts)

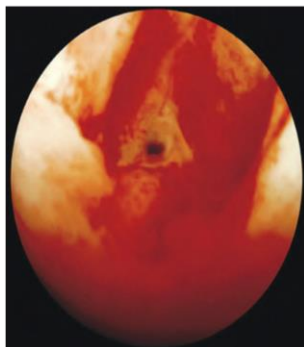


Fig. 8.5. Posttraumatic ureter stenosis

Fig. 8.4. Iatrogenic injury of the right ureter (is observed dilatation of pyelocalyceal system and ureter up to the lower parts)

Differential Diagnosis

It is necessary to differentiate ureter and bladder injury. One can use the method of filling the bladder with colored liquid (methylene blue, indigo): if bladder is injured, colored liquid is excreted through urinary fistulas, while when ureter is injured, unpainted urine continues to leak out of the fistula.

Treatment

Once ureteral injury is suspected, emergent hospitalization is necessary. Treatment choice depends on the nature of the injury and the timing of diagnosis, but surgery is the basic method.

If ureteral injury is not severe (maximum - partial rupture of its wall) nephrostomy or stenting can be performed (the latter is preferred). Stenting can be performed both retrograde and antegrade with the help of X-ray tv-set, under the control of ureteropyelography, using flexible conductor. In addition to stenting, catheterization of the bladder is performed to prevent reflux. The stent is removed after 3 weeks. In order to clarify ureteral passability excretory urography or dynamic nephroscintigraphy should be performed 3-6 months later.

Treatment of severe ureteral injuries is operative. Any intervention on the injured ureter should be completed with drainage of retroperitoneal space, nephrostomy or stenting. If ureter is injured and it is diagnosed during surgery, it is necessary to restore its integrity and to place ureteral stent. Operative accesses are determined by the nature and localization of damage. In the case of isolated ureter injury, lumbotomy or pararectal access are preferred. If the lower third of the ureter is injured, or if injury is combined with abdominal cavity organs trauma - laparotomy is performed. Videolaparoscopic technique in ureter surgery is now widely used (Fig. 8.6). When complete rupture of the ureter occurs, the only acceptable method of treatment is surgical restoration of its integrity.

There is only one situation in which immediate nephrectomy is needed: when ureteral injury is accompanied with aortic aneurysm or severe vascular injury, requiring replacement. Nephrectomy helps to avoid extravasation of urine, urinoma formation, and infection of the prosthesis.

Complications

There are early and late complications of ureteral injuries:

- *early complications:* **uroplania**, development of urohematoma, a variety of infectious and inflammatory complications (pyelonephritis, retroperitoneal abscess, urinary peritonitis, sepsis);
- *late complications:* strictures and obliterations of the ureter, urinary fistulas.

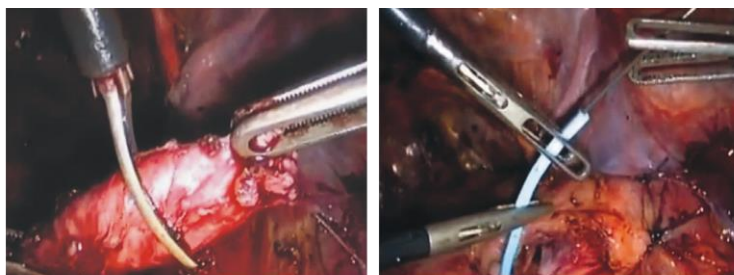


Fig. 8.6. Videolaparoscopic iatrogenic ureteral injuries correction: a – ureter is crossed above the zone of injury, and b - formation of neocystoureteroanastomosis around the stent

Prognosis

When open or closed ureter injury occurs, prognosis depends on the nature and type of injury, presence of complications, injuries of other organs, when trauma is combined; on timeliness and quality of the assistance provided. Patients, who underwent ureteral injury, are at risk of late complications for a long time

8.3. Urinary bladder injury

Injury of the bladder is considered a severe trauma of the abdomen and pelvis and emergency care is needed. Among abdominal injuries that require surgical treatment, bladder injuries make up about 2%, among them closed (blunt) injuries - 67-88%, open (penetrating) - 12-33%.

Traffic accidents cause injury of the bladder in 86-90% of all cases. If injury of the bladder is closed (blunt), dome of the bladder is damaged in 35%, if open (penetrating) sidewalls are damaged in 42%.

Grade	Type of injury	Description of injury
I	Hematoma	contusion, intramural hematoma
	laceration	partial wall thickness
II	laceration	extraperitoneal bladder wall laceration (< 2 cm)
III	laceration	Extraperitoneal (≥ 2 cm) or intraperitoneal (<2cm) bladder wall laceration
IV	laceration	Intraperitoneal bladder wall laceration ≥ 2 cm
V	laceration	nterperitoneal or extraperitoneal bladder wall laceration extending into the bladder neck or ureteral orifice (trigone)

Table 8.3. Urinary bladder injury

The combined injuries are common: in 62% of cases with open (penetrating) injuries and 93% - with closed (blunt). In 75-90% of patients with injuries of the bladder, pelvis fractures are diagnosed.

Mechanisms of the bladder injury. Common causes of closed injuries of the bladder: car accidents, falls from heights (katatrauma), work injury, outdoor and sports injuries.

Probability of the bladder injury increases in the presence of severe injuries of the

pelvis and abdomen.

Classification

Modern classification of urinary bladder injury (according to AAST) is given in table

8.3. Pathological anatomy

There is contusion and laceration of the urinary bladder wall. When contusion occurs, the submucosal inside detrusor hemorrhages. Hemorrhages often resolve without a trace.

Partial tears can be internal (in violation of the integrity of mucosa and submucosa only) or external - in case of damage (usually - with bone fragments) external (muscle) layers of the wall. In the first case there is bleeding into the cavity of the bladder, the intensity of which depends on the type of damaged vessels: venous bleeding stops quickly, arterial - often leading to bladder tamponade with blood clots. When external laceration occurs, blood flows

in paravesical tissue, leading to deformation and displacement of bladder wall. When complete laceration happens, the integrity of the bladder wall throughout its entire thickness is damaged. It is distinguished into intra- and extraperitoneal lacerations: complete intraperitoneal lacerations are located on the top or top and posterior side, often on the midline or near it, more often they are isolated, straight, but can be numerous, irregularly shaped. Bleeding, caused by these lacerations is negligible due to the absence of large vessels in this region and reduction of the injured blood vessels along with emptying the bladder into the abdominal cavity. Urine, that poured, is partly absorbed (leading to an early increase in the concentration of urea and other products of protein metabolism in the blood), causing chemical irritation of the peritoneum, which is then followed by aseptic and purulent peritonitis. Isolated intra-peritoneal laceration symptoms are increasing gradually, for a few hours. During this time the abdomen accumulates a large amount of fluid (a mixture of urine and exudate).

Extraperitoneal lacerations usually occur with pelvic fractures, often localized on the front or anterolateral surfaces of the bladder, are small, of regular shape. Extraperitoneal lacerations are usually accompanied by significant bleeding into paravesical tissue from the venous plexus and pelvic bone fractures, in the cavity of the bladder - out of bladder neck and ureteral orifice. Consequently, urohematoma is formed, which deforms and displaces the bladder.

All this leads to septic intoxication, weakening of the defense mechanisms. Granulation tissue is not formed, resulting in rapid melting of fascial septa, and alkaline decomposition of urine

starts, deposition of salts and their inlay on necrotic tissue, urinary phlegmon develops. Inflammation starts from the bladder wound and then engages the whole of its wall. If there are combined fractures of the pelvis, a purulent cystitis and osteomyelitis appears.

Clinical picture

Closed injuries of the bladder are characterized by a combination of symptoms of the bladder injury, signs of other organs and pelvic bone trauma, symptoms of early and late complications of trauma. Hematuria, urinary disorders, pain in lower abdomen and suprapubic area during the initial examination of a patient with a history of trauma can point out to bladder injury.

If there is an isolated injury, pain in suprapubic area, the impairment of urination and hematuria appears. Disorders of urination, when bladder is injured, are various. The nature of the disorders is associated with the degree of emptying of the bladder through the laceration in the surrounding tissue or into the abdominal cavity. In the case of contusion and incomplete bladder laceration, painful and frequent urination occurs; acute urinary retention is possible. Sometimes, when injury is mild, urination is normal. Complete ruptures are characterized by failure to urinate, and

by frequent, painful urges to urination, but unlike urinary retention, tympanitis is defined above the pubis. If

injury is extraperitoneal, tympanitis is soon replaced by progressive blunting without clear boundaries; in the case of intraperitoneal lacerations, tympanitis is combined with large volume of free fluid in the abdominal cavity. When bladder is ruptured, on the background of useless urges to urinate, sometimes, a few drops of blood are possible to be excreted, either a prolonged absence of urination and urgency to it.

Hematuria is an important feature, the intensity of which depends on the type of injury and its localization. If bladder contusion, internal or external incomplete intraperitoneal laceration occurs, hematuria is either short, or absent, at the same time, a significant laceration in the area of the bladder neck triangle causes gross haematuria. However, the isolated bladder injuries are rarely accompanied by significant blood loss and shock. When

extraperitoneal injury happens in a few hours hematuria intensity decreases, but pain, the frequency and urge to urinate are increasing. In the suprapubic and groin areas swelling of the skin and subcutaneous tissue appears, the patient's condition gradually deteriorates due to the increasing toxicity and the development of pelvic phlegmon or abscess.

If bladder laceration is intraperitoneal, peritoneal symptoms develop slowly, increasing gradually (2-3 days), are mild and transitory, which is often causes late diagnosis of urinary peritonitis. Getting of infected urine into the abdominal cavity leads to an earlier appearance of the clinical picture of diffuse peritonitis, but clinic of dynamic obstruction of the intestines is at the forefront. In 50-80% of cases of associated bladder injuries, patients are collapsed and shocked, that significantly changes clinical manifestations and complicates timely diagnosis. Isolated fractures of the pelvis with paravesical hematoma may also be manifested by pain, dysuria, tense and pain of the anterior abdominal wall, gas, feces and urine retention. These symptoms are probably related to the stimulation of the parietal peritoneum with hematoma, compression of the bladder neck.

N.B.

Bladder injury suspicion – is indication for of specific studies using, that allow to confirm the fact of injury, to determine its type and plan a treatment tactics.
Diagnostics

Diagnostic catheterization - the most easy and affordable method for diagnosis of bladder injury that requires high skills and special equipment.

Catheterization should be performed with caution, with soft catheter, with no signs of damage to the urethra. Signs, that indicate bladder injury: absence or a small amount of urine in the bladder of a patient who has not urinated for a long time, a large amount of urine, which far exceeds the physiological capacity of the bladder; admixture of blood in the urine (renal origin of hematuria must be excluded), the discrepancy of fluid injected through the catheter amounts and removed (positive symptom

Zeldovich); liquid withdrawn through the catheter (a mixture of urine and exudate) contains 70-80 g/l of protein.

Laparoscopy and laparocentesis - are widely used for the detection of blood and urine in the abdominal cavity. Introduced in the abdominal cavity catheter is guided alternately in subcostal area, in the iliac and pelvic cavity, contents of the abdominal cavity is extracted with the help of the syringe. Upon blood, fluid mixed with bile, intestinal contents or urine obtaining, internal organs injury is diagnosed and emergency laparotomy is performed. In cases when fluid does not come out of the catheter, 400-500 ml of physiological sodium chloride solution is injected in the abdomen, then aspirated and tested for impurities of blood, urine, diastase. A negative result of laparocentesis lets abandon laparotomy.

Retrograde cystography – is a “gold standard” of the bladder lesions diagnosis, which can detect deflection of the bladder integrity, permits to provide differential diagnosis between intraperitoneal and extraperitoneal lacerations, establish the presence and location of tissue

urine infiltration. In addition to the high information content, the method is safe,

does not burden the state of the victim, do not provoke any complications, related with contrast material inflow into the peritoneal cavity or paravesical fiber (at laceration detection according to cystography, surgical drainage of the abdominal cavity, of uroplania

must be performed. Retrograde cystography performing is advisable to combine with Zeldovich probe (Figure 8.7).

Methodology: the catheter is injected slowly into the bladder and at least 300 ml of water-soluted contrast agents (10-15% solution), 1-2% solution of novocaine with broad-spectrum antibiotic are infused, and then radiography is performed. Evaluation of results:

the main radiological signs of the bladder injury - is the presence of contrast material outside (uroplania) the bladder, up or sideways displacement, shape deformation. Adverse symptoms are often observed in cases of extraperitoneal laceration and paravesical

hematomas. Signs of extraperitoneal laceration: fuzzy contour of the bladder, vagueness, radiopaque substance infiltration paravesical fiber as separate bands (tongue-shaped, diverge ray-shaped) with small tears; nebulous shadows - at medium, continuous dimming without clear contours - with a large laceration.

Excretory urography with downward cystography, is in most cases of the urine bladder injury, less informative due to the fact that the concentration of contrast material is insufficient for identifying uroplania, so, its usage in diagnostic is inappropriate.

Ultrasound can detect free fluid in the abdominal cavity, liquid foundation (urohematoma) in the pelvic tissue, blood clots in the cavity of the bladder or the lack of visualization of the bladder when it is filled through catheter. Use of ultrasound is limited now, due to the fact that most patients with polytrauma pass CT - a more informative diagnostic method.

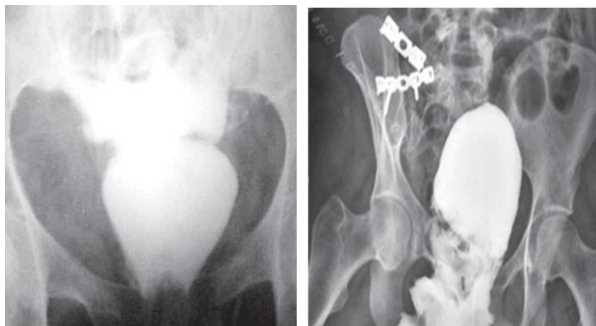


Fig. 8.7. Retrograde cystogram: A - intraperitoneal laceration of the bladder, contrastin abdominal cavity; b - separation of the bladder neck

Despite the fact that the CT – is a method of choice for the study of blunt and penetrating injuries of the abdomen and pelvis, its routine usage, even when the bladder is full, is not reasonable, as it is impossible to differentiate urine from transudate. For this reason, in order to diagnose bladder injury, CT should be performed in conjunction with retrograde contrasting (Figure 8.8).

Treatment

Suspected bladder injury – is indication for emergency hospitalization. Approach to treatment depends on the nature of the

bladder injury and combined injuries of other organs: the presence of symptoms of shock before surgery is indication to antishock measures; with contusion and a partial rupture of the bladder conservative treatment is held: prescribed bed rest, hemostatics, analgesics, antibacterial and anti-inflammatory drugs, to prevent two-

staged rupture of the bladder permanent urinary catheter is introduced.

The duration of bladder drainage is individual and depends on the severity of the injury,

the general condition of the patient, the nature of injury, duration of hematuria, pelvic hematoma resorption duration (average 7-10 days). Before removing the urethral

catheter cystography must be performed and absence of contrast material infiltration – verified, treatment of

complete closed injuries is always surgical.

In postoperative period antibacterial, hemostatic, antiinflammatory, infusion therapy are conducted, as well as stimulation of intestinal peristalsis and correction of homeostasis disorders.

Duration of drainage of the abdominal cavity and the bladder is determined

individually, depending on the characteristics of the postoperative period. Thus oriented

to indicators of intoxication, duration of hematuria, presence of infectious and inflammatory complications.

Complications

Complications often arise due to late diagnosis of injury and treatment delays.. Complications of bladder injury include: rising urohematoma, pelvis phlegmon, localized abscesses, urinary peritonitis, sepsis, adhesive intestinal obstruction.

If the bladder neck, vagina, rectum are injured, urinary incontinence, fistula, stricture can develop, without timely treatment. Subsequently, these complications may require implementation of planned operations. An extensive buttocks, sacral roots or pelvic nerve trauma, leads to denervation of the bladder and urinary dysfunction. If the cause of urinary dysfunction – is a innervation violation, a catheterization may be needed after time.

Iatrogenic injury of the urine bladder

Iatrogenic injury of the bladder can be closed and opened. The causes of iatrogenic injury of the bladder: bladder catheterization; urethra bouginage, pelvic organs surgery; obstetrics and gynecological surgery, Tension-free Vayinal Tape (free synthetic loop)operation, TUR of bladder and prostate, hernioplasty, orthopedic treatment of pelvic

bone fractures; aortofemoral bypass, setting of intrauterine devices.

Risk factors for intraoperative injury of the bladder: poor visibility or exposure of surgical field (large tumor in the region of the pelvis, pregnancy, obesity, pelvic bleeding, malignancies, inadequate operational access or retraction, poor lighting); anatomical deformity (fusion scar, surgery for pelvic conducted previously, pelvic prolapse, congenital anomalies, radiation therapy, chronic pelvic inflammatory

disease, endometriosis, malignant infiltration, or stretched thin wall of the bladder).

Diagnosis of intraoperative bladder injury

Signs of intraoperative bladder injury: occurrence of liquid (urine) in the operating field, visible wound of the bladder, the emergence of air in urine collecting device (in laparoscopic surgery), haematuria. If one suspects damage to the bladder during surgery an audit of its walls should be performed, indigo diluted in 300 ml of sterile isotonic sodium chloride solution, should be administered by catheter, in order to detect possible leakage of urine. In doubtful situations cystotomy and audit of the bladder are performed, that allows to determine the location, laceration size, and its relationship with ureteral orifice.. Symptoms of bladder injury in the early postoperative period: hematuria, oliguria, elevated levels of serum creatinine, pain in the lower abdomen. In the later period symptoms of peritoneal irritation, the appearance of urinary fistulas and uroplania may occur (Figure 8.9). Suspicion of iatrogenic injury of the bladder in the postoperative period is an indication to retrograde cystography. Treatment:

- treatment of iatrogenic injury of the bladder is usually surgical;
- principles of treatment are the same as in non iatrogenic;
- indications for laparoscopic correction are: failures directly while performing laparoscopic surgery: minor injuries, urologist masters laparoscopic surgery technic, good exposure and visibility of the surgical field, there is no risk of damage to the ureter or bladder neck.

If injury is detected late or there is complications, treatment is selected individually, considering patient's condition and the time elapsed since the injury. In some cases, multi-stage treatment with temporarily epicystostome needed.

8.4. Injury of the urethra

In peacetime, urethra injury occurs in 15% urinary tract injury survivors. In most – it is open injury. This type of injury is more common in men (women's urethra is rarely injured, usually while pelvic bones fracture. About 70% of urethral injuries occur in car accidents, 25% - after falling from a height and 5% - as a result of other causes, including iatrogenic.

Etiology and pathogenesis

Open urethral injury occur more frequently as gunshot wounds, and closed - fractures of the pelvis and a fall on the perineum. Sometimes this injury occurs when the forced introduction of medical instruments in urethra is held (metal catheter, bougie, cystoscope, resectoscope), when passing stones, penile injury, birth trauma, surgery for prostate and more.

From an anatomical and practical point of view urethra I divided into two portions: the posterior (fixed urethra) and anterior. The boundary between them is the urogenital diaphragm. Injury of these two parts can vary significantly according to the mechanism of injury, clinical course and treatment policy. Therefore, they are usually studied separately.

Injuries of the posterior urethra

These injuries usually occur with fractures of the pelvis, broken ends of which are a major factor damaging this part of the urethra. Most often urethra is injured by horizontal bone fractures, especially in the presence of iliac-coccygeal joint diastase.

Depending on the severity of urethra and pelvic bones injury, there are two types of injury: simple - a small dislocation of symphysis, safe urethra and a relatively small mucosa distraction (up to 3.3 cm); complex lesions in which there is a significant symphysis dislocation, complete urethra stumps divergence, often with interposition of other tissues and severest mucosa distraction (3.8 cm). In rare cases, urethra injury without pelvic bone fractures is possible. Blunt trauma of the perineum can cause this injury.

Posterior urethra may also be injured during vaginal endoscopic and open operations. Ischemic traumas of the urethra and bladder neck during prolonged childbirth are described also.

Incomplete tear of urethra anterior wall is usually observed in women, complete separation is rare.

Perforation of the urethra occurs in 2% of transurethral resection of the prostate cases.

Classification

Urethra injuries, depending on the integrity of the skin are divided into open and closed. There are also isolated and combined injuries of the urethra. Closed injuries are observed in 96% of all cases, and only 4% - open

According to injury localization, spongy (penile), membranous and prostatic urethra injuries are distinguished, moreover, urethra can be injured both from inside and outside.

Among closed injuries of urethra it is distinguished: contusion, stretched injury, partial disruption, complete disruption, crush.

Among open injuries (wounds) of urethra it is distinguished: tangents and blind wounds without all urethra layers laceration; tangential, blind and cross-cutting injuries with all layers laceration, urethra disruption; crush..

Also, urethra disruptions are divided into simple, when disrupted stumps are on the same axis and are separated by a small gap, and complex, in which there is considerable diastase among displaced relative to one another ends of urethra. Classification of urethra injuries, proposed by AAST is shown in Table. 8.4, 8.5. The new classification is anatomical and is based on treatment strategy comparison and long-term results.

Grade	Injury type	Injury description
I	contusion	blood at urethral meatus; urethrography normal
III	stretched injury	Elongation of urethra without extravasation on urethrography
III	partial wall disruption	Extravasation of urethrography contrast at injury site with visualization in the bladder
IV	complete wall disruption	Extravasation of urethrography contrast at injury site without visualization in the bladder; <2cm of urethra separation
V	complete wall disruption	Complete transaction with ≥ 2 cm urethral separation, or extension into the prostate or vagina

Table 8.4. Urethra injuries classification

Table 8.5. Classification of anterior and posterior urethra injuries

grade	Injury type	Description
I	elongation	Elongation of urethra, according to urethrography, without contrast extravasation
II	contusion	blood at urethral meatus, no contrast extravasation
III	Partial disruption of the wall of anterior or posterior urethra	Contrast extravasation, contrast in proximal uretra and urine bladder
IV	Complete disruption of the anterior urethra	Contrast extravasation, contrast in proximal uretra and urine bladder is absent
V	Complete disruption of the posterior urethra	Contrast extravasation, no bladder visualization
VI	Complete or partial disruption, combined with extension on bladder triangle or vagina	

Tactics of treatment depends on the extent of injury:

- First grade - does not require treatment;
- II-III grade - cystostomy must be performed or urethral catheter introduced;
- IV-V grade - the implementation of an open or endoscopic surgery (immediate or delayed) is indicated;
- VI lgrade –open surgery needed.

Diagnostics

Clinical manifestations of the urethra injuries: urethrorahiya or hematuria, painful urination or inability to urinate; palpation - bladder is full; perineal hematoma and swelling. In the absence of urethrorrhagia and / or hematuria , the probability of urethral injury is very small and it can be quite easily excluded by catheterization of the bladder, which is usually done in patients with polytrauma. However, during physical examination urethrorrhagia, perineal hematoma and high standing of the bladder bottom are not found in 57% of patients with urethral injury during physical examination This can be explained by fact, that if hospitalization is rapid, listed symptoms have no time to appear.

Therefore,absence of obvious signs of urethra injury during physical examination can not be considered as a ground for refusal of further investigation.

Instrumental methods of investigation:

- **retrograde urethrography** - is a "gold standard" for urethral injury diagnosis.

Methods of examination:

- Foley catheter CH 12-14 is introduced in fossa navicularis, then balloon is filled with
 - 2-3 ml and 20.0 ml of water-soluble contrast is injected slowly;
 - X-ray is performed with body tilted at 30 °, it enables us to detect fractures of the pelvis, the presence of a foreign body, bone fragments in the projection of the urethra or bladder (Fig. 8.10);
 - If urethra injury is diagnosed, cystostomy must be done, further it helps to perform cystography and downward urethrography; the latter is done in a week, if primary delayed urethraplasty is planned, or 3 month later, if delayed urethraplasty is planned urethrography might be combined.



Fig. 8.10. Retrograde urethrography (posterior urethral injury)

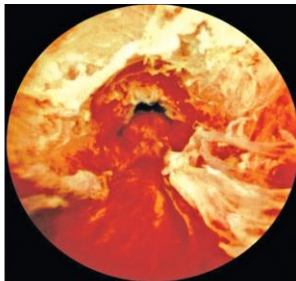


Fig. 8.11. Urethrascopy: iatrogenic injury (false passage) of the membranose urethra.

If retrograde urethrography can not visualize the urethra injured area, MRI and endoscopy, which is done through cystostoma can be informative (Figure 8.11).

Endoscopy and retrograde

Treatment

In case of partial rupture of posterior urethra cystostomy must be applied, or urethral catheter installed, 2 weeks

later retrograde urethrography must be repeated. Such lesions, as usual, heal without stricture formation or nonextended stricture formation, which can be treated by optical urethrotomy or dilatation.

One of the most common causes of partial urethra disruption – is perforation of the prostatic capsule while TURP performing.

Methods of treatment of disruption of the posterior urethra: primary endoscopic urethral passability restoration, urgent open urethraplasty, delayed primary urethraplasty; delayed urethraplasty, delayed endoscopic incision.

Injuries of the anterior part of urethra

In partial disruptions of the anterior urethra the treatment is based on cystostoma applying, suprapubic or urethral catheter introducing. *Closed injuries* of the anterior urethra are accompanied by contusion of corpus spongiosum, that complicates the differentiation of viable segments of the urethra at the site of injury, it is for this reason that in such cases of emergency urethroplasty is not indicated..

In penetrating wounds of the anterior urethra caused by firearms of low velocity, bladed weapons or animal bites, which are often accompanied by penis and testicles injury, primary surgical restoration is indicated (stricture formation is observed in 15% of cases or less). Anastomosis is applied with waterproof, tension free suture.

Small defects can be sewed with absorbable sutures. Perioperative prophylaxis with antibiotics is used. After 10-14 days retrograde urethrography must be performed with urethral catheter in situ, then (in the absence of extravasation) catheter is removed.

Complications of urethral injury

There are early and late complications of urethral injury. Frequent early complications – are: urinary infiltration and inflammatory and infectious complications (cystitis, urethritis, pyelonephritis, pelvic tissue phlegmon, urosepsis, osteomyelitis of pelvic bones). These complications are often the direct cause of death, especially

with gunshot wounds.

Prognosis

Prognosis depends on the size of injury, time for recognition, character and timing of surgical care. In all cases, the prognosis of urethral injury is serious enough.

8.5. Injury of scrotum organs

Injury of the external genitalia is more common between the ages of 15 to 40 years, but about 5% are patients younger than 10 years. Closed (blunt) injury accounts for 80% of injuries of the external genitalia, and open (wound) - 20%.

Blunt damage resulting from external blows with a blunt object, and penetrating are wounds of any depth, blowed with a sharp object exactly in the area of the external genitalia. Damage to the external genitalia have been reported in 2,2-10,3% of hospitalized with various injuries. Thermal, radiation, chemical, electrical injuries are rare.

Etiology and pathogenesis

Risk factors for injury of the external genitalia, including the scrotum and testicles: aggressive sports (hockey, rugby, contact sports), motorcycling, mental illness, transsexuality. During military operations open scrotal trauma is often. To injuries arising from animal bites serious infection is inherent. In such cases, the most common infectious agents are: *Pasteurella multocida* (50 %), *Escherichia coli*, *Streptococcus viridians*, *Staphylococcus aureus*, *Bacteroides*, *Fusobacterium spp.*

Closed injures

In case of injury, scrotum organs are damaged less than scrotum itself (in 25-50% cases) because at the time the injury occurs, reflex contraction of the muscles that lift testis, and it migrates from the area of traumatic force's impact.

Closed trauma causes damage to the testes in cases, where severe blow falls on testis located directly next to the pubic bone. In some cases, suddenly applied force can push a testis up towards the inguinal canal or even through it in abdomen. Such injuries are

more common in road traffic accidents for drivers of motorcycles due to a sharp and sudden impact with the wide gas tank.

This damage, called testicular dislocation is quite rare. Dislocation can be single and bilateral, the dislocated testicle is often not damaged. Closed testicular dislocation is

divided into two groups: external (subcutaneous) and internal. The first include inguinal, pubic, femoral, perineal, and dislocation under the skin of the penis also. The

second –are dislocations in the inguinal and femoral canals, intraabdominal and acetabular.

Classification

Modern classification of scrotum and testicles injuries, proposed by AAST, makes it possible to distinguish between patients with severe trauma, whom surgical treatment is indicated, and patients who can be treated conservatively (Table 8.6, 8.7).

Table 8.6. Grades of scrotum injuries

Grade	Injury type
I	Concussion
II	Disruption of < 25 % scrotum diameter
III	Disruption of > 25 % scrotum diameter
IV	Avulsion (tearing) the cutis scroti < 50 %
V	Avulsion (tearing) the cutis scroti > 50 %

Table 8.7. Grades of the testicles injuries severity

Grade	Injury type
I	Concussion or hematoma
II	Subclinical laceration of tunica albuginea
III	Laceration of tunica albuginea with parenchyma loss < 50 %
IV	Laceration of tunica albuginea with parenchyma loss > 50 %
V	Total testicle destruction or tearing or avulsion

Clinical picture

The closed injuries (contusion, pinches) of scrotum because of its abundant vascularization and loose connective tissue often result in external hemorrhages like massive bruises and hemorrhagic infiltration, which often extend to the penis, perineum, inner thighs, anterior

abdominal wall. In this case, blood is accumulated in the wall of the scrotum, and it does not penetrate deeper than external spermatic fascia.

The pain during closed trauma is usually mild and it is quickly changed to a feeling of heaviness and tension in the scrotum.

After bleeding cutis scroti becomes purplish-blue, sometimes almost black. During palpation of the scrotum there is moderate pain, blood infiltrated tissues have dough consistency. However, through the wall of the scrotum it is possible to touch testicle, its epididymis, spermatic cord.

Along with the scrotum its organs may also be injured on one side and rarely on both sides. It is possible to have closed (subcutaneous) contusions and ruptures of the testis and its epididymis, spermatic cord and tunics of these organs. Such injuries are accompanied by the deep bleeding (hematoma) which are divided into extravaginal and intravaginal

During the **extravaginal hemorrhages** the blood, which poured, did not penetrate deeper than tunica vaginalis testis, so the sizes of hematoma may be different and it usually does not have clear boundaries. In some cases hemorrhage is small and it's possible to palpable it in a limited area of the spermatic cord. In other cases the

haemorrhagic infiltration extends from the testicle to the external opening of the inguinal canal. These hemorrhages occur during the injuries of the spermatic cord elements and testicle tunics located outside the vaginalis tunica. During such hemorrhages it is unable to palpate the testicle.

Intravaginal bleedings (hematomas) are called traumatic hematocele. This type of bleeding occurs during the injuries of the testicles or its vaginalis tunica. During the examination and palpation such hemorrhage may seem like dropsy of testicular tunica. Typical hematocele occurs as a result of testicular tunics rupture at their dropsy. The crucial moment in diagnostics is to collect the history of injury properly, as well as pain on palpation, negative ray symptom. Closed injuries of the scrotum, especially of testicles and its epididymis result in the severe pain, often accompanied by vomiting, convulsions, fainting, shock. There is often an increase of scrotum size and its tension, the testicle is not palpable. Severe hematocele may occur even without the testicle injury.

The dislocation of the testicle is often diagnosed for the patients with polytrauma (on the basis of the abdominal cavity CT scans).

During the dislocations, most often the testicle is not injured, but sometimes it is distorted in the region of the spermatic cord. It happens due to the wide inguinal canal, false cryptorchidism. This leads to disruption of the blood supply to the testicle.

Diagnostics

Despite the severe clinical picture, diagnostics of scrotum organs closed injuries is often difficult because of consensual scrotum injuries. Ultrasound investigation in the

diagnostics of blunt testicular injury plays a significant role, as it has the possibility to diagnose intra- and / or extratesticular hematoma, testicular rupture, sometimes testicles concussion or foreign body.

Information obtained by ultrasound investigation, may be supplemented with duplex, doppler tomography. It provides information about organ perfusion and makes it possible to diagnose the vascular injuries and false aneurysms.

CT or MRT may provide helpful information during scrotum injuries but sometimes even with these researches it is impossible to determine exactly the nature of scrotum and its organs injury and exclude the injury of the testicle. In such cases the scrotum exploration surgery is recommended.

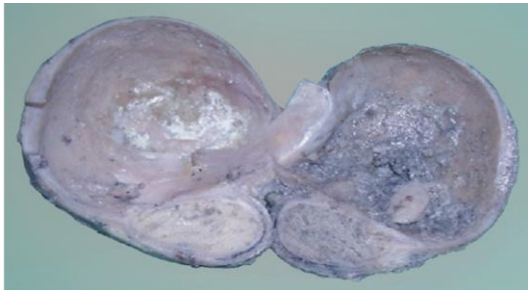
The treatment depends on the nature and severity of injuries.

Drugs-free treatment.

The contusion with surface hemorrhages and small hemorrhagic infiltration of the scrotum wall should be treated conservatively. During the first hours after trauma the immobilization of scrotum should be performed (the raised position by applying suspensory bandage). The local cooling may be done using ice pack. Starting from 2-3rd day after the injury thermal treatments should be prescribed: hot compress, heater, sollux, sitting baths, paraffin baths.

A good blood supply to the scrotum assists in rapid resorption of hemorrhages.scrotum

If there is hematocele without testicle rupture conservative treatment is possible provided that the size of hematocele does not exceed the size of contralateral testicle by 3 times. However, this approach to



Pic. 8.12. Testicular hematoma with its parenchyma destruction

treatment is not a standard, because when hematocele has large

sizes there is still a high need for delayed (more than 3 days) surgery.

Surgical treatment

The conservative treatment of the scrotum closed injury and its organs has been recently predominant. At the same time nowadays the preference is given to active operational tactics. According to earlier clinical experience (in the first hours and days after injury) the surgery is the most effective way to maintain viability and function of the testicles tissues, which leads to faster recovery

of the patient.

Indications for early surgical treatment (during first hours and days after injury) are testicle rupture, branchy surface hemorrhage, type of hemorrhage scrotum infiltration; deep hemorrhages, especially when they are growing fast together with severe pain, nausea, vomiting, shock (fig. 8.12); closed testicle dislocation after an unsuccessful attempt of bloodless reset, twisting of spermatic cord; the presence of doubt that the injury of the scrotum and its organs is more serious than just a bruise.

Later on the indications for surgery are scrotum hematomas which are not resolved for a long time.

There are practically no contraindications to surgery of isolated closed injuries of the scrotum and its organs. For severe combined trauma surgery on the scrotum can be performed secondarily. The preoperative preparation is usual. Trimecaine, procaine (novocaine) blockage of the spermatic cord is indicated for severe pain and shock that occur during the injury of the testicle and its epididymis. At the same time usual antishock actions are performed. If branchy hemorrhages the scrotum blockade is performed by infiltration of spermatic cord with trimecaine and novocaine within the inguinal canal.

Anaesthetization: in isolated closed injuries of scrotum and its organs the surgery can be performed under local infiltration anesthesia combined with block anesthesia; in other cases the narcosis is used.

Types of surgery

Depending on the injuries that occurred the following should be done: Remove the superficial and deep hematomas and make the final termination of bleeding; revise the scrotum organs, remove obviously nonviable testicular tissues and its epididymis, tunicas; put in catgut stitches to tunica albuginea testis, testicular resection, its orchotomy, bring down the testicle into the scrotum and fix it if dislocated, untwist the spermatic cord and fix testicle in the normal position when the spermatic cord was twisted; stitch or bandage ductus deferens.

Complications:

- Sclerotic and atrophic changes in testicular parenchyma result in testicular injuries and further traumatic orchitis and periorchitis
- Formation and festering of hematomas occur after groundless surgery refusal and wound drainage.



Fig. 8.13. Scrotum injury with the testicles evisceration

- Prevention of these complications is the timeliness and thoroughness of the surgery and use of antibacterial therapy during the postoperative period.

Open injuries

Clinical picture

Open damages or injuries of the scrotum and its organs mostly happen during the war; during the industrial works in peacetime they are very rare.

According to the mechanism of injury and the nature of the hurting instrument there are: incised, stab, avulced, compound, crushed and other types of scrotum injuries. The main difference of these injuries is different amount of tissue destruction at the time of injury.

Gunshot injury of the spermatic cord is usually accompanied by blood vessels injury, which is an indication to perform orchiectomy and vasoligation.

The amount of open injuries of the scrotum and testicles in peace time is less than 1% of all injuries of the genitourinary system. As a rule open injuries of scrotum and testicle are often knife (stab) or missile. Fall on sharp objects may also hurt the scrotum.

The peculiarities of the cutis scroti structure and its blood supply lead to frank openness and pulled up edges of the wound, the intensive bleeding and the formation of branched hemorrhages, which extend to the anterior abdominal wall, penis, perineum, pelvic cellular cavity. Particularly intensive bleeding and hemorrhages occur during the injuries of scrotum root area with the spermatic cord injury. Bleeding of the testicular artery usually results in significant blood loss and may be dangerous to life of the injured person. As a result of contusion injury traumatic orchitis and epididymitis often occur. Gunshot wounds of the scrotum result in one or two testicles eviscerate into the wound (Pic. 8.13). Injuries of the testicle itself may be accompanied

by shock, evisceration of testicular parenchyma necrosis of which leads to its atrophy. Injury of the scrotum and its organs make negative emotional and psychological impact on the sufferer. That is why starting from the first aid to specialized medical care, you should follow the principle of maximum anatomical preservation and functional recovery of injured organs. During the injury of the testicles the shock is observed in all the cases. The grade and severity of shock is determined by the severity of combined injuries.

Diagnostics

Clinical:

Diagnostics of open injuries (gunshot wounds) of the scrotum is quite simple. Usually it is enough to examine. In a gunshot entrance perforations openings are almost always placed on cutis scroti, but their sizes as a rule don't determine the severity of the injury.

- Great attention should be paid to timely recognition of combined injuries of closely placed organs: urethra, bladder, etc. The branched hemorrhagic infiltration makes it difficult or impossible to palpate the testicles. In such cases, the scrotum injuries are diagnosed during the surgical wounds cleaning

Instrumental methods:

- During shots, especially shrapnel wounds of scrotum the indication is X-Ray (X-Ray analysis) to localize the foreign bodies.
- If penetrating injuries the indication is always an ultra sound diagnostics and urine analysis. If necessary one makes CT of abdominal cavity with or without cystography.

Treatment

The treatment of open injuries of scrotum and its organs is always **surgery**. Operations, depending on the severity of the injury and the presence of combined injuries are performed under local anesthesia or under narcosis.

Complications:

- major complications of scrotum and its organs injuries are purulent wounds infection, necrotizing orchitis, scrotum gangrene;
- their prevention is careful hemostasis, wound drainage and the use of antibacterial medication;
- treatment of gunshot complications and other scrotum and its organs injuries are carried out at the stage of specialized medical care.

8.6. Penis injuries

Penis injuries are reported in 50% of all external genitalia injuries that make up 30-50% of all injuries of genitourinary system. 1% of penis injuries are combined with both testicles injuries.

Etiology and pathogenesis

The genital injuries of men mainly include ruptures or bursting of penis frenulum of prepuce, penis contusion, subcutaneous establishment of corpora cavernosa, dislocation and pinching, degloving, incised, stab or bitten injuries.

The genitals injuries of men are most common not only because of their external location, but also because men are more involved in traumatic sports (rugby, hockey, cycling, motorcycling, wrestling, skiing and other active sports). Risk group consists of patients with mental illnesses,

people of not traditional sexual orientation, transsexuals. Such injuries are also connected with injuries from bladed objects and gunshot wounds, the frequency of which increases annually.

Iatrogenic injuries of penis are observed at circumcision, reconstructive operations because of hypospadias and extrophy of bladder manipulations during priapism. Bites are rare penis injuries.

There is data that the medical personnel treating patients with external genitalia injuries are more prone to infection of hepatitis B and / or C, since 38% of such patients are carriers of hepatitis viruses B and / or C.

Classification

- By the type of damage there are following penis injuries:
- closed (blunt): contusion, fracture, dislocation, and pinching (make 80%);
- open (penetrating): avulced-compound, degloving, bitten, stab-incised, shots are about 20%;
- frostbite;
- thermal injuries.
- Nowadays, AAST classification of penis injuries is more and more widespread, table. 8.8. It is believed that this classification makes it possible to identify the

patients with severe injury who should be treated with surgical method, and patients whose injury can be treated conservatively.

• Grade	• Injury characteristics
• I	• Tissue rupture\concussion
• II	Transection of Buck's fascia (corpora cavernosa) without loss of tissue
• III	Transection (avulsion) of tissue (transection of penis with the assistance of external opening of the urethra), with defect less than 2 sm of urethra corpora
• IV	The defect of more than 2 sm of corpora cavernosa of urethra, partial panectomy
• V	Full panectomy

Table 8.8. Classification of penis injuries according to the grade of severity

The clinical picture

Closed injuries

The least severe injury of penis is its contusion. The reasons of contusion can be very different: the most often contusion appears while making physical exercises with apparatus (against the bar), during sports games, while falling down, kicking during fighting or fights e.t.c.; in case of penis contusion the integrity of exterior layers is not damaged, the laceration of tunica albuginea of corpora cavernosa does not happen, corpora cavernosa are



Fig. 8.14 Appearance of penis during its fracture

not damaged, but urethra injuries are possible, during penis contusion soft hypodermic fatty cellular tissue that has abundant blood supply is damaged.

That is the reason why the contusion of penis is accompanied by strong pain, bifurcated bleeding which is often spread on scrotum and/or hypodermic fatty cellular tissue.

While penis is hit it increases in size, its edema, walking difficulties appear, bifurcation of hematoma having blue-purple colour appears which is spread

on pubis, on scrotum and perineum.

Hematomas can press urethra and cause difficulties during urinating and even a delay of urinating.

Heavy closed injuries appear during penis trauma in the state of erection, in this case the width of tunica albuginea diminishes to 0,25-0,5 mm. instead of 2-4mm. in the

state of detumescence. In the state of absence of erection a blunt blow does not cause the laceration of tunica albuginea, only hypodermic hematoma appears.

Fig. 8.14 Appearance of penis during its fracture

Penile fracture

Anamnesis in case of penile fracture is classical, but not universal: around 60% of penile fractures happen when it is hit during the erection. Tunica albuginea has 2 cm width but is elastic that is why it is damaged during sexual intercourse when penis is harshly bent. Penile fracture (hypodermic laceration of corpora cavernosa) most often occurs during rough sexual intercourse, when penis coming out of vagina is fractured as a consequence of quick and intense blending of erected penis while resting into woman's pubic bone or perineum. In 10-25% penis fracture is accompanied by urethra and spongy substance damage. Fracture is accompanied by a characteristic crack that appears due to fracture of corpora cavernosa (sound of opening cork or breaking glass). During the trauma a patient is feeling a strong pain, erection stops, internal

tissue bleeding starts, hematoma appears, penis declines in the opposite direction, pain intensively increases, symptoms of shock can appear. (Fig. 8.14)

- Penis hematoma size that occurs during Buck's fascia laceration depends on the brancheous injury of tunica albuginea and corpora cavernosa. It may be large in size, blood often spreads to the scrotum, pubis, perineum, inner thighs, anterior abdominal

wall; the skin becomes cyanotic and later on it darkens. If urethra is injured during the fracture, urinary

retention may arise. If hematoma is not apparent, it is possible to palpate the defect of corpora cavernosa. The swelling can often reach large sizes, making it difficult to palpate the organ. In this case, one can

use ultrasound investigation with doppler mapping and x-ray studies (cavernosography, urethrography)

- Dislocation of penis is one of rare injuries that occurs for the same reasons as its fracture. During penis dislocation there is a laceration of bands which fix the penis to the coxal bones. In this case the corpora cavernosa of penis migrate under the skin of perineum, thigh, pubic bones area and scrotum (penis is palpated like an empty bag).

- Penile pinch occurs when compressing or putting on items of ring shape (various rings, screws, ropes, rubbers, wire, etc.) The injuries are made by the sufferers themselves or by their sexual partners to reach erection or prevent bedwetting. Such injuries are diagnosed for psychiatric patients, and they may also be the result of children mischief or masturbation.
- During penile pinch the pain occurs, blood circulation and lymph efflux are distressed. As a result, there is swelling of the tissues, which later on leads to trophesy, up to skin necrosis and penile gangrene. Compression of the urethra from outside leads to acute urinary retention.
- Open damage (injury)
- Open penile injury arises as a result of vulnerary objects impact (gunshots, incised, stab wounds) and animal bites. Open penile injury is often accompanied by other organs injuries including the urinary system. Children injuries most often occur during games with sharp objects or after falling down.
- Injuries caused by bladed objects which penetrate into the thickness of corpora cavernosa are often accompanied by complete or partial amputation of organ and therefore are considered serious injuries. Most of these injuries are accompanied by injury of hanging urethra part. If circumcision operation was technically incorrect iatrogenic injuries are also

possible. The literature has repeatedly reported the description of penis amputation during circumcision of the foreskin during religious rituals. Superficial injuries that do not reach the tunica albuginea are accompanied by slight bleeding. At the same time the main cause of such injuries is excessive friction. Such problems often arise in passionate lovers and in men who has just begun their sexual lives. For the first ones relatively deep skin damage, after which the scars remain is characteristic. For the second ones frenulum of prepuce injuries is typical. Often penis frenulum of prepuce injuries (laceration or bursting) occur during intense sexual intercourse and / or because of congenitally short frenulum of prepuce. They are accompanied by significant pain and bleeding, which is possible to be stopped only with prompt surgery, i.e. stitching the wound or using electrocoagulation.

- During injuries with bladed objects of rotating machines, tools or other instruments the branching wounds of this organ skin occur. Sometimes they have significant defects of not only skin but also the corpora cavernosa, with significant blood circulation disorders that lead to necrosis. Penis bites may be the result of pets hostile mood or biased actions of sexual partners.
- For such injuries a small injured tissue area is characteristic, as well as minor bleeding and poor regenerative ability. When this happens such injuries are almost always infected. Gunshot wounds of penis is relatively common type of military trauma, they are rare in peaceful time (Pic. 8.15). At the time of such injuries together with the corpora cavernosa urethra, scrotum, testicles, thighs, bones and pelvic organs may be injured. Gunshot wounds

of penis are accompanied by bleeding that does not correspond with the size of wound and depth of injured tissue. Bleeding may be significant during massive injuries of corpora cavernosa.

- When penis together with cloths falls into the mechanisms that move, there are often branched degloving wounds that move to the scrotum, accompanied by intense pain syndrome and even traumatic shock. In this case there is a possibility of complete detachment of scrotum and penis skin.

In such cases, there is a large skin defect and the majority of treatment problems are connected with it. It is important to bring the degloving skin to the medical department.

Otherwise penis defect is closed with the skin of the anterior abdominal wall, and the testicles are moved under the skin of the thighs.



Fig. 8.15. Gunshot wound of penis

Thermal injuries

- These injuries include burns with acids, alkalis, thermal burns and frostbite of penis. The isolated frostbite of penis is also possible for men who are not dressed warm enough and have been going for a long time towards cold wind. Penis burns occur when exposed to hot liquid and hot objects, chemical reactive substances, X-rays, radioactive isotopes. During the superficial burn of I degree there is hypermia and penis tissues swelling. During deeper burns (II degree) there are skin blisters, tissues dropsy, which can lead to urinary retention. During the burns of III degree there is skin necrosis. During the burns of IV degree there is necrosis of not only skin but also of deeper located tissues. If frostbite of the penis in most cases the

foreskin is affected, there might be freezing of penis scapus as well. Immediately after freezing the affected skin becomes purplish-blue, itching appears, there is stabbing pain, urination disorders. After a few days these symptoms disappear. During deeper injury necrotic parts of skin have ulcers with purulent discharge. Ulcers spread has torpido speed and they are healed for 3 months. **Diagnostics**

Diagnostics of penis closed injuries is not difficult, but anamnesis, mechanism of receiving trauma should be carefully studied and taken into consideration.

In the complicated cases instrumental methods are used.

In the case of necessity to precise the damage of tunica albuginea cavernosography and MRT are recommended, they allow to detect laceration of tunica albuginea and make a decision about the necessity of surgical intervention.

Cavernosography in the majority of cases gives an opportunity to detect penis traumas that

require surgery, but it is less informative in detecting deep veins damages

MRT allows to detect more precisely not only corpora cavernosa, but also to precise

the presence and location of accompanying damages (urethra, testicles) and the location of haematoma.

- In case of urethrorrhagia or hematuria the use of retrograde urethrography is recommended to exclude traumas of urethra. If during the performance of retrograde urethrography

extravasation of contrast substance with the involvement of corpora cavernosa occurs it eliminates the necessity of cavernosography.

- Diagnostics of open penis injuries is based on anamnesis data, examination (location, character of injury, direction of injury canal, presence of external exit, palpation (defects corpora cavernosa, foreign objects) and also results in instrumental examination (if necessary): echography and an X-ray study (to discover and define location of foreign bodies).

• Treatment

Closed injuries

Treatment in case of penile contusion includes usage of ice, rest, avoiding erection, preventive antibacterial treatment.

- *Treatment of penile fracture depends on hematoma branching and size of tunica albuginea damage*

In case of minor injuries treatment can be limited to the same methods as in case of penis contusion;

in case of severe damages of tunica albuginea and corpora cavernosa which are usually followed by massive bleeding urgent surgery is required which includes hematoma opening,

eliminating clots of blood, termination of bleeding, stitching of tunica albuginea and corpora cavernosa (with resolvable and not resolvable threads) injury, drainage of injury in the area of hematoma. As a rule such treatment gives positive results (pic.8.16).

In case of urethra injury the volume of surgery includes restoring urethra injuries with (the help of) anastomosis "end in end" and a corresponding urinary bladder drainage, more often with suprapubic epicystoma.



Pic. 8.16. Penile fracture surgery



Pic. 8.16. Penile fracture surgery

In postoperative period the necessary antibacterial therapy with wide-spectrum of action antibiotics, ice, adequate anesthesia and prevention of erection are required.

- The treatment of penis dislocation is only surgical and consists of baring of a penis root, hematoma drainage, conducting hemostasis and penis setting, afterwards stitches are put on broken ligaments, fixing cavernous bodies to the pelvis bones.

The treatment of penis pinching consists of removal the pinching objects as soon as possible



Pic. 8.17. Penile reimplantation after its traumatic amputation: a - treatment penile residual limb B - surgery final look

and liberation of the organ. If after the removal of pinching urination is not renewed, urina is removed with the help of trocar cystostomia.

- If there is a development of penile necrosis more distal from the pinched point, its necrotic part is removed and later on plastic surgery is performed. The necrosis of the skin only is the indication for split-thickness graft autodermo-transplantation.
- *Open injuries*
- *Treatment of open penis injuries in the prehospital phase begins with the applying of protective aseptic, if necessary - compressive dressing on penis and if possibly a tourniquet. One starts antibacterial therapy, tetanus toxoid is inserted.*
- *Surgical treatment* includes initial surgical debridement, the final bleeding termination, urine diversion from the bladder. In case of partially ripped off penis the initial debridement is made with preserving excision of tissue and restoration of damaged parts of the organ. Amputation and excision of penile skin is only possible with necrosis. Plastic surgery for replacement of skin defects and restoring penile operations are performed in a specialized medical department.

After complete traumatic penile amputation, the cut off organ should be preserved because during the first 18-24 hours after injury it can be sewn to the residual limb (Fig. 8.17). To maintain the viability of an amputated organ, it is washed with liquid of povidone-iodine packed in a sterile package filled with a liquid of complex sodium lactate (Ringer-Lactate-Viaflo), and stored on ice up to the surgery.

- Surgical treatment of **penis thermal burns** is conducted on general principles: it is aimed at the removal of necrotic tissue, skin defects and corpora cavernosa replacement, penis function restoration. In cases of apparent changes localized in the area of the foreskin the circumcision is performed

Control tasks

1. What are the characteristic clinical features of closed kidney damage?
2. Is there a connection between hematuria grade and kidneys injury?
3. In which case a conservative treatment of isolated kidneys injury is performed?
4. Indications for minimally invasive interventions during kidney damage.
5. Is hematuria a loyal indicator of ureteral injury during trauma?
6. Signs of ureteral injury on excretory urogram.
7. Tactics of a patient treatment with partial rupture of ureter wall.
8. To perform differential diagnostics of intra-abdominal rupture of bladder with extra-abdominal rupture.
9. Patients with bladder extra-abdominal rupture treatment technique .

10. Make a plan of patient's examination of suspected urethra injury.
11. What measures should be taken for a patient with a closed testicle injury

Chapter 9

Neoplasm's of the urinary tract and male reproductive system

9.1. Renal parenchymal cancer (Renal carcinoma, adenocarcinoma, hypernephroma, clear cell renal cell carcinoma)

Renal parenchymal cancer – is the malignant tumor of parenchyma, which does not have for certain time, clinical manifestations and manifests in the later stages as general weakness, dizziness, hematuria, anemia, mild back pain.

Epidemiology

Every year in the world, are detected more than 200 000 of new patients with a diagnosis of "renal cell carcinoma". More than 90 000 patients die each year. Renal cancer amounts 3% of all malignancies.

Etiology and pathogenesis

Etiology of renal cancer is unknown. The risk of renal cancer is increased in 2 times for patients who smoke. High risk of disease is among people who have regular contact with industrial dyes, salts of heavy metals, asbestos, tannic matters, drugs (amphetamines), patients with obesity hypertension. Among these people occurs the cancer of the renal parenchyma from epithelium

of proximal tubules. Distinction is made between family and sporadic renal cancer. It is assumed that cancer is caused by family compensated by reciprocal transplantation between the short arm of the 3rd and the long arm of 8 chromosome.

Classification

TNM classification for renal cancer stage (International Classification of 2002 with the addition of 2009).

T - Primary tumor

- Tx - Primary tumor cannot be evaluated
- T0 - no data about primary tumor.
- T1 - Tumor ≤ 7 cm in greatest diameter is limited by kidney.
- T1a - tumor ≤ 4 cm in greatest diameter, is limited kidney.
- T1b - Tumor > 4 cm but ≤ 7 cm in greatest diameter, is limited the kidney.
- T2 - Tumor > 7 cm in greatest diameter, is limited the kidney.

- T2a - Tumor > 7 cm but ≤ 10 cm in greatest diameter, is limited the kidney.
- T2b - Tumor > 10 cm in greatest diameter, is limited the kidney.
- T3 - Tumor spreads into major veins or invasion into perirenal tissue and does not spread beyond of the fascia Herota.
- T3a - tumor spreads to the renal vein or on its segmental branches, or tumor invades perirenal tissue or renal sinus, but not beyond fascia Herota.
- T3b - the tumor spreads to the inferior vena cava below the diaphragm.
- T3c - tumor spreads to the inferior vena cava or its wall above diaphragm.
- T4 - tumor spreads beyond the fascia Herota (with germination in the adrenal glands).

N - Regional lymph nodes

- Nx - regional lymph nodes cannot be assessed
- N0 - no signs of metastasis to regional lymph node
- N1 - Metastasis in a single lymph node
- N2 - metastasis in more than one of regional lymph node

M - Distant metastases

- M0 - distant metastases are absent
- M1 - distant metastases are present

G - The degree of histological graduation

GX. Grade of differentiation cannot be assessed

G1. Well differentiated tumor

G2. Moderately differentiated tumor

G3. Low differentiated tumor

G4. Undifferentiated

There is pathoanatomical classification - pTNM (pT, pN, pM correspond to the T, N, M categories). Based on the TNM classification is performed by grouping in stages:

- **Stage I** T1 N0 M0
- **Stage II** T2 N0 M0

- **Stage III** T1 N1 M0
- T2 N1 M0
- T3, N0,N1 M0

- **Stage IV** T4 N0,N1,N2 M0
- Any T N2 M0
- Any T Any N M1

According to the WHO classification distinguish 3 main histological types of renal parenchyma cancer growth:

- Clear cell carcinoma (80-90%)
- Papillary carcinoma (10-15%)
- Chromophobe carcinoma (4-5%)

In patients with papillary cancer identified two different prognostic subgroups:

- The presence in tumor of chromophile cytoplasm and low malignant potential;
- Tumors with eosinophilic cytoplasm, high malignant potential and a high propensity to metastasize.

Clinical picture

Complaints:

- a) in the early stages of kidney cancer symptoms are absent;
- b) 40% of kidney tumors are diagnosed accidentally in the early stages (planned examination at the company, comorbidity diagnosis, screening for atypical tumor kidney symptoms;
- c) In the late stages is characterized by simultaneous triad of symptoms (10-12%) or individual symptoms (80-90%): pain, hematuria, tumors that palpable;
- d) In 30% of patients are observed: weight loss, anemia, cachexia, pyrexia, increase in the erythrocyte sedimentation rate (ESR), hypertension, hypercalcemia;
- e) In 20-25% of patients with is clinical manifested the secondary complications - pathological fractures, hemoptysis, rapid increase in neurological symptoms, icterus due to metastasis;
- f) Pain and hematuria occur in the later stages of the disease and are caused by the rupture of the tumor, hemotamponade of cavity system, compression of vessels, adjacent organs, formation of retroperitoneal hematoma;
- g) At later stages of the disease is palpated the tumor (15%);

h) In cases of compression by tumor of the vena cava inferior appears the additional symptoms such as swelling of the legs, venous thrombosis of lower extremities and abdomen subcutaneous veins, varicocele.

Case history:

- a) The patient does not have complaints, but is concerned about the results of ultrasound or computed tomography (CT), conducted by elective;
- b) Complaints of weight loss, weakness, and sometimes hematuria, low-grade fever over a period of several weeks or months.

Objective data:

a) Observation:

- the patient has no obvious signs of disease;
- sometimes swelling of lower extremities, weight loss;

b) Palpation:

- rarely is palpated tumor in subcostal area formation;

c) Percussion:

- tapping of lumbar areas does not lead to increased pain;

d) Auscultation:

- Possible reduction of intestinal peristalsis (only at later stages of the disease).

Diagnostics**Laboratory diagnosis:*****Blood test:***

- Possible decreasing in hemoglobin and increasing of erythrocyte sedimentation rate;
- Increasing of alkaline phosphatase may indicate the presence of liver metastases and bone;
- Increasing of creatinine points to the renal dysfunction (single kidney the tumor) or presence of two-way process.

Renal tumor markers (molecular factors)

At renal cancer are detected many biological factors: carbonic anhydrase, vascular epithelial growth factor (VEGF), a factor is induced by hypoxia (NIF), cellular proliferation factor (Ki67), p53, homologs of phosphatase and tensin (PTEN), cellular adhesive molecular factor (E-Cadherin), cellular superficial polypeptide

(CD44), proliferative cellular nuclear antigen (PCNA). Neither of markers can be used for early diagnosis, as well as in observation after treatment.

Urinalysis:

- At the early stages of the disease - without pathology;
- At later stages - erythrocyturia, proteinuria;
- Examination of urine for the presence of atypical cells is a little informative (not available in the early stages, on latter stages - cannot be observed against the background of total hematuria).

Instrumental methods:

- Ultrasound has a high diagnostic value. 50-60% of patients are turning for examination to the urologist after ultrasound. It is possible to estimate the size of the kidney and its deformation, structure, location and size of the tumor.

Ultrasound in conjunction with vascular dopplerography enables the assessment of tumor blood flow (hematoma with rupture of the kidney), the presence of circulatory disorders of the kidney, vascular compression, the presence of germination or thrombus in large vessels. Also, the presence of hematoma is diagnosed in perirenal tissue;

- X-ray examination;
- Survey urography allows us to estimate the size and deformation of the kidneys;
- Excretory urography enables to estimate renal function (such as a tumor on its side and on the other side).



Figure. 9.1.
Excretory urography
with parenchymal
tumor of the left
kidney.

On the side of the tumor often takes place the symptom of "amputation" calyces, calcification (Figure 9.1);

- Cystoscopy is performed with hematuria to determine the source;
- CT has a high diagnostic value (Fig. 9.2, 9.3):
- After contrasting there is a significant difference in the density of the renal tissue and tumor as well as in same tumor are detected the areas with increased density;
- Allow to estimate the prevalence of tumors in the renal vessels, large vessels and adjacent organs, adrenal, perinephric tissue;
- Allow to detect the presence of metastases in regional and distant lymph nodes, and the bones, liver, lungs and more.
- Magnetic resonance imaging (MRI) competes for the diagnostic value with CT, but has an advantage in assessing the condition of large vessels;
- Angiography allows to diagnose the degree of renal vessels compression, to identify the characteristics of tumor vascular

proliferation, the presence of arteriovenous fistulas, tumor thrombus, etc. (Fig. 9.4, 9.5) - is rarely used because it can be

accompanied by complications: bleeding, thromboembolism renal artery nephrotoxic effect of X-ray contrast agents. Is appropriate to perform angiography in the planning of organ-preserving surgery;



Figure. 9.2. CT scan of the patient with cancer of the right kidney with germination in the inferior vena cava.



Figure. 9.3. CT scan of the patient with cancer of the right kidney and tumor embolus (denoted by a dash) in the inferior vena cava.

- Radioisotope renography is rarely performed in case of intolerance to X-ray contrast medium;
- Osteoscintigraphy is rarely conducted in order to detect bone metastases;
- Puncture of tumor is rarely performed because:
- Operation is shown for all patients with cancer of the kidney with subsequent verification;
- Is performed upon detection of disseminated tumor to verify before palliative antitumor treatment;

- To conduct differential diagnostics.

Differential diagnosis

Differential diagnosis is conducted with cysts, echinococcal cysts, abscesses, tumors of different origin, benign tumors of the kidney epithelial tumors of the kidney, lymphogranulomatosis, non-Hodgkin lymphoma, metastatic tumors in the kidneys of other organs.



Figure. 9.4. Venacavagram of patient with cancer of renal parenchyma. Tumor thrombus in the inferior vena cava.



Figure. 9.5. Selective angiogram. Parenchymal tumor of the right kidney.

Ultrasound clearly distinguishes between homogeneous fluid in patients with cysts and heterogeneous dense structure with renal cancer. It is possible to use of percutaneous or laparoscopic biopsy.

Treatment

Surgical treatment

Radical surgery

a) Radical nephrectomy is the main treatment for patients with renal cancer;

b) Lymph dissection is necessarily shown at the presence of metastases (according to CT, MRI, and palpation);

c) Adrenal gland is removed into it in the case of tumor germination or tumors of the kidney, larger than 7 cm, with a high risk of metastasis in the kidney.

Organ preserving operations are performed when:

- Tumor ≤ 4 cm and have the opportunity to remove it completely;
- Only one kidney;
- Problems with contralateral kidneys (hydronephrosis, concrements, shrinkage);

Laparoscopic surgery:

- Are held as an alternative method of open surgery;
- Are used as retro- and transperitoneal access;
- Are held frequently in patients with kidney tumors up to 4 cm, rarely at a rate of 7 cm;
- From drawbacks: more intra- and postoperative complications.

Alternative methods of the intervention treatment:

- Percutaneous radiofrequency ablation;
- Microwave ablation;
- Laser ablation;
- Cryoablation;
- Ablation by focused ultrasound waves.

Indications for these procedures:

- Patients with a high surgical risk;
- Small, accidentally found tumor, especially in old people and patients with a single kidney.

Contraindication:

- Large tumors;
- Multiple metastases;
- Tumor localization (near the renal vessels, ureter);
- Coagulopathy.

Surgical treatment of metastatic cancer renal parenchyma:

- Gives a positive result only in case of all tumor lesions removal;
- Positive result in combination with immunotherapy;
- Target therapy is more effective in patients who underwent palliative nephrectomy than in patients in whom it is not performed.

Radial therapy of metastatic renal parenchyma cancer is used to reduce of pain syndrome on inoperable metastases in the bones, brain; is not performed in patients with unverified tumors, tumors of the collapse.

Conservative treatment of patients with renal cancer

- In patients without evidence of metastasis is recommended 1-2 times a year to carry out a course of therapy with combined 5-fluorouracil and immunotherapy;
- In patients with evidence of metastasis is conducted immunotherapy and targeted therapy:
 - Immunotherapy is conducted by interferon-alpha, interleukin-2. Quite often an interferon-alpha is used in conjunction with bevacizumab;
 - Target therapy is used as monotherapy (often in combination with interferon-alpha) is an inhibitor of angiogenesis.

There are 4 of targeted drugs:

- Sorafenib - multikinase inhibitor;
- Sunitinib - tyrosine kinase inhibitor;
- Bevacizumab - humanized antibody;
- Temzyrolimus - kinase inhibitor TOR.

9.2. Wilms tumor

Wilms' tumor (nephroblastoma, embryonic kidney adenomiosarkoma) is a malignant tumor of fetal renal parenchyma was named after German surgeon Max Wilms (1867-1918), who first has described histogenesis of this neoplasm.

Epidemiology

Nephroblastoma is approximately 20-30% of all malignancies in children. In Ukraine the morbidity of nephroblastoma in pediatric population is 7.2 per 100 000. The average age of patients is 36 months for boys and 43 months for girls. Apogee of morbidity registers in age from 2 to 4 years. The ratio between the incidence of boys and girls is same.

Etiology and pathogenesis

Nephroblastoma in 60% of cases - is the result of somatic mutations, 40% of Wilms tumors are caused by the hereditary-determined mutations. Great importance is attached by mutations of recessive suppressor genes WT1, WT2 and p53, located on chromosome 11. According to the theory of Knudson carcinogenesis, the starting mechanism of Wilms tumor occurrence can be considered as reproductive cell mutation and further modification of alternative gene in homologous chromosome. Wilms tumor is most often common in

children with certain congenital malformations: aniridia - anomaly in which there is no iris (responsible for resizing of the pupil and provides color eyes); hemihypertrophy - is characterized by the fact that one side of the body of a child is developed more than the other; cryptorchism - undescended testicle or testicles in the scrotum, hypospadias - Hypospadias – is the absence of posterior wall of the distal urethral part , Denis-

Drash syndrome - includes Wilms tumor and men pseudohermaphroditism (hypoplasia of the genitals) and cryptorchism; syndrome Beckwith - Wiedemann - includes

omphalocele (umbilical hernia), macroglossia (an increase of tongue) and an increase in the internal organs.

Classification

Morphological classification

By stages:

According to recommendations of protocol

"SIOP-2001" (WT), morphological types of nephroblastoma is divided into three basic risks by histological variant, the degree of malignancy and prognosis of disease recurrence.

Stage I: Tumor is limited kidney and completely removed. The capsule of the kidney is intact; the integrity of the tumor is not damaged during removal. No residual tumor.

Stage II: The tumor spreads through the capsule of the kidney, but is completely removed. Extrarenal vessels may contain tumor or be infiltrated by the tumor.

Stage III: Residual not hematogenous tumor in the abdomen, with spread to the lymph nodes, the peritoneum dissemination or tumor around the edge of the operational section.

Stage IV: Hematogenous metastasis in lungs, liver, bones, brain and other organs.

Stage V: Bilateral renal involvement at diagnosis.

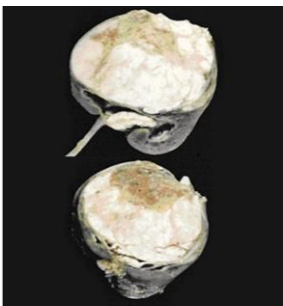


Figure. 9.6.
Macroscopic
appearance of the
Wilms tumor.

TNM-classification (Figure 9.6):

- Tx - Primary tumor can not be evaluated
- T0 - no signs of primary tumor
- T1 - Unilateral tumor size (including the kidneys) 80 cm² or less.
- T2 - Unilateral tumor size

(including kidney) more than 80 cm²

- T3 - Unilateral tumor with rupture

before treatment

- T4 - bilateral tumor.
- Nx - regional lymph nodes can not be evaluated.

Classification

1. Low risk:

- Mesoblastic nephroma;
- Partially differentiated cystic nephroblastoma;
- Completely necrotised nephroblastoma.

2. Medium risk:

- Epithelial type;
- Stromal type;
- Mixed type;
- Regressive type;
- Local anaplasia.

3. High risk:

- Blaster type;
- diffuse anaplasia;
- Clear cell sarcoma of the kidney;
- Rhabdoid tumor of the kidney.

Clinical picture

The most common symptom of Wilms' tumor in children - asymptomatic occurrence of tumors that is palpated (61.6%). Most often tumors are found during the examination of the child, if there are no complaints (9.2%). It is may be occurred macrohematuria (15.1%), constipation (4.3%), weight loss (3.8%), urinary infection (3.2%), diarrhea (3.2%). Less common symptoms are: nausea, vomiting, pain, occurrence of abdominal hernia in the presence of large tumor and high blood pressure (BP). (Figure 9.6).

Diagnostics

At suspicion of Wilms tumor in a child it should to make urgently the complete examination by using of radiological, radioisotope, ultrasound and other methods. In the general blood test can be noted the reduction in hemoglobin and changes in the number of leukocytes. In urine are detected red blood cells. Excretory urography is specific for the revelation of Wilms tumor method, but not always sufficiently

informative in tumors of small size, the differential diagnosis of volume formations, emanating from kidneys, from retrorenal, such as adrenal neuroblastoma. Renal ultrasound can detect the volumetric tissue formation in the kidney, to differential diagnosis of cystic formations. MRI and CT scans of the abdominal cavity and retroperitoneal space are one of the most accurate methods of Wilms tumor detection, assessment of regional lymph nodes condition and surrounding organs and tissues. These types of research are now considered mandatory before treatment. Renal arteriography is used when it is impossible to confirm the diagnosis by other methods.

Radiographs of the chest and skull are performed to detect metastases in the lungs and in the bones of the skull. Venocavography is used to detect tumors in the germination of the

inferior vena cava and determine the position of the inferior vena cava in relation to the tumor.

Radioisotope scanning of the skeleton is used for the detection of metastases in the bones. For the detection of liver metastases is used ultrasound and radioisotope scanning of the liver. One of the ways to increase the effectiveness of early diagnosis of Wilms' tumor is the search for specific markers of tumor. The most perspective for definition of tissue polypeptide specific antigen are serum markers of tumor activity. In patients with Wilms tumor its level is significantly increased in comparison to patients with benign tumors of the kidneys and healthy.

Percutaneous needle biopsy of the tumor is not performed to establish the diagnosis, because it can lead to undesirable consequences and complicate the disease. Accurate diagnosis should include both stage of tumor process as well as histological characterization of tumors. For example, the diagnosis may be as follows: Wilms tumor, stage II, favorable histology or stage II, unfavorable histology.

Differential diagnosis

Differential diagnosis of Wilms tumor should be done with a simple cyst kidney, hydronephrosis, polycystic, renal vein thrombosis, carbuncles kidney xanthogranulomatous pyelonephritis. The greatest difficulties in the preoperative period represent the differential diagnosis of Wilms tumor with other tumors of the kidney.

Treatment

The best results can achieve the multimodal approach that includes surgical treatment, chemotherapy and radiotherapy.

Operation at Wilms tumor involves the removal of primary tumoral locus. For this purpose is performed resection of kidney or removal of it (nephrectomy). Along to these

interventions is conducted the removal of single metastasis (if they are): resection of liver or lung. Radiotherapy for Wilms' tumor is conducted according to various schemes. It can be performed preoperatively, during and after surgery. In addition, radiotherapy is used in later stages of tumor when the process has gone too far and operation is not possible. Currently is considered one of the perspective methods of chemotherapy application that is the combination of several chemotherapy drugs. Most often in chemotherapy of Wilms tumors are used chemotherapy drugs such as doxorubicin, vinblastine, vincristine, etc.

Prognosis

Prognosis in children with nephroblastoma is favorable.

Three-model therapy leads to recovery of 80-90% patients.

With timely and adequate treatment the overall survival makes:

Stage of tumor	Histological form	Operation	Chemotherapy	Radiotherapy
I, II	Favorable	Nephrectomy	Vincristine, dactinomycin (18 weeks)	No
I	Anaplasia			
III,IV	Favorable	Nephrectomy	Vincristine, dactinomycin doxorubicin (24 weeks)	Yes
II,III,IV	Focal anaplasia			
II,III,IV	Diffuse anaplasia	Nephrectomy	Vincristine, dactinomycin, cyclophosphamide, etoposide (24 weeks)	Yes

Stage

I: 80-90%;

• II stage: 70-80%;

• III stage: 30-50%;

• IV stage: less than 20%.

Algorithm for treatment is determined depending on the stage of kidney disease and anaplasia (Table 9.1).

9.3. Tumors of the upper urinary tract

Epidemiology

Cancer of the upper urinary tract (UUT) are rather rare localization of urothelial cancer and makes 5-10% of tumors of the kidney and UUT. The disease is more common in men of age 40-60 years.

Transitional cell carcinoma can occur in any segment of the upper urinary tract, ranging from small calyces and ending by ureteral-vesical combination. Tumors of the renal pelvis occur twice as often as

tumor of ureter. Tumors are multiple; there is a possibility of metastasis implantation in the lower urinary tract, including the bladder. In 8-13% are revealed the combined tumors. The prevalence of UUT tumors in Western countries is also low - 1.2 cases per 100 000 population.

Etiology

Risk factors are:

- Smoking and systematic effects of dyes and rubber;
- Drug nephropathy caused by chronic administration of analgesics;
- Balkan endemic nephropathy - the disease of unknown etiology was diagnosed in residents of Bulgaria and Yugoslavia;
- "Chinese herbs nephropathy" – the wrong use of Aristolochia fangchi as part of preparations for slimming.

Classification

Clinical TNM-classification

T - Primary tumor

- Tx - insufficient data to assess the primary tumor
- T0 - Primary tumor is not defined
- Tis - Carcinoma in situ
- Ta - Noninvasive papillary carcinoma
- T1 - The tumor grows into the subepithelial connective tissue
- T2 - The tumor grows into the muscle layer
- T3 - Tumor extends to parapelvic tissue or renal parenchyma;
- T4 - Tumor spreads to adjacent organs; is spread through the parenchyma into perirenal tissue.

N - Regional lymph nodes

- Nx - Not enough data to assess the status of regional lymph nodes
- N0 - No signs of metastatic lesions in regional lymph nodes
- N1 - metastatic lesion of one lymph node less than 2 cm
- N2 - metastatic lesion of one lymph node more than 2 cm but less 5 cm or several metastases less than 5 cm
- N3 - Metastasis more than 5 cm.

M - Distant metastasis

- Mx - Not enough data to assess the presence of distant metastases
- M0 - No signs of distant metastases
- M1 - There are distant metastases.

Pathomorphology

The source of most tumors in UUT is urothelium, i.e. at histological structure they are urothelial. Other morphological forms (epidermoid and neuroendocrine carcinoma, sarcoma, adenocarcinoma) are rare and account for about 5% of the total. Important prognostic value also has the differentiation of the tumor, by which are distinguished the tumor with low, moderate and high potential for malignancy.

Clinical picture

Symptoms of UUT tumors are very limited. Most often there is a macro and microhematuria - 70-80%, rarely - pain on the affected side - 20-40%, more rarely tumors are palpable - 10-20%.

The presence of systemic manifestations (deterioration of general health, weight loss, nausea, etc.) is caused by usually by the presence of metastasis.

Diagnostics

Palpation allows to identify the rarely neoplasm's. "Gold standard" examination of UUT is multidetector CT with the use of contrast agents. MRI has significantly lower sensitivity and is used as a rule; when it is impossible perform a CT scan. The positive results of urine cytology may help in diagnosis of UUT tumors, but it must be preceded by cystoscopy to exclude bladder tumors and prostatic urethra. The best method for

diagnosis of UUT tumors is Ureteroscopy. It is not only allowed to visualize well the ureter, renal pelvis and calyces, but also to take the material for cytological or histological examination and to perform retrograde pyelography.

Differential diagnosis

Differential diagnosis should first of all to conduct with bladder cancer, especially in the detection of suspicious during cystoscopy at cell tumors of the ureter, or detection of tumors in the ureter in the presence of proven bladder cancer. Also, blood clots in the renal pelvis can be taken on the CT images for neoplasm. In these cases, the deciding method is Ureteroscopy.

Treatment

"Gold standard" treatment of UUT cancer – is nephroureterectomy with radical resection of the bladder wall with ureteral orifice. Nephroureterectomy is performed regardless of the tumor. Resection of the bladder is performed to prevent recurrence in this area. Among the methods are proposed to simplify the removal of the distal ureteral section, the most common is transurethral resection (TUR) of the bladder wall and ureteral orifice. An alternative to nephroureterectomy- is organ preservation treatment, but it has own testimony: absolute (renal insufficiency, solitary kidney) and elective (normal contralateral kidney) with highly differentiated tumors at early stages. The main methods of organ-preserving treatment - are endoscopic (ureteroscopic) resection and open segmental resection of the ureter. Open segmental resection of the renal pelvis and calyces is almost never used due to technical difficulties and a high frequency of relapses. Most frequently after organ-preserving treatment is carried out the local chemotherapy or BCG therapy (through the nephrostoma or stent). In metastatic disease, are used

systemic chemotherapy, radiotherapy and palliative nephroureterectomy. Considering that the most common morphological form of UUT tumors is transitional cell cancer, these neoplasm's are referred to chemo-sensitive tumors and use the same chemotherapy regimens as in the treatment of bladder cancer.

Follow-up clinical examination, dispensation

Surveillance of patients after surgical treatment is required, since it allows to detect recurrence and distant metastases. The examination should include, in particular, cystoscopy and urine cytological examination and last no less than 5 years.

9.4. Bladder Cancer

Bladder Cancer - is the oncological disease in which malignant tumor develops from the bladder wall.

Epidemiology

Bladder cancer is one of the most common malignant tumors of the urinary tract. All over the world level of morbidity is 10.1 per 100 000 in men and 2.5 per 100 000 women. In Europe, the highest incidence rates are observed in Western countries (23.6 in men and 5.4 in women). Low incidence is observed in Eastern Europe (14.7 in men and 2.2 in women). Global mortality among men in the world is 4 per 100 000 men, compared with 1.1 per 100 000 women. In Ukraine, level of morbidity reaches 12.96 per 100 000 and 1.73 per 100 000 women, and the mortality rate makes 5.96 in men and 0.5 in women.

Risk factors for bladder cancer:

- Smoking.
- Occupational hazard. Professions in which occurs the exposition to carcinogens include the industrial workers, which use dyes, rubber, textiles, paints, leather and chemicals.
- Remote radiotherapy. It is known about fourfold increase in risk of malignant development of vesical tumors after the application of remote radiotherapy for gynecologic onco-diseases.
- Chronic urinary tract infection. Invasive bladder cancer is directly related to the presence of chronic urinary tract infection. Schistosomiasis of the bladder is the reason of bladder cancer and its risk increases in 4 times.
- Chemotherapy. Cyclophosphamide - alkylating agents is correlated with the subsequent development of invasive bladder cancer with a latency period of 6-13 years.
- Gender. Men are more likely to develop of bladder cancer than women. The discrepancy in the levels of estrogen and progesterone levels between men and women can identify some differences in incidence by gender.

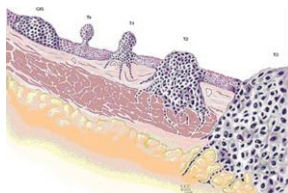


Figure. 9.7. TNM-classification of bladder cancer (by Alan J. Wein et al.).

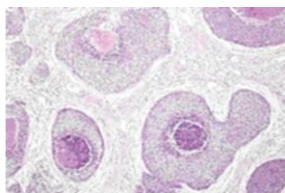


Figure. 9.8. Microscopic picture of clear cell cancer.

Classification

TNM-classification of bladder cancer (2002) (Figure 9.7)

- T - primary tumor
- Tx - Primary tumor cannot be assessed

- T0 - no data on the primary tumor
- Ta - non-invasive papillary carcinoma
- Tis - carcinoma in situ - "flat tumor"
- T1 - tumor spreads to the subepithelial connective tissue
- T2 - tumor invasion of the muscular layer
- T2a - tumor invasion of superficial muscle layer (inner half)
- T2b - tumor invasion of deep muscle layer (outer half)
- T3 - Tumor extends to paravesical fiber
- T3a - microscopically
- T3b - macroscopically (extravesical masses)
- T4 - tumor invasion in any of the following organs: prostate, uterus, vagina, pelvic wall, abdominal wall.
- T4a - Tumor extends to the prostate, uterus, or vagina
- T4b - Tumor extends to pelvic wall or abdominal wall
- N - the lymph nodes
- Nx - regional lymph nodes can not be assessed
- N0 - no metastases in regional lymph nodes
- N1 - Metastasis in a single lymph node less than 2 cm in greatest size
- N2 - Metastasis in a single lymph node more than 2 cm but less than 5 cm in greatest size, or multiple metastases in the lymph nodes, but not more than 5 cm in greatest size.
- N3 - metastases in lymph nodes larger than 5 cm in greatest size
- M - distant metastases
- Mx - distant metastasis cannot be assessed
- M0 - No distant metastasis
- M1 - there are distant metastases.

Pathomorphology

The most common form of bladder cancer is the clear cell cancer (Figure 9.8).

In 1998, the WHO (WHO) and the International Society of Urological Pathology (ISUP) was adopted a new morphological classification of bladder cancer (classification of WHO / ISUP 1998). It was published by WHO in 2004:

- Urothelial papilloma.
- Papillary tumor with low malignant potential.
- Papillary urothelial carcinoma with low-grade malignancy.
- Papillary urothelial carcinoma with high degree of malignancy.

Depending on the depth of tumor invasion into the bladder wall in the clinic they are divided into superficial and invasive forms. The boundary between them is basal membrane of the mucosa.



Figure. 9.9. Roentgen CT. Multifocal bladder tumor.

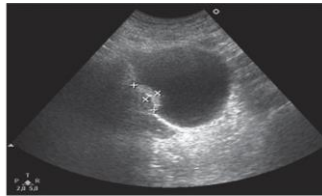


Figure. 9.10. Ultrasonogram of bladder cancer.

Clinical picture

The most common symptom is painless haematuria. In addition, some patients complain of acute urinary retention, dysuria, frequent urination and pain in the pelvis. Pain, and all the symptoms are associated with urinary tract obstruction, occur in more common tumors.

Diagnostics

Physical examination

Physical examination includes rectal and vaginal bimanual examination. Tumor mass in the pelvis are palpated at patients with common tumors. Excretory urography, cystography and CT. Large tumors can be detected as a filling defect of the urinary bladder. Excretory urography is also used to identify defects in filling the calyx, renal pelvis and ureter, detection of hydronephrosis, which may be a sign of the ureteral tumor. CT with contrast of the urinary tract provides more information than excretory urography, both for the primary tumor and the lymph nodes on the state of the pelvic lymph nodes (Figure 9.9).

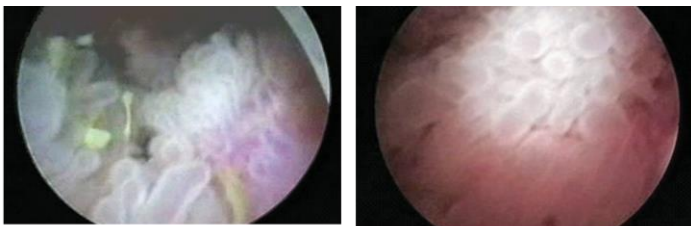


Figure. 9.11. Cystoscopic picture of bladder cancer.

Ultrasound

It is used most often as the primary method of the urinary tract assessment. Transabdominal ultrasonography allows to see the local thickening of the bladder wall, immovable hyperechoic formation on the wall of the bladder (see Fig. 9.10).

Cytological examination of urine

Research of urine sediment or washing water from the bladder on desquamated tumor cells has high sensitivity in poorly differentiated (high-grade malignancy) tumors.

Cystoscopy

Cystoscopy with biopsy of the tumor is mandatory method of diagnostics of bladder cancer. At cystoscopy assess the location, size, number and appearance of the tumor and also presence of changes in the mucosa (Figure 9.11). For confirmation or exclusion of metastases in the lungs is carried out radiography of the chest. If you suspect a metastases in bone is carried out radiography bone.

TUR of bladder cancer is performed, in particular with a view to resection biopsy with subsequent histological examination.

Generalization of disease diagnostics
The study of complaints and anamnesis of disease
Physical examination
General clinical and laboratory examination
Ultrasonography of the kidneys and bladder
Cytological examination of urine
CT or MRI
Cystoscopy with description of tumor, a biopsy of tumor
TUR of small tumor (less than 1 cm) single block
TUR-biopsy of a large tumor

Differential diagnostics

Differential diagnostics is made with pathological processes that look at cystoscopy like neoplasms: tubercular or syphilitic granulation tumor, tuberculosis and simple ulcers, bladder endometriosis, chronic granulomatous cystitis or hemorrhagic and nodular peri-arthritis. Also cystoscopic picture of uterine tumors and its appendages, prostate or rectum that germinate in the bladder, do not differ from that in primary bladder cancer. At differentiation of vesical tumors with all the diseases listed above the most important is biopsy.

Treatment

Treatment of bladder cancer is determined by the stage of disease and condition of the patient. Treatment of this disease is multimodal (multistage) and includes surgery, radiation, chemotherapy and other methods.

Cancer in situ

Primary carcinoma in situ, is limited to bladder effectively treated by intravesical BCG therapy, which causes a complete response in 83-93% of patients. Patients with incomplete the answer to 9 th month of observation with tumor recurrence in the bladder or extravesical relapse should be performed cystectomy.

Superficial bladder cancer (without invasion into the muscle layer)

At the superficial forms of the disease the primary method of surgical treatment is TUR of bladder tumors. This operation has two main goals: first, curative - removal of vesical tumors, and, secondly,

diagnostic - all removed tissue are exposed to careful pathomorphologic study. According to the results is established the final stage of the disease and the degree of tumor malignancy. TUR of bladder tumors is performed by using of special endoscopic instrument - resectoscope, which is cut the basis of the tumor along with the underlying layers of the bladder wall within the healthy tissue and coagulated bleeding vessels.

Invasive Bladder Cancer

Operations with preservation of the bladder

TUR of bladder tumors

Application of TUR is possible in tumors, the growth of which is limited to the superficial muscle layer, and if at the diagnostic biopsy no detected residual tumor. TUR should be chosen as a treatment method in which patients refuse of open surgery are contraindications to performance of cystectomy or applies multimodal therapy for

bladder preservation. Tumors that are located on the anterior or anterolateral wall that have not captured the ureteral orifices or bladder neck, most available for resection. At involving in

the tumor infiltrate of the ureteral orifices the ureters is shown the ureterocystoanastomosis.

Radical cystectomy

In most Western countries Radical cystectomy is the standard treatment for invasive bladder cancer. Traditionally the radical cystectomy is recommended to perform the patients with invasive bladder cancer T2-4a, N0-x, M0. The other indications include: recurrent superficial tumors, carcinoma in situ, is refractory to BCG vaccine, disseminated papillary tumor that is not subject to TUR and infravesical therapy. Also is shown radical cystectomy to patients who were not given an answer to conservative therapy, with relapses after treatment with preservation of bladder, at no transitional bladder tumors. Radical cystectomy includes the removal of bladder and adjacent organs such as the prostate and seminal vesicles in men, appendages of the uterus in women. Radical cystectomy involves the regional lymphodissection.

The methods of urinary derivation after radical cystectomy

From an anatomical point of view, after a cystectomy, there are three alternative approaches of urinary excretion:

- external removal in the anterior abdominal wall - ureterocutaneostomy, iliac intestinal or colonic reservoir and various forms of cutaneous retaining reservoir, these methods are divided by continental and incontinental derivation. The first is reservoirs that are periodically emptied by catheter through urinary fistula on the front urinary wall, to the second - reservoirs with a constant flow of urine through the fistula in the urinal;
- Urinary diversion in rectum or sigmoid colon, such as uretero (ileo) sigmotomy;
- Removal through the urethra, which includes different variants of gastrointestinal reservoirs that are connected with urethra - orthotopic urinary diversion, which is currently considered the "gold standard" due to high quality of life.

Intravesical chemotherapy

Implementation of adjuvant chemotherapy for all patients with a tumor on stage Ta-1 after TUR is needed because these tumors recur in a high percentage of cases. For the intravesical chemotherapy is used mitomycin C, epirubicin or doxorubicin.

Intravesical BCG immunotherapy

BCG vaccine in the treatment of superficial forms of bladder cancer and prevention of its recurrence after TUR acts as a nonspecific immunostimulant, wherein the mechanism

involves several factors that affect on cells of the immune system. BCG detects a stimulating effect on the spleen, of the spleen increases macrophagocytal function and activates natural "killer cells". BCG vaccine is used intravesically for the treatment of bladder cancer. The vaccine instillation is conducted 1 per week for 6 consecutive weeks 2-3 weeks after TUR or biopsy of the bladder, then are conducted 3 instillations every week at 3 and 6, 12, 18,24, 30 and 36 months. Under this scheme, a full course of 27 instillations is 3 years.

Multimodal therapy

To preservation strategy of the bladder belongs combination of TUR, chemotherapy and radiation therapy. Rational conduction of TUR and radiotherapy leads to local control of tumor growth. Appointment of additional systemic chemotherapy aims to eradicate micrometastases. However, it is recommended to perform cystectomy as soon as possible to patients who have not observed complete regression in combination therapy.

Chemotherapy

Approximately 10-15% of patients at diagnosis already have metastases. To this group of patients is shown chemotherapy. Bladder cancer belongs to chemosensitive tumors. There are different schemes of chemotherapy: GP (Cispaltin, Gemcitabine), M-VAC (Methotrexate, vinblastine, Doxorubicin, Cisplatin) Gemcitabine + Oxaliplatin, Paclitaxel and Cisplatin.

Follow-up observation

In patients with bladder cancer, with stage Ta-1 (low risk of recurrence and progression) cystoscopy should be performed after 3 months. If the answer is negative, the following cystoscopy is recommended after 9 months and then annually for 5 years. Patients with tumors of Ta-1 at high risk of progression and patients with carcinoma in situ cystoscopy and urine cytology should be performed after 3 months. If the answer is negative, the following cystoscopy and cytological examination of urine must be performed every 3 months for 2 years, every 6 months to 5 years, then 1 per year. After cystectomy monitoring regime depends on the stage of the primary tumor after cystectomy. This means that if stage of the primary tumor is higher, the risk of tumor recurrence will be greater. Thus, the observation of a higher frequency will detect a greater number of relapses.

No oncologic observation, such as monitoring of renal function should probably carry throughout their lives. After 5 years of oncological observation the surveillance can be terminated, and functional - continued.

9.5. Benign prostatic hyperplasia

Benign prostatic hyperplasia (BPH) and prostate cancer are two diseases of one organ, which are attracted great attention of worldwide urologists. BPH is probably the most common disease of men over 50 years old. Is believed that the 60-90% of men over 60 years have histological signs of BPH and 25-50% - dysuria, which are used the term "lower

urinary tract symptoms" (LUTS). For today every person with age 40 years has a 30% chance to survive the surgery on the prostate (25 years ago - 10%). The main change in BPH is anatomical increasing of organ that leads first of all to reduce the diameter of the urethra and violation of the urinary outflow. At the same time, not all clinical manifestations, which until recently was associated with BPH can be explained by the increase in its own anatomy, as recently recommended by the European Association of Urology the notion LUTS and BPH are considered the various diseases. One of the main arguments for this view has become a proven the absence of significant relation between

the severity of LUTS and size of the prostate. The term "benign prostatic hyperplasia" is recommended to use primarily as a histological diagnosis and LUTS is estimated as polyetiological condition one factor of which can be BPH.

Etiology and pathogenesis

For a more thorough explanation of prostate cancer reasons (prostate cancer) and BPH we will focus on the important anatomical features of the prostate. Fundamentals of anatomical division of gland was embedded by Gil Vernet (1953), who found that there are three main parts of the prostate - cranial, caudal and transient (transient). Areas of the prostate (Fig. 9.12)

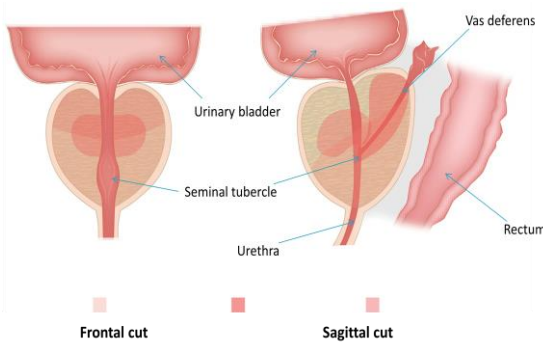


Figure. 9.12. Areas of prostate (by Gil Vernet)

:

1. The caudal (peripheral) area - 70% of the prostate. Lateral and back parts body.
2. Cranial (central) area - 25%. Around the seminal ducts is adjacent to base the bladder neck and the top - near veromontanum.
3. Transient area - 5.10%. Around the urethra, in front of it – the biggest part of the fibromuscular stroma.

This topographical distribution became the basis for establishment of fundamental differences in the anatomical and embryological sources of BPH and prostate cancer

origin. Today is established that BPH originates exceptionally from the transient zone of the prostate, while 60-70% of prostate cancer occurs in the peripheral zone that is proved about important features of these embryological tumors. According to Gil Vernet, cranial part of the prostate, cervix, and bladder triangle originated from the mesoderm, whereas the caudal part - from the ectoderm. This fact leads to further regulation of cell division in these areas (which lies in the activity of any tumors) by different incentives. General regulation of prostate growth is carried out through the sex hormones - male and female. Recall that 90-95% of testosterone is produced in the Leydig cells of the testes and the rest - in the adrenal glands. Out of circulating testosterone only 2-3% is free, which is able to undergo prostate cells and turn into dihydrotestosterone, which in 2.5 times more active. In this transformation lies the most important endocrine function of the prostate. Violation of various parts of this process is a key factor in occurrence of prostate cancer and BPH. Conversion of testosterone is influenced by the enzyme 5-alpha-reductase activity which is one of the most important factors that control the process of cell division. Androgens are important activators of prostate cancer cell division - as endothelium and stroma. It is proved that availability of sufficient male sex hormones level is absolutely necessary factor in the growth of the prostate - both physiological (in puberty) or pathological because historical data suggest the absence of occurrence BPH and prostate cancer in castrated in adolescence males. By the way, currently it is the only effective tool for prevention of prostate tumors. At the same time, there is no direct dependence of testosterone concentration and appearance of prostate tumor. Recent studies have shown

that the occurrence and growth of BPH have great value in the violation of androgen metabolism and dihydrotestosterone accumulation in cells of gland (called "male menopause") increasing the number of cytoplasmic receptors, changing the balance of androgens and estrogens in the body, violation of the intracellular balance of enzyme groups and others.

According to modern ideas about reasons of BPH origin the great importance attaches to stromal-epithelial ratio and growth factors that regulate them. For the first time, in 1925 Reischauer, was suggested regarding of the development in BPH from periurethral fibromuscular nodes. The basis for the further development of this direction of research was the discovery in 1970 the fact of impossibility epithelial cells separation without the presence of stromal cells. It has been shown that androgens do not show the direct mitogenic effect on prostate epithelium, as previously thought. In 1976 was first identified the growth factors (GF) of prostate cancer tissue, later it was proved the existence of similar substances in BPH and in normal prostate. Then Lawson was first suggested the development of BPH due to stimulation of fibroblast separation by epithelial GF. Today the most important GF that directly control the growth of prostate cancer, are considered the main fibroblastic growth factor (MFGF or FFG-2) keratinocyte GF (KGF), transforming growth factor β (TGF β) and epidermal growth factor (EGF). MFGF is determined in most tissues of the human body or other animals. The main function of it is the activation of the fibrous growth and angiogenesis. It has participated in many fundamental biological processes

(embryogenesis of organs, wound healing, tumor growth). MFGF is usually kept in the basal membrane of cells. In the prostate gland it causes the proliferation of the stroma. KGF is secreted by fibroblasts and stimulates cell division of prostate epithelium. It is proved that neutralization of KGF during morphogenesis of the reproductive system leads to disruption of the secretory apparatus formation not only in the prostate, and also in seminal vesicles. The activity of the GF depends on the content of androgens. MFGF cause the inhibition of proliferation as the epithelium and stroma, also TGF β that is the only GF which inhibits the cell division of fibroblasts. Androgens suppress the production of GF and tissue receptors.

The working hypothesis of benign prostate enlargement has the following form. Directly in the gland the main mediators that influence on this process are KGF, MFGF, TGF β and to a lesser extent EGF. In normal prostate, there is a balance between stimulating effect on the epithelium of KGF and EGF from the one side of and TGF β from the other. Similarly, the impact on stroma of MFGF is equivalent to effect on it from TGF β . Shift the balance towards the increased synthesis of cells in the first equality leads to epithelial hyperplasia of

the prostate, and the second - to stromal hyperplasia. At the central level the synthesis of GF is regulated by primarily androgens - ie GF is still not well-known to local implementation mechanisms of their effects directly on the cells of the prostate. Androgens directly affect to the production of KGF and TGF β , while MFGF secretion is regulated by changes in the concentration TGF β . The confirmation of the important role of stromal hyperplasia in the occurrence of BPH is the change in the ratio stroma, muscle and epithelium in this disease. If the ratio is normal the stroma / epithelium is equal to 2/1, then for BPH - 4-5/1. Lawson was suggested the hypothesis according to which the main triggering occurrence factor of BPH - is the located microtraumatisation of periurethral prostate cells - as stroma and epithelium (during urination, ejaculation, infections of the prostate gland). It leads to releasing of the active MFGF as part of the recovery process in damaged tissue, which subsequently can cause the stromal hyperplasia. The increase in stromal cells leads to activation of the KGF synthesis and mitogenic effect on epithelial cells. There is one important fact that was opened relatively recently. Changes in the prostate and violation of the urinary outflow from the bladder lead to severe secondary changes in the bladder wall, occurrence of which is also depended on changes in the balance of GF that activate or inhibit mitosis. The main mechanism of the pathological process startup is considered the microtrauma of bladder wall due to hyperextension. Activation MFGF and KGF contribute to the appearance of gross changes - a significant increase in detrusor weight, increase

of the collagen amount in the wall, causing a secondary circulatory disorders and innervation. It leads to poor detrusor contraction, reducing its ductility, and the appearance of hypersensitivity. It is proved that dysuric phenomenon of BPH, the appearance of residual urine which is previously connected with the anatomical changes in the prostate, and mostly is the result of the above changes in the detrusor. Another important component of bladder emptying violations in elderly men is the age changes in muscles of the lower urinary tract. From the one side, it is manifested by spasms of the smooth muscle in bladder neck (due to activation of alpha-adrenergic receptors) that regardless of the prostate size impairs the emptying. From the other side, occurs the so called age hypersensitive of detrusor that leads to occurrence of excessive contraction and dysuric disorders. The final reason of such changes of

neuromuscular system is not clearly established. Thus, the condition that was associated only with the development of prostatic hyperplasia is explained by combined influence of three factors: the mechanical obstruction of the bladder neck + infringement reducing of smooth muscle in bladder neck + violation of detrusor contraction. It is considered that there is no clear dependence between them; each of these factors can be developed independently. Thus, among the causes of LUTS in males distinguish several important moments (Table 9.2):

- Mechanical obstruction of vesico-urethral segment due to anatomical increase in cancer.
- Violation of the smooth muscle contraction in bladder neck, the reason of which is not clearly established, but the tonus increasing of the smooth sphincter has a great role in violation of the urinary outflow in elderly men.
- Violation of detrusor contraction, which are discussed above.

REASON	CONSEQUENCE
Anatomical prostate enlargement	Mechanical obstruction of vesico-urethral segment
Contraction of bladder neck muscles	Dynamic obstruction of vesico-urethral segment
Hypersensitivity of the detrusor	The appearance of pollakiuria, nocturia, urinary incontinence.

The clinical picture

Clinical manifestations of the disease are fairly well known. The main things of them are the variety of dysuric disorders, LUTS that are quite conventionally divided into three groups - the symptoms of obstruction, irritation and after excretion. To the symptoms of obstruction belong weakening and interruption of urinary stream, delay of the urination start, strangury. The symptoms of irritation - are thauria, nocturia, compelling urge to urinate. The latter include the feeling of incomplete bladder emptying and leakage of urine immediately after voiding. Recent years has been a significant reassessment of the dysuric disorders role in BPH. Previously they were just a guideline for the diagnosis, and now is generally accepted that their activity with the size of the prostate and urinary tract changes is an objective criterion for determining treatment strategy and control over its effectiveness. With the purpose of objectification the patients with urinary violation at BPH is generally accepted to survey the patients on a specially designed scales that helps to determine the severity of dysuria in points. The summation of points in the survey of patients gives an objective understanding of the disease manifestations.

If the bladder emptying violation takes the considerable time and is quite pronounced, it leads to secondary lesions of the bladder and upper urinary tract and the occurrence of complications.

A typical feature is the appearance of residual urine, bladder stones, hydroureteronephrosis, chronic cystitis and pyelonephritis. Clinically, patients notice (except severe bladder emptying disorders) signs of complications - the appearance of pain during urination, dull pain in the lower back, fever and so on. Specific complications of BPH are the occurrence of acute urinary retention (AUR) - the sudden termination of outflow in overflowing bladder. This complexity often leads to the emergency hospitalization of patients with BPH. It may occur at any stage of the disease, and its appearance is triggered mainly by external factors - consumption of spicy foods and alcohol, constipation, hypothermia, deliberate delay of urination for a long time or the prolonged stay in the sitting position (for example, during travel). The AUR may also be iatrogenic - most often with active stimulation of diuresis in the elderly men (for example, at the treatment of heart disease). More details of AUR is considered in the chapter of urgent urology. In the traditional soviet classification, the activity of dysuric disorders is taken into account in determining the of BPH stage.

The first stage is characterized only by the violation of urination. The second is characterized by urinary retention without significant lesions of the upper urinary tract. The third is characterized of pronounced changes in kidneys and ureters, paradoxical ischuria. Abroad, such a classification is not used.

Diagnostics

At the first appeal of patients with BPH, to 25% of patients is show only observation. To 60-65% of patients is shown the conservative treatment, and only 10 - 15% of patients have absolute indications for surgical intervention.

For the diagnosis of BPH are used the following methods:

1. Determination of dysuric symptoms, which is an important factor to the choose the treatment. For this purpose are used the specially designed survey sheets or the dysuric evaluation system disorders. The most common of them - is IPSS (international prostate symptom scale). The last 7 contains questions about the main LUTS (thamura, strangury, nocturia, etc.), the activity of which is measured from 0 to 5 points with the following summation of scores for all questions (Table 9.3).
2. The additional 8th question concerns the quality of patients life with dysuric disorders - because the perception of the same symptoms varies greatly between patients. For example the necessity to get up 2 times at night to urinate for one man is taken practically as a tragedy and for the other man it is taken as "normal" aging process. The level of assessment by patient of their condition is also the relative indication for more aggressive treatment of the disease (for example, surgical treatment at a relative indication).

Overall score of the questionnaire is divided by severity into 3 categories:

Almost always	5	5
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	Does not occur at all	Less than 1 case of 5	Less than in half cases	Approximately in the half cases	More than in half cases
1. During the last 4 weeks, how often have you had a feeling of incomplete bladder emptying after urination?	0	1	2	3	4
2. During the last 4 weeks, how often have you emptied the bladder again less than two hours after the last urination?	0	1	2	3	4

3. During the last 4 weeks, how often have you noticed	0	1	2	3	4	5
4. During the last 4 weeks, how often have you found it difficult to	0	1	2	3	4	5
5. During the last 4 weeks, how often have you	0	1	2	3	4	5
6. During the last 4 weeks, how often have you had to strain or	0	1	2	3	4	5
	Never	Once	2 times	3 times	4 times	5 times or more
7. During the last 4 weeks, how many times	0	1	2	3	4	5

Total rating IPSS

Assessment of quality life due to urinary disorders							
	Very satisfied	Satisfied	Mostly satisfied	Between satisfied and dissatisfied	Mostly dissatisfied	Dissatisfied	Very dissatisfied
If your attitude to the fact that you would have to live with the existing urological problems	0	1	2	3	4	5	6
Index for evaluating the quality of life							

Poorly expressed (0-7), moderate (8-19) and highly expressed (20-35). Patients of the first category are subject mostly to dynamic observation. Medicamentous therapy is shown to the secondary category of patients with further evaluation of effect therapy. If the total score of the questionnaire is more than 25, then LUTS is considered mostly expressive and it is one of the indications for surgical treatment. In addition, the questionnaire is a reliable tool for evaluating the results of the treatment. Thus, the assessment of symptomatic severity by using the questionnaire is an important part of the initial evaluation of patients.

IPSS helps in determining the treatment strategy, prognosis and monitoring of treatment efficacy.

1. Digital rectal examination (DFE) is an important assessment method of the prostate, primarily as the simplest, though not the most reliable differential diagnostics method with prostate cancer. The positive estimated value in the diagnosis of prostate cancer (PEV) makes 26-34%. BPH is characterized by tightly-elastic consistency of glands, its uniform increase with clear separation from surrounding tissue, painlessness, smoothing of the median ditch, the mobility of the rectal wall of the prostate (Table 9.4).

2. Urodynamic examination allows objectively identify the degree of urinary flow impairment from the bladder. Simplest method - is uroflowmetry, which defines the main indicators of summary urination (average and maximal urinary flow rate, urinary volume, etc.). At fuzzy data is necessary to conduct of deeper research - cystometry (registration of pressure changes in the bladder at its filling) urethral profilometry (registration of pressure change along the urethra), a survey of "pressure - flow."

	Sign	BPH	Prostate cancer
	Increasing of gland	Symmetrical	Dissymetric
	Surface	Smooth	Hilly
	Consistence	Tightly-elastic	Stony
	Median furrow	Saved	Saved
	Borders	Clear	Unclear
	Mobility of the mucous	Saved	Absent

In practical medicine is primarily used the uroflowmetry. All protocols recommend it as a standard method for examination of patients. This method is noninvasive, its performance takes a few minutes, the results are obtained immediately. In norm the uroflowmetry curve has a typical "bell-shaped" appearance. Qmah more than 20-25 ml / sec, urinary discharge

volume – is more than 200 ml (Figure 9.13). In severe mechanical obstruction Qmah less than 5.10 ml / sec and the curve become significantly more elongated, with a low peak,

which is a relative indication for surgical treatment. At symptoms of detrusor overactivity volume of urination, usually less than 100 ml with a slight decrease in Qmah.

3. Ultrasound provides the information about the anatomical features of the prostatic structure - the degree of increase in the, presence of seals. Ultrasound can be performed transabdominally or transrectally. The latter option is more accurate and allows for more information about anatomical features of prostate, including the possibility of the prostate cancer existence. Also, transrectal ultrasound is used for biopsy changed areas of the prostate.

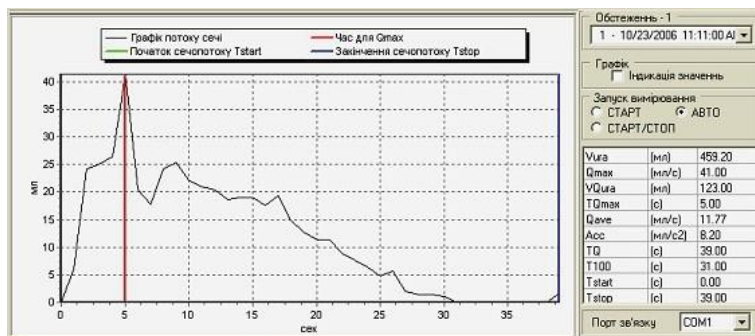


Figure. 9.13. Normal curve of uroflowmetry. Qmah, - 41 ml / s, urine volume - 429 ml.

4. Enlarged prostate more than 25 cm³ is considered as sign of hyperplasia. It is also important determination of residual urine (preferably twice), which

characterizes the degree of decompensation detrusor function. Residual urine more than 300 ml is a relative indication for surgical treatment. In AUR the incontinence of urine in the bladder may reach 2.3 liters at its normal capacity of 300-350 ml.

5. **Prostate specific antigen (PSA)** PSA is a representative group of kallikrein peptidase - enzymes with proteolytic activity that excel in many organs of the human body (reproductive system of men and women, skin, lungs, etc.). Today, we know relatively not much about the role of kallikrein in biological processes associated with a variety of the kallikreins (which at present are allocated at least 15, and they are taken from all tissues of the human body, except nerves). It is well known that the exchange of kallikrein is closely

related to the level of many hormones, especially steroidal. Now most of the kallikrein are positioning primarily as an expression biomarkers hormone-sensitive receptors and associated with it genes.

PSA is a kallikrein (KK) 3, which is produced in various tissues of the body, but most of all (hundred times more) - in the prostate. Overall in male sexual system are

produced almost all of kallikrein, but most of all - KK 2, 3, 5, 11. The main proved effect of these substances is the dilution of semen (which is an important component of fertility) due to the effect on gel-forming components - seminogelin 1 and 2. There is also evidence of possible effect of kallikrein on cancer progression by stimulating of tumor cell invasiveness. In general, currently KK 2 and 3 are most used as markers of prostatic cells differentiation, especially in the context of prostate-specific hormone expression. That's why CC 3 (PSA) is an important marker of atypical prostate cells differentiation, which may indicate the existence of a tumor. PSA was discovered in 1971, and the introduction of its clinical use from 80-ies of the last century, led to the radical changes in the diagnosis and treatment of prostate cancer. The first few years was noted a significant increase in the frequency of prostate cancer by identifying tumors that were previously impossible to diagnose. Subsequently there was a gradual decrease in the frequency of prostate cancer. Currently, PSA is considered practically convenient marker for early detection. Prostate cancer, although the search for a more sensitive and accurate markers continues. In most countries, PSA determination is made all men over 50 years old who apply for urological care. Recent studies conducted in the Netherlands have shown a probable reduction (25-30%) of mortality from prostate cancer, provided the annual determination of PSA in men.

PSA is produced by prostate epithelium constantly throughout a man's life (Figure 9.14). Normally, the vast majority of PSA is excreted into the ducts of the prostate, and in the future - out with sperm. At the growth of tumor part of the prostatic epithelial cells are separated from the ducts, causing PSA enters the extracellular space, and then - in the general circulation, that makes its concentration in the plasma to increase significantly. Temporary increase of PSA plasma levels can also be observed in the activation of

inflammation in the prostate, active manipulation of it (biopsy, massage) or urethra (catheterization, cystoscopy). Therefore, the definition of PSA should be made within 2 days after them. Most commonly is determined the total PSA. Assessment of performance is carried out as follows:

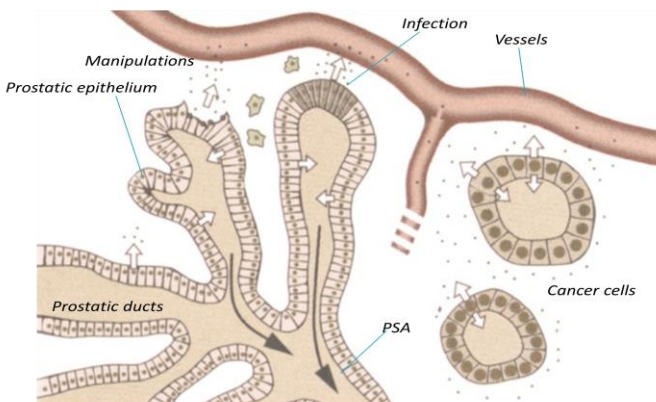


Figure. 9.14. The scheme of excretion ways of the PSA in norm (black arrows) and at the pathological conditions (white arrows).

- up to 4 ng / ml - the norm (but 10-15% of men may have prostate cancer);
- 4-10 ng / ml - is necessary to exclude of prostate cancer (in 20-35% - prostate cancer).
- > 10 ng / ml - high probability of prostate cancer (70-85%)
- > 20 ng / ml - in most patients is already metastasis of prostate cancer. In addition to diagnostics of prostate cancer, blood serum PSA may be used for risk of AUR assessment and necessity of surgical intervention.

6. Determination of serum creatinine:

BPH may result in dilatation of the upper urinary tract and kidney failure, which is observed in the 11-30% of cases, it is recommended to study the kidney function by determining the level of creatinine.

It has been proved that patients with BPH and renal failure have a higher risk of postoperative

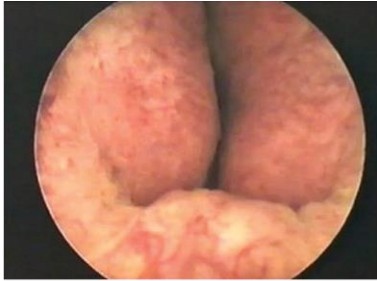


Figure. 9.15. The view of increased prostatic lateral parts (above) and spermatic tubercle (below center) in BPH.

complications and a significantly higher mortality in comparison with patients with normal renal function. Among patients with azotemia the vast majority are also have the diabetes and hypertension, where can be the different reasons of increase in creatinine level. 7. Urinalysis is recommended to exclude other causes LUTS (eg, urinary infection, bladder cancer). The most common changes can be signs of urinary infection (leukocyturia, bacteriuria, proteinuria, etc.). 8. X-ray examination (excretory urography, cystography, CT) and MRI - are not recommended for BPH and are made only at indications. They include the availability of the upper urinary tract expanding or other signs of a pathological condition of the upper or lower urinary tract. In this case, we define the features of the structure and functioning of the upper urinary tract, the presence of enlargement, reduction of functional

capacity, presence of other diseases (urolithiasis, tumors , etc.). These changes are also characterized by the degree of urodynamics.

9. Endoscopy (cysto-, ureteroscopy) - is also not recommended for BPH and conducted only by indications (Figure 9.15). These include suspicion of other

pathology of bladder or urethra, which cannot be diagnosed by non-invasive methods (eg rentgenocontrast concrements, small tumors, urethral stricture), or gross

hematuria, to diagnose its source. Prostatic biopsy is performed only in the presence of suspected existence of prostate cancer. Details are provided in the relevant chapter.

Treatment

To treat the condition was used a variety of methods, most of which have only of historical interest. Traditionally, there was active opposition between conservative and surgical treatment of this pathology tactics. With the widespread introduction in practice the transurethral resection of the prostate in the 80s advantage of surgical methods has become impressive. This was due to two main factors. First, is the reduction of mortality and complications of surgical treatment in comparison with traditional prostatectomy. Second, the large number of medications for conservative treatment of BPH, whose effectiveness has not been objectively investigated, greatly undermined the credibility of the non-operational methods in general. The decision to standardize clinical trials of new medications and the appearance of fundamental research on the etiology and pathogenesis of BPH contributed to the development of new methods of conservative treatment, which is led to significant changes in the ratio between the frequency of surgical and conservative treatment of BPH. If in the countries with developed economy in 1985 to the 30% of patients was shown TURP and only the 3% treated conservatively, in 1995, the number of operations has decreased up to 7% and by conservative methods were cured about 30% of patients, and this percentage continues grow.

Conservative treatment

Nowadays, the methods of conservative treatment are major:

1. The tactics of active surveillance is used in men with mild symptoms that have no impact or have insignificant impact on quality of life. In addition to periodic control examination (usually once every 6 months) with a score IPSS, UFM and residual urine of

patient is recommended the correction of lifestyle. Thus it is necessarily to inform males about prostate cancer. Advices about lifestyle include the exclusion or moderate consumption of caffeine, alcohol and synthetic drinks that have diuretic and irritative effect on mucous membranes, unlike medications that have a diuretic effect, substitution or other, no such effect, prevention and treatment of constipation and urinary infection.

2. From the conservative treatments for BPH 5-10 years ago the absolutely preferred was the using of animal or plant medications. With the large medication number was raised into question about the real effectiveness of each. It was the main reason for introduction into the practice standards surveys proving the effectiveness or denies this or that medication. This standard is recognized only for multicenter randomized study that is conducted with double-blind placebo-control. Large research on most of these medications was not carried out, and there is also proven of data on possible ways to influence them in the pathological process in BPH. The observation that exist, are related to the small group of patients and carried out without complying with the current requirements. All this suggests of their effective method of BPH treatment, especially

with placebo in one third of patients was noted improvement urination, which later passed. For now the main directions of conservative BPH treatment with proven efficacy are:

1. **Alpha-blockers (AB)** - are preparations of choice for patients with moderate and severe LUTS. The principle of their use in BPH is that the increasing of vesical sphincter tonus is important in the occurrence of dysuric disorders regardless of the prostatic size (dynamic obstruction). Major role in the functioning of the sphincter play alpha-adrenergic receptors - at their activation the tonus of sphincter increases (for example, in the phase of filling of the bladder), and at blocking - is reduced. Therefore, in BPH are used the alpha blockers, which primarily lead to a reduction of dynamic obstruction. It is clinically proven that statistically significant impact on the improvement of their dysuric symptomatic and urodynamic indicators the lower urinary tract in these patients. The main factor that definitely restricts the use of these medications is an immediate effect on vascular adrenergic receptors which leads to a decrease in blood pressure, especially orthostatic. This situation has stimulated the

development of selective action of medications that affect mainly on the receptors of the bladder neck. Studies have shown that it contains primarily alpha 1A-adrenergic receptors, which are practically absent in the vessels. Therefore, the development of these subtypes of adrenoceptor blockers was specified to reduce the risk of complications.

The first medication of new generation became tamsulosin. It affects mainly on the alpha-A1-adrenergic receptors. Due to this, the medication has practically absent effect on blood pressure. Among other AB are used doxazosin, alfuzosin, terazosin, and prazosin. The effectiveness of all these AB is about the same, but the third-party actions are best in tamsulosin and alfuzosin. AB reduces the dynamic component of prostatic obstruction and irritative symptoms in 20-40% of patients by improving on 16-30% rate of urine outflow in comparison with placebo.

The effect of the application of AB is observed after 1-2 days, from the initial duration of treatment - at least 1 month. Further use of the AB (constant or course) solved by re-observation of the doctor.

2. **Blockers of 5- α -reductase** reduce the activity of the corresponding enzyme, which corresponds to the formation by dihydrotestosterone in the prostate. The latter, in turn, is in ten times more active than testosterone and considered as one of the main promoters of prostatic cell growth. The first representative of this group was finasteride. Effect in the using of blockers or 5- α -reductase is observed after 3 months of therapy. The medication is used not more than 6 months It is marked not only the reducing of LUTS, but

also the reduction the prostatic volume. Number of operations in patients using finasteride for 4 years has decreased by 34%, the occurrence of AUR - 57%. The main side effects of this group of preparations are erectile dysfunction (5.8%) and reduction of libido (3.6%). Now there is another representative of this medications group - dutasteride, which has a

pronounced ability to block 5- α -reductase, but the conducted researches have shown an approximately equal clinical efficacy of both drugs. 3. Holinoblockers (HB) became

recommended by the European Association of Urology as method of BPH treatment only in 2010, after accumulating of sufficient data on their efficacy and safety in this disease.

The basis of action is inhibition of the M- cholinergic receptors activity on the bladder wall, which is responsible for detrusor contraction. Consequently, the indications for use of these drugs in LUTS are the presence of symptoms of overactive bladder (AUR) in these patients - i.e. at urgency to urinate, of its increased, urinary incontinence. The basis for their application become the facts of insufficient efficiency of adrenergic blockers as first-line medications in the treatment of about 20-30% of patients with BPH. Conducted in recent years, research has shown that this group of patients has the dominated signs of AUR. Thus, in patients with BPH and symptoms of AUR the using of HB (individually or in combination with other medications) significantly improves the outcome. Contraindications for using of HB is primarily a large amount of residual urine (more than 200 ml) and a significant reduction of maximum urinary flow rate (less than 5 ml / sec.) in connection with possibility of AUR as a complication of using HB. HB can be divided into several generations. One of the first was oxybutynin. It has shown quite good efficacy in AUR, but half of the patients are stopped the treatment due to side effects (most often - headache and dry mouth). For medications of next generation belongs first of all tolterodine which has a much better profile "efficacy / safety." The most modern and effective drug of this group for today is solifenacin that is now claims to the "gold standard" of HB.

4. Combined therapy. Currently increasingly are used the combinations of different medication groups in BPH, given the data of recent years about expressed heterogeneity of this group of patients. Among these combinations are often appointed by the simultaneous use of adrenergic blockers and 5 α -reductase blockers. The indications for their combined use is first of all the size of the prostate, including the possibility of its reducing in the treatment of 5 α -reductase blockers. Researches have shown that the addition of 5 α -reductase blockers is good for prostate with volume more than 30 cm³. An obligatory condition is treatment duration for at least 6 month. Another possible combination is adrenergic blockers and HB. As noted above, such combination is shown to patients with symptoms of overactive bladder.

Research shows that about 20-25% of patients with BPH are not getting the facilitating after taking the AB, but when you add the cholinolytics in 35-40% of them are reduced dysuric symptomatic.

5. Among other directions of treatment attract the attention of **herbal medications**; however none of them are not recommended in protocols of the modern BPH treatment. The reason for this is the lack of sufficient evidence of herbal preparations efficiency and the inability to standardize their production. Due to impossibility of select a single active ingredient, the use of different plants and different methods of extraction, the 5th.

International consultation on BPH was indicated that among the various medicamentous extracts from the same plant, there are significant differences, and the results are demonstrated using a single medication is not allowed to extrapolate another. Unfortunately, a large number of promotional materials of herbal preparations use studies conducted by other campaigns with a similar medications that is totally incorrect. From all herbal preparations only 2 have a number of placebo-controlled studies which are considered to the standard of proof the effectiveness of any medical preparation - fruits *Serena repens* (American palm) and extracts of *Pygeum africanum* (African plum). Extract from the fruit *Serena repens* (trade name

"original" preparation Permixon, there are several dozens of similar preparations of different companies) has antiandrogenic effect reduces swelling of the prostate tissue. The possible major way of permixon influence in BPH is the inhibition of 5α -reductase inhibitors and anti-inflammatory action. Serena repens medications have a number of placebo-controlled trials, most of which have showed a positive result, although some studies not revealed probable effect. The indicated, and the insufficient number of patients in most studies, their small duration (most - up to 3 months.), does not allow to make any definitive conclusions on the effectiveness of Serena repens in BPH, and therefore they are not included in the official recommendations. Serena repens extract is used by 160 mg 2 times a day. The recommended duration of treatment - at least 3 months. With the side effect of the medication is indicated nausea in the use of the medication on an empty stomach. The operating principle of the other herbal preparation - pygeum africanum extract in oil,

perhaps, lays in the inhibition of hyperproliferation of fibroblasts, which are caused by fibroblast growth factor (FGF) and reduction of production of transforming growth factor. The possible result of this is to reduce the swelling of the prostate, age hypersensitive of detrusor and increase of its plasticity - ie preparation may have effects not only on the prostate, but also on the bladder wall. African plum extract through the inhibition of proliferation of fibroblasts inhibits proliferation of connective tissue in the prostate gland and prevents its fibrosis. Medication is administered orally 1 capsule (50 mg) 2 times a day, morning and evening, preferably before meals. Typically, course of treatment lasts at least 6 weeks. Side effect of the drug is not described.

As mentioned above, the frequency of surgical treatment of men with BPH is constantly reduced due to the advent of effective conservative treatment methods. The main indications for surgical treatment are:

IPSS > 19 points;

AUR, which is not liquidated conservatively;

Chronic urinary retention more than 300-500 ml;

Signs of obstruction in urodynamic researches;

Concrements of bladder;

Macrohematuria;

Renal failure due to obstruction.

Surgical treatment

From the available methods is primarily available **TURP**. This operation is the "gold standard" for all transurethral operations. The implementation of this method has allowed the reducing of postoperative mortality (compared with conventional prostatectomy) and the number of serious complications (such as bleeding). This method is not shown only in combination with other disorders of the bladder (eg, concrements which are not crushed) and for large prostates (weight more than 80-100 g).

The operation is performed via resectoscope - a special tool that is injected transurethral (Figure 9.16). The principle of operation is to gradually cut pieces of the prostate under visual control with the help of electric current supplied to a special loop. Thus, periurethral part of the prostate is removed; cut pieces of tissue are washed away from the vesical cavity by constant liquid flow during operation. Simultaneously, is conducted the coagulation of blood vessels through another current mode. The prostate is removed within its surgery capsule, but certain part of the body still remains, which may lead in further to recurrence of benign prostatic hyperplasia (observed in 15%). After surgery is usually administered urethral catheter and bladder irrigation (for 3-12 hours) by sterile fluid for the prevention of blood clotting in its cavity. Today are actively introduced other methods of transurethral therapy for BPH, the main

principle of which is the removal of the periurethral part of prostate under the various power factors. Among these should be mentioned TUMT - microwave therapy, TUNA - transurethral needle ablation, TUV - vaporization of the prostate, ILC - laser coagulation of prostate, HIFU - High Intensity Ultrasound, VLAP - Laser ablation of the prostate and more. The advantage of these methods is greatly reduced surgical trauma; it can be used in severe patients. The disadvantage is available their lower efficiency compared to the tour and the impossibility of performing at large BPH. **The open prostatectomy** abroad is rarely used (5-10% of all surgeries at BPH). The indications for its implementation are available mostly large prostate size (more than 80-100 g), large concretions, and impossibility of carrying out instrument through the urethra. The operation is performed frequently by transvesical access, where is made the incision of anterior abdominal wall and bladder wall - transvesical prostatectomy (TVPE). After the last revision is conducted dull extraction of hyperplastic nodes within the surgical capsule. Taking into account that completely sew up of the received defect of bladder wall as normal wound is impossible (because in the deep of it is located urethra), it may be liquidated in two main ways. 1. If the defect is relatively small, the retrograde catheter Foley is entered into the urethra (preferably with a large capacity cylinder - 40-50 ml) balloon is inflated in the bladder cavity. Under visual control cylinder is placed in the prostate bed and controlled stop of bleeding. The wound

of the bladder is sutured tightly or imposed the epitsystostoma. Immediately is adjusted an irrigation of the bladder with saline (or through catheter-stoma, or if there is no three-way catheter is used, the two channels which are used for irrigation), and to the distal end of the catheter attached little weight to the permanent pressing of balloon to the prostate bed (up to days).

2. If the prostate bed is large, then the overlay is performed two or three ligatures on the edges of the mucous membrane of the bladder (not tied ligatures), and their ends are excreted through the urethra and tied them to a small burden for constant traction threads. Simultaneously is entered into the urethra catheter for constant bladder irrigation. After 1-3 days after reliable hemostasis threads by traction at either end of stretch, the catheter is removed after 3-5 days. If there is a stoma, in the future it originally clamped to restore self-urination, and removed after 1-2 days. The hole usually closes independently. Rarely is performed retropubic prostatectomy through perineal incision without opening the bladder. At the same time, in the practice of urologists are met serious complications of BPH and pronounced changes in the urinary tract where is necessary to perform the palliative surgery - epicycstostomy.

It is performed as the first stage of surgical treatment if the patient that arrive in bad condition or serious complications (pyelonephritis, renal failure, etc.), when the performance of radical surgery is impossible. Postoperative mortality within 3 months after surgery is 1.5% for TURP, 3.4% for TVPE. However prostatectomy is much less likely to be inefficient and require reoperation due to recurrence within 5 years in 0.4% of cases at 3.4% - after TURP. The most common postoperative complication is erectile dysfunction - after TURP occurs in 12-14% of patients after TVPE - 15-20%. Rarely is observed incontinence and stricture of the urethra.

Further observations

Patients on conservative treatment and patients after the operation, should be observed on a particular schedule (see Table 9.5).

Standard methods of patient monitoring is the scale IPSS, UFM, PSA and the amount of residual urine. In case of unsatisfactory results of treatment need to perform the urodynamic examination.

Table 9.5. Observation dates of patients with BPH

Type of treatment	1 year after treatment			Further 1 per / year
	6 weeks	12 weeks	6 months	
Active surveillance	–	–	+	+
Inhibitors of 5 α -reductase	–	+	+	+
α -blockers	+	–	+	+
Surgery and Miniinvasive	+	+	+	+

9.6. Prostate Cancer

Prostate cancer (PC) - (prostate cancer lat. Prostatic adenocarcinoma) – is a malignant tumor that occurs from the epithelium of the alveolar-cell cortex.

Epidemiology

Currently, PC – is one of the important of medical problems facing the population of men. PC – is the most common solid tumor in Europe, with the incidence rate of 214 cases per 1,000 people, which exceeds the incidence of lung cancer and colorectal cancer. In addition, PC is currently ranked second among the causes of death from malignancies in men. Moreover, since 1985, most countries had registered a slight increase in the number of deaths from PC, even in countries or regions where the PC occurs rarely. In developed countries, PC is about 15% of all tumors in men compared to 4% in developing countries. In Ukraine in 2010, the incidence rate was 37.99 men per 100 000 population. Also in 2010, in Ukraine from prostate cancer have died 3237 men.

Etiology

The reasons could be:

- Age-related hormonal changes;
- Genetic predisposition;
- An imbalance of nutrients (biologically meaningful elements);
- Chronic cadmium intoxication;
- Possible additional reason - the presence of the virus XMRV.

There are risk factors of prostate cancer: advanced age, ethnicity (the highest rates in the U.S. and northern Europe and low - in Southeast Asia) and heredity. To etiological factors also include: feeding habits and sexual behavior, alcohol consumption, exposure to ultraviolet radiation and occupational hazards.

Classification

TNM-classification of prostate cancer (2002)

- T - evaluation of the primary tumor.

- T0 - no signs of tumor.
- T1 - tumor is clinically evident, not palpable nor visualized.
- T1a - tumor occupies less than 5% of the removed material, or three three microscopic foci of tumor.
- T1b - tumor occupying more than 5% of the removed material, or more than three microscopic foci of tumor.
- T1c - tumor biopsy was found about elevated levels of PSA.
- T2 - The tumor is localized in the prostate.
- T2a - tumor occupies less than half of one lobe of the prostate.
- T2b - tumor occupies more than half of one lobe of the prostate.
- T2c - Tumor spreads to both share of prostate cancer.
- T3 - tumor extends beyond the prostate.
- T3a - tumor invades the paraprostatic tissue (one or both sides).
- T3b - germination in seminal vesicles.
- T4 - Tumor is fixed or invades in the adjacent organs other than seminal vesicles: the neck of bladder, external sphincter, rectum, m. levator ani, or fixed to the pelvic wall.
- N - evaluation of regional lymph nodes.
- Nx - to assess the status of regional lymph nodes is not possible.
- N0 - lesions in regional lymph nodes is not available.
- N1 - the presence of metastases in regional lymph nodes.
- M - distant metastases.
- M0 - metastasis missing.
- M1a - metastasis to distant lymph nodes.
- M1b - metastasis in the bones.
- M1c - metastasis in the other organs.

Classification of prostate cancer in clinical stages

- **Stage I - T1a H0 M0**
- **Stage II - T1a-2 M0 H0**
- **Stage III - T3 M0 H0**
- **Stage IV - T4 H0 M0 or Tx N1 M0 or Tx Nx M1**

Gleason Score scale is commonly used for staging of adenocarcinoma of the prostate. Gleason Score scale can be carried out using only the morphological material (biopsy or postoperative). Cytological

preparations are not used. Gleason Score scale - is the sum of the two most common tumor differentiation stages (stages 1-5), which are in the tumor varies from 2 to 10 points, where 2 points - the least aggressive and 10 points - the most aggressive tumor. At biopsy is recommended necessarily to include the worst degree of tumor differentiation.

Histological classification of prostate cancer

In the prostate is observed a large number of morphological types of prostate cancer, but a significant share of them in the so-called conventional acinar adenocarcinomas origin.

(Figure 9.17).

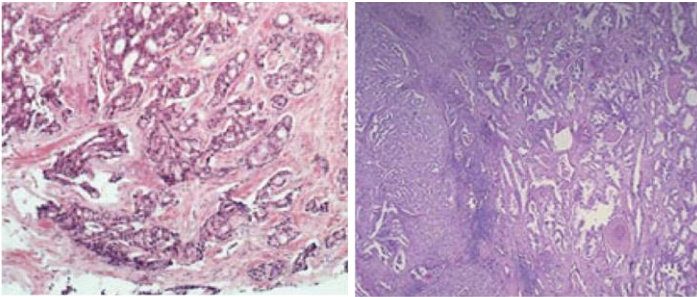


Figure. 9.17. *Microscopic picture of prostatic adenocarcinoma.*

The clinical picture

Symptoms specific to prostate cancer does not exist. Many of the symptoms are similar to those with prostate cancer. They are: irritative symptoms - frequent urination, feeling of incomplete emptying of the bladder, spastic or painful sensations in the perineum, obstructive symptoms –

difficulties in urination, the presence of intermittent or thin

stream of urine, urinary retention, increased time of urination, necessity to strain the abdominal muscles for a complete emptying of the bladder. Pain and all the symptoms are associated with obstruction of the upper urinary tract and occur in more common tumors. However, symptoms may be associated with the appearance of metastases and tumor growth when it comes to advanced stages of cancer. Metastases spread the tumor through the blood and lymphatic. There are metastases in bone and lymph nodes.

Diagnosis

The main methods of diagnosis of prostate cancer are: DRE, determine the concentration in serum PSA and transrectal ultrasound (TRUS). Thus, for the diagnosis of prostate cancer is obligatory proof of tumors with the help of morphological studies of prostate biopsy or cytology conclusion after aspiration biopsy.

DRE prostate

For malignant tumors of the prostate most characteristic as follows:

- Increase in density as a separate units of various sizes or the entire prostate. Often the consistency of the prostate is characterized as "woody" or "cartilaginoid";
- Asymmetry of the prostate and the lack of anatomical shape;
- Real estate due to the presence of tumor infiltration;

- The lack mobility of the mucosa of the rectum above the prostate;
- Blurred contour of the prostate;
- Seminal vesicles as a "bull horns".

Determination of the PSA concentration

Currently, PSA is the most sensitive and specific of all tumor markers (sensitivity 88%, specificity 90%). The concept of "acceptable upper limit of normal" PSA for different age groups ranging from 2.5 ng / mL for males of 40-49 years to 6.5 ng / ml in 70-79 years. In order to improve quality of prostate cancer diagnostics use the additional modifications determining the PSA concentration: the PSA determination of density (the ratio of the PSA serum to the first volume of cancer, according to TRUS), the PSA assessment of changes in the dynamics of the definition of free and bound PSA - threshold values "free PSA / total PSA × 100%" is available 15% (below 15% - necessary to perform a biopsy of prostate gland).

Ultrasound

This is one of the essential techniques for diagnosis and assessment of local PC spread. The most commonly is used transabdominal and transrectal scanning. TRUS provides the best visualization of the prostate, allows obtaining images in the transverse projection and determining the size, acoustic structure of the gland and surrounding tissue.

Biopsy of the prostate

At establishing the diagnosis of prostate cancer it is obligatory proof of tumors with the help of morphological research of the prostate tissue. There is open (operating), transurethral (endoscopic), and needle aspiration (perineal and transrectal) biopsy of the prostate (Figure 9.18).



Figure. 9.19. A device for performing fine needle biopsy.

Currently, transrectal prostate biopsy under TRUS control is standard manipulation, rarely is performed perineal biopsy. In order to receive material with prostate typically use automatic devices (Figure 9.19).

Further diagnostic tests are applied on the basis of results of the biopsy and

should be aimed at clarifying the stages (spread tumors). It is usually performed by:

- Radiography of the lungs;
- CT or MRI (Fig. 9.20);
- Osteoscintigraphy.

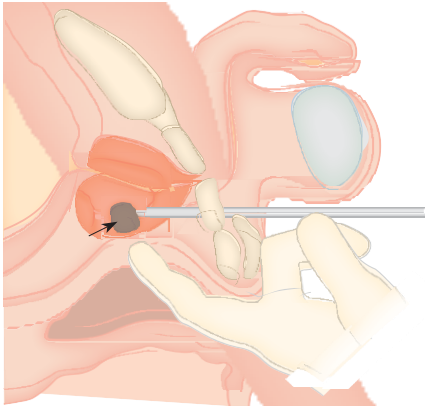


Figure. 9.20. CT of prostate cancer with germination outside capsule of gland.

Figure 9.18 biopsy of the prostate.

Differential diagnosis

Differential diagnosis should be made with BPH, prostate sclerosis, granulomatous prostatitis, tuberculosis of prostate, prostate concretions.

Summary of diagnostic

- The study of complaints and anamnesis of disease

- Physical examination
- General clinical and laboratory examination
- DRE of the prostate
- Ultrasound (TRUS mostly)
- PSA
- Biopsy of the prostate
- Radiography of lungs
- CT or MRI
- Osteoscintigraphy

Treatment

In local forms (Stages I and II, without metastasis) of cancer, the following types of treatment:

- Removal of the prostate (radical prostatectomy, Fig. 9.21.).

- Distant X-ray therapy - irradiation of prostate and lymph nodes that are nearby, at a dose of 40 Gray, later irradiation of the tumor increasing to 70 Gray
- HIFU-therapy - tumor ablation by focused high-intensity ultrasound.
- Brachytherapy or interstitial radiation therapy - putting into the tumor the grains of radioactive medications.
- Monotherapy with antiandrogens - the rarest type of treatment.

Treatment for stage 3 and stage 4 with metastases

Distant X-ray therapy + hormonal therapy

Irradiation of the prostate and lymph nodes that are nearby, with the combination therapy analogues (ie, agonists) of gonadotropin-releasing hormone (GnRH analogues)

Monotherapy analogues of gonadotropin-releasing hormone

- Lifelong purpose (cancellation can only be removed by a doctor, for example, in the case of recovery or intolerance).

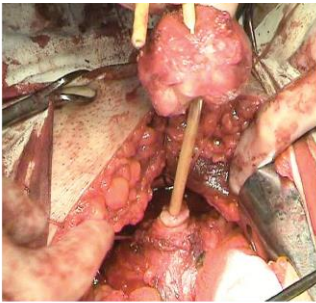


Figure. 9.21. Phase of the operation - radical prostatectomy: removal of prostate from the bladder.

- Intermittent therapy (approved schemes are not made. This scheme is determined individually).

Operative, surgical castration

Effectiveness is comparable to castration medicamentous GnRH analogues, but the operation is irreversible and detrimental effect on the mood of the patient. According to studies, the majority of patients, the presence of financial need, choose the pharmacological castration. In the treatment of cancer with early metastasis can

be used also chemotherapy. For this purpose, shall apply: docetaxel, mitoxantrone, paclitaxel, doxorubicin, vinorelbine, carboplatin, estramustine as monotherapy and as part of various schemes polychemotherapy. Currently the most effective are considered chemotherapy regimens based on the use of docetaxel.

Neglect forms of cancer are treated only symptomatically or palliative, with use of antiandrogens and radiotherapy can improve the quality and duration of patient's life.

Treatment of bone metastases

In patients with metastatic prostate cancer most often affects the bone system (mostly flat bones, most of all - the spine, ribs, pelvis and skull). For the treatment of bone metastases (blocking

osteolysis caused by osteoclasts, and recovery or stabilization of shattered bone structure) used bisphosphonates (clodronate, pamidronate, risedronate, ibandronate, zoledronate) and calcitonin.

Further observations

The main method of monitoring and diagnosing of possible relapse after treatment, and to assess the effectiveness of palliative therapy which is conducted - is the determination the PSA level. Also are performed: DRE of prostate, ultrasound, CT or MRI, osteoscintigraphy. After radical treatment the frequency of surveys is 3, 6 and 12 months after surgery, every 6 months for 3 years and then annually. In the palliative treatment patients are observed all life. After the start of hormone therapy is recommended controlled observation every 3-6 months. With good response to treatment i.e. improvement of the clinical picture, good mental attitude, and proper compliance with the regime treatment regimens, levels of serum PSA <4 ng / ml is necessary to conduct controlled observation 1 every 6 months. Patients whose disease progresses and who have not responded to treatment in accordance with these criteria, requires the individual scheme of controlled survey.

9.7. Testicular tumors

Testicular tumors – is a malignant neoplasm of testis. Testicular cancer develops in one or both testicles and affects men, usually at a young age. Testicular cancer is well treatable and curable in most cases.

epidemiology

Testicular tumors ranged from 1 to 1.5% in the general oncological morbidity in men and 5% of all tumors of the urogenital tract. In Western Europe is registered 3-6 of new cases a year on 100 000 male population. Over the past 30 years was a clear tendency to growth incidence of testicular tumors in most developed countries of North America, Europe and Oceania. At the same time there are unexplained differences in incidence rates between neighboring countries.

In Ukraine were registered 486 cases of testicular cancer in 2010.

Etiology and pathogenesis

Despite the great amount of research devoted to testicular cancer, the etiology of this form of tumor is still not established.

Risk factors include: endocrine factors (preeclampsia during pregnancy, the mother postponed prolonged use of estrogen during pregnancy, high FSH), factors that lead to atrophy of the testicles (cryptorchidism, chemical agents - pesticides, herbicides, poisonous substances, trauma, idiopathic testicular atrophy, infectious diseases - mumps, HIV), genetic risk factors (Klinefelter syndrome). The testes are composed of various types cells all of which may be generated into a cancerous tumor. In this regard, there are many kinds of tumors of the testis. It is important to distinguish each of their species because they vary in prognosis (survival) and treatment.

Germ cell tumors

90% of testicular tumors develop from germ cell cells (Hermina - seed; germ cell cells produce sperm). There are two types of germ cell tumors - seminomic (60%) and non-seminomic (40%). Seminomic germ cell tumors are developed from cells of the testes that produce sperm. At primary diagnosis in most patients with seminoma (70%) tumor does not extend beyond the testicle, in 25% of patients are affected lymph nodes, and only 5% are distant metastases. There are 2 types - typical seminoma and spermatocytic seminoma. The majority (over 95%) seminomas are typical, they occur in men over 40. Spermatocytic seminoma grow very slowly and mostly do not provide metastases. The average age at

which there are spermatocytic seminoma amounts 55-60 years. Non-seminomic tumors occur in earlier age. Main types: embryonal carcinoma, yolk sac carcinoma, teratoma and choriocarcinoma. In most cases non-seminomic tumors are represented by two or more components of the tumor.

- Embryonic cancer among non-seminomic tumor is the most common and makes 40% of all non-seminomas. Pure embryonal carcinoma is rare (3-4%). It grows rapidly and spreads beyond the testicle. More than half of patients with a primary diagnosis already have distant metastases (in the lungs and liver). For this type of tumor is characterized by pain.

- yolk sac tumor is more common in adolescents and can be easily treated. It is often attains to the large size. In adults, yolk sac tumor proceeds less favorable, however if the tumor is "clean" (i.e. no other components), the chemotherapy is very effective even if there are metastases. Yolk sac tumor secretes into blood the protein - alpha-fetoprotein (AFP).

- teratoma is more common in adolescents (40%) and less frequently - in adults (7%). Teratoma is diagnosed more often after treatment (chemotherapy) or recidivism of tumor. Teratoma may be mature, immature, and with malignant transformation:

1. Mature teratoma is represented by different tissues of mature cells. Mature teratoma does not metastasize. However, the growth of mature teratoma can occur after chemotherapy (syndrome "mature teratoma"). In this case is made the surgical removal of the tumor that grows at the end of chemotherapy.

2. Immature teratoma may spread to other organs and tissues, i.e., in contrast to mature, immature teratoma has a high potential for local growth and metastasis.

3. Teratoma with malignant transformation - is very rare kind of teratoma.

- Choriocarcinoma - is the most aggressive type of the testicle tumors, that more common in adults. Quickly metastasizes to the lungs, brain and bone. In its pure form is not found,

but is present in combination with other types of tumors of the testis. Choriocarcinoma produces human chorionic gonadotropin (hCG).

Classification

Morphological classification (Figure 9.22).

Below is recommended the morphological classification of WHO 2004 p.:

1. Germ cell tumors:

- Intra-tubular germ cell neoplasia

- Seminoma (including tumor cells of syncytiotrophoblast)

- Spermatocytic seminoma (includes sarcomatous component)

- Combined tumor with the presence of more than one of histological type (should indicate the proportion of each component)



Figure. 9.22. Macroscopic view of testicular tumors.

2. Stromal tumors of sexual strand / gonadal stromal tumors

- tumors of Leydig cells
- Malignant tumors of Leydig cells
- Tumors of Sertoli cells
- Malignant tumors of Sertoli cells
- Granular cell tumor

- Adult type
- Juvenile type
- Tumors group of Tekom - fibromas
- Other stromal tumors of sexual strand / gonadal stromal tumors
- Not fully differentiated
- Mixed
- Tumors that contain germ cell cells and stromal cells of sexual strand (Gonadoblastomas)

3. Various nonspecific stromal tumors

- Epithelial tumors of testis
- Collecting duct tumors and testicular networks
- Tumors (benign and malignant) of non-specific stroma

TNM Classification

- T - primary tumor
- Tx - insufficient data to assess the primary tumor
- T0 - primary tumor is not detected (eg, a scar in testis according to histological examination)
- Tis – intra-tubular germ cell neoplasia (carcinoma in situ)
- T1 - tumor within the testis and epididymis without its invasion into blood / lymph vessels, tumor may grow into albuginea testis, but not in the vaginal membrane
- T2 - tumor within the testis and epididymis of its invasion into blood / lymph vessels or tumor that grows in the vaginal membrane
- T3 - tumor spreads to spermatic cord with or without blood / lymphatic invasion
- T4 - tumor spreads to the scrotum with or without invasion into the blood / lymphatic vessels

- N - regional lymph nodes (clinical score)
- Nx - insufficient data to assess the status of regional lymph nodes
- N0 - No signs of metastatic defeat in regional lymph nodes
- N1 - there is metastasis in one or more lymph nodes up to 2 cm in greatest size
- N2 - there is metastasis in one or more lymph nodes, the maximum size of 2 to 5 cm
- N - there is metastasis in the lymph nodes larger than 5 cm in greatest dimension
- M - distant metastases
- Mx - insufficient data to assess the presence of distant metastases
- M0 - no signs of distant metastases
- M1 - there is distant metastases
- M1a - metastatic defeat non-regional lymph nodes or lungs
- M1b - distant metastases in other organs

The clinical picture

Usually, disease is manifested with pain and appearance or accidentally discovered tumor in the scrotum. Sometimes scrotal trauma may help to identify testicular tumors. Gynecomastia occurs in 7% of cases and is more typical for non-seminomic tumors. Back pain or at the waist is registered in 11% of cases. The development of testicular tumors may be preceded by reducing it in size. Approximately 10% of testicular tumors can imitate orchiepididymitis which leads to deferment establishing the correct diagnosis. Therefore, any suspected cases should be carried by ultrasound. Clinical examination of the scrotum can identify characteristics of tumors. However, this research should always be accompanied by the general observation, as not to miss possible distant metastases that are palpated in the abdomen, and gynecomastia. Also, the clinical picture may be caused by the presence of metastases and determined of their localization: back pain by increasing of retroperitoneal lymph nodes, swelling of the lower extremities (compression of the inferior vena cava and block of lymphatic ways), renal failure (in violation of the urinary passage); intestinal obstruction (at increasing of retroperitoneal lymph nodes), shortness of breath, coughing (with mediastinal lymph nodes) dishormonal manifestations of no-germ cell testicular tumors (gynecomastia, decreased libido, feminization, impotence, masculinization).

Diagnosis

Visualization of testis (Radiologic diagnosis)

The sensitivity of ultrasound in the detection of testicular tumors reaches almost 100% and allows determining the localization neoplasia. MRI has a higher sensitivity and specificity compared to ultrasound and allows differentiating seminoma from non-seminoma tumors. **Methods of metastatic diagnosis:** chest radiography, ultrasound, CT of the abdomen, retroperitoneum and chest, osteoscintigraphy

Laboratory methods of research

Serum tumor markers are important prognostic factors. They are used in diagnostics and staging of disease at. You must specify the following markers: AFP (is produced by yolk sac cells), human chorionic gonadotropin (is expressed by trophoblast), lactate dehydrogenase (level may be elevated in patients with distant metastatic testicular cancer).

Differential diagnosis

Differential diagnosis should be made with the following diseases: hydrocele, varicocele, spermatocele, torsion of the spermatic cord, testicle trauma, orchitis, epididymitis, idiopathic scrotal edema, hernia.

Treatment

Surgical treatment

All patients with suspicion on testicular tumor should be performed the surgical revision of testicle with the withdrawal the latter together with membranes in surgical wound. At detection of tumor should be initiated immediately orchifuniculoectomy. Thus the spermatic cord should be crossed and tied directly to the internal inguinal ring. If the diagnosis is unclear, testicular biopsy is performed, followed by histological examination.

Retroperitoneal lymphadenectomy

In case of failure to conduct chemotherapy of nerve-preserving retroperitoneal lymphodissection is performed in the presence of non-seminoma tumors.

Chemotherapy

Usually chemotherapy is used in the presence of metastases. Most commonly is used to treat testicular cancer, the following chemotherapy: cisplatin, vinblastine, bleomycin, cyclophosphamide, etoposide, ifosfamide.

Radiotherapy

With a large (82% or more) volume lesions, patients have to spend adjuvant radiotherapy (20 Gy).

9.8. Cancer of the penis

Cancer of the penis – is rare malignant tumor that usually occurs in the epithelium of the prepuce and the glans penis and has similar properties to cancer of the oropharynx, female genital organs and the anus.

Epidemiology

The prevalence of penile cancer depends on the geographical region, race and ethnicity. Today this disease is uncommon tumor that makes 1-2% of all tumors of the genitourinary system. In Europe and the U.S. incidence of less than 1.0 per 100 000 population, but India and Brazil, this figure reaches 3.0 and 8.3 per 100 000 men. Typically, the average age of patients is 55-58 years but tumor may occur in young age. There are isolated reports of penile cancer in children.

Precancerous diseases are Erythroplasia of Queyrat and Bowen's disease. Erythroplasia of Queyrat is called cancer in situ at localization of the primary focus in the area of glans, corpus or preputial sac of penis. Bowen's disease - is the skin lesions of other reproductive organs and perineal area. There has been an increase in the frequency occurrence of tumors of the penis in men who were not exposed to circumcision, due to chronic irritation of smegma and products of bacterial decomposition of

desquamated epithelial cells. A similar effect is enhanced in the presence of phimosis. In this regard, the incidence of penile cancer

varies markedly depending on the hygiene standards as well as cultural and religious practices in different countries.

Etiology and pathogenesis

The most significant risk factors for penile cancer are: phimosis, chronic inflammatory diseases (balanoposthitis, balanitis xerotica obliterans), smoking, a large number of sexual

partners and peaked condylomas. Pathogenetic mechanisms of cancer are the chronic skin irritation due to phimosis or inflammatory diseases and dysregulation of the cell cycle during infection by papilloma viruses.

Classification

Clinical classification TNM (Fig. 9.23)

T - Primary tumor

- Tx - insufficient data to assess the primary tumor
- T0 - Primary tumor is not determined
- Tis - Carcinoma in situ
- Ta - Noninvasive verrucous (warty) carcinoma
- T1 - The tumor grows into the subepithelial connective tissue
- T2 - The tumor grows in spongy or cavernous body
- T3 - The tumor grows into the urethra
- T4 - Tumor spreads to other surrounding structures

N - Regional lymph nodes

- Nx - Not enough data to assess the status of regional lymph nodes
- N0 - No signs of metastatic lesions in regional lymph nodes
- N1 - one metastatic lesion of inguinal lymph node
- N2 - Multiple or bilateral metastases in superficial lymph nodes
- N3 - Metastasis in deep inguinal or pelvic lymph nodes

M - Distant metastasis

- Mx - Not enough data to assess the presence of distant metastases
- M0 - No signs of distant metastases
- M1 - there are distant metastases

Pathomorphology

Most common histological form of penile cancer - is squamous cell carcinoma (95% of all cases) the significantly less common are melanoma and basal carcinoma. There are a number of diseases which are regarded as precancerous and can lead to the formation of squamous cell cancer: cutaneous horn, bowenoid papulosis and balanitis xerotica obliterans, intraepithelial neoplasia.

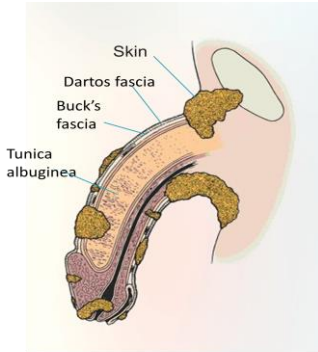


Figure. 9.23. Localization scheme of penile cancer

Clinical picture

At the beginning of the disease on the skin is appeared small size tight area which gradually increases, it becomes fixed and accompanied by the formation of ulcers. Focus

can be in the form as exophytic as well as flat neoplasms. At infection of tumor excretion gains the fetid character. The most common tumor is the penile glans, much less - the foreskin and very rare - the corpus of the penis. Local destructive process in the early stages is usually not

accompanied by pain. The general condition of the patient remains satisfactory for a long time, but with tumor growth and metastasis occurrence appear weakness, weight loss, fatigue.

Diagnosis

The main complaint that present patients with cancer of the penis - the presence of tumor, pain in the region of tumor, pain in the inguinal area, pain during urination and the presence of the inguinal lymph nodes. The feature of penile tumors is late treatment of patients with, caused usually by fear, shyness and low medical culture.

Physical and additional examination methods

At the initial examination of the affected area is necessary to estimate its size, location on the penis, the number of lesions, and color limits of tumors, the relationship of tumor protein shell and urethra, spongy and cavernous bodies, penile size and macroscopic characteristics of the tumor (papillary, nodular, ulcer, etc.). To assess the depth of tumor invasion, in addition to palpation and visual inspection method is considered sufficiently informative MRI.

As the regional lymph nodes for inguinal penile is necessary to carry out their thorough palpation. It should be noted that the presence of enlarged lymph nodes at initial examination does not mean the presence of regional metastases - about half due to reactive hyperplasia due to concomitant inflammatory reaction to establish metastatic nature of enlarged lymph nodes can help needle aspiration biopsy. To further detection of distant metastases is used CT of the abdomen and pelvic and chest radiography.

Thus, the diagnosis of penile cancer is based primarily on visual inspection. If you have any doubt about the nature of malignant tumors is recommended to perform its biopsy or

cytology. The depth of tumor invasion, in addition to inspection and palpation is evaluated by MRI. For staging of the disease is important palpation assessment of the inguinal lymph nodes in dynamics. If they defeat is recommended further evaluation using ray diagnostic methods.

Differential diagnosis

Differential diagnosis of penile cancer should be made with primarily described above precancerous diseases - balanitis xerotica obliterans, genital warts and bowenoid papulosis, as well as a range of cutaneous, infectious and sexually transmitted diseases - syphilitic chancre, chancroid, venereal lymphogranuloma, herpes, tuberculosis and others. These diseases can be recognized by using the cytological, histological, cultural, and serological methods with the assistance of contiguous professionals.

Treatment

The therapeutic penile cancer depends on the stage of the disease and the general condition of the patient. Usually treatment of the primary tumor and regional metastases is performed separately. In superficial tumors (T0, Tis, Ta, T1a) are used, usually organ-preservation technique: surgical excision of the tumor with or without circumcision, excision and laser photodynamic therapy in combination with local chemotherapy applique. At deeper invasion of glans (T1b) before the wide excision of the tumor with laser a course of systemic chemotherapy in more advanced cases, amputation of glans is performed with subsequent reconstruction, also radiation therapy. Any surgical method involves the selection of the tumor within healthy tissue binding of postoperative pathomorphological research, which aims in particular, to confirm the absence of tumor resection along the edge of.

At invasion of cancer in spongy or cavernous body (T2) is shown amputation or partial amputation glans of the penis (depending on the localization of lesions). The alternative in

this case is radiation therapy. The standard method of surgical treatment for tumor spread to the urethra (T3) is amputation of the penis with perineal urethrotomy, the propagation

of the tumor to the surrounding structures (T4) amputation member prior systemic chemotherapy.

Upon confirmation of the presence of metastatic lesions in regional lymph nodes is performed lymphodissection. In the presence of distant metastases or inability to surgical removal is conducted regional palliative chemotherapy.

Further observations, clinical examination

The purpose of the dynamic monitoring of patients after the treatment is the identification of local and regional recurrence, as they are curable. Period of supervision shall be 5 years, as most recurrences can occur precisely during this period.

The main methods of observation are the visual examination and ultrasound.

Control tasks

1. A patient 62 years old complains on loss of 10 pounds of body weight in 2 months constantly-progressive lumbar pain, weakness, loss of appetite, subfebrile temperature. On examination in the left upper quadrant detected tight formation. In a blood test: Hb - 90 g / l, Er - $2,8 \times 10^{12}$ / L, L - $8,8 \times 10^9$ / L, ESR - 42 mm / h. In urine specific gravity - 1018, protein 0.06 g / l, Er - by the whole field of view, L - 10 in p / s. Your preliminary diagnosis? Algorithm test?

Answer. Tumor of the kidney.

2. To conduct differential diagnosis of renal cell carcinoma with carbuncles and abscesses of the kidney.
3. The child 8 months is observed by parents on loss of appetite, pale skin, increase in abdominal volume that has been determined due to its right half. On palpation of the right half of the abdomen is determined densely-elastic consistency of tumor formation $10,0 \times 7,0$ cm The positive symptom of moving. The most likely diagnosis?

Answer. Nefroblastoma (Wilms' tumor).

4. What is the most accurate method for diagnosis of ureteral tumors?
5. Treatment in patients with cancer of the upper urinary tract of the metastatic process.
6. Patient S., 65 years old, was admitted with complaints of gross hematuria massive presence of shapeless discharge of blood clots, frequent painful urination. Also notes the modest weight loss over 3-4 months. Gross hematuria is not accompanied by pain and dysuria, first appeared 3 months ago for no apparent reason, and in a few days the bleeding had stopped independently. About what disease should think about? Make a plan for diagnosis.

Answer. Tumor of the bladder.

7. Treatment in patients with invasive bladder cancer.
8. Describe the clinical examination of patients with BPH and prostate cancer.
9. The methods of conservative treatment of patients with BPH. Absolute indications for surgical treatment.
10. What is the analysis for prostate specific antigen? How is it used?
11. Describe the clinical examination of patients with testicular cancer.

Chapter 10

Acute and chronic renal failure

10.1. Acute renal failure

Acute renal failure (ARF) is polyetiologic disease, clinical and pathological syndrome in which all kidney function are impaired entirely or almost entirely. It is based on glomerular and renal tubular apparatus lesion due to many reasons. They are divided into 4 groups: prerenal (relating to renal blood supply lesion, which often occurs in various types of shock), renal (in severe renal diseases, poisoning by nephrotoxic substances, prerenal forms not corrected timely manifested by acute tubular or cortical necrosis), postrenal or obstructive (mechanical obstacles in the urine flow from both kidneys at the same time or from only one functioning kidney) and arenal or renopryval – in case of congenital lack of kidneys or their removing for vital indications as a result of traumatic injury.

Epidemiology

ARF frequency is 8–9,5 case per 100K of people (1,3–2,5 % patients at the hospitals).

Ethiology and pathogenesis

Prerenal ARF may include the cases of renal artery embolism by atheromatous

masses in atherosclerosis, especially in the elderly people or upon surgical manipulations on the main vessels. Postrenal ARF occurs when the urine flow is blocked from both kidneys or only kidney (in case of lack or functional incapacity of opposite one) with urolithiasis, retroperitoneal fibrosis (Ormond's disease), tumors of urinary system, pelvis (retroperitoneal tumors of ureters, urinary bladder, prostate), as a result of surgery or accidental ligation of ureters, irradiation of pelvic organs, urethral stricture). Rare case of postrenal obstruction of both ureters by *Candida tropicalis* balls is described.

ARF of postrenal type may evolve in case of accidental ligation of both ureters during abdominal hysterectomy, ureteral reflex spasm in the postoperative period.

Many substances having expressed nephrotoxic action are described: inorganic mercury and other heavy metals compounds, cadmium, uranium, nitrites, benzene and its derivatives, chlorinated hydrocarbons, vinegar essence, ethylene glycol, dichloroethane, linoleic acid, uranium acetate, the organic phosphates. 0.8 to 8% of all ARF cases of

medicamental ARF due to hypersensitivity to certain drugs. About 60% of them are caused by antibiotics administration (mainly beta-lactam ones) and non-steroidal anti-inflammatory drugs. Main chain in ARF pathogenesis is decrease in renal blood flow followed by subsequent decrease in glomerular filtration rate. The role of renin-angiotensin system activation, prostaglandins, local intrarenal homeostasis, lipid peroxidation in the pathogenesis of ARF has been proved.

Classification

The most accurate and overall ARF classification by E.A. Tareev:

1. By lesion place:
 - prerenal;
 - renal;
 - postrenal.
2. By etiopathogenesis:
 - shock kidney (shocks of various etiologies, prerenal ARF with possible transition to renal form);
 - toxic kidney (poisoning with exogenous poisons, renal ARF);
 - acute infectious kidney (renal ARF);
 - vascular obstruction (prerenal ARF with possible transition to renal form);
 - urologic obstruction (postrenal ARF);
 - arenal condition (congenital lack of kidney, removing of both kidneys or one functioning).
3. By course:
 - initial ARF period (during the initial action of etiological ARF factor);
 - oligoanuria period (diuresis 50-500 ml per day is oliguria, less than 50 ml anuria);

recovery diuresis period:

phase of initial diuresis (diuresis up to 1800 ml per day);

polyuria phase (diuresis exceeding 1800 ml per day);

recovery period (upon normalization of diuresis and disappearance of hyperazotemia).

Variants of ARF course may be:

- cyclic (acute tubular necrosis, acute tubulointerstitial nephritis, internal tubular blockade, prerenal ARF);
- recurrent (chronic obstructive renal diseases, analgesic nephropathy, thromboembolic disease, Burzhe disease, lumbar hematuric syndrome, hemolytic anemia);
- reversible and irreversible (bilateral cortical necrosis, total papillar necrosis, fast progressing nephritis, hemolytic uremic syndrome, necrotizing angiitis, malignant hypertension, acute sclerodermic kidney).

Periodization of irreversible renal failure is limited to the development of initial period, oliguria and anuria, and reversible one is characterized by the periods of diuresis restoration and recovery

By severity:

- 1 phase — light: creatinine concentration in plasma is increased in 2-3 times;
- 2 phase - moderate: creatinine is increased in 4-5 times;
- 3 phase - severe: creatinine is increased in more than 6 times.

The classification provided is essential to practical medicine, allows to assess the etiologic diagnostic criteria and to divide ARF by the periods of disease progress and degree of severity. Thus, the use of plasma creatinine concentration indicators is important as a criterion of ARF severity, which clearly shows the status of glomerular filtration, which reduction is one of major ARF pathogenetic mechanisms. The incidence of prerenal, renal and postrenal ARF is 70, 25 and 5% respectively.

Clinical findings

The symptoms of ARF initial period depends on the etiological factors and the severity of the underlying disease. The average duration of the stage is from few hours to 2-4 days. The clinical picture is dominated by the symptoms of the underlying disease. Despite the increase in

creatinine and urea in plasma, patient's general condition is satisfactory. As the azotemia grows, general weakness, vomiting, drowsiness, confusion are observed. Respiratory disorders,

dysfunction of blood circulation are observed. Subsequently, hyperhydration (edema) or dehydration (exicosis) develop. This phase is characterized by gradual decrease in diuresis and relative density of urine within normal parameters and rapid growth of azotemia with no clinical manifestations of uremia and blood electrolyte disorders.

Oligoanuria period is main in ARF course, lasts up to one week, sometimes up to 15-25 days. It often starts 2-4 days after exposure to the etiological factor. The main morphotech substrate stage oligoanuria (especially anuria) - acute tubular necrosis, which comes to basement membrane tubules. Membrane itself remains, and regeneration of the epithelial tubular cells starts. Basal membrane lesion makes it impossible to complete recovery of renal function upon ARF. Duration of oligoanuria phase coincides with the period of regeneration of renal tubular epithelium. The regeneration process has 2 phases: structural and functional recovery. However, in some cases, oligoanuria may begin within a few hours (eg. shock state) and, even a week or more later (in case of poisoning, chronic septic conditions).

The patients are often inhibited, adynamic, periodically excited. Sometimes, twitching of individual muscle groups, seizures, psychosis are observed. The main symptoms are the signs of water-electrolytic balance disorder. Dry skin, dry mucous membranes of mouth and tongue, itching, quenchless thirst, headache, nausea, vomiting, diarrhea, weakness, drowsiness, loss of consciousness are observed. Purulent parotitis, rhinitis, pharyngitis, bronchitis, pericarditis develop. Nose boils may appear. Urine is excreted in small amounts, it looks dense and has dark rusty color. Proteinuria, leukocyturia, eritrocyturia are observed. The density of the urine decreases to hyposthenuria level. Already during the first days, the levels of urea and creatinine significantly increase. Hyperhydration during anuria is accompanied by increased venous pressure, pulmonary edema, acute heart failure are possible. Sometimes the course of ARF is complicated by thrombosis and embolism (including renal arteries).

During the period of polyuria, significant water loss with the urine, with inadequate correction of water-salt exchange cause arterial hypotension, arrhythmias, collapse. Thus, pulse is poor and with bad tension. It should be emphasized that acute heart failure is one of the most frequent causes of death in the patients with ARF. The syndrome of hypodynamia, myocardial contractility disorders may be observed as well during recovery period. The changes in the gastrointestinal tract are observed in the most patients with ARF. The most characteristic ones are gastritis, enterocolitis (especially ulcers), intestinal paresis with dynamic intestinal obstruction. Some patients have gastrointestinal bleeding as a result of gastrointestinal ulcers and imbalance of blood coagulation. Maximum negative change are observed in the colon. Severe hyperazotemia and water-electrolyte balance disorders are the factors which may cause gastrointestinal disorders and dynamic intestinal obstruction. The stomach is affected more often than duodenum. In all patients with ARF, dysbiosis develops which is difficult to correct in 40-50 % of patients even upon recovery. Nervous system lesions are caused by hyperazotemia, disorders of water- electrolyte balance, cellular dehydration. General weakness, headache, sleep disturbance, astenia, sluggishness, loss of consciousness, seizures, intoxication psychosis, periodic excitations are observed more often. Attention and memory are drastically reduced. The patients are inactive, periodically groundless irritation, psychomotor agitation with hallucinations appear. Encephalopathic meningoencephalopathic, encephalopolineuropathic syndromes are observed. In severe cases, there are brain edema, epileptiform seizures, cerebral blood circulation disorders. Finger tremor of limbs, convulsive twitching of individual muscle groups, nystagmus, anisocoria, tonic extremities contracture, sight paresis, anisoreflexia, diffuse muscle hypotonia, pyramidal signs, paresis of the extremities - focal neurological symptoms which are often observed in ARF. Nitrogen metabolism

disorder due to significant reduction or cessation of nitrogenous substances excretion with urine are demonstrated by hypercreatininemia, increase of urea residual nitrogen, uric acid concentration in plasma. Protein catabolism and decrease in potassium excretion with urine lead to hyperkalemia. This is caused by hyponatremia, hypocalcemia and acidosis.

Hyperkalemia is characterized by increased excitability of muscles (as well as heart muscle), hyperreflexion, extrasystole, blinking arrhythmia, heart failure sometimes occurs. Toxic affect of hyperkalemia is particularly evident under the conditions of metabolic acidosis and hypocalcemia developing more often on the 3-5th or 9-11th day of disease.

The 3rd period is restoration of diuresis, or diuretic. On the 3-5th day (sometimes 2-3 weeks later) of oliguria or anuria, diuresis begins to grow rapidly. The speed is individual: 500 ml to several liters already during the first day of polyuria. This is due to the regeneration of renal epithelium which takes on average 5-10 days and starts on the 3-6th day on preserved parenchyma islets. On the 3-4th day, average diuresis is 3-5 liters per day and is maintained at this level for several days to several weeks. It is important that urine volume depends a little way on the amount of fluid introduced into the body. The clinical picture is similar to oligoanuria phase: astenia, headache, nausea, vomiting, loss of consciousness, 60-80 % have secondary infection, and abrupt loss of body weight is specific. Recovery period, depending on the degree of pathological changes, lasts up to 6 months, and sometimes 1-2 years. Although the general state of the patient is satisfactory, renal function is reduced. Therefore, the patients should be under medical supervision for a long period.

The course of ARF and recovery depends on the cause of the disease, the degree of renal parenchyma lesion and also on the timeliness and adequacy of treatment. The immediate reason for death at anuria stage may be irreversible renal lesion, hyperkaliemia, pulmonary or brain edema, and at the stage of diuresis recovery - water-salt metabolism and cardiocirculatory system disorders.

The ARF prognosis depends on ARF severity, the degree of secondary lesions of internal organs, presence of infectious complications,

Laboratory diagnostics

1. Complete blood count
2. Complete urine test
3. Creatinine and urea concentration in plasma
4. Diuresis findings and glomerular filtration rate (Reberg – Tareev test)
5. Ionogram (potassium and sodium concentration in ARF patients is the most important among ionogram parameters)

course of the underlying disease, which was the cause of renal failure. In case of severe ARF forms, renal function is completely restored in 30% of patients within 1-2 years upon treatment. In 70% of patients, chronic renal failure develops.

Diagnostics

ARF diagnostics is based on anamnesis data, patients' complaints, clinical symptoms, laboratory examinations and diuresis observation. Carefully collected anamnesis allows to identify the factors that contribute to ARF occurrence.

Radiological examination:

6. plain urography;
7. excretory urography;
8. computed tomography.

Ultrasonography (plays an important role in the diagnostics of postrenal ARF nature, in determination of the number of kidneys, presence of renal block, including one functioning kidney). An important method of ARF diagnostics is renal **x-ray**.

The degree of hyperazotemia is usually determined by ARF severity. The exception is extrarenal hyperazotemia in the cases of blood resorption from large hematoma or gastro-intestinal bleeding, hypercatabolism. ARF is often accompanied with the development of metabolic acidosis manifested by decrease in bicarbonate level up to 13-15 mmol/l. Acidosis is a consequence of impairment of sulfates and phosphates excretion by kidneys.

Treatment

ARF treatment depends on its etiology, period and clinical manifestations of the disease. All treatment measures applied can be divided into 3 groups: conservative treatment, surgical treatment and methods of extrarenal body clearance. ARF Conservative treatment

In clinical practice, the use of etiological treatment is generally accepted. One should start with elimination of the reasons causing ARF. At the initial ARF stage, intensive therapy aimed on shock and arterial hypotension suppression by administration of corticosteroids (prednisolone 180-210 mg i.v. bolus dosing, followed by 60-90 mg i.v. 4-6 times per day for 3 days ; hydrocortisone 500-700 mg i.v., dexamethasone 20-40 mg i.v.) is expedient, vastonics (Mezaton, Noradrenaline), blood and blood substitutes transfusion (plasma, protein solutions, Rheosorbilact, Sorbilactum 1.5 - 2 l) and anticoagulants to improve renal microcirculation and prophylaxis of disseminated intravascular coagulation syndrome.

One of the highlights is prescription of diuretics in case of oliguria and anuria and their prevention in the initial period. Stimulation of diuresis should be initiated only upon normalization of hemodynamic parameters. Diuretics prescription on the background of hypovolemia and shock is inefficient and may lead to its intensification.

In case of danger of pulmonary edema, infusion volume is reduced to 250 ml or less per day, strophanthin, corglycon are administered, antihistamines, ganglionic blockers (contraindicated in case of hypotension) antipsychotics are prescribed, insufflation by oxygen and saturated vapors of ethanol are conducted. If there is no effect of the above mentioned therapy, the patients are transferred to artificial respiration, Furosemide i.v. (sometimes up to 1000 mg per day) are prescribed because low doses are inefficient. Oral administration sorbitol or xylitol (up to 150 grams per dose) causes diarrhea and loss of up to 5.6 liters of liquid and hyperhydration reduction.

At the initial ARF stage (when diuresis is preserved) and in case of oliguria, mannitol administration (20 % solution with dose of 1-1.5 ml/kg body weight of the patient) is more expedient. Together with mannitol or instead of it, intravenous furosemide (sometimes dose reaches 1000 mg per day) is prescribed. It is recommended to combine furosemide with dopamine 3-5 mcg/kg/min. When using this combination for 6-24 hours, cardiac function improves, spasm of renal glomeruli reduces, glomerular filtration rate and diuresis are increased.

Prescription of high doses of furosemide is dangerous because of its ototoxicity and nephrotoxicity, and the use of mannitol because of acute heart failure, hyperkalemia and hyperosmolarity.

Carbohydrate and fat diet (300-500 g honey or jam + 100g butter + 200g sour cream + 15g flour as mash) is important. Mandatory conditions of diet: minimal amount of protein, maximum reduction in potassium, high calorie content. The maximum allowable protein is 15-30 grams per day. If a patient can not eat on his own, 40% glucose, mixture of amino acids, intralipid (250 ml

of 10 % solution are administered.

A diet providing administration of 18-20 g protein, 70-90 g fat, 350-400 g carbohydrates is recommended for children with ARF. The total energy value is 2000-2500 kcal. The diet includes rice, potatoes, milk, cream, eggs, butter. The amount of salt should not exceed 2 g/day.

For the prevention of secondary infection (stomatitis, mumps, gingivitis) constant care of oral cavity (soda rinsing, treatment of mucous, drinking lemon juice) is required; hygienic treatment of skin 4-5 times per day to prevent pressure ulcers and phlegmons; permanent care of wounds, removal of necrotic tissue, drainage of purulent lesions to prevent the spread of infection in hematogenous way.

To fight against acidosis and recover acid- base balance, 100 - 200 ml of 5% sodium bicarbonate (baking soda), 100-200 ml of sodium citrate, 100-200 ml sodium lactate, 200-300 ml trisamine are administered i.v.. According to the formula – patient's weight divided into 2, we determine required single dose of 5% solution of sodium bicarbonate per ml. It is recommended to the patients to take mineral water: Borzhomi, Essentuki, Polyana Kvasova, Polyana Kupil.

Lespedeza capitata plant tincture (1 teaspoonful 2-6 times per day), various enterosorbents (30-60 grams per day 2 hours before meal, for 7-25 days) are used as anti-azotemic drugs. To reduce protein catabolism and stimulate the regeneration of tubular epithelium, anabolic hormones (testosterone propionate 100 mg/day or methandrostenolone 5 mg t.i.d.) and vitamins (A, B, C, E, nicotinic acid in normal doses, preferably in parenteral way) should be prescribed. Anabolic administration improves appetite, increases body weight and muscles, and it is especially important in exhausted patients, reduces bone pain, reduces azotemia.

If ARF conservative treatment does not provide the desired results and Anuria persists, the methods of extrarenal blood clearance shall be applied.

ARF surgical treatment

Mostly, the cases of postrenal ARF require surgery. Renal drainage with ureteral catheter or stent allows adequate preparation of a patient to surgery. For the prevention of secondary pyelonephritis it is desirable to leave the catheter in the ureter for more than 1 day.

Impossibility of ureteral catheterization, lack of precise data of concrement location (in combination with the emergence of secondary purulent pyelonephritis signs) are the indications for urgent nephrostomy. In case of bilateral lesion of kidneys, bilateral nephrostomy is indicated.

Urine passage restoration from kidneys removes ARF signs not in all patients. According to the literature data, if urine flow from the kidney is blocked for 3 days, postrenal ARF in most cases passes into renal form due to the emergence of significant changes in renal parenchyma.

Maximum attention should be paid to the patients with single functioning kidney. Preparation and surgery in case of postrenal ARF in these patients should be performed within the shortest time, because mortality in ARF patients with single kidney is three times higher than in those with two functioning kidneys.

Methods of extrarenal blood clearance

Ultrafiltration method is based on filtration of proteinfree blood fraction through semipermeable membrane under hydrostatic pressure in the blood or with the use of negative pressure on the outside of dialyzing membrane. The purpose of ultrafiltration is to reduce hyperhydration by removing excessive amount of fluid from bloodstream, reducing hyperazotemia.

Hemofiltration is based on filtration of liquid blood fraction and substances dissolved in it through a membrane with high hydraulic permeability with partial or complete ultrafiltrate substitution with Ringer - Locke solution or others, selected depending on the state of water-salt and acid-base balance.

Hemofiltration is the most efficient in case of non-catabolic oligoanuric ARF. The most common method of extrarenal blood clearance is ***extracorporeal hemodialysis*** by means of the apparatus "artificial kidney". Hemodialysis is based on the diffusion of urea, creatinine, uric acid,

electrolytes and other substances detained in the body during uremia, due to the concentration gradient through low-permeable membrane, with the help of dialyzed solution. Hemodialysis, unlike hemofiltration does not require the use of substituting solution.

Sometimes hemodialysis is combined with hemosorption.

In case of ARF with severe decompensated metabolic acidosis and unstable hemodynamics, biofiltration (option of hemodiafiltration) should be performed with the use of acetate dialyzing solution and high permeable membranes. The volume of ultrafiltrate is substituted by administration of bicarbonate solution (up to 3l per session).

In case of *peritoneal dialysis*, the role of semipermeable membrane is played by peritoneum. Nitrogen compounds, average weight molecules, uremic toxins diffuse from the blood through the peritoneum after concentration gradient. Excess water is removed through osmosis.

Depending on the increase in the glucose concentration in dialyzing solution (maximally to 4.25%) the amount of water that passes from the blood into the dialysate increases. Negative feature of the peritoneal dialysis method is the danger of infection of the peritoneum and the development of peritonitis. At intensive dehydration by dialyzing solution with high concentration of glucose, hypotension, dizziness, dimming, heart rhythm disorders occur.

Plasmapheresis is extracorporeal detoxification method used for treatment of certain ARF types. The principle of the method is based on removing of the patient's blood, with subsequent separation of plasma by centrifugation or separation of blood on membrane separators and patient's plasma substitution by donor plasma, albumin and other plasma substituting solutions. Complications of plasmapheresis are: phlebitis, sepsis, risk of infectioning by hepatitis and AIDS, reducing of blood coagulation with hemorrhages, thrombotic complications (thrombosis of peripheral veins, pulmonary embolism).

The choice of dialysis therapy method depends on the patient, hemodynamic status, severity of hyperhydration, degree of hypercatabolism, severity of metabolic acidosis and water- salt metabolism disorders.

Therapeutic tactics in ARF depends on the type of ARF, degree of its severity, stage and course, level of protein catabolism. ARF course is often complicated by the development of poliorgan failure, despite the active medication and the use of extrarenal blood clearance methods.

Prognosis and follow-up monitoring

The **prognosis** of acute renal failure depends on the underlying disease, degree of internal organs damage, presence of infectious complications and course of basic disease that led to the development of renal failure. **Follow-up monitoring**

With a full recovery after ARF, a patient should have follow-up nephrologist's monitoring for two years. In the cases of previous postrenal ARF, further treatment strategy and prevention of recurrent ARF should be discussed with urologist.

10.2. Chronic kidney disease

Chronic kidney disease (CKD) is a complication of progressing chronic renal disease of both or one functioning kidney. It develops as a result of gradual dying off of large number of nephrons and is accompanied by progressive reduction and loss of all or almost all renal functions. The number of patients with CKD in Europe, USA and Japan fluctuates in the range of 157 to 443 people per 1 million population. In the CIS countries: 212 patients per 1 million. And by the causes of mortality it ranks 11th. The frequency of CKD is increased with age, starting from 12 cases per 1 million of population group for child age (0-19 years) and 680 cases per 1 million of population for the patients aged 65-74 years. In 2002, within

the frameworks of cooperation of National Kidney Foundation (NKF, USA) the experts (nephrologists, children nephrologists, epidemiologists, specialists in clinical laboratory diagnostics, nutrition, gerontology, social care and family medicine) defined the concept of **chronic kidney disease (CKD)** CKD is characterized by long (for at least three months) and constantly progressing structural and/or functional renal changes according to the clinical, laboratory, instrumental and morphological examination data provided that there is no acute pathological process in kidney. The main criterion for CRF diagnosis is long (more than

3 months) decrease in glomerular filtration rate less than 60 ml/min/1.73 m² with no signs of renal lesion. In its turn, CKD is a symptom complex occurring at the final stages of CKD progress due to the irreversible reduction of critical mass of functioning nephrons. CKD is characterized by lesion of leading renal functions, has lasting (at least 3 months), multiple (disorder of at least 2 functions) and significant (significantly alters the qualitative state of main renal compensatory mechanisms and the system "kidneys - body ") nature.

Etiology and pathogenesis

The diseases which often lead to CRF include:

- inflammatory diseases of urinary system ;
- metabolic and endocrine diseases;
- cardiovascular diseases;
- hereditary and congenital diseases;
- obstructive nephropathy;
- medicinal and toxic nephropathies

The most important disorders of homeostasis include:

- | | |
|--------------------------------|------------------------|
| 1. Hyperhydration. | 6. Hyperphosphatemia. |
| 2. Azotemia. | 7. Hypermagnesemia. |
| 3. Sodium retention. | 8. Metabolic acidosis. |
| 4. Na- dependent hypertension. | 9. Hyperuricemia. |
| 5. Hyperkalemia. | |

Despite a number of etiological factors, morphological changes in kidneys with CRF are similar. It should be noted that only the death of more than 70% nephrons may be accompanied by clinical signs and biochemical abnormalities. They take place as a result of increasing pressure on the intact nephrons.

Factors and mechanisms of CRF progress:

Main renal disease	inflammation, hyperglycemia, growth abnormalities or other kidney lesion
Hemodynamic	<ul style="list-style-type: none"> • arteria; hypertension; • inner glomerular hypertension / hyperfiltration; • increased protein load; • anemia.
Metabolic	<ul style="list-style-type: none"> • proteinuria; • hyperlipidemia; • hyperglycemia; • hyperuricemia; • metabolic acidosis; • hyperlipoperoxydation; • dysembryogenesis.
Intercurrent	<ul style="list-style-type: none"> • infection; • obstruction of the ureter; • pregnancy; • allergic reactions; • iatrogenic factors; • hyponatremia, hypokalemia; • hypovolemia, dehydration, blood loss

With a slight lesion of renal tissue at the initial CRF stage, one or more renal functions are impaired. These lesions are compensated by increasing filtration and reabsorption processes in intact areas of the parenchyma. Consequently, compensated renal failure develops which has no clinical manifestations. CRF in children often remains for long unrecognized owing to latent course of chronic infections and congenital malformations. In young children with terminal stage of chronic renal failure, there is considerable growth retardation.

Classification

CRF classification according to MPH and AMS of Ukraine order № 65/462 dd. 30.09.2003:

Stages	Glomerular filtration rate	Plasma creatinine level
I stage	<90 ml/min. ≥ 60 ml/min.	> 123 ≤ 176 μmol/l
II stage	<60 ml/min. ≥ 30 ml/min.	> 176 ≤ 352 μmol/l
III stage	<30 ml/min. ≥ 15 ml/min.	> 352 ≤ 528 μmol/l
IV stage, terminal	<15 ml/min	> 528 μmol/l

Clinical findings

CRF clinical findings depend on the underlying disease and its course, and from intercurrent pathology, general condition of the patient and the adequacy of treatment. Clinical manifestations are single-type, without much dependence on the CRF causes.

CRF I stage may have no clinical manifestations. General condition of the patient is satisfactory, subjective signs and objective examination data are specific to the underlying disease. In parallel with the symptoms of underlying disease, unpronounced adynamia, fatigue, certain tendency to nocturia and isosthenuria are recorded. In the study of daily diuresis, no deviations are found. Creatinine concentration is increased to 176 μmol/l. Glomerular filtration is reduced to 60 ml/min. Increased excretion of glucose, reduced secretory capacity of tubules. Disaminuria, periodical proteinuria are observed.

CRF II stage. Clinical manifestations are similar, but they occur more frequently and are marked by the patient. Both the manifestations of the underlying disease and failure of renal function are observed: general weakness, hypodynamia, anorexia, polydipsia, polyuria, nocturia, hypoissthenuria. During this period, the patients lose weight, note dry mouth, thirst, their skin becomes pale yellow, dry, with low elasticity. The daily diuresis is 2-3 liters owing to reduction of tubular reabsorption. Glomerular filtration 60 to 30 ml/min. Despite this and steady increase in blood creatinine up to 350 μmol/l (176-352 μmol/l), general condition of the patient is satisfactory for a long time, the functions of other organs and systems are not generally affected (except arterial hypertension and slight anemia). Urine osmolarity is reduced. Electrolyte shifts due to periodic increase in natriuresis are possible. The disorders of water-electrolytic and acid-base balance are compensated.

CRF III stage is characterized by further decrease in glomerular filtration rate and tubular reabsorption. Renal function and homeostasis are drastically impaired. There are significant disorders in water-electrolytic and acid-base balance.

Hyperazotemia is gradually increasing staying within the limits 352-528 μmol/l for creatinine. Glomerular filtration 30 to 15 ml/min. Concentration ability of kidneys (urine has low relative density) abruptly decreases.

This period of CRF development is characterized by the alteration of improvement and impairment of the patient due to the exacerbation of underlying urological disease or other previous intercurrent disease or surgery. There are characteristic features of suburemia. The patients complain of headache, general fatigue, weakness, poor appetite, nausea, vomiting, dry mouth, thirst. dyspeptic symptoms are often observed in children. Children have physical development retardation.

The patients have dry skin, pale greenish-grayish tint, subcutaneous tissue is swelling or thin. Blood pressure often increases, there are changes in eye fundus in the form of optic nerve edema, hemorrhages to the retina. Anemia is observed. Reserve alkalinity of blood, hydrocarbon levels reduce. Hypocalcemia, hyponatremia, hypermagnesemia are observed. If proper treatment is not provided in time, the disease would rather quickly transform into terminal stage.

CRF IV stage. Clinical syndrome of chronic uremia is observed. Thus, the functions not only of kidneys, but of other organs and systems are abruptly impaired. Filtration and reabsorption ability of kidneys abruptly reduces. Oligoanuria is gradually developing, urine osmolality is reduced to the level of plasma (300-350 mosm/L) edema, hyperkalemia, hyponatremia, hypochloridemia appear, creatinine concentration increases over 528 $\mu\text{mol/l}$, decompensated acidosis. Reversible dysfunctions of circulatory system organs, lungs and other organs are moving to more pronounced stagnation phenomena in lung and liver, progress of hypertension. Progressive arterial nephrogenic hypertension is observed. Subsequently, advanced decompensated heart failure develop.

Disorders of water-electrolytic balance, acid-base balance and hyperazotemia cause extremely serious condition of patients. They lose weight, become sickly, apatic, uncommunicative. Their skin is pale, greenish yellow, exfoliates, its turgor is reduced, sometimes petechial hemorrhages may occur. Subcutaneous tissue is fine. The mucosa is pale, with hemorrhages. The tongue is dry and covered with dirty gray deposit, sometimes ulcers appear.

Severe uremic intoxication occurs with hyperazotemia over 1500 $\mu\text{mol/l}$ for creatinine, accompanied by hyperkalemia above 6.7 mmol/l , decompensated acidosis, dyselectrolytemia. Decompensated heart failure, cardiac asthma, polyserositis, anasarca, liver and other organs dystrophy are diagnosed. Uremic coma develops. CRF at this stage of the disease is practically incurable.

Uremic coma develops at the terminal stage of CRF. Coma development is slow. Initial symptoms are general weakness, heavy head, headache, nausea, frequent vomiting, general anxiety and insomnia. Gradually, the patient falls into a state of prostration. His skin is pale yellow, mucous membranes are dry, the eyes are dry, do not react to light. Often, hemorrhages appear on skin and mucous. Ammonia breath, rapid pulse, rapid breathing (in case of severe coma by Cheyne - Stokes type), high blood pressure, which can not be corrected, toxic diarrhea and sometimes convulsions are observed.

Systems and organs lesions with CRF

From the respiratory organs - stagnation at the late stages - X-ray picture "water lung", accumulation of effusion in pleural cavities (exudative uremic pleuritis). Breathing is frequent, complicating, bronchitis or pneumonia develop, which is often the cause of fatal outcome. Dyselectrolytemia and acidosis are often the reasons for the emergence of suffocation.

manifested by bloody vomiting and melena. Nitrogenous toxins discharges by the peritoneum lead to the development of uremic pseudoperitonitis picture.

Neurological symptoms - lethargy, drowsiness, intoxication psychosis in 1/3 patients. Agitation, anxiety, euphoria, possible loss of conscious appear from time to time during the development of uremic coma. On the background of areflexia and hyporeflexia, seizures may develop.

Disorders of blood coagulation system and hemorrhagic manifestations are associated with prothrombotic disorder, coagulation and vessels state in CRF. Not only reduction in platelet count is peculiar but also their dysfunction, generalized lesions of blood vessels endothelium. Disseminated intravascular coagulation syndrome may occur. Inhibition of erythropoiesis due to reduction of erythropoietin **Lesions of cardiovascular system** are caused by the progressive development of arterial hypertension of nephrogenic origin, hyperkalemia, general anemia and growing uremic intoxication. The boundaries of heart are dilated, the tones are damped, systolic murmur is observed, the signs of myocardial contractility disorder on ECG. Significant edema of subcutaneous tissue, circulatory failure,

exudation of fluid in the cavities dramatically worsen the patient's condition. In 30-40 % of patients at the terminal stage uremic pericarditis develop. On eye fundus, the arteries are narrowed sharply, are twisting, optic disc is swollen. Because of retinopathy, visual acuity is reduced. The changes in the gastrointestinal tract are of great importance. At the early stages of CRF, through the stomach and intestines wall, the products of nitrogen metabolism begin to escape, leading to nausea, vomiting, loss of appetite, constant feeling of unpleasant taste in the mouth. Stomatitis which consequence may be serious is developing. CRF complication is mumps. Anorexia, nausea, vomiting are observed. This reinforces hyponatremia and hypokalemia, thus favouring hypochloremic acidosis. Uremic gastroenterocolitis leads to the development of necrotic ulcerative processes along the gastrointestinal tract discharge and simultaneous hemolysis lead to anemia, the degree of which almost always corresponds to the degree of renal failure. In CRF, immune reactivity reduction, disposition to infectious diseases, afebrile course of infection, lymphopenia are always observed.

The degree of lesions in systems and organs and the severity of the clinical manifestations are always directly proportional to the degree of hyperazotemia and CRF severity.

Diagnostics

Based on complaints, clinical manifestations, anamnesis data, biochemical methods, clearance tests, puncture biopsy of kidneys. Determination the glomerular filtration rate and tubular reabsorption by plasma creatinine concentration and urine and diuresis are obligatory.

Clinical criteria for CRF diagnostics:

1. Main symptoms:

- symptoms of endogenous intoxication
- oliguria
- edema
- nausea
- vomiting

2. Possible symptoms:

- arterial hypertension
- macrohematuria or microhematuria
- urination disorders
- itchy skin
- hemorrhage

Laboratory criteria of CRF diagnostics:

Urine test:	Total blood count:	Biochemical blood count:
<ul style="list-style-type: none"> • proteinuria • hypoisostenuria • cylindruria • possible abacterial leucocyturia • possible hematuria 	<ul style="list-style-type: none"> • anemia • increase in erythrocyte sedimentation rate (ESR) • Possible moderate leukocytosis • possible left shift in leukogram • possible thrombocytopenia 	<ul style="list-style-type: none"> • increased levels of urea, creatinine, residual nitrogen in blood • increase in total lipids, B-lipoproteins • hyperkalemia • hypocoagulation • hypocalcemia • hyperphosphatemia • possible hypodysproteinemia • hypercholesterolemia •

Diagnostics of urological CRF causes requires special instrumental, ultrasound and X-ray examination, depending on the disease nature. In order to detect early forms of CRF, preventive examinations of children and adults should be performed with mandatory use of renal function tests.

Treatment

Conservative treatment

Diet therapy is based on the following principles:

1. Reduction of protein in food – low protein diet (LPD).
2. Control of fluid intake.
3. Reducing consumption of foods containing sodium, potassium, magnesium, chlorine, phosphates.

Low protein diet contributes to inhibition of CRF progression. Limitation in protein consumption depends on CRF stage:

I stage	Protein 0,9–1,0 g/kg/day	Phosphorus — up to 1,0 g/day
	Potassium — up to 3,5g/day	Calorie content—2200–2500
II stage	Protein 0,6–0,7g/kg/day	Phosphorus —up to 0,7 g/day
	Potassium —up to 2,7	Calorie content—2500–2700
III stage	Protein 0,5–0,6 g/kg/day	Phosphorus —up to 0,4 g/day
	Potassium —up to 1,6g /day	Calorie content—2700–3000
IV stage	Protein up to 20 g per day	Calorie content—2800–3200
	Potassium up to 0,8 per	ccal/day

Preference is given to proteins of plant origin, with low content of phosphorus. It is desirable to use herbal oils in sufficient quantities (100-110 g/day), which is the basis of calory content in food. The sources of carbohydrates are products of plant origin. Legumes, mushrooms, nuts, pumpkin seeds and sunflower seeds should be limited.

Control of water consumption. It is recommended to consume sufficient amount of water while monitoring daily diuresis. The patients with CRF with preserved diuresis are allowed to take large amounts of fluid up to 3.5 liters, which promotes the removal of uremic toxins. The limitation for sodium chloride is 10-15 g / day. Having polyuria, a patient should drink 500 ml + liquid per day corresponding to the amount of urine for the previous day.

It is important to limit phosphorus consumption. Elevated plasma level of phosphorus and development of secondary hyperparathyroidism promotes osteopathy, activates CRF progression and increase the risk of death. At the stages I and II of CRF, the amount of phosphorus in the daily diet should not exceed 1 g per day. Big phosphorus content is in milk and dairy products, beans, eggs, liver, salmon, sardines, tuna, corn, drinks (beer, cola), chocolate, nuts. AT the stages III and IV, except restricting the consumption of Phosphorus to 1 g per day, phosphate binders (phosphates binding drugs) are used, they bind phosphorus in the intestine: aluminum hydroxide 1-3 capsules orally with meals, calcium carbonate 0, 5-1,0 g t.i.d. with meals. Monitoring of phosphorus - calcium exchange is realized in terms of the total calcium and phosphorus in plasma every 2 weeks. Ionized calcium level should be checked once per 3 months and maintained within 1.4-1.5 mmol/l.

At hypocalcemia and osteodystrophy, active metabolites of vitamin D3.

Hyperazotemia correction. In order to reduce the level of azotemia, toxic uremic load by enhancing their excretion, the following means are used:

1. Hypoazotemic herbs : Artichoke fresh leaves extract 2-3 tablets × t.i.d 15 minutes before meal or 2 capsules × b.i.d. intramuscularly or intravenously daily for 14-21 days; *Lespedeza capitata* plant tincture 3-6 teaspoonful per day or intravenously 1ml/kg of body weight.
2. Enterosorption using enterosorbents 1.5-2 hours before / or after meal and drugs : activated carbon- 5g × 4 times / day; carbovit - 5g × 4 times/ day; enteros gel - 1 tbsp. l. (15,0) × 4 times / day, microcrystalline cellulose - 1-5 t.× 4 times / day.
3. Intestinal dialysis with the introduction to the colon through a tube 8-10 liters of solution containing : saccharose - 90 g/l; glucose - 8 g/l; potassium chloride - 0.2

g/l, sodium hydrocarbonate - 1 g/l, sodium chloride -1 g/l, or forcing diarrhea using 3-4

liters hyperosmolar Jung solution, comprising: mannitol or sorbitol - 32.8 g/l, potassium chloride - 0,3 g/l, sodium hydrocarbonate - 1.7 g/l, sodium chloride - 2.4 g/l, calcium chloride - 0.11 g/l or gastric lavage with 2% soda solution in 1 liter and its subsequent suction.

To **normalize metabolism**, reduce catabolism of protein and manifestations of hemorrhagic syndrome, anabolic steroids and vitamins (A, B, C, E, nicotinic acid in normal doses, preferably parenterally) are used. The use of anabolic steroids improves appetite, increases body weight and muscles, which is especially important in exhausted uremic patients, reduces bone pain, reduces azotemia. **Arterial hypertension** is treated with the purpose to reduce hyperfiltration in glomeruli. Target blood pressure in the patients with CRF and proteinuria under g/day is 130/ 80 mm of mercury, in the patients with CRF and proteinuria above 1 g/day is 125 /75 mm of mercury. When using hypotensive means to lower blood pressure, it should be done gradually, as with its rapid decrease, blood flow in kidneys is impaired, glomerular filtration is decreasing, and azotemia is increasing. The drugs with extra renal excretion should be administered.

Correction of dyslipidemia. The highest lipid-lowering effect on low-density lipoproteins in the patients with CRF, nephrotic syndrome, transplanted kidney in the patients with hemodialysis and peritoneal dialysis is with the statins (Lovastatin, Simvastatin, Pravastatin, Cerivastatin, Fluvastatin, Atorvastatin). The desired level of cholesterol of low-density lipoproteins < 2.6 mmol/l. The primary treatment for the patients with CRF is **extracorporeal hemodialysis** using artificial kidney apparatus.

10.3. Kidney transplantation

The **indication** for kidney transplantation is terminal chronic renal failure.

Contraindications:

1. The presence of *immune cross-reaction* with donor lymphocytes.
2. *Malignant neoplasms* present at the time of transplantation or within a short period upon radical cure.
3. *Active infections*.
4. *Systemic diseases* with active course and high probability of the transplanted kidney lesion within postoperative period.
5. *Extrarenal diseases* at the stage of decompensation.

6. *Patient's refusal to adhere to medical recommendations*.

7. *Personality changes* in case of chronic psychosis, drug and alcohol addiction.

8. Advanced age of the patient, presence of diabetes and subcompensated extrarenal disease are relative contraindications to transplantation.

Complications of kidney transplantation:

Surgical complications of kidney transplantation:

- bleeding;
- graft's artery thrombosis;
- rupture of graft;
- graft's artery stenosis;
- thrombosis of iliac artery of the recipient;
- venous thrombosis;
- venous thromboembolism;
- aneurysms and fistulas.

Urologic complications:

- impossibility of urinary anastomosis;
- obstruction of the urinary tract;
 - hematuria;
 - lymphocele;
 - wound infection.

Specific complications:

- acute graft failure ;
- reaction of graft rejection (extra acute, acute, chronic);
- complications associated with immunosuppressive therapy.

Prognosis. The prognosis of conservative CRF treatment depends on the nature of the underlying disease, peculiarities of its course, timely diagnosis and adequate treatment. Prognosis after kidney transplantation depends on the immunologic histocompatibility. The grafts taken from living donors (next kin) function well in 90-95 % of patients within 1 year and in 85-90 % within 2 years. The grafts taken from the cadavers with brain death, transplanted into leading centers, function well in 70 % of patients within the first year and in 60 % for more than 4 years. Known survival periods of the patients with transplanted kidneys are over 20 years.

Prevention. It is recommended to follow a diet, to quit smoking and drinking alcohol, to control blood pressure, water balance. One should refrain from taking nephrotoxic drugs, in particular iodine-containing radiocontrast substances and non-steroid anti-inflammatory drugs. Pregnancy with CRF of the stage III-IV is contraindicated. One should eliminate the influence of allergens, hypovolemia, dehydration, blood loss. During outpatient treatment at the stages I and II: follow low-protein diet, liquid regime, daily emptying the bowel, limitation of salt consumption in case of edema and hypertension, drug therapy - antihypertensive, hypolipidemic, iron medicines and erythropoietin, adsorbents, soda clysters, gastric lavage.

Follow-up monitoring. Medical examination must include: 1) examination of CRF patients: I stage 3 times per year, II stage 6 times per year and with III stage CRF monthly, prescription of adequate regime, employment and rational choice of dietic and therapeutic measures; establishing and elimination of factors that contribute to CRF progress. In the event of intercurrent diseases, the patients are examined in addition. The patients with IV stage CRF should undergo hemodialysis or peritoneal dialysis. Symptomatic therapy is prescribed in case of presence of contraindications for renal replacement therapy and should be organized at the place of residence. The patients after kidney transplantation should have follow-up monitoring for life.

Control tests

1. Provide the description of clinical course of oligoanuria period in case of acute renal failure.
2. What form of acute renal failure requires surgical treatment?

3. Make a plan for conservative treatment of acute renal failure.
4. Give a clinical description of terminal stage of chronic renal failure.
5. 30 years old patient complains of headache, weakness, nocturia. Proteinuria for 5 years, increased blood pressure for 2 years. Objective data: pulse 88 beats /min, blood pressure 150/100

mm of mercury, blood creatinine 230 $\mu\text{mol/l}$, blood urea 9.1 mmol/l , glomerular filtration 50 ml/min . What would you think about?

Answer. Chronic renal failure 2 stage.

6. Diet therapy in case of chronic renal failure.
7. Indications and contraindications for renal transplantation.
8. A patient in bad general condition and anuria arrived to toxicology clinic. In anamnesis: accidentally drank 50 ml of antifreeze. What is the form of acute renal failure ?

Answer. Renal form.

9. On the 4th day after the transfusion of incompatible (by group) blood, in a patient, diuresis has progressively acutely decreased, anuria has developed, general condition has acutely deteriorated, blood pressure has increased. In laboratory study : plasma creatinine 680 $\mu\text{mol/l}$, plasma urea 24 mmol/l . What disease and stage of the disease would you think about?

Answer. Posttransfusion acute renal failure, anuria

Chapter 11

First Aid in urological diseases

First Aid in urological diseases with various causes and pathogenesis i.e. (urolithiasis , acute inflammation of the kidneys and urinary tract , tumors , trauma , etc.) . , In most of the cases they are clinically manifested by one or more leading urological syndrome : renal colic, hematuria, acute urinary retention, anuria .

11.1. Renal colic

Renal colic -It's a sharp pain that occurs suddenly in the area of the kidney or in the urinary pathway , which has a certain irradiation ,often of paroxysmal character and is accompanied by violations during urination and paresis of the intestines. Renal colic is the leading clinical symptom of many diseases and needs emergency medical care . The development of acute renal colic is often manifested by clinical symptoms such as -" acute abdomen " and calls for differential diagnosis .

Etiology and pathogenesis

The cause of renal colic is the mechanical obstruction of the ureter with compounds of crystals and amorphous salts. Acute impaired obstruction of the ureter may be caused by a fragment of the tumor , blood clots, pus clots,etc . The reason of sharp sudden pain seen in renal colic may be due



Fig. 11.1. The scheme of spread the pain at renal colic (1 - irradiation at localization of stones in the kidney and upper third of the ureter, 2 - irradiation in the localization of the stone in the middle and lower third of the ureter)

to acute processes around renal tissue (paranephritis, hemorrhage in

the perirenal fat , etc.).

Mechanical obstruction of the ureter is accompanied by a spasm of its walls and increased intrarenal pressure :

with incomplete obstruction urine seeps between barrier (stone, clot) and the wall , causing pain temporarily reduced, and when there is a spasm of the ureter - the pain is intensified again ;

the complete obturation pain is of constant character that causes ineffective contractions of the pelvis of the kidney.

Increased intra pelvic pressure leads to acute stretching bowel and leads to acute stagnation processes in the kidney , which leads to stretching of the fibrous capsules kidney irritation and an extensive network of nerve receptors

The clinical picture:

Complaints

Symptoms that simulates in kidney - lash colic symptoms of diseases of the zealous cavity (" acute abdomen " - abdominal tension , nausea , vomiting , etc. .) Is a consequence of the reflex response bodies adjacently innervated , and is often caused by severe paresis of large intestines. As the ureter stone advances there is another factor of pain - Irritable - receptors of the ureter (Fig. 11.1) :

at the location of the stone in the upper or middle part of the ureter pain spreads to the side of abdomen on the affected side (paresis of the intestines , bloating);

at the location of the stone in the lower third of the ureter pain begins irradiating in the lower abdomen (irritation of iliac vessels) and femur, in men in the scrotum and testis (irritation of vas deferens in men) , women - in labia majoris (irritation of round

ligament of the uterus) ;

the localization of the stone near the bladder pain radiates along the urethra. Fever, leukocytosis , and other inflammatory manifestations of renal colic caused by pelvis - venous reflux.

Patients with renal colic complain of acute attacks of pain on the affected side. Sometimes the pain can cover the entire abdomen or be strongest in contralateral side (" healthy side ") of the kidney. Pain radiates to the anterior abdominal wall down to the ureter to the bladder and finally to the genitals. In the future there may be symptoms such as dysuria, nausea , vomiting, abdominal distension (bloating). This symptoms can also be accompanied by chills , and subfebrile fever. A typical symptom of renal colic is a change in color of urine red or muddy (found in all phases of the disease , except during complete ureteral obstruction).

History of the disease

Usually the attack of renal colic occurs suddenly and lasts from several hours to several days . cessation of pain attacks can occur suddenly as well as by in gradual regression of symptoms (pain cessation or change of position is explained stones, or discharge from the ureter and restoration of the flow of urine from the kidney) .

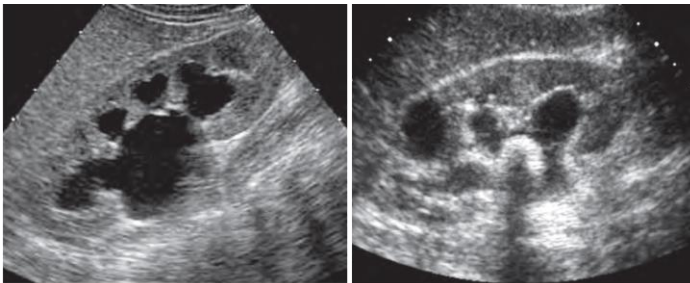


Fig. 11.2. Ultrasonography of kidney: a - enlargement pyelo-calyceal system with obstruction of the ureter; b - stones of the renal pelvis, that led to dilation of pyelo-calyceal system

Objective data

review:

patients with renal colic are in a state of excitation of the motor movements i.e., continuously changing their position ("Stone moves, patient moves");

palpation:

often the tension of the abdominal

wall , resembling the picture of acute abdomen ;

percussion:

tapping on the side of the lumbar lesion leads to increased pain ;

auscultation :

reduced intestinal peristalsis maybe auscultated .

Diagnosis

Laboratory diagnosis :

Complete blood count : leukocytosis possible without significant changes in leukocyte formula;

urinalysis :

hematuria often amplified during the movements and decreased at rest and rarely manifests as microhematuria ;

leukocyturia, and pyuria may be present.

Instrumental Data:

Ultrasound examination is of important role in the diagnosis of renal colic , methyl Todd does not require special preparation of the patient ,It enables us to determine the size of stone and structure , presence of stones, expansion pyelocaliceal system, indicating the presence of obstacles in the ureter , which led to attack; pregnant is the leading method of diagnosis (Fig. 11.2) ;

X-ray study :

Sightseeing urography can determine the presence of stones (Fig. 11.3) in the affected kidney or urinary tract infection (if stones roentgen negative)

excretory urography can determine the level of constraints , the degree of expansion of the renal pelvis , calyces , ureter , renal function (Figure 11.4) .

Chromocystoscopy time and intensity discharge indigo-carmen lets us mark the degree of

impairment of renal excretory function , blockage of the lumen of the upper urinary tract.

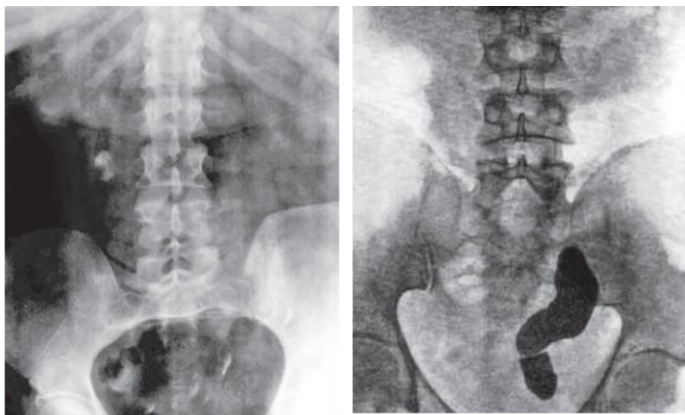


Fig . 11.3. Survey urogram: a - right kidney stones and upper / 3 right ureter b - stone in lower / 3 of the left ureter

CT Scan : the method is highly sensitive , usually urate kidney stones are not detected in

Review urography and CT scan on them are clearly visible (Fig. 11.5), computed tomography with intravenous contrast substances can simultaneously identify

stones and kidney function , to a virtual reconstruction of the urinary system.

Differential diagnosis

Renal colic in 20-25% of cases has an atypical course and can simulate a variety of pathological processes, including acute surgical diseases of the abdominal cavity (acute appendicitis, acute cholecystitis, acute pancreatitis, acute intestinal nephrosis, etc. .) and gynecological diseases (adnexitis, torsion of an ovarian cyst, ovarian apoplexy, ectopic pregnancy, ligation of the ureter during gynecological operations). Particularly difficult to distinguish acute inflammation of lumbar placed appendix of cecum of renal colic caused by the passage of pebble on the right ureter.

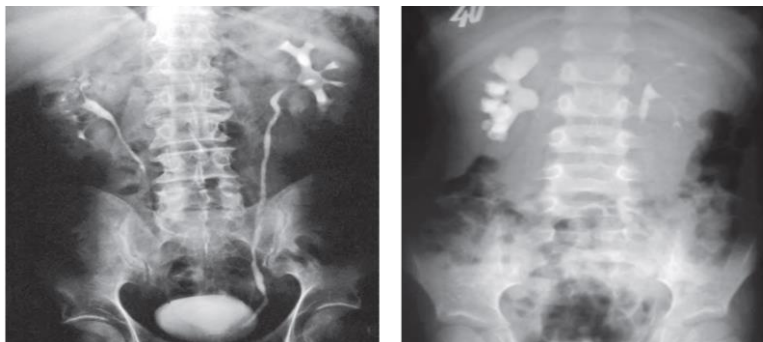


Fig. 11.4. Excretory urogram: a - roentgen negative stone bowls left kidney, b - a staghorn stone in right kidney, marked dilatation of the pyelocaliceal system of the right kidney

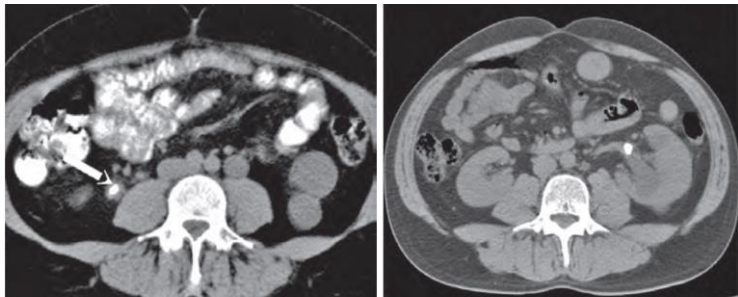


Fig. 11.5. CT scan: a - stone in lower third of the right ureter b - stone in proximal part of left ureter

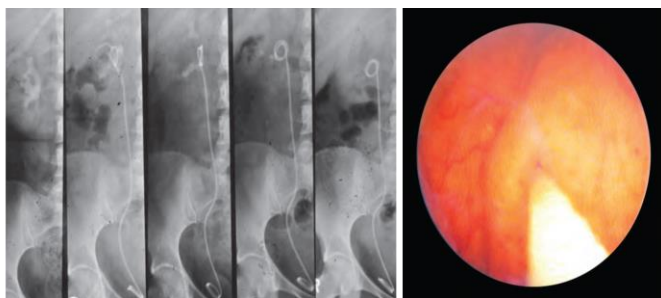


Fig . 11.6. Drainage of the upper urinary tract: a - ureteral catheterization B - stent of the right ureter , C - percutaneous nephrostomy

Treatment

First aid for renal colic :

First, the patient needs pain management . To do this, make him a warm bath (37 ° C), administered by intramuscular injection " cocktail " containing calming and anesthetizing drugs: papaverine, metamizol sodium bromide + + fempivernon pitofenon

hydro- chloride, drotaverine in cases of very severe pain - trymeperydyn (morphine hydrochloride since it , removes pain & increased spasm of the ureter wall).

At the beginning of an attack of renal colic it is advised a high dose combination of herbal remedies : madder root tincture magnesium salicylate + + essential oils.

Where the pain is caused by stones proximal ureter persists, perform novocaine (procaine) blockade of the spermatic cord (women - round ligament of the uterus) by Lorin - Epstein administered 60-70 ml 0,25-0 5 % solution Novocaine, warmed to body temperature (novocaine blockade not only has a therapeutic effect, but also helps to hold the differential diagnosis of right-sided renal colic with acute appendicitis , in which the block does not eliminate the pain).

With the threat of acute pyelonephritis it is necessary to drain the renal pelvis through: establishing ureteral catheter or stent of the urinary tract or performing percutaneous nephrostomy (Figure 11.6).

11.2. Hematuria

Hematuria - presence of red blood cells in the urine , which is determined during the total urine analysis :

microscopy of urine sediment in the study - more than 2 red blood cells per field in two of the three tests ;

the study of urine - more than 1,000 red blood cells in 1 ml among stage of practical portion of urine .

Risk factors for hematuria .

Patients at high risk for renal disease:

severe proteinuria (more than 0.5 grams per day);

signs of kidney failure ;

presence of modified erythrocytes in urine sediment ;

cylindruria ;

elevated levels of creatinine in serum.

In the detection of hematuria patients should go for the treatment to a nephrologist .

Patients at high risk for urological diseases:

smoking tobacco;

occupational hazards : Contact with chemicals (dyes , etc. .)

age over 40 years;

a history of urological disease symptoms or indications for diagnosed in past urological nosological form ;

a history of LUTS ;

recurrent infections of the genitourinary system resistant to antibiotic treatment ;

prolonged use of analgesics.

If you find microhematuria at least once in a patients urine then there is a high risk of urological disease. patient must go for urologist for consultation and treatment. It is obligatory to perform in these patients cystoscopy , ultrasound and urinary tract X-ray examination of the urinary tract , urine cytology (for these patients as a screening test to hold the urine for hemoglobin using special diagnostic strips).

Classification

The magnitude of hematuria distinguished:

gross hematuria if admixture of blood in urine determined visually (more than 0.5 ml of blood in 500 ml of urine);

microhematuria if microscopy of sediment urinalysis define more than 2 red blood cells per field .

According to etiology distinguished:

hematuria of glomerular origin :

acute glomerulonephritis ;

Goodpasture's syndrome ;

IgA- nephropathy ;

renal lesions in hepatitis B and C;

systemic lupus erythematosus ;

Essential mixed cryoglobulinemia ;

Wegener's granulomatosis ;

hemolytic uremic syndrome ;

Alport 's disease ;

Fabry disease ;

disease - Henoch schloein ;

benign hematuria family Tina ;

syndrome nail - patella 1;

hematuria of glomerular genesis - in :

tubulointerstitial diseases (acute tubulointerstitial necrosis) ;

tubulointerstitial hereditary kidney disease (polycystic , multicystic);

infections (pyelonephritis , tuberculosis, schistosomiasis);

interstitial nephritis medical etiology (antibiotics , diuretics, nonsteroidal anti-inflammatory drugs , anticonvulsants , anticancer drugs) ;

interstitial nephritis infectious origin (syphilis, toxoplasmosis, cyto- megalovirus , Epstein - Barr virus);

interstitial nephritis resulting from systemic diseases (sarcoidosis, Lim , Thomas, Sjögren's syndrome);

Froleya syndrome ;

metabolic disorders (hypercalciuria , hiperucosuria);

urological disease of the kidney (renal cell carcinoma, Wilms' tumor , renal cysts);

diseases of the blood vessels (arteriovenous fistula , renal artery stenosis , thrombosis or thromboembolism of renal artery, renal vein thrombosis);

diseases of the blood (leukemia, lymphoma, decrease in blood coagulation due to receiving antiplatelet agents and anticoagulants);

injury of the kidney (renal and Marching hematuria), tumors of the upper urinary - tract and bladder ;

specific or non-specific inflammatory diseases of the upper urinary tract and bladder ;

injuries of the upper urinary tract and bladder calculus presence in renal -pelvis system , ureters , bladder and urethra posterior part , benign prostatic hyperplasia or prostate cancer , prostatitis.

1 The syndrome nail - patella (born nail - nail , Lat . Patella - knee-cap) - a hereditary disease characterized by the absence or hypoplasia of nails and patella symptoms jade , inherited in a dominant type

Diagnosis

History of the disease

An examination of the patient is necessary to specify :

conditions conducive to the emergence of hematuria (hyper- Term_ja , physical activity , sexual intercourse , trauma, relationship to the menstrual cycle);

Complaints:

discoloration of urine;

possible attacks of pain in the type -term renal colic (the formation of dense blood in the urinary tract).

anamnesic information about travel to tropical countries to exclude parasitic diseases (schistosomiasis , malaria);

features of family history to identify inherited disease that results in the development of gross hematuria (Fabry disease , Alport , etc.);

a history before illness (tonsillitis, urinary stone illness asthma, bladder tumor , etc.);

data on the administration of drugs : aminoglycosides, amitriptyline, nonsteroidal anti-inflammatory drugs, anticonvulsants and anti-malarial medicines, diuretics,

oral contraceptives , antibiotics penicillin series, antiaggregants and anticoagulants.

The intensity of hematuria does not always correlate with the severity of disease that cause emergence of symptoms.

Physical examination of the patient with hematuria

When examining a patient with gross hematuria is first necessary to visually assess urine. Urine color can be changed :

When administered drugs:

pink - while taking piramidonu ;

saffron yellow - Nitroxoline ;

Brown - Senna ;

Magenta - phenolphthalein (Purgenum);

red-brown - muddy red

If you use certain types of food:

Magenta - after eating beets ;

brown - rhubarb.

With the development of certain pathological conditions:

brick - acute porphyria ;

red-brown - a sign of myoglobinuria (the syndrome of prolonged crushing).

Possible blood clots : worm like form clots indicates their formation in the upper urinary tract ;

formation of large shapeless clots occur in the bladder .

It is important to refine the appearance , extent , nature and duration of hematuria :

staining the blood of only the initial portion of urine diagnosed initial blood- tory resulting from trauma, inflammation or tumor growth urethra. possible

combination of this form of urethrorrhagia - Bleeding from the urethra beyond the act of urination ;

uniform color of all portions of urine with blood - a sign of total hematuria . It is typical for diseases of kidneys, ureter , bladder, and prostate cancer;

terminal hematuria (bleeding at the end of urination) shows the localization of the pathological process in the region of the neck of the bladder (cystitis , urethra , tryhonit - women , prostatitis, inflammation or swelling of the spermatic tubercle - in men , a tumor of the bladder neck) .

the presence of pain its location may indicate the possible cause of hematuria : pain in the back on the affected side to the top of hematuria , and its appearance after relief of pain may indicate on- patency of stones in the ureter , the emergence of pain after obturation

hematuria indicates ureteral clots ;

difficulty urinating after the appearance of bloody urine indicate the development of bladder tamponade .

On examination, the patient pay attention to :

presence of hemorrhagic lesions on the skin and mucous membranes , indicating a possible disease of hemostasis , hemorrhagic fever with renal syndrome ;

edema, increased blood pressure indicate the likelihood of renal disease;

fever may be caused by an infection ;

swollen lymph nodes characteristic of infectious diseases, blood diseases, cancer.

Physical examination

palpation of the abdomen often allow for the exigencies detect an increase in kidney, liver , spleen , tumors of the abdominal cavity and in the retroperitoneal space;

Male patients must convince you digital rectal and for women - vaginal examination ;

All patients performed an overview of the external opening of the urethra.

Laboratory studies Research urine for the presence of hemo- globin - accessible and sensitive me-

Todd diagnosis, especially for doctors

general practice in a visit to patients , yenta :

possible false positive results ,

myoglobinuria ;

false negatives - in patients receiving preparative ascorbic or acetyl-salicylic acid , as their metabolites in the allocation of the urine may prevent a change in color of the

test strip ;

positive results obtained during this method of diagnosis , and fault to be confirmed by urinalysis

and microscopy of sediment in some cases supporting the diagnostic value of urine may be for nechyporenko (content of red blood cells in 1 ml of urine) and Addis - Kakovsky (content erythrocytes in a total volume of urine that the patient is allocated a day). In urinalysis pay attention to protein, when expressed as protein - Nuri high probability renal disease (in doubtful cases, performance studies on the selectivity of proteinuria).

Microscopic examination of the sediment using modern phase contrast microscope allows for topical diagnosis of hematuria :

upon detection of unmodified erythrocytes in the sediment - urological disease high probability of finding the source of hematuria in the lower urinary tract, ureter or pyelo-renal system ;

availability in the sediment and altered erythrocyte cylinders indicates nephrological disease.

Leukocyturia , and pyuria indicate a urinary infection

when it detects these changes in urine indicated Bacteriological study to the definition sensitivity of microorganisms to antibiotics;

presence of pyuria with repeated negative results of bacteriological study considered an indication for the analysis of urine for *Mycobacterium tuberculosis* , chest X-ray and consultation TB .

In the topical diagnosis of hematuria helps performance tests :

with isolated hematuria in the first portion - the source of bleeding is located in the urethra ;

with isolated hematuria in three portions - the neck of the bladder.

When performing biochemical analysis of blood of such patients should pay attention to the level of total protein, glucose, creatinine, urea and PSA.

Instrumental Research

Routine inspection:

Ultrasound of the kidneys , bladder , prostate ,

excretory urography (performed at normal levels of creatinine and blood urea);

cystoscopy (performed after the exclusion or the absence of suspicion of the presence of acute inflammation of the urogenital system).

According to the testimony can carry out more tests :

Helical CT for the diagnosis of stones and tumors of the upper urinary tract and tumors of kidney volume ;

Doppler to assess blood flow in the renal vessels ;

digital subtractive angiography for assessment of renal vessels ;

Pelvic MRI to evaluate the bladder, prostate and seminal vesicles ;

retrograde ureteropyelonephritis , intraluminal ultrasonography and ureteropyelocystoscopy for the diagnosis of papillary tumors of the upper urinary tract

biopsy of the kidney, pelvis , ureter , bladder , prostate, for verification of morphological diagnosis.

Specialized urological examination of the patient with hematuria without evidence of disease includes the following steps :

Exploring complaints, medical history , conditions of hematuria:

review and physical examination of the patient, the digital rectal examination;

triple test.

Mandatory inspection of patient with hematuria:

Ultrasound of the kidneys , bladder, with determination of residual urine ;

transrectal ultrasound of the prostate, seminal vesicles ;

Urine cytology ;

excretory urography (in the absence of chronic renal failure and pregnancy);

ureterocystoscopy (to the exclusion of acute inflammation of the lower seminal vesicles, absence of data on benign prostatic hyperplasia or prostate cancer).

In addition , conduct a special survey (Table 11.1).

Table 11.1. *Special examination of patients with hematuria suspected based on a disease*

Vascular disease or volumetric neoplasms	Disease of pyelocaliceal system and ureter	Bladder diseases	Prostate diseases
--	--	------------------	-------------------

- Marching sample;
- ultrasonography in the Doppler mode;
- spiral CT;
- digital subtraction angiography;
- renal biopsy;

- spiral CT;
- ureteropyelography (Fig. 11.7);
- retrograde ureteropyelography;
- intraluminal ultrasonography;
- Biopsy of ureteral pelvis

- MRI of the pelvic organs;
- Urinalysis on cancer markers of urinary bladder;
- Flow cytometry;
- Photodynamic cystoscopy (Fig. 11.8);
- Bladder biopsy;

- Analysis of serum PSA;
- Transrectal ultrasound of prostate at Doppler mode;
- Biopsy of prostate;
- MRI of the pelvic organs;

Indications for consultation with other specialists:

Consultation nephrologist:

appearance of hematuria in patients with systemic diseases;

detection of severe proteinuria in patients with hematuria ;

detection of higher concentrations of creatinine and urea in patients with hematuria .

Consultation hematologist:

enlarged liver and spleen in patients with hematuria ;

presence of subcutaneous hemorrhage in patients with hematuria .

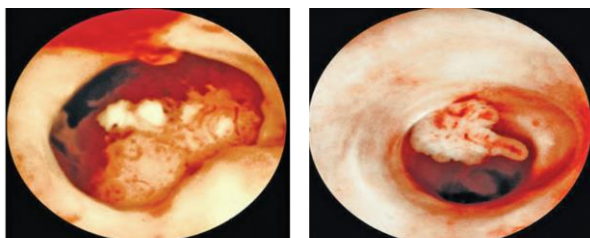


Fig. 11.7. Ureteropyelocystoscopy: A - Carcinoma of the renal pelvis, which became a source of hematuria; B - bleeding tumor of ureter

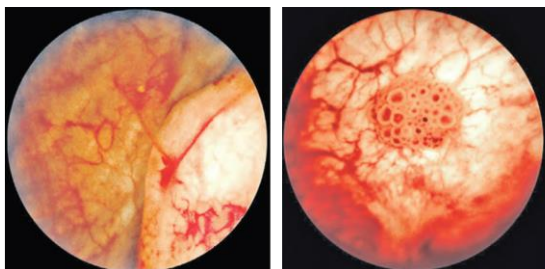


Fig. 11.8. Cystoscopy: A - bleeding from the ureter b - a bladder tumor that has become a source of hematuria

emergency hospitalization in urological hospital .

Treatment

Treatment of patients with hematuria should be aimed at eliminating the causes calling the development of hematuria.

Drug treatment:

In the presence of the patient's hematologic diseases shown Tami treatment components and blood products (depending on the diagnosed defects of hemostasis).

In infectious and inflammatory diseases of the urinary system antibacterial conduct , anti-inflammatory and infusion- detoxification therapy.

With the development of hypovolemia prescribed infusion therapy colloidal and crystalloid solutions.

If renal disease is the main pathogenetic therapy of the disease glucocorticoids and cytostatics.

In addition to these methods of treatment, in most cases, prescribe nonspecific hemo- static treatment.

Surgical treatment:

The goal of surgical treatment in the presence of hematuria considered is stopping the bleeding.

Indications:

recurrent hematuria caused by urological diseases requiring surgery (tumors , strictures , stones); gross hematuria , which led to the development of anemia, bladder tamponade - in preaching to emergency surgery.

Type of surgery :

Consultation infectious disease:

combination of hematuria with diarrhea, fever and skin rash.

TB Consulting:

combination with persistent hematuria, pyuria , resistant to antibiotic treatment

Indications for hospitalization: gross hematuria is an absolute indication for

When hematuria , caused by an injury of the kidney , depending on the damage to the kidneys, the kidneys perform an audit , suturing of bleeding vessels , kidney resection or nephrotic - volume.

When tumors of the kidney , leading to the development of hematuria, as shown resection or nephrectomy.

In serious condition of the patient or inoperable tumors may conduct embolization of bleeding vessels after the angiography.

When hematuria , caused by injury of the bladder , perform the audit authority coagulation or suturing of bleeding vessels , cystostomy .

When hematuria , caused by a tumor of the bladder, depending on the clinical situation, stage and tumor size can carry out surgical intervention :

transurethral or " open" resection of the bladder ;

cystectomy ;

angiography and embolization of the internal iliac artery ;

ligation of the internal iliac arteries.

When hematuria , caused by diseases of the prostate, may execution of transurethral or " open" prostatectomy.

Further treatment of the patient:

If by reason of hematuria and establishing a clinical diagnosis further treatment of the patient is carried out according to the standards of treatment of disease detected .

When unexplained reason hematuria necessary to conduct these surveys (according to order) :

6, 12 , 24 and 36 months - total and cytological analyzes of urine, blood pressure control ;

cystoscopy is indicated for :

Repeated episodes of gross hematuria → ;

→ detection of tumor cells in cytological analysis of urine ;

→ irritable appearance of symptoms without signs of urinary tract infections ;

observation of a nephrologist is recommended for:

→ development of hypertension ;

→ emergence or strengthening of proteinuria ;

→ cylindruria appearance and altered red blood cells in the urinary sediment .

In conducting health education activities among patients is especially important to pay attention to the need for an emergency appeal for help in case of impurities of blood in the urine.

11.3. Acute urinary retention

Acute urinary retention (AUR) - this is the impossibility of micturition with adequate filling of the bladder. This is an extremely uncomfortable condition of the patient , which poses a potential threat to life. AUR is fairly common pathology , especially in elderly men . The incidence of AUR in patients with benign prostatic hyperplasia in 10 years ranges from 4 to 73%. Due to the need for immediate appeal for help to eliminate serious illness state AUR is rarely complicated by renal failure (Figure 11.9).

Etiology

AUR reasons are:

stricture of the urethra ;

Acute and chronic prostatitis ;

tumors of the bladder neck ;

bladder stones ;

blood clots in the bladder ;

neurogenic disorders ;

AUR in men is often on the background of benign cystic pre- cancer.

Risk factors AUR :

alcohol abuse ;

stay in cold water ;

certain medications (antidepressants) ;

instrumental studies urogenital ;

Transurethral microwave therapy of benign prostatic

hyperplasia ;

Radiation therapy to the pelvic area ;

"Premature " removal of the urethral catheter during surgery on the prostate gland ;

other surgical intervention (complicating factor here is the anesthesia , pain, etc. - fusion solutions , immobilization).

AUR in patients receiving drugs:

Medication is a common cause of AUR . In particular, anticholinergic drugs and alpha - adrenergic agonists can cause AUR due to inhibition of detrusor contractile capacity and increase the resistance of the lower urinary tract. In view of this , these drugs should be administered carefully in men with benign prostatic hyperplasia .

Most drugs prescribed for depression, allergies, Parkinson's disease and overactive bladder with



Fig. 11.9. A patient with acute urinary retention.

anticholinergic properties. Alpha- agonists often a component of non-prescription drugs. Undoubtedly , these drugs only expresses in stages infravesical obstruction. In control bladder emptying and no residual urine in the adjusted velocity urination in BPH patients with these drugs is not contraindicated.

Surgical procedures:

Authentically found that in men after surgery using general anesthesia is a risk of AUR. Inhibitory effect of drugs for anesthesia in detrusor contractility and arising under this hyperextension of the

bladder may contribute to the development of AUR. AUR frequency after short-term epidural about 0.5% , with the exception of rectal , gynecological surgery and hernioplasty. Without a doubt, the only anesthesia is extremely limited risk factor.

Bladder catheterization routinely carried out in most surgical interventions Chan as to account for the diuresis and for the prevention of AUR . For example , patients who underwent implantation of joints without the use of catheterization in the postoperative period, AUR occurs in 52 % of cases, and the use of a catheter for 18-24 hours this complication occurs 2 times less.

Diagnostic procedures:

AUR may occur after diagnostic procedures in the area of the lower urinary tract:

cystoscopy ;

prostate biopsy ;

ureteroscopy ;

Ureteroscopy ;

transrectal ultrasound (TRUS).

Prevention:

cystoscopy is usually carried out using a rigid cystoscope . The use of modern flexible cystoscope significantly reduces the risk of complications. Also, application of modern methods of prostate biopsy under ultrasound -term sensor rarely leads to the development of AUR ;

men over 50 should be screened for the disease, which results in the development intravesical obstruction (IVO), especially before performing surgical procedures involving the use of general anesthesia. If you find IVO the appointments relevant drugs (see section on BPH), if necessary - used surgery .



Fig . 11.10. *Catheters Nelaton*

Treatment

Catheterization of the bladder

Catheterization of the bladder is one of the most common procedures that is used by a urologist . Catheterization technique requires a good knowledge of the anatomy of this area. Undoubtedly , a very important practical skill is the fulfillment of this procedure . In the modern period known various types and model of urethral catheters. Also use 3 -way catheters. They are used for the purpose of genome for prolonged washing urinary bladder.

Catheter Nelaton seemingly simple straight tube with a hole at the narrow end and connecting bell at the opposite end to connect to the urinal (Fig. 11.10) . These catheters are used for one-time or repeated catheterization of urinary bladder.

Catheter Foley. There are many types and models of Foley catheters . This catheter is a catheter Nelaton, made of latex rubber with a balloon at the end , those that can be filled with water through an additional tip, coupled with Mr. Balo thin tube that is in the wall of the catheter. The amount of water that can be put into the cylinder , said at the tip (Fig. 11.11) . As the tip is

equipped with a valve , the water is introduced into the cylinder, but effectively prevents unauthorized nude - catheter removed . Unlike catheter Nelaton, this type of catheter is basically used for st long to the use in patients who are not able to urinate , or exactly the first account of diuresis during intensive therapy.



Fig. 11.11. Foley catheter

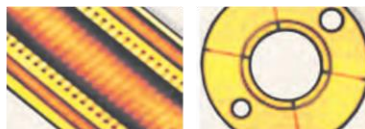


Fig. 11.12. Three-way catheter : a - general view , b - layout of channels

3 -way hemostatic catheters - a special catheter Foley, which is an additional channel in the wall (Fig. 11.12) , which opens the distal balloon. Through this channel , the possibility fou infusion fluid (eg , NaCl 0,9%) in the bladder, which prevents the formation of blood clots in its lumen .



Fig . 11.13. Suprapubic catheter

Suprapubic catheters are basically indistinguishable in appearance from Nelaton catheters or Foley, first cancellation is the way of introduction. Suprapubic catheter is inserted through the skin immediately above the pubic bone (Fig. 11.13) . The procedure is performed under ultrasound for the accurate identification of the bladder and perform puncture injury- guts. Suprapubic catheter is extremely effective in the long-term need for catheterization sechovoho bladder, for example , in patients with paraplegia . Nelaton catheters and Foley may have different ends, which are inserted into the urethra . Forms catheter tips that you are and would korystovuyutsya often representatives ted in Fig. 11.14 . This configuration of catheter helps to overcome the re- pony in the prostatic urethra department .

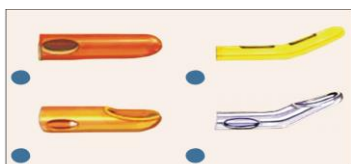


Fig. 11.14 . Type config "working " end of the catheter : a - direct b - bend , c- Kuveler, d - Dyufu

Indications for catheterization in men and women:

Fig. 11.14 . Type config "working " end of the catheter :

a - direct b - bend , c- Kuveler, d - Dyufo

Retention of urine in the bladder, is the complete absence of opportunities are self - voiding.

Determining the volume of residual urine (the preferred noninvasive methods give - for example , ultrasound).

Incontinence issues against the background of care (eg, bedsores or maceration of the skin of the perineum).

Massive hematuria, which leads to the formation of blood clots and bladder tamponade (requires setting 3-way catheter).

What size and type of catheter should be used?

Typically, men and women use catheter diameter of 18 French (sometimes - 16 Fr.). The view that the smaller diameter catheters are less traumatic, false . Such catheters , bending, injure the mucous membrane of the urethra , without getting into a world - bladder.

Typically, a single deletion urine volume less than 500 ml should be used -ing catheter Nelaton. When the bladder contains more than 500 ml of urine is the best catheter Foley. In all cases where the catheter remains in the bladder C. for a period of time , to be used exclusively Foley catheter .

In most cases, the best use straight catheters. Only in some cases catheters with curved ends better penetrate the prostatic urethra department . But their use is possible only if sufficient experience catheterization of bladder , due to their more traumatic . Inept use of the catheter with a curved tip often leads to complications such as urethral stricture , Ruggie and urethra.

Technology bladder catheterization in men. The patient is a switch to press :

Take the foreskin if the patient is not circumcised and there is phimosis. Firmly grab the penis between your thumb and forefinger just behind it , Zeboim groove, then pull the penis so that it throw out - so you straighten the first bend of the urethra. Enter a few milliliters of gel into the urethra with a syringe for subsequent lubrication of the catheter that is inserted into the urethra.

Before the introduction of the catheter can be connected to urinal . Enter the catheter gently to the feeling of light interference - the second bend of the urethra.

Direct stretched penis down while continuing to introduce catheter. If necessary, the penis can be lowered even further so that proves s catheter through the prostatic urethra department in a slightly upward direction.

Enter the catheter as deep as possible into the bladder, to stop flare catheter in the external opening of the urethra. This method is a mandatory part catheterization : Foley catheter is often not fully injected into the bladder and inflate his balloon in the prostatic urethra department . It is because it should be possible to introduce a catheter into the lumen of the bladder and does not stop when the urine starts to flow outside.

After the Foley catheter balloon should be filled with the required amount of liquid (water, but not saline). The catheter will then need to carefully pull the lumen of the

bladder until you can feel the balloon stayed at the neck. Gen - tea container injected 10-15 ml of fluid . Typically, this comes from the catheter urine. If not , indicating that the atonic bladder , do light compression of the lower abdomen .

Problems with catheterization in men:

Phimosis :

→ The opening of the foreskin is quite wide : Continue catheterize not - fashioning of the foreskin .

→ The hole is very narrow gently widen the opening of the foreskin clip , we use a smaller catheter .

The boat can not hold immediately after scaphoid fossa :



Fig. 11.15 . *Hard conductor for urethral catheters*

→ Try using a smaller diameter catheter use urethral bougie .

The catheter can not push through prostatic urethra department :

→ Use a larger diameter catheter . This may seem counterintuitive, but it is not. Remember that the prostatic urethra in part is not narrow, but choked surrounding the

prostate. Thus, more rigid catheter majority Shogo diameter allows push particles prostate that compress the urethra.

→ Use a silicone catheter that is more rigid than latex .

→ Use a Foley catheter with a curved tip. In this case, you should have to adequate experience catheterization , not to injure the urethra.

→ Use a rigid conductor that is inserted into the lumen of the catheter (Figure 11.15).

This tool makes the catheter more rigid and more manageable.

N.B. Remember that using hard conductor is quite dangerous so it should be used only urologist with sufficient experience.

If the catheter is impossible to push through the neck of the bladder:

Use a smaller diameter catheter .

Use rigid conductor (but- read above).

Problems after catheterization:

Urine does not come from the catheter immediately after catheterization:

Wait a short time, then - carefully , to exert pressure on the bladder area .

Enter the catheter a few ml of 0.9 % solution of NaCl.

Men : Make sure that the catheter is held in the bladder.

Urine ceased to flow through the catheter :

Wash the catheter with a solution of 0.9% NaCl.

Ensure that the catheter is not moved from the urinary bladder.

Make sure that the kidneys produce urine.

B. If necessary, prolonged catheterization use only closed system using a sterile urinal, changing them at least 1 time per day (Fig. 11.16).



Fig. 11.16 . Bag to collect urine prostate.

prostate.

If no other idea - spend catheter .

Hematuria :

Wash the catheter a few milliliters of 0,9 % NaCl.

Spasms (tenesmus) of the urinary bladder:

Assign analgesics, antispasmodics.

Assign anticholinergic preparations ratification (tolterodyn , oxybutynin).

Bold around the catheter :

May be associated with irritation by catheter the urethral wall, use a silicone catheters.

Disappear after catheter removal.

Pain in the penis and urine leakage around the catheter :

Pain can be caused by irritation ,

nennyam bottom of the bladder or



Fig. 11.17. Puncture catheterization of the bladder.

Leakage of urine can be caused by contractions of the bladder :

→ Reduce the volume of liquid in the tank .

→ Assign anticholinergic

Puncture catheterization of bladder (trocar epicystostomy) (Fig. 11.17)

Indications:

Failure to input urethral catheter connection

with severe obstruction.

The presence of prostatitis, which is not curable by means of the urethral catheter.

The need for long-term catheterization of the bladder.

Contraindications:

A. A small volume (<200 mL) bladder

B. Purpose of antibiotics necessary not only for the obvious infection of the upper

or lower urinary tract.

Use of anticoagulants (due to the threat of massive hematuria).



Fig . 11.18 . Standard set for puncture catheterization of bladder

Technique:

The catheter is introduced directly into the bladder through the percutaneous puncture urinary bladder above the pubis. By using custom - ultrasound test to rule out damage to the intestines.

Given the fact that this procedure is carried out for a long time using silicone catheters such as Foley, size 12 Fr, sometimes in the formulation of the catheter in a shorter period is used catheter Nelaton size 10-12 Fr, which is fixed to the skin using sutures (Figure 11.18).

Suprapubic catheter size 16 Fr can

simply to change .

11.4. Anuria

Anuria - no urine in the bladder due to renal failure or dysfunction of the urinary tract. This term is used when the daily urine output is 5 % of normal as a rule. This is one of the first symptoms of severe acute renal failure (kidney shock) .

Etiology

The causes of anuria may include: sudden kidney blood supply disturbances , various toxic effects (poisoning , bacterial toxinemia), transfusion of incompatible blood shock, impaired patency of the ureter or ureter single kidney and so on.

Classification

If anuria in the bladder urine is not present, It is conditioned by two factors: a) the

kidneys are not producing urine - renal , or secretory , true anuria b) urine produced by the kidneys does not reach the bladder by mechanical interference in the upper urinary tract –

postrenalna or excretory , false anuria.

Secretory anuria - can be caused by a lack of both kidneys (removal of a single kidney - arenal anuria), cessation of blood supply of the kidney , for example, due to thrombosis of the renal artery bacteriotoxic shock , dehydration prerenal anuria. This group includes anuria that developed during the formation of edema. Because hypovolemia through the kidneys is a small amount of plasma filtration pressure so low. If anuria associated with the demise of all or most of the functioning renal parenchyma , it is called the actual secretion .

The reasons for impaired patency of both ureters (or single kidney ureter) belong calculus , compression tumors observed in cancer patients shy -ing of the uterus , bladder (with infiltrating tumor growth) , prostate cancer.

Compression of the ureter may be due to retroperitoneal fibrosis . Most often this occurs in the pelvic department , at least - in the lumbar or throughout urinary water. Anuria occurs despite the fact that the ureters are blocked and can not fully proves s catheters. A role play and functional factors . The disease is accompanied by no pain. Diagnosis is based on the results of X-ray studies .

Postrenal anuria may be iatrogenic origin. It occurs when ligation of both ureters during surgery for cancer of the uterus, rectum. It is observed as a result of violations of the relative and the emergence during the operation of life-threatening bleeding (blood vessels capture with ureter) .

Treatment

Patients with prerenal (predefined shock - septic , posttransfusiional , traumatic) and renal (kidney parenchyma due to lesions) anuria may be treated in nephrotoxicity log . By urological causes anuria than bilateral pyelonephritis include all kinds of obstruction of both ureters (postrenal or excretory anuria) or single kidney ureter .

It is important to identify the cause of anuria. If it has a mechanical origin, not necessary surgery, and if secretory anuria - other emergency measures . To distinguish mechanism

of secretory anuria . When mechanical anuria strained kidneys , the patient feels pain. It turns out the expansion of the upper urinary tract during the ultrasound.

- mean noise level by using catheterization of the ureter .

11.5. Testicular Torsion hydatid and its appendages

Testis and epididymis Hyatid (Greek hydatids - water bubble) - is the rudiments Muller's ducts, which are the extension of additional entities of the testicles , which consist of individual particles and containing convoluted tubules associated with egg and taxes or under - placed on the leg . Hyatids are formed during reverse development of Muller's

ducts when not their reduction during puberty and are left as remainder.

Etiology and pathogenesis

The cause of the disease may be acute, subacute and chronic circulatory disorders that occur as a result of torsion or microtrauma hydatid. Torsion occurs when there is a long and narrow legs of patient. Of pathological changes in hydatid promotes arterial circulation type , loose stroma and delicate organ of the absence of elastic fibers. According to the clinical and morphological research torsion stem hydatid is detected in the small number of cases. It is more common blood circulation infringement of hydatid

or its inflammation. These changes result from excesses legs hydatids , torsion with spontaneous promotion, impaired venous outflow during exercise or scrotal trauma .

The clinical picture

Hyatids manifests with the appearance of pain in the testicle, inguinal canal and less abdominal pain radiating to the lumbar region. First day is determined by dense painful infiltration in the region of the upper pole of the testis or epididymis areas. Swelling and redness appear later due to progression of the disease process. Patients determined by seals and increased testis. Infiltration palpable depending on the localization hyatids. It should be noted that the localization of clinical evidence of a suspending develops gradually and in the ancient period of defeat is not always expressed.

In the area of testis or epididymis noted symptom "blue spots ", which is responsible for the localization distorted hyatids (painful consolidation shines through the skin of the scrotum in the form of host dark

–bluish color). This symptom can be seen in the first 2 days of the disease . Often children with lesions appear hyatids nausea and vomiting , and in the later stages of the

disease - fever to subfebrile numbers.

For the height of the disease is characterized by redness and swelling of the scrotum increase - syndrome " swollen and hyperemia " (Fig. 11.19). In this stage of the disease and the egg appendage not differentiated .



Figure . 11.19 . Syndrome of swelling and hyperemia

Thus, the main clinical signs of hyatids -are:

sudden onset of pain in the testicles ;

moderate asymmetric swelling and redness of the scrotum ;

the presence of a dense infiltrate.

Diagnosits

Diagnosis is based on clinical manifestations of the disease . In situations where the clinical picture is unclear , apply instrumental methods of

examination :

Diphonoscopy(review scrotum in penetrating light) can detect the formation of dark-colored area in the default location hydatid.

When ultrasound hyatids are defined as speech or tubercle size of 2-5 mm , usually at the upper pole of the testicle or in the furrow between the egg and first- cunningly his appendage. Such entities may be few, but sometimes they are not recognized by ultrasound because due to their delicate structure are not always differentiated from the surrounding tissues.



Figure . 11.20. *Torsion hyatids*

Differential Diagnosis

The disease must be distinguished from acute orchi - the one that occurs in children is relatively rare , has similar clinical symptoms but require different treatment.

Treatment

Conservative treatment is carried out only when expressed mild clinical manifestations and tendency to regress the disease the next day .

Surgical treatment

In the revision of the scrotum in 60-90 % of cases , you are abnormal hydatid appendage as torsion of legs. Today it is generally accepted that when testicular torsion hydatid shown urgent operation , which avoids these complications:

chronic hydrocephalus testicles continued existence of which adversely affect the blood and lymph circulation and testicular function , leading to its atrophy ;

secondary non-specific epididymitis, epididymoorchitis that promote on- the manual vas ways and of infertility;

dysfunction healthy testicle and its atrophy.

Surgical technique:

Inguinal access all layers cut through the wall of the scrotum , testes membranes reveal all . With the opening of the serous cavities allocated a small amount of light, turbid or hemorrhagic effusions , which are sent to the bacteriological study.

Testicle in most cases changed. Often an increase in the head and body of the epididymis . In the area of the upper pole of the testis or epididymis his head are hyatids , removal of the wound (Fig. 11.20) . Affected hyatids enlarged, sometimes it even more testicles , dark purple or black. Distorted hyatids only with long and thin legs . Torsion can be either clockwise or counterclockwise.

hyatids are removed from the section of the unchanged to prevent prohrresuvan - of

vaginitis. Remove hidatydy also unchanged . Performed spermatic channel blockade - teak 10-15 mL 0.25-0.5 % solution of procaine (Novocaine) with antibiotics (with kala- turbid effusion or vaginitis) . Defect parietal layer of the vaginal membrane testicles sewn . In the scrotal cavity injected rubber graduate or drainage tube and put stitches on the skin.

No suturing of the vaginal membrane testicles last recorded postoperative adhesions from scar -formation that subsequently accompanied his traumatization and promotes fibrosis. Operation Winckelmann not shown because the removal hidatydy , including unchanged , eliminating the conditions for the further development of a hydrocele .

Postoperatively prescribe anti-inflammatory treatment .

Forecast

Day after surgery for lesions hidatydy favorable.

11.6. Testicular Torsion

Testicular torsion (volvulus testis torsion of the spermatic cord) - a pathological skru - vigil spermatic cord caused by rotating or mezorhiuma testes (testicles and between the folds of their appendage), resulting in jamming or testicular tissue necrosis. Recoil testes may occur at any age, but most often between the ages of 10-15 and 60-70 years.

Epidemiology

Incidence is 1 in 500 patients in the children's urological hospitals. On during the first 10 years of life twisting testicles noted in 20% of cases, and after 10 years and puberty - 50%. Thus, the principal place in the etiopathogenesis of acute testicular diseases in children occupy mechanical factors, such as testicular torsion.

Etiology and pathogenesis

Etiological factors testicular torsion can be injured purse, jerky movements, strestion abdominals, leading to reflex contraction of the muscle that lifts the testicle. Lack of

proper attachment of the testis to the bottom of the scrotum - an anomaly that arises during the accession appendage to the testicles, leading to disruption of mutual fixation, which results in the separation of the two entities. Distortion when the egg falls malformations associated with the violation of its migration into the scrotum (cryptorchidism).

There is a rotation around the vertical axis of the testis. If you turn the testicle along with spermatic cord exceeding 180°, blood circulation in the testis, formed numerous blood

spills, there is thrombosis of the spermatic cord, serosanguineous transudate in its own shell cavity testis develops swelling purse.

Ekstravahinalne testis occurs along with its defense column was (Fig. 11.21). Testicle towards the vaginal process of peritoneum located mesoperitoneal and fixing it is not broken. A key role in the development of this form of testicular torsion plays no flaw in its development and morphological immaturity of the spermatic cord and surrounding tissues - muscle hypertonicity, lifting egg,



Figure. 11.21. Scheme of over-tunicary (a) and (b) intra-tunicary

(b) testicular torsion friability adhesions between the membranes themselves short cue - wide inguinal canal, which is almost straight direction.

Vaginally distortion occurs in the testes in the vaginal cavity of its own shell. It occurs in children older than 3 years, especially those aged 10-16 years. Distortion testicles while there followed a manner: while reducing muscle that lifts the testicle, it along with the surrounding shell tightened up and performs a rotary motion. Rigidity and density accretion and the inguinal canal,

which is intimately covers the spermatic cord in the form of a tube does not allow the testicle to perform a full rotation around the axis, so at some time in the rotation - derecognised. Testicle that has a long ripple and high mobility, inertia keeps rotating - tystya. Then the muscle fibers relax, egg, raised in the upper cavity, recorded and kept in a horizontal position. With further reduction of muscle that lifts the egg, turning continues. The longer the mesentery, a large force of muscle contraction and the greater weight of the testicles, the more pronounced the degree of twisting. Increased incidence in prepubertal and pubertal period brings about Leno increasing mass body at this age.

Classification

There are two forms of testicular torsion

testicular torsion (above parietal attachment peritoneum) - occurs in children under 1 year;

intravaginal torsion - is more common in children than in adults.

The clinical picture

Start acute illness: there is pain in the testicle and scrotum respective half radiating to the groin, sometimes - nausea, vomiting, condition. Clinical signs depend on disease duration, age of the patient and the location of the testes (inguinal, abdominal):

distortion in newborn testis is often diagnosed at initial examination as moderately painful increase in the corresponding half of the scrotum, which is often accompanied by flushing

infants restless, crying, refusing the breast;

older children and adults complain of sudden, sharp pain in the testicle radiating to the groin and lower abdomen.

Objective symptoms:

near the inguinal ring or in the upper third of the scrotum appears painful, further twisted testicle becomes upraised and trying to raise it even higher pain increases (symptom Prena);

usually testicle palpated at the upper pole of the scrotum that is associated with spermatic cord; palpation Gates is little-painful, sometimes with torsion appendage located in front of the testicle, spermatic cord torsion due to thickened;

the following days there swelling and redness of the scrotum was violation lymphoid stream formed secondary hydrocele.

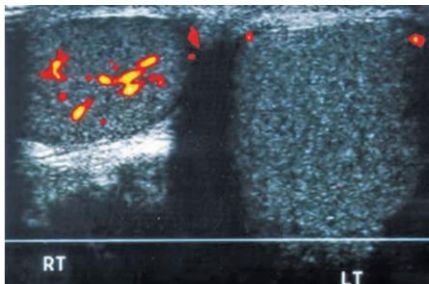


Figure. 11.22. Doppler studies in testicular torsion (left - marked reduction of blood flow)

Diagnosis

Based on the clinical manifestations of the disease and the data supporting them - instrumental methods of examination.

Instrumental examination

Sonography:

ultrasound examination recruit testis is characterized by non-

homogeneity image parenchyma with alternating hyper- and hypoechoic areas, thickening of the tissues

covering the scrotum, swelling of the epididymis, a non-large hydrocele;

changes in the early stages and cannot find or are not specific in subsequent periods are recorded changing the structure of the testis (myocardial and cerebral hemorrhage). In studies have shown that testicle with echogenicity unchanged during surgery is a viable and hypoechoic or heterogeneous

echogenicity per testis - viable.

Doppler ultrasound:

architectonic testicle and its appendages well visualized and disturbances in blood flow in the testis: Torsion decreases in blood flow or even stops completely, etc. (Fig. 11.22).

Unauthorized detorsion testis leads to increased blood flow jet.

Differential Diagnosis

Testicular torsion must be differentiated from orchitis (inflammation of the testicles, which complicates the course of mumps infection) and allergic angioedema in which all increased pressure, liquid penetrates all layers forming during thinned skin blister.

Treatment

External manual detorsion of testicles

In 2-3% of patients distortion can be eliminated in the first hours of the disease, use of external manual hand detorsion.

Methods:

patient lay on his back perform in the opposite direction of twisting of the testicle. It should be



Figure. 11.23. Operation with testicular torsion (after detorsion stored pronounced changes in the testis)

remembered that the right testicle rotate clockwise, left - anti;

user guide for choosing the direction of unwinding testes are scrotal median suture;

testis with scrotal tissue capture mouth - tion and 180° in the direction opposite to the seam median calf while doing mild traction testicles down;

after the egg is released and manipulation is repeated several times;

With the successful detorsion disappears or is significantly reduced pain in the testicle,

it

becomes more mobile, occupies the usual position in the scrotum ;

in the case of ineffective conservative detorsion for 1-2 minutes , stop the manipulation and the patient operated .

Surgical treatment

The syndrome of " swollen scrotum " -required emergency surgery because of very sensitive to ischemia and can quickly

mortify (irreversible changes occur within 6 hours).

Quick access :

choice of access depends on the form of twisting and age of the patient: in infants and draw -ing used groin access , because the predominant form extravaginal , in older children and adults form predominates vaginally , so convenient access through the bag.

Surgical technique:

in all cases to expose the egg protein shell , allowing a wider audit and determine the shape of twisting ;

twisted egg into the wound , detorsion and evaluate its viability. To improve microcirculation and determine the status of the testis is recommended to enter the spermatic cord in 10-20 ml of 0.25-0.5 % solution of procaine (Novocaine) heparin , to improve blood circulation in the testis is also used warm compresses isotonic solution of sodium chloride for 20-30 minutes;

restored circulation in the egg becomes pink ;

If it is difficult to determine the viability of the affected testicle, use transilyumi - natsiyne research testicles on the operating table, testicular ray evidence of its viability ;

in the absence of symptoms ray performed at the opening of the protein shell of the lower pole , with the appearance of bleeding testicle recognize viable ;

necrotic testis, despite the measures taken to improve its vascularization, the color does not change , no pulsation of blood vessels , blood vessels of the tunica albuginea and

these changes are an indication for removal of the testes (Fig. 11.23). It is proved that under preservation gangrenous testicle in the remote period of the disease in the patient

antisperm antibodies appear , the disease spreads to kontrla - teralne egg , resulting in infertility ;

preserved egg with two sutures filed to the membrane at the bottom Due appendage without tension elements of the spermatic cord , injected into the wound drainage ;

in the case of testicular torsion in cryptorchidism after negative consequences , in addition to the above measures for transmitting relegation and fixing the testicle in scrotum .

Postoperative treatment :

in postoperative patients prescribed desensitizing agents , fiziote therapeutic procedures, drugs that normalize microcirculation in the damaged organ -m (daily novocaine blockade of the spermatic cord

, intramuscular administration of heparin, intravenous sodium chloride reopoliglyukinu etc.).

to reduce the permeability barrier hemotestykulyarnoho patients prescribed acetate tylsalitylovu acid (by 0.3-1.5 g per day) for 6-7 days;

if necessary, continue to be performed preventively orhipeksiya pro- tylezhnoho hand to prevent testicular torsion in the future.

Complications twisting his testicles and hydatid:

In belated diagnosis and untimely executed operations developing atrophy and non- Crozet testicles disturbed reproductive function.

In bilateral process occur infertility and impotence.

11.7. Paraphimosis

Paraphimosis - pinching the glans penis coronary sulcus in the region of transition narrowed foreskin fold (Fig. 11.24 a). Develops increasingly as a complication of

phimosis when driven quite at the head of the foreskin is not returns and there is compression ring through which there is swelling of the head and foreskin in violation of blood

circulation until the head necrosis . Treatment of paraphimosis is bloodless reposition the head by Esmarch (Fig. 11.24 b) , and in the first 1-2 days of practice does not cause labor - noschiv .

Because therapy paraphimosis belongs to the urgent nature of the measures . In the case of a dramatic swelling of the foreskin , not only , but also the head, and an inability to Exercise resort to howl bloodless surgery " bloody " reduction .

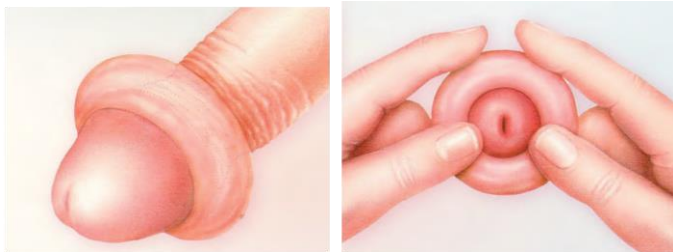


Figure . 11.24 . Paraphimosis : A - appearance , - a bloodless reduction

longitudinally on the probe , and then easily reduce a head ;

to impose aseptic bandage the wound .

Further treatment is the usual anti-inflammatory methods.

Forecast favorable .

Control tasks

A patient 30 years complains of severe pain in the right half of the abdominal cavity us , nausea, and vomiting. Ill 2 hours ago .

OBJECTIVE: body temperature -36 , 5 ° C, pulse - 62. Kidneys are not palpable. Palpable - pain in the right iliac region . Peritoneal signs there. Urination pochaschene , small in rtsiyamy .

Technology " bloody " reduction :

treated skin antiseptics and isolate the operative field ;

under compression ring on the dorsum of the penis sum bellied bougie;

compression ring dissected

Diagnosis ? What studies confirm ?

Answer . Urolithiasis . Concretions right ureter . Right- renal colic . Doobste -tion : the analysis of blood and urine tests, ultrasound.

Make a plan first aid for renal colic .

Which disease is characterized by painless hematuria total ?

Patient 74, for 2 years, noted zatrudnene urination , thus was the need to strain flabby stream of urine , which is often interrupted. When hospitalization is noted incontinence,

constant pain arching above the vagina , where there is bulging , the upper edge of which konturuyetsya at the navel . Percussion in the area defined by stupidity. Urine for several days continuously without control allocated drops. What dysuria in a patient ?

Answer . Paradoxical ishuriya .

Causes and risk factors for acute urinary retention .

When executing a puncture catheterization of the bladder ?

Clinical characteristics of the syndrome and hyperemic swollen scrotum.

Spend the differential diagnosis of acute testicular torsion orchiepididymitis.

Treatment in patients with testicular torsion.

NEPHROPTOSIS

Nephroptosis is a pathological state of the kidney when it is displaced beyond its physiological motility. It is most frequently displaced towards the pelvis. Nephroptosis is a chronic disease brought about by various causes and pathogenesis (sharp loss of weight, traumas, surgical interventions, etc). Clinically it is manifested by several evident symptoms: pain on physical exertion, unstable arterial pressure, microhematuria. Complications of nephroptosis (permanent pain, stable hypertension, hematuria, etc) result in stable loss of capacity for work.

Etiology and pathogenesis

The cause of nephroptosis is rapid loss of weight of the patient due to infectious diseases, surgical interventions, depression as a result of stress, long-term standing on feet, fall from the height, jump onto the feet, frequent deliveries. Not infrequently nephroptosis is one of the manifestations of visceroptosis. Peculiarities of the shape and depth of the renal bed also contribute to development of nephroptosis. The pelvis is wider in women than in men, the perispine cavities are not so deep, and they are wider. The women also have reduced tonus of the abdominal wall after deliveries. Therefore, nephroptosis is encountered much more frequently in women than in men (90-95% of cases).

Mechanism of nephroptosis development

Fixation structure of the fatty tissue of the perirenal space is disturbed, which consists of ligaments, vessels, renal fascia, fatty capsule of the kidney;

- The kidney is considerably displaced without reliable fixation structure (especially in the vertical position of the patient) both towards the small pelvis and abdominal cavity (especially in the lateral recumbent position of the patient);

- During displacement the kidney may rotate in vertical and transversal direction;
- Displacement of the kidney leads to a change of the angle of the renal vessel origin from the abdominal part of the aorta and lower vena cava from 90° to 50-60°.

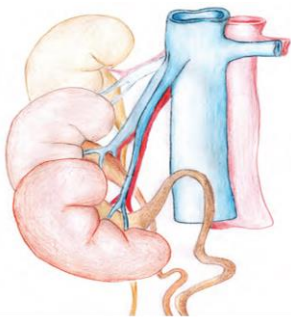


Figure. 12.1. Schematic representation of the various stages of formation Nephroptosis

In case of turning the kidney around the vertical or transversal axis the angle of the renal vessel origin is changed in the renal sinus;

- Without support of the fixation structure the displaced kidney is “hanging” only on the vessels. The kidney stretches out the vessels under its weight disturbing their anatomical structure. Constant microtraumas of the vascular walls result in growth of the connective tissue adhesion in them, loss of elasticity (especially during physical loading)

and narrowing of their lumen;

- Simultaneous, sometimes temporary disturbance of the blood circulation with alteration of the angle of the vessel origin, change of their structure and diameter lead to secondary changes in the renal vessels of smaller caliber;
- The lower are the kidneys, the more disturbed is blood circulation in the vessels of the renal parenchyma;

- Besides vessels the nerves, lymph vessels are stretched and traumatized too
- At the initial stage of nephroptosis development the patient has disturbed blood circulation in the kidney in the vertical position; the general arterial pressure is reduced. In progress of nephroptosis and structural changes of the vessels the general blood circulation in the kidney decreases and the work of renin-angiotensin-aldosterone system (RAAS) is stimulated by reflex. It results in single and then permanently elevated arterial general pressure with development of nephrogenic hypertension;
- Temporary displacement of the kidney towards the small pelvis also becomes the cause of pathological retroversion of the ureter. During progress and duration of nephroptosis pathological retroversions of the ureter become fixed. As a result urination is disturbed. Combined disorder of the blood circulation and urination is a cause of pain, erythrocyturia, development of pyelonephritis, changes of the arterial pressure, etc.

Classification

There are 4 stages of nephroptosis:

- In I stage of nephroptosis we can palpate the lower edge of the kidney in breathing in of the patient;
- In II stage almost the whole kidney can be palpated in the vertical position of the patient;
- In III stage the whole kidney is palpated in the horizontal position of the patient lying on the side;
- In IV stage the kidney is free displaced in the horizontal position with rotation along the longitudinal or transversal axis.

Clinical picture

Complaints

The patients complain of dull pain in the lumbar region. In increased displacement of the kidney the pain spreads all over the abdomen and back. The pain may be of constant character.

Most frequently the pain develops in the daytime after being in the vertical position. It abates in 15-20 min of being the patient in the horizontal position.

At the end of the day there may develop general weakness, reduction of the arterial pressure from 80-100 mm Hg of the upper value to 60-70 mm Hg of the lower value. Not infrequently there may be dysuria, nausea, a feeling of discomfort in the abdominal flank, headache, and loss of appetite; sometimes the patients complain of elevation of the body temperature to a subfebrile level, the urine color may change to red but without blood clots. At the later stages of the disease (III-IV) the patients develop

headache, constant pain in the lumbar region on the side of nephroptosis, permanently high arterial pressure (the lower margin is over 90-100 mm Hg).

Anamnesis of the disease

Usually the patient feels slight discomfort in the lumbar region; it is not long and frequent. Not infrequently the patient feels nausea, dizziness, reduction of the arterial pressure. Sometimes there is temporary moderate pain in the lumbar region, dysuria as frequent urination. In some time symptoms manifest themselves more frequently and longer. The patients often associate the development of symptoms with sharp loss of weight, delivery, considerable physical activities. 90% of patients are characterized by these symptoms in the daytime, they are absent at night.

Objective data

a) *examination:*

- Most patients with nephroptosis are women, up to 90% ;
- Of all patients 70% have underweight;

b) *palpation:*

- Movable tumor-like structure is palpated in the lumbar region in the lateral recumbent position, in the vertical position (with a little bend forward);
- The kidney is painless to palpation in 50%, in 30% there is pain. 20% of patients have a feeling of discomfort;
- In the reclining position on the back the lower pole of the kidney is palpated in 60% of the patients, in other cases the kidney is not palpated at all;

c) *percussion:*

- Percussion of the lumbar region on the side of affection does not cause painful feeling;

d) *auscultation:*

- Intestinal peristalsis is not inhibited.

Diagnosis**Laboratory diagnosis:**

- a) clinical analysis of blood: blood indices are normal;
- b) general urinalysis;

There may be erythrocyturia confirmed by urine analysis by Nechiporenko, Addis-Kakovsky.

- There may be leucocyturia in combination with erythrocyturia but quite rare.

Instrumental studies

- a) Ultrasound investigation should be made both in the horizontal and vertical position of the patient. There are no changes in the parenchyma but there may be pyeloectasia. In deep breathing in there may be increased motility of the kidney (up to 5 cm and more). In the vertical position the kidney is displaced downwards with a change of inclination regarding the vertical axis (the upper pole is displaced laterally and the lower one – medially);
- b) Roentgenological examination is a main method of diagnostics of nephroptosis degree, kind and disorder of urination;
 - *Exploratory urography* gives a possibility to reveal separate calculi in the kidney projection (3% of patients with nephroptosis have concrements against the background of disorder of the urine outflow);
 - *Excretory urography* gives a possibility to establish delay of the contrast substance excretion (functional state of the kidneys), kind of nephroptosis (movable, fixed with preference of ptosis, rotation), stage (I, II, III, IV), complications (pyeloectasia, hydrocalycosis, concrements, shrinkage). Urography is made obligatory in the horizontal and vertical position of the patient.

In excretory urography the kidney function is not disturbed in nephroptosis of I stage. In the vertical position kidney displacement along the vertical axis does not exceed one vertebra.

Nephroptosis of II stage is characterized by undisturbed kidney function (there are only rare exceptions), displacement of the kidney by 2 vertebrae, sometimes with rotation of the lower pole medially.

In III stage of nephroptosis there is moderate disorder of the contrast substance excretion due to formation of the fixed retroversion of the ureter, pyeloectasia, hydrocalycosis, hydronephrosis. The kidney is displaced by more than 2 vertebrae.



Figure. 12.2. Excretory urogram of bilateral Nephroptosis I-II stage with abnormal bend of the ureters



Figure. 12.3. Excretory urography with right-Nephroptosis, complicated by pyelektasia

In progress of the disease (nephroptosis of IV degree) there is a considerable dysfunction of the kidney (delay of the contrast substance excretion), diminishing of the kidney, and obligatory presence of complications: hydronephrosis, fixed retroversion of the ureter.

There is a combination of ptosis,

rotation and torsion of the kidney, which may result on bad contrasting of the renal pelvis.

There is fixed nephroptosis when cicatricial adhesions are formed around the kidney as well as adhesions around the ureter. In this case the kidney does not have characteristic motility and the ureter has a pathologically fixed retroversion.

c) Retrograde pyelography is made quite rare and only when differential diagnosis of true stricture of the ureter is needed and mistaken caused by pathological adhesion processes, fixed retroversions.



Figure. 12.4. Excretory urography right-Nephroptosis with rotation of the kidney

In this case only complications are diagnosed but not nephroptosis.

d) Cystoscopy is made very rarely, only in hematuria or erythrocyturia. The purpose of the investigation is exclusion of the urinary bladder pathology as well as the source of bleeding;

e) Selective angiography is made only in case when there are signs of neurogenic hypertension (vasorenal or vasoparenchymal kind). In case of vasorenal hypertension the renal artery diameter increases by over 30% and the length increases 2-3 times. The length, diameter and angle of the vessel origin are established. Stenosis of the renal artery in the vertical position,

which disappears in the horizontal position confirms the diagnosis of nephroptosis;

f) Computer tomography is made to determine such complications as concrements (roentgen-negative), degree of the ureter dilatation, kidney pelvis, calyx. The introduction of the roentgen-contrast substance during computer tomography allows to estimate the kidney function, structure and architectonic of the cavity system.

g) Radionuclide renography determines the kidney function in the horizontal and vertical positions.

Differential diagnosis

Presence of tumor-like formation in the abdominal area, in the retroperitoneal space and small pelvis requires exclusion of such diagnosis as a tumor, renal cyst, echinococcal cyst, pyelonephrosis, abnormal

kidney development (doubling of the kidneys, horse-shoe –shaped, S-like kidney, etc). lumbar, iliac and pelvic dystopia. It is necessary to exclude tumors and cysts of the abdominal cavity as well as general visceroptosis, one of the manifestations of which there may be uni- or bilateral nephroptosis. It is obligatory to make differential diagnosis with epithelial formations of the urogenital organs, hemorrhagic cystitis, vasculitis, concrements, abnormalities, which may be the cause of proteinuria, erythrocyturia, hematuria, especially in painful manifestation of nephroptosis. In the 1st case it is necessary to exclude other genesis of hypertension: hypertension disease, cysts and tumors of the adrenals, pheochromocytoma and pheochromoblastoma, vascular pathology (stenosis, vegetovascular dystonia), etc. to establish primary character of the disease (true, mistaken stricture of the ureter and such pathological chain; stricture of the ureter- hydronephrosis – secondary nephroptosis or nephroptosis–fixed retroversion of the ureter – hydronephrosis). Tactics and scope of intervention (possible performance of ureterolysis with resection of the renal pelvis without resection of the pyeloureteral segment) depends on it.

Treatment

First aid in nephroptosis

1. First of all, it is necessary to recommend reduction of the physical activity. When pain develops the patient should take temporary (15-20 min) supine position.
2. In rare cases pain is relieved by spasmolytics (papaverin, hydrochloride, drotaverin, etc).

Indications to emergency hospitalization

- Significant pain syndrome;
- Total hematuria (fornical bleeding), pyuria;
- Obstruction by the secondary concrement of the cavitory system

Medicinal treatment

- There is no independent medicinal treatment of nephroptosis;
- Medicinal treatment is only aimed at complication: pyelonephritis, control of the pain syndrome, control of fornical bleeding, stabilization of the arterial pressure;
- There may be prescribed polyvitamins, high calorie diet in thin and weakened patients, antiemetics (if necessary).

Therapeutic exercises

- Aimed at strengthening of muscles of the lumbar area;
- Therapeutic exercises include recommendations as to the periodic horizontal position of the patient for 15-20 min after physical exertion, standing on feet for a long time, development of pain, decrease or increase of pressure, in weakness, nausea, etc;
- It is recommended to sleep mainly on the back or side of nephroptosis;
- Wearing of tightening corset; introduction of gels in the retroperitoneum, paranephral cellular tissue are not considered expedient nowadays;
- There may be dynamic follow-up in patients, in whom clinical symptoms do not increase for a long time, there are no complications and roentgenological signs of the disease progress.

Surgical treatment

Surgical treatment is a main method of treatment of the patient with nephroptosis.

Absolute indications to surgical intervention are:

- Exhausting pain;
- Hydronephrotic transformation;
- Frequent cases of exacerbation of pyelonephritis;
- Elevation of the arterial pressure.

Relative indications to surgical intervention are:

- Periodic pain;
- Periodic increase of the arterial pressure;
- Presence of concrements (up to 1 cm in diameter);
- Erythrocyturia, proteinuria;
- Nausea, general weakness, rapid fatigability;
- Nephroptosis of I-II degree



Figure. 12.5. Nephropexy by tendon-muscle flap according to the method of Rivoir - Lopatkin modification:

a) the selection of muscle-tendon flap; b) conducting the flap over created subcapsular tunnel; c) fixing the flap of the capsule with the kidney.

conditionally divided into groups.

Groups of nephropexy:

Autoplastic:

- a fragment of the renal capsule is used;
- formation of the fascial vagina of the kidney;
- fixation by the fascial fragment;
- fixation by the muscular flap;
- fixation by the cutaneous flap.

Alloplastic:

- by a catgut;
- by undissolved threads;
- by alloplastic fabric, net;
- by gel

Combined:

- simultaneous ureterolysis ;
- removal of the concrement;
- resection of the renal pelvis'
- elimination of stenosis of the renal artery.

Kinds of surgical interventions:

- open surgical intervention;

Contraindications to surgical intervention are:

- General state of the patient (age, systemic chronic diseases, tumors, insults, myocardial infarction) visceroptosis (after nephropexy the symptoms may persist), disorder of blood coagulation, etc.

The main method of surgical intervention is nephropexy, which is

- laparoscopic operation;
- retroperitoneoscopic operation.

CONTROL TASKS

1. Pathogenesis of arterial hypertension in nephroptosis.
2. Describe the pain syndrome in nephroptosis.
3. Peculiarities of physical examination in nephroptosis of II and III stage.
4. Describe the roentgenological signs of nephroptosis of III stage on the excretory urogram.
5. Make a differential diagnosis of nephroptosis with pelvic dystopia of the kidney.
6. Make up a plan of conservative treatment of nephroptosis of I and II stage.

Chapter 13

Neurogenic bladder dysfunction

Bladder dysfunction combines a number of conditions the main manifestation of which is urination disorder. Until now they were named by common term (taken on the territory of the former USSR), **neurogenic bladder**. According to modern international classification, the term "neurogenic bladder" understands as the secondary urination disorder due to severe pathology of the central or peripheral nervous system (spinal tumor or trauma, stroke, after operations on the pelvic organs, etc.). Such violations of urination may be diverse (from AUR to its permanent uncontrolled excretion) and are relatively rare.

Etiology and pathogenesis

Urination is a coordinated process that consists of two synergistic functions: detrusor contraction and relaxation of the vesical sphincter. In patients with neurogenic dysfunction, which are caused by disorders of the central or peripheral innervation, observe the inconsistency of these processes. Neurogenic bladder - is a syndrome that combines the conditions arising in connection with congenital or acquired lesions at different levels of the nerve pathways and centers that innervate the bladder and provides function of the arbitrary urination, named:

- 1 - Center of the cerebral cortex of arbitrary control over the urination;
- 2 - The stem center of urination control (bridge);
- 3 - Retrosplinal and lumbar sympathetic ganglia;
- 4 - Parasympathetic ganglia and nerve pathways;
- 5 - Detrusor muscle of the bladder;
- 6 - Bladder sphincter apparatus.

Adaptive function of the bladder is controlled by the sympathetic nervous system. Retrosplinal sympathetic ganglia provide the function of the urinary accumulation by maintaining of relaxed state and tonic detrusor contraction of internal sphincter. Constant inhibitory effect on the signals of the filling that come from receptors of the bladder normally provides the stem center urination control. The threshold adaptation is accompanied by its urge. Thus the further retention of urine is controlled by cortical centers that provide arbitrary reduction of external urethral sphincter through somatic nerves. Emptying the bladder is achieved mostly through the parasympathetic ganglia and nerve pathways at the lumbosacral spinal cord. For adequate urination is necessary for simultaneous synergistic contraction of detrusor and relaxation of the vesical sphincter.

Somatic innervation is presented by fibers of n. pudendus that comes out of S1-2 segments and regulates the function of the external vesical sphincter. The main function of the somatic nervous system - retention of urine by the sudden increase of intravesical pressure (tension during physical work, sport exercises, coughing, laughing). In the etiology of neurogenic bladder dysfunction the major significance have a level and the prevalence of nervous system. Thus, trauma, tumors, inflammatory-degenerative diseases that causes the transverse dissociation of the spinal cord in the area of lumbosacral segments or above, will lead to essentially same, albeit with specific hues of LUTS.

There are three levels of damage localization:

- Cerebral (supraspinal);
- Suprasacral;
- Sacral (sacral).

For each of these levels are characterized by certain mechanisms of disorders and urination symptoms.

Classification

From the standpoint of pathogenesis and possible evaluation of denervation of the most successful is the following classification of neurogenic bladder dysfunction:

1. Uninhibited cortical bladder.
2. Spinal reflex bladder.
3. Unadapted bladder:
 - Spinal;
 - Ganglionic.
4. Areflexic bladder:
 - Spinal;
 - Ganglion;
 - Intramural primary (megalocystis);
 - Intramural secondary (mioneurogenic atony).
5. Combined (arereflexive-unadapted) bladder.
6. Contracted bladder.

Clinical picture

Uninhibited cortical bladder - is characterized by weakness of functional cortical centers that are unable to provide inhibitory effect on spinal structures with arbitrary control of urinary retention, in case of urge incontinence it is absent or weak. In these patients, the usual manifestation is the presence of unrestrained (imperative) urination which leads to the urgent incontinence.

Reflexive spinal bladder - occurs in patients with spinal cord injury above the lumbosacral centers. In the absence of inhibitory impact of brain, urination occurs at low volume with filling of the bladder involuntarily, by the type of spinal reflex.

Unadapted bladder - is characterized by reduced adaptive (cumulative) bladder function due to damage of sympathetic centers in the spinal cord or retrospinal sympathetic ganglia. In patients with unadapted bladder the urges are usually absent or greatly weakened, due to the impossibility of filling the bladder to the threshold.

Areflexic bladder - is characterized by absence or significant weakening of the urge to urination due to loss of sensitivity in damaged spinal or ganglionic parasympathetic centers, as well as in underdevelopment or destruction of peripheral nerves of the bladder (intramural form). In these patients, equivalent urge can be achieved only at the maximum filling of the bladder.

Combined urinary bladder manifests by chronic urinary retention with subsequent dilatation of upper urinary tract and increasing renal insufficiency. Normally in patients occurs the urinary incontinence at the overflow bladder (paradoxical ischuria).

Contracted bladder - develops as a result of the degenerative progression and sclerotic changes of detrusor in the conditions of denervation in it, joining of infection or prolonged bladder drainage.

A typical manifestation of urination disorders at localization of demyelinating defeats above the center of urination, located at the bridge of the brain can be hyperreflexia of detrusor. Frequent urination at short intervals, imperative urinary incontinence, strangury are the common symptoms of detrusor hyperreflexia. Arising at any time and in any place, these symptoms make considerable discomfort to patients. The mechanism of these symptoms lays in the reducing or losing of voluntary control in the urination act and lowering of adaptive capacity of detrusor. This reflex arc, which includes the located in sacral section center and the urination center in the bridge of the brain, remains unused. In other words, at the hyperreflexia of detrusor, despite the self-preservation of urination, the accumulation of sufficient amount of urine in the bladder becomes impossible.

At the damage of the sacral top area, the patients may feel the lack of autonomous vesical contractions, which are accompanied by detrusor hyperreflexia, as in the case of cerebral disorders. At the same time, spinal damages have their own characteristics in the form of reticulospinal damage of paths that go from the bridge of the brain and are involved in the synergistic integration of active urethral sphincter and detrusor. In addition to involuntary

detrusor contractions, while there is contraction of the urethral sphincter that causes urinary retention and accompanied by increased intravesical pressure. The specified condition is called - detrusor sphincter dyssynergia. Clinical manifestations of sacral top damage of spinal cord consist of irritative (accelerated, imperative urination) and obstructive (strangury, interruption of stream, urinary retention) symptoms. For detrusor sphincter dyssynergia is characterized the incomplete emptying of the bladder with retention of urine, which increases the possibility of developing inflammatory complications of bladder and upper urinary tract and also - urolithiasis. In addition, in these level of damage can be marked the incomplete relaxation of the sphincter and its paralysis, resulting urinary incontinence (incontinence of sphincter). Sacral defeat of area causes loss of reflex detrusor contraction (detrusor areflexia) and loss of contractile ability of the urethral sphincter. In this situation, patients complain on the absence of urge to urination. The absence of normal bladder emptying in patients develops in the future as urinary incontinence due to overflow of bladder. Another option of urination disorders with sacral damages is reduction of contractile detrusor ability, which causes to violation of vesical emptying and manifests as the difficult urination with sensation of incomplete emptying of the bladder. The above symptoms of lower urinary tract can lead to various disorders of upper urinary tract - vesico-ureteral reflux expansion of ureters and pelvis, pyelonephritis, and chronic renal failure. Taking into account that denervation of the bladder, leads to the sharply pronounced trophic disorders, the course of disease is often complicated by interstitial cystitis that causes the sclerosis and vesical contraction (microcystis).

Diagnostics

The complexity and variety of primary and secondary symptoms in neurogenic bladder dysfunction, creates significant difficulties in diagnosis, as it is not necessary to establish the diagnosis, but also to assess the condition of the kidneys and urinary tract and to detect the concomitant changes in the other organ systems. Great importance in the diagnosis has the anamnesis of disease determination- namely, the nature of urination disorders, conjunction with other disorders, urinary symptoms - bowel function

disorders, general symptoms (malaise, headache, thirst, dry mouth, hypertension, and violation of vision) injury of the spine and head, diseases of the nervous system, spinal hernia. On examination of the patient should pay attention to the external signs of innervation feet violation, signs of urination and defecation, presence of stretched bladder, urination from the urethra by pressing on the lower abdomen, atony of the rectal sphincter with digital examination. X-ray of the spine reveals the splitting of the spinal canal in the lumbosacral area,

spinal hernia, deformity, hypoplasia or complete absence of the sacrum and coccyx. According to the testimony is conducted

X-ray and radioisotope examination, ultrasound, cystoscopy, cystometrogram, sphincterometry, uroflowmetry and profilometry urethra.

Treatment

Treatment of neurogenic bladder dysfunction remains is a difficult and largely impossible task. There are three main areas of treatment: medicamentous, physical therapy and surgery. The main treatment of urological disorders in patients with neurogenic bladder dysfunction is a medicamentous treatment.

The medications for the treatment of neurogenic bladder dysfunction include:

- Anticholinergic drugs;
- Myotropic relaxants;
- α -blockers;
- β -blockers;
- α -adrenomimetics;
- Calcium antagonists;
- Prostaglandins E and F; 2; 2 α
- Neurotoxic drugs for intravesical introduction:
- Urinary antiseptic.

From physical therapy methods are used the low-frequency electrical stimulation and local hyperthermia in the area of the bladder by the naftalan paste or ozokerite. In the absence of conservative treatment effect is evaluated the feasibility of invasive methods. Most common is the sacral neuromodulation: using the bilaterally implanted needle electrodes in the sacral openings is achieved the required effect on the detrusor and sphincter apparatus of the bladder. We use the percutaneous sacral blockade with anesthetics, ethyl-phenol denervation of the pelvic nerve root and plexus. In extreme cases is possible to conduct the operations of reinnervation, revascularization, remusculisation, multiple myotomy of bladder detrusor, dissection of the external urethral sphincter. It should be noted that none of the treatments does not provide of satisfactory stable result.

Control tasks

1. The role of the autonomic nervous system in providing of urination.
2. How does the bladder and sphincter work after complete spinal cord injury above the sacral part

reflex arc?

3. In patient S., 75 years after stroke were arose events of daily polaciuria and nocturia. Also, it was noted by patient the compelling urge to urinate, strangury, the phenomenon urgent incontinence.

Diagnosis?

Treatment?

Answer. In a patient – are the typical symptoms of detrusor hyperreflexia, specific to supraspinal injury (so-called "cortical uninhibited bladder"). Drugs of choice for reduction of the detrusor activity are anticholinergic agents. We use tablet form of M-cholinoblockers (solifenacin, 4 oxybutynin or tolterodine).

4. Patient S., 58 years old, with Schmorl hernia has the complaints of the urination lack, incontinence. The examination was diagnosed the overflow bladder, bilateral ureterohydronephrosis, chronic renal failure.

What type of urination disorders and level of damage in this patient?

Answer. Patient with detrusor areflexia is characterized by the lesions of lumbosacral spinal cord.

Chapter 14

OTHER UROLOGICAL DISEASES

14.1. Hyperactive bladder

The symptom complex, which is called by the term “hyperactive bladder” (HB) according to the decision of the International Consultation on urine retention, is encountered most frequently among dysuric disturbances of the neurogenic character that has recently started to be considered a separate disease.

Epidemiology

According to its prevalence HB is much more common than other diseases. In general population of over 40 the HB prevalence ranges from 12% and 22% and grow with age, reaching 31%-42% in people over 75. Lately it has been shown that up to 15%-20% of males over 50 having dysuric disturbances traditionally associated with benign hyperplasia of the prostate gland (BHPG) are operated on without good reasons. The main cause of their disuria is HB; therefore surgical treatment of BHPG does not give any relief.

Etiology and pathogenesis

The immediate cause of its development is uncontrolled (involuntary) contraction of the detrusor. In the norm the volume of the bladder is 250-300 ml and the first vesical tenesmus may be checked by the person for a long time, in HB the first vesical tenesmus may develop already in 30-50 ml and the patient can't check it – it results in urgent tenesmus. Such uncontrolled contractions of the

bladder wall develop due to different causes. The main cause is considered to be the processes of “aging” of the bladder wall,

age hypersensitivity of receptors of its wall, disbalance of the growth factors, etc. The triggering factors may include chronic gynecological inflammatory processes, chronic prostatitis, benign hyperplasia of the prostate glands, etc.

Clinical picture

The complex of symptoms of HB is characterized by the following complaints:

- Imperative vesical tenesmus (urgency) - a compulsory symptom of HB – sudden vesical tenesmus, which cannot be put off (otherwise there will be involuntary urination);
- Incontinence of urine (any involuntary urination);
- Polaciuria (frequent urination) – urination over 7 times a day;
- Nocturia (urination more than once at night).

Among the mentioned dysuric disturbances the patients suffer much more from urgency and urine incontinence (UI). These sufferings have their definite peculiarities. HB is not life – threatening disease but has a significant influence on the every day life of the patient, limiting his activity, social contacts, sexual intercourse, sometimes resulting in change of work, worsening of life quality. Our experience shows that most specialists (including urologists) do not have clear idea about methods both of diagnosis and treatment of this unpleasant feeling;

therefore, the patients get no aid or they are administered antibiotics considering this to be a manifestation of cystitis.

Diagnosis

The main methods in diagnosis of HB are:

- **Complaints of the patient.** Qualification evaluation of the manifested complaints of the patient with this disease is as important as data of the objective examination. As it was already noted, the main manifestations of HB are vesical tenesmus, polaciuria, nocturia and UI in different combinations. At the same time hematuria, painful urination, difficult
- urination and other complaints are not typical of HB. In HB there is urgent type of UI - when the patient feels sharp tenesmus, which cannot be delayed and doesn't have time to evacuate the bladder. Other type of UI is stress –induced characterized by involuntary excretion of urine on physical exertion as well as in coughing, sneezing, dancing.

Anamnesis of the disease. Its thorough taking is an obligatory step for making a diagnosis. It is necessary to pay attention to such facts, which are evidence of the nervous system pathology – traumas of the spinal cord or brain, pelvis, spine disorders (unmarked osteochondrosis, changes of the intervertebral discs), multiple sclerosis, Parkinsonism. Other significant diseases that may lead to HB and UI are diabetes

- mellitus, pathology of the pelvis organs due to surgical interventions in the uterus and ptosis of the pelvic organs, difficult and pathological deliveries, in males there may be pathology of the prostate gland.
- **Filling in of the 24 hour graph of urination** by the patient during 48 and 72 hours, which registers the hour of urination and volume of urine. HB is characterized by urination rate more than 7 times a day; the average amount of urine for urination does not exceed 100 ml. Besides, the patient should mark the development of dysuric manifestations (imperative tenesmus, UI, pains, etc). The investigations proved that such a graph was much more objective than simple questioning the patient.
- **The obligatory element of the urological examination of all patients with HB is urinalysis and ultrasound investigation** to exclude other pathology, which may cause dysuric disturbances, most frequently these are inflammatory diseases or tumors of the bladder or prostate gland.

When no other pathology is revealed by these methods and clinical picture corresponds to the typical one, there is no need to make additional studies (X-ray examination, computer tomography, etc).

HB has special peculiarities in different categories of patients:

- In females HB is often accompanied by UI (more frequently in the day time). Most frequently it is women in the menopausal period and elderly women. It is necessary to diagnose clearly stress and imperative UI. Frequently there is no initial cause for development of HB and UI. One of the most frequent concomitant problems is chronic cystitis.
- In males HB is rarely accompanied by UI. Most frequently these are elderly men with BHPG; chronic prostatitis is the cause in younger age. UI develops rarely, as a rule in expressed anatomical changes (neurological pathology, tumors of the prostate gland, postoperative pathologies). Stress UI develops, as a rule, after surgery of the prostate gland.
 - HB frequently depends on congenital causes. Quite frequently it is complicated by cystitis, pyelonephritis. UI typically develops at night. Stress HB is observed rarely.

Treatment

According to all protocols anticholinergic medicines (cholinolytics (CL) are the medicines of choice in treatment of HB. Their action consists in blocking M-cholinoreceptors of the bladder wall that are responsible for contraction of the detrusor. In treatment with CLs one should bear in mind that their efficacy is manifested mostly during their intake; on finishing the course of treatment this effect often disappears. The treatment should be given for a long time (3-6 months) as most CLs exert their influence only after 3-4 weeks of treatment. General side effects of CLs are dryness in the mouth (most frequently), constipation, blurred vision.

Oxybutinin was the first drug among CLs but it had a lot of side effects. CLs of further generation became more effective and with fewer amounts of side effects (tolterodin). At present solifenacyn succinate – a modern CL has the best characteristics (efficacy/tolerance). It has a long-term effect in treatment of all symptoms of HB and predominate over all other CLs in absolute majority of indices.

The drug may be used for a long time (months and years); tolerance does not develop in gradual growth of the drug efficacy.

About 60% of patients got rid of UI while using solifenacyn, 40% of patients do not have urgent tenesmus. Considering nonmedicinal methods of treatment of HB the electrostimulation of the bladder is used in a special regimen, which allows to normalize the muscular activity of the detrusor and sphincter apparatus and may be used simultaneously with CLs. Thus, the hyperreactive bladder is a complex of symptoms, which are often encountered both among males and females and results in considerable social and personal problems, and modern drugs allow to treat it effectively.

14.2. Nephrogenic arterial hypertension

Nephrogenic arterial hypertension is hypertension resulting from the disease of the renal vessels or their parenchyma.

Classification

There are two forms of nephrogenic hypertension: vasorenal and parenchymatous.

Vasorenal nephrogenic hypertension

Etiology and pathogenesis

Vasorenal nephrogenic hypertension is caused by affection of the renal artery or its large branches resulting in insufficiency of blood inflow to the kidney.

Renin-angiotension-aldosterone system plays a prominent role in pathogenesis of the disease. Renin secretion increases due to insufficient inflow of the blood to the juxtaglomerular apparatus. Angiotensinogen produced in the liver under the influence of rennin is transformed into angiotensin I, which is transformed in angiotensin II under the effect of angiotensin-transforming enzyme. The latter is found in the lungs, kidneys and blood plasma. Angiotensin II is a potent pressor substance that causes systemic and local spasm of the arterioles, enhancement of sodium

reabsorption by the kidneys. Angiotensin III is formed as a result of angiotensin II metabolism, which is a hormone having a slightly expressed pressor effect but stimulating considerably the

production of aldosterone. The elevation of the arterial pressure is associated both with vasoconstriction at the

expense of angiotensin II influence and secondary hyperaldosteronism and retention of sodium and water in the organism. Accumulation of the sodium results in hypervolemia and increase of the cardiac discharge. The causes of vasorenal hypertension may be congenital and acquired affections. The congenital causes include fibromuscular dysplasia of the renal artery, aneurism of the renal artery, hypoplasia of the artery, arteriovenous fistulas, anomaly of the aorta development.

The acquired affections include arteriosclerotic stenosis of the renal artery, stenosis of the renal artery or vein in nephroptosis, thrombosis or embolism of the renal artery, panarteriitis, aneurism of the renal artery, compression of the renal artery.

Clinical picture

There are no characteristic symptoms. The disease is characterized by sudden onset manifested by high arterial pressure or complicated hypertension being before and becoming insensitive to therapy. There is a characteristic malignant course, early

enlargement of the left ventricle, angiospastic retinopathy. There are characteristic high figures of the diastolic pressure and sharp development of crises.

Diagnosis

The differential diagnosis is made with hypertension disease, parenchymatous nephrogenic and symptomatic hypertension of different kinds.

Treatment

Medicinal and surgical intervention is used in treatment. Conservative therapy is given while preparing the patient to the operation and in the postoperative period. Its aim is to maintain the arterial pressure under control using measures to minimize the affection of the target organs and trying to avoid

undesirable side effects of the medicines. In ineffectiveness of the conservative treatment there may be discussed surgical treatment to restore the main blood circulation in the kidney.

The character of the operation depends on the kind, localization, degree of narrowing of the renal artery, extension of the process, amount and quality of the preserved parenchyma in the affected and contralateral kidney.

Kinds of surgical intervention:

- Plasty of the a.renalis;
- Ballon dilatation of the a.renalis;
- Nephrectomy.

Nephrectomy is contraindicated in bilateral stenosis of the renal artery, atherosclerosis of the contralateral kidney.

Prognosis

The prognosis is unfavorable without operation; in timely operation it is favorable but the patients should be kept under doctor's observation.

Parenchymatous nephrogenic arterial hypertension

Etiology and pathogenesis

Parenchymatous nephrogenic arterial hypertension develops due to diseases that involve the renal parenchyma. The causes of parenchymatous nephrogenic arterial hypertension may be chronic pyelonephritis, glomerulonephritis, nephrolithiasis, hydronephrosis, polycystosis of the kidneys, kidney tumor, kidney tuberculosis, spongiform kidney. There are several mechanisms in pathogenesis of this disease; the

main ones are water-electrolytic disbalance, activation of the pressor hormonal systems, and inhibition of the depressor ones.

Decreased number of the active nephrons due to affection of the renal parenchyma by this or that pathologic process results in sodium retention and enhancement of its reabsorption, which in its turn, lead to hyperhydratation, hypervolemia, increased cardiac

discharge and development of arterial hypertension. The affection of the intrarenal vessels because of the sclerotic changes of the parenchyma in chronic pyelonephritis or edema of the interstitial tissue due to the inflammatory process may be a trigger in activation of the pressor hormonal systems, first of all, rennin-angiotensin- aldosterone system.

Clinical picture

The symptoms of arterial hypertension resulting from chronic pyelonephritis are composed of symptoms of pyelonephritis and elevated arterial pressure. At the same time almost in 30% of patients chronic pyelonephritis is manifested only by hypertension, which is not infrequently revealed by chance. During development of the disease hypertension becomes stable, with high indices of the diastolic pressure and resists conservative therapy. Only some patients complain of headache, thirst, subfebrile body temperature and polyuria.

Diagnosis

The diagnosis is based on determination of the etiological association of the renal disease and arterial hypertension. To diagnose chronic pyelonephritis it is important to have urinalysis and reveal pyuria in certain data of the anamnesis. Decrease of the arterial pressure against the background of effective therapy of the renal disease is evidence of association of the latter and hypertension.

Differential diagnosis

The differential diagnosis of the parenchymatous form of nephrogenic arterial hypertension is made with hypertension, different kinds of symptomatic arterial hypertension. The diagnosis is based on the same tests as in vasorenal hypertension.

Tests of Howard and Rappoport as well as angiotensin test of determining the level of aldosterone and catecholamine in urine, aortography, etc are of additional significance in the diagnosis of the parenchymatous form of nephrogenic arterial hypertension.

Treatment

Treatment of the parenchymatous form of nephrogenic arterial hypertension at the initial stage of the disease consists in administration of hypotensive drugs and obligatory treatment of the renal disease.

In stable hypertension against the background of unilateral chronic pyelonephritis nephrectomy is indicated in the shrunken kidney. In bilateral chronic pyelonephritis the process of shrinkage in one of the kidneys is more intensive.

Therefore, it is also expedient to perform nephrectomy in malignant arterial hypertension when the other kidney may provide homeostasis. In the advanced forms bilateral nephrectomy is necessary with further transplantation of the donor's kidney.

The simultaneous application of corticosteroids, antibacterial and hypotensive drugs in chronic pyelonephritis contributes to inactivation of the inflammatory process and decreases the possibility of hypertension development. The use of diuretics – spirolacton – blocks the intracellular receptors of aldersterone. Reserpin, hydrochlorthiazide, guanstadin and others are administered for decreasing the pressure.

Blockers of β -adrenergic receptors take an important place in the complex treatment. They inhibit the cellular activity of the juxtglomerular apparatus, especially when rennin-angiotensin- aldosterone system takes part in the

pathogenesis of supporting arterial pressure. Pindolol has the highest sympathomimetic activity and propranolol has a membrane-stabilizing effect. Beta-adrenoblockers are contraindicated in atrioventricular blockade, bronchial asthma, manifested stages of the blood circulation insufficiency. The optimal dose of propranolol is 60-100 mg per day. It is taken for many years.

Beta-blockers in the complex with saluretics of the thiazide line favorably influence renal hemodynamics supplementing each other; they influence different links of arterial hypertension. Early diagnosis of acute and chronic pyelonephritis may give effective and rational treatment, thus the prevention of hypertension.

Prognosis

After nephrectomy performed before the irreversible changes in the contralateral kidney as well as in unilateral chronic pyelonephritis that caused arterial hypertension, the prognosis is favorable.

14.3. URINO-GENITAL FISTULAS IN WOMEN

Urinary fistulas (UF) are pathological junction between the urinary organs and external surface of the body (external urinary fistulas) or genitals (urino-genital fistulas), intestines (urino-intestinal fistulas).

Epidemiology

According to the WHO statistics about 2 mln women with UF live in the countries of Africa and the Near East, and about 100,000 women increase this

figure yearly. At this moment according to the WHO data the prevalence of the obstetric fistulas makes about 0.3% in all deliveries.

Most of vesico-vaginal and urethra-vaginal fistulas are formed as a result of the obstetric trauma in the countries of the third world, in the economically developed countries the main cause of the fistula formation is different gynecological operations. They make over 70% of UF in Great Britain and the

USA. According to different data the rate of UF formation after hysterectomy ranges on the average from one case per 650 operations to one case per 900 operations in Europe.

Etiology and pathogenesis

External UF is, as a rule, labelloid with straight short tract, which is formed in the close contact of the epithelium of the genital walls with the skin surface. There is hyperemia of the skin about the fistula opening, not infrequently there are purulent affections. There are external fistulas of more complex structure that have long twisting tracts and pockets, which contribute to development of abscesses and phlegmonas in the

surrounding tissues. There may be self-closing of the fistula in restoration of the passage of the urinary tracts lower than the fistula.

Internal UFs include vesico-vaginal, uretero-vaginal, salpingovesical, urethrovaginal, urethroprostato-rectal as well as uro-intestinal fistulas. The most frequent fistulas are those that connect the organs of the urinary and sexual systems. They are observed predominantly in women as a result of injuries obtained during complicated deliveries, in medical and criminal abortions as well as in trauma of the ureter and bladder during gynecological operations. In urogenital fistulas voluntary urination is preserved but there is urine outflow from the vagina.

In the undeveloped countries the vesico-vaginal fistula occurs most frequently after deliveries. Prolong deliveries may lead to increased pressure on the bladder resulting in development of the bladder necrosis and vesico-vaginal fistula. The development of obstetrics in the developed countries allowed to decrease considerably the rate of postpartum UF. The most frequent cause of UF formation in

the developed countries is iatrogenic trauma of the bladder during surgical intervention. Gynecological operations make approximately 70-80% of all cases of UF formation. UF is formed in 1% of cases after laparoscopic vaginal hysterectomy. After radiation therapy fistulas are formed on an average in 1-4% of cases. Radiation affection of the bladder may become the cause of UF development and the fistula may be formed in 6-12 months after finishing treatment, however, it may develop in several years.

Most frequently development of UF is explained by a consequence of necrosis due to insufficient blood supply in the bottom area of the bladder or erosion that was formed under the influence of ligatures located between the bladder and vaginal fornix.

UF may be a consequence of unintentional perforation of the bladder wall. Urine, which outflows from the perforation opening, is accumulated in the pelvis behind the bladder (urinoma). Undrained urinoma may cause pain and abdominal distention, paralytic obstruction of the intestines, after a while UF develops when the site of the urine outflow from the injured bladder is a line of the vaginal sutures. UF is formed when the junction between the bladder and vagina is epithelized.

Classification

There are *congenital and acquired, external and internal UFs*. *Congenital UF* is a consequence of malformations – complete or partial atresia of the embryonic ducts and fissures. In complete atresia of the urinary duct the fistula is formed between the bladder and umbilicus. Congenital urinary fistulas also include vesico-intestinal, urethrorectal and urethroprostato-rectal fistulas.

Acquired UFs are encountered more often than congenital ones. The main cause of their formation is combination of the traumas, inflammatory and purulent complications of different

diseases of the urinary and abdominal organs, trophic changes of the tissues due to radiation therapy of the tumors, disintegration of the tumors of the small pelvis.

A separate group is formed by *artificial external UFs* that are applied for the outflow of urine (nephrostoma, cystostoma).

There is also clinical morphological classification of UF.

Bladder fistulas:

- Vesico-vaginal;
- Vesico-uterine;
- Vesico-appendages.

Ureter fistulas:

- Ureter;
- Ureter-vaginal;
- Ureter-uterine.

Urethrovaginal and urethrovesicovaginal fistulas

Combined fistulas.

- Urogenital;
- Urointestinal

Complicated urogenital fistulas.

Clinical picture

Usually patients note painless vaginal discharge on the 7th-14th day after surgery. The discharge volume differs significantly depending on size and localization of the fistula. Most UFs are located in the fundus area of the bladder and are quite big for most part of urine or even the whole amount of urine to outflow from the vagina. A very small fistula may lead to periodic leakage of small portions of urine.

Diagnosis

The most reliable method of diagnosis of vesico-vaginal fistula (VVF) is a test of the bladder filling. The bladder is filled with liquid through the catheter or cystoscope and the vagina is examined using the speculum. Usually the examination reveals outflow of the liquid from the fistula into the vagina. Almost always there may be revealed some inflammation of its fornix, which is indispensable sign of most UFs. When the diagnosis is still doubtful, different methods with dyes are used. The solution of methylene blue or indigocarmine is introduced into the bladder through the catheter, which is then taken out of the ureter very carefully to avoid discharge of the dye. The site of probable localization of the fistula in the vagina is examined paying attention to appearance of blue coloring in the fluid discharged. By other technique a tampon is placed in the vagina after introduction of the staining solution. Staining of the upper part of the tampon indicates VVF, while the external part is stained mainly in incontinence or urine or urethra-vaginal fistula.

Cystography may help in diagnosis but usually it is not made. When the diagnosis has already been established it is necessary to make cystoscopic examination, which helps to establish the number, size and localization of the fistulas as well as determine the expressiveness of the concomitant bladder inflammation. Fistulography, urethrography are made to clear up the fistula passage.

Differential diagnosis of UF.

A small amount of the vaginal discharge after hysterectomy may appear due to discharge of the serous fluid from the vaginal fornix. Gynecologists frequently take urine

discharge in UF for signs of seroma (accumulation of the serous fluid) of the vaginal fornix resulting in delay in making a correct diagnosis. On the other hand, urine discharge from the vagina after

surgical intervention in the organs of the small pelvis may be caused by other urinary fistulas, for example,

ureter-vaginal ones that are encountered more often. The possible variants of the urinary fistulas are urethra-vaginal, vesico-uterine fistulas as well as different fistulas between the intestines and bladder that may involve the vagina. Patients with very small UFs, who periodically discharge quite little amount of urine may be mistakenly taken for patients with stress urine incontinence.

When it is unclear whether the discharged fluid is urine from the vagina, it should be collected and investigated for nitrogen of the blood urea and creatinine. When the indices of urea and creatinine exceed those in the blood (usually 20 times) the presence of VVF should be considered as proved. As the ureter-vaginal fistulas are rarely combined with vesico-

vaginal ones, and taking into account that these fistulas are quite frequent cause of urine discharge after surgical interventions in the pelvic organs, it is important to exclude this diagnosis. The ureter-vaginal fistulas are characterized by normal spontaneous urination from the bladder and constant urine discharge from the vagina. On the basis of intravenous urography we may find out not only the site of fistula localization with different degree of urine discharge into the vagina but also accompanying obstruction of the ureter and hydronephrosis. Retrograde urography may also help in diagnosis of the ureter-vaginal fistulas.

Treatment

Treatment of UFs is predominantly surgical. The fistula is excised, the passage of the urinary tracts is restored, the organs and tissues taking part in the fistula formations separated. Different operations are proposed for treatment of the urinary fistulas.

The main principles of fistula closing:

- Refreshing of the fistula opening edges by the method of splitting;
- Sufficient mobilization of the tissue that allows to suture them without tension;
- Thorough approximation of the edges;
- Application of the multi-row suture
- Constant catheterization of the bladder for 10-14 days.

Suturing of the vesico-vaginal fistula by the transvaginal approach:

- An approach to the operation field is made by the speculums;
- The vaginal walls are incised by the round incision 1 cm from the fistula edge or by cross-like incision;
- The fistula edges and bladder walls are separated acutely off the vaginal wall (sometimes the tissues are infiltrated by 0.25% solution of novocaine);
- Suturing of the bladder wall by applying separate sutures;
- Interrupted sutures are applied on the vaginal wound edges.

To close highly located UFs that open into the vaginal stump the operation of Savitskaya is performed:

- The vagina is opened by speculums.

- The postoperative cicatrix in the vaginal stump is taken by the long clamps on either side of the fistula opening and drawn the fistula nearer to the vaginal entrance;
- The horizontal incision is made along the cicatrix of the vaginal stump under the posterior edge of the fistula;
- For complete mobilization of the posterior edge of the fistula the peritoneum behind the uterine recess is dissected by the transversally long scissors to separate the adhesion of the rectum with the bladder.
- After mobilization of the posterior edge of the fistula the vesico-vaginal septum is split
- Bypass or anchor incision is made;
- The bladder defect is sutured by rows of interrupted sutures;
- Peritonization of the bladder sutures is performed at the expense of the peritoneum of the small pelvis;
- The interrupted sutures are applied on the edges of the vaginal wound (anterior and posterior wall).

The patients whose defects of the bladder are unapproachable from the vaginal side may be performed laparotomy.

The operation is performed by the following technique:

- After laparotomy the peritoneal vesico-uterine fold is excised in the area of the vaginal stump;
- The bladder fundus with the fistula opening edges are separated from the anterior wall of the vagina.
- The edges of the fistula opening are gripped by soft clamps;
- The bladder wall is mobilized;
- The fistula opening in the bladder is sutured by two rows of the interrupted sutures;
- The vagina remains open for drainage of the abdominal cavity;
- The vaginal stump is peritonized by suturing of the vaginal anterior wall edge to the edge of the vesico-uterine fold; edges of the posterior vaginal wall – to the edge of the retrouterine – rectal recess;
- The abdominal wall is tightly sutured.

In presence of the vesico-cervical fistula, the opening in the uterine cervix is sutured after restoration of the bladder integrity; then the edges of the vaginal wound are joined together and with the uterine cervix.

Vesico-appendages fistulas develop in perforation of the uterine appendages in the bladder or untimely operation for purulent formations in the uterine appendages. Such patients are indicated surgical treatment:

- Laparotomy is performed;
- The changed uterine appendages are removed;
- When the opening in the bladder is quite big in size, the operation of the bladder dissection is performed through its anterior wall;
- The fistulas edges are excised within the healthy tissues.
- The bladder integrity is restored by applying interrupted sutures;
- Foley catheter is left in the bladder.

Suturing of the veciso-vaginal fistulas is performed after elimination of the inflammatory process and epithelization of the fistula in 3-4 months, while ureter-vaginal fistulas require rapid intervention. Long-term waiting is accompanied by affection of the kidney and may lead to its complete dysfunction.

The operation of **Boari** is performed in cases when affection of the ureter involves the whole pelvic part.

Urethrocystoanastomosis is performed in presence of the fistula in the juxtevesical part of the ureter. The important stage of the operation for UF is separation of the tissues and organs taking part in its formation. The attempts are made to close fistulas with the help of tissues of the cervix and uterine body, perineum, skin of the vulvar lips, thigh, flaps of the pelvic fascia. The operations give a relatively high percentage of recurrences.

14.4. DROPSY OF THE TESTICULAR MEMBRANES (HYDROCELE)

Hydrocele is a disease characterized by accumulation of the serous fluid between the visceral and parietal leaves of the internal (of its own or vaginal) membrane of the testis.

Hydrocele volume is usually from 20 to 200 ml, in exclusive cases it is up to several liters. Hydrocele fluid is transparent, of light-yellow color.

Congenital dropsy of the testicular membranes and spermatic cord is observed in atresia of the vaginal process of the peritoneum, it results in junction of the abdominal cavity with the cavity where the testis is and the serous fluid is accumulated in the cavity of the proper tunic of the testis (Fig.14 1).

Etiology and pathogenesis

Primary idiopathic hydrocele develops in disbalance between the secreted fluid and the fluid absorbed by the proper tunica of the testis. The most frequent cause of secondary hydrocele is inflammatory and neoplastic diseases of the testis and its epididymes as well as traumas of the genitals.



Fig. 14.1 Congenital dropsy of the testicular membranes: a - schematic description; b - external view

In congenital dropsy of the testicular membranes and spermatic cord is diagnosed when the vaginal process of the peritoneum remains open along the whole spermatic cord and testis. When it is obliterated along the whole course up to the testes and the fluid is accumulated between two leaves of the proper tunica of the testis then hydrocele occurs. When the vaginal process remains open along the whole course of the spermatic cord and

the fluid is accumulated between its leaves this is a combined hydrocele of the spermatic cord. The latter occurs gradually and unnoticed in most cases. In partial obliteration of the process, one or several cysts are formed on the spermatic cord.

Classification

1. Congenital dropsy of the testicular membranes
 - a) connected hydrocele (which is connected with the abdominal cavity);
 - b) Unconnected
2. Acquired dropsy of the testicular membranes
 - c) Primary (idiopathic)
 - d) Secondary (symptomatic)

Clinical picture

A painful or tense tumor suddenly appears in this or that vaginal area under the influence of tension of the abdominal press, usually in coughing. The abdomen is slightly distended and becomes sensitive to palpation; there are vomiting and retention of excretion. The clinical picture resembles reduced hernia. The disease with such clinical manifestations is called reduced, combined with dropsy of the spermatic cord.

In dropsy of the testis and spermatic cord enlargement there is enlargement of one or sometimes (in bilateral process) both halves of the scrotum, swelling spreads upward in

the direction of the inguinal canal (Fig. 14.2). In dropsy of the testis swelling is of the spherical shape, soft and elastic to the touch; the testis is located in its lower part. Dropsy is characterized by the fact that it is transparent; therefore diaphanoscopy is used for its diagnosis. Accumulation of the fluid in the cavity of the vaginal membrane may be revealed at once after birth or later. When it is revealed later we may suppose that dropsy developed under the influence of elevated intraabdominal pressure (for example, unceasing cough, etc) in a child who did not have complete obliteration of the vaginal process of the peritoneum.

Diagnosis

The ultrasound investigation allows to make a precise diagnosis of hydrocele – accumulation of the fluid is visualized from the enlarged scrotum. As to the secondary nature of dropsy, US investigation allows to determine the cause of its development



(tumor of the testis, epididimitis, orchitis). On diaphanoscopy the whole dropsy is shown through. The symptom of showing through may be negative in case when the testis membrane sharply got thick, there is hematocele or pyocele (blood or pus in the testis

membrane), or tumor of the testis. Hematocele is hemorrhage into the cavity of the testis membrane dropsy, which may

develop due to trauma, in hemorrhagic diatheses, after failed puncture of hydrocele.

Pyocele - suppuration of the testis membranes in its dropsy - is a complication of abscessing orchitis or epididimitis.

The examinations made:

- Examination, palpation;

Treatment

Reactive dropsy of the testis membranes in acute epididimitis, orchitis requires conservative treatment – rest, wearing of suspensory, antibacterial therapy. Puncture of hydrocele with further aspiration of its contents and introduction of sclerosant substances (alcohol solution of iodine, alcohol, etc) is nonradical method of treatment, which threatens to develop complications (pyocele or hemocele). Sometimes involuntary disappearance of the connected dropsy is observed at the breast-feeding age. Therefore, small dropsies that do not have any tendency to enlargement do not require surgical intervention. The operation of Vinkelman and Bergman is the most effective method of surgery (Fig. 14.3)

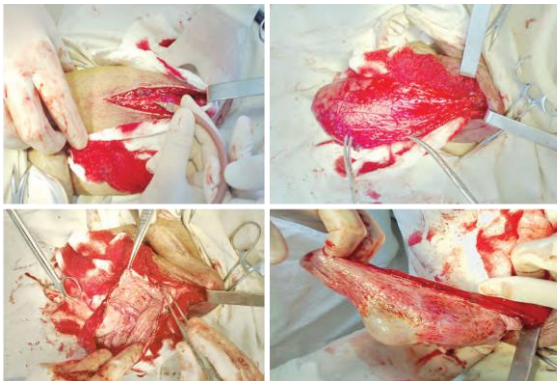


Fig. 14.3. Surgical technique by Vinkelman: a-d - intraoperative photos, b - schematic description the line of cut of hydroptic sac

The technique of Vinkelman's operation:

(It is indicated in small dropsies when the vaginal membrane is small and easily pulled out).

- The skin is treated with antiseptics and the operative field is isolated;
- The skin and dartos muscle are incised by the incision along the anterior-external surface of the scrotum by 5-7 cm in length parallel to the middle suture;
- The testis with membranes is exfoliated from the dartos muscle and delivered into the wound;
- The parietal leaf of the vaginal membrane is dissected, its edges are delivered outside and sutured behind the testis by interrupted or uninterrupted catgut suture;
- The testis descends into the scrotum, the scrotum cavity is drained by rubber strip, which is delivered into the lower angle of the wound; the wound is closed in layers up to the drainage.

The operation by Bergman differs in the fact that the vaginal membrane is not pulled out but is excised 1-1.5 cm from the testis and then the uninterrupted catgut suture is applied to the remnants of the vaginal membrane.

The operation by Bergman –Vinkelman differs in the fact that after partial excision of the external leaf of the vaginal membrane the edges are sutured together behind the testis. It is performed in large dropsies of the testis. Antibacterial drugs are administered in the postoperative period and the patient should wear suspensory for some time.

14.5. VARICOSE VEINS OF THE SPERMATIC CORD (VARICOCELE)

Varicocele - varicose veins of the spermatic cord – is related to the wide –spread diseases of the children’s reproductive system (Fig. 14.4). Varicocele is diagnosed in 10-25% of children and teenagers. Severe disorders of spermatogenesis are determined in approximately 30% of patients operated on in the children’s age. 40% of the childless marriages are associated with varicocele.

Etiology and pathogenesis

It is proved that development of varicocele is based on disorder of embryogenesis of the testicular veins and spermatic cord. During the puberty period the boys grow rapidly, which is marked by additional elevation of pressure in the cluster-like plexus because of the elevation of the orthostatic pressure. The intense inflow of the arterial blood to the testes is observed in the same period. The increased outflow of the blood evenly stretch the testis vein, moving apart the valves and thus, opening the way of the retrograde incoming of the blood from the overfilled renal vein into the testis one. The varicose deformation of

the walls of the changed network of the testis veins develops under the influence of considerably larger pressure. Long-term haemostasia results in increased temperature, development of sclerotic changes in the testis and disturbance of differentiation of the spermatogenous epithelium. These disturbances may be caused by blood shunting when the arterial blood bypassing the microcirculation of the testis parenchyma comes into the venules leading to development of circulatory hypoxia of the testicular tissue, which is one of the main causes of formation of pathospermia and infertility. At the same time the hematotesticular barrier is damaged. The autoimmune process develops. The circulating antibodies in the general circulation of the blood can overcome the hemotesticular barrier of the right testis due to different causes and bring about its morphologic disturbance and dysfunction. Later on it can be manifested by decrease of general spermatogenesis, appearance of the pathological forms of spermatozoa and infertility.

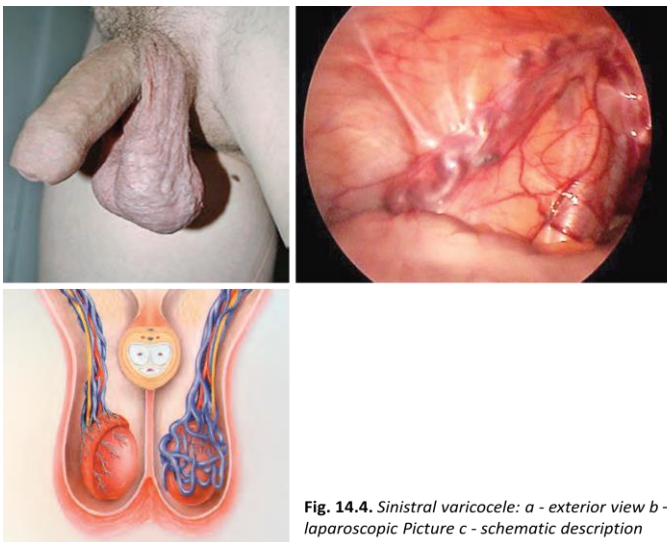


Fig. 14.4. Sinistral varicocele: a - exterior view b – laparoscopic Picture c - schematic description

Primary varicocele (idiopathic) is caused by inability or pathology of the valves of the testicular vein that develops against the background of its congenital changes (absence of collagen of the 4th type and absence of collagen of the 3rd type in the vein wall), secondary varicocele is conditioned by venous hypertension in the renal vein and reverse flow of the blood from the renal vein to the testicular cluster-like plexus and

then by the system of the external seminal vein into general glomerular one with formation of the compensatory renocava anastomosis. The venous hypertension in the kidney may be caused by organic stenosis of the renal vein due to cicatricial process in the surrounding cellular tissue, kidney tumor, ring renal vein, kidney anomalies of the type of “arteriovenous fistulas” of the posttraumatic and tumor character, nephroptosis, thrombosis of the renal vein. The functional stricture formation of the renal vein (functional varicocele) is of great

importance, i.e. compression of the left renal vein in the vertical position between the upper mesentery artery and aorta in the excessively acute angle of its origin. The angle value between the aorta and upper mesentery artery changes depends on the body position. In clinostasis the angle is bigger and outflow by the renal vein is not disturbed. In orthostasis the venous flow goes from the renal vein downward by the testicular vein into the cluster-like plexus; in clinostasis its direction is usual – from

the testicular into the renal vein. Sharp overfilling of the cluster-like plexus in the standing position disappears in the reclining position of the patient. It was called “aortomesentery forceps”; it is encountered in about 15-20% among all patients with varicocele. Of great importance is distinguishing clinical and subclinical forms. The varicocele symptoms in subclinical forms are not revealed on physical examination but they are found by the ultrasound investigation. As a rule, the patients with subclinical forms are revealed during examination for infertility in the adult age. That’s why it is significant to find this disease early and, if possible, to start treatment directed at improvement of the intraorgan blood circulation in the testis.

Varicocele develops predominantly on the left side (80-95% of cases). Its localization on either side is determined by different authors as 20%, on the right side – up to 10%; as a rule, it is evidence of the vascular anomalies in the patient or volumetric formations of the retroperitoneal space.

Classification

1. By the side of affection:

- Left-sided;
- Right-sided;
- Bilateral

2. By etiology:

- Primary
- Symptomatic
- Functional (secondary).

3. By the character of the venous reflux:

- With renotesticular reflux
- With ileotesticular reflux;
- With mixed variant of reflux

4. By the degree:

- I degree (veins of the spermatic cord are dilated to palpation but do not descend below the upper pole of the testis, there are clinical manifestations
- II degree (veins of the spermatic cord are dilated visually and to palpation but do not descend below the lower pole of the testis, there are moderate clinical

- manifestations, in the reclining position the veins collapse, there is moderate hypotension of the testis);
- III degree (veins are considerably dilated, they descend below the lower pole of the testis, the clinical manifestations are marked, there is hypotension of the scrotum and atrophy of the testis)
 5. By combination with hypertension in the renal vein:
 - Varicocele with hypertensive syndrome in the renal vein;
 - Varicocele without hypertensive syndrome in the renal vein;
 6. By clinical manifestations:
 - Clinical;
 - Subclinical.

Clinical picture

Symptoms of varicocele are usually scanty. The following variants are encountered:

1. Patients do not have any significant complaints and the diagnosis is made during screening examinations, and in the adult age – during examination for childless marriage.
2. Patients complain of periodic nagging persisting pain in the corresponding part of the scrotum, which may increase on physical exertion, sexual arousal and in the vertical position of the body (due to elevation of the venous pressure).
3. Patients complain of presence of dilated veins in the scrotum (“a bundle of worms”, “grapes cluster”) that are revealed during self-examination, especially during the puberty period.

The clinical manifestation of secondary varicocele associated with venous hypertension may be pains in the lumbar area of the dull or acute character (sometimes there are marked pain syndrome, fever, oliguria) and blood admixtures in urine (recurrent macro- and microhematuria, proteinuria).

Diagnosis

The examination is started with thorough taking of the anamnesis paying attention to the prescription of the symptom, presence of the trauma of the lumbar area. Then the patient is examined in the vertical and reclining position. Both spermatic cords should be examined when the patient is in the vertical position to detect difference in their size. It is necessary to make light tractions of the testis to decrease the effect of the cremasteric reflex. Any signs of testicular atrophy should be determined.

Functional tests are made – Ivanisevich and Valsalva (“cough push”). The test of cough push is made on palpation of the spermatic cord. During coughing the impulse is determined in the area of the external inguinal ring in sick children, which arises due to transmission of the elevated intraabdominal pressure to the veins of the cluster-like plexus; usually this impulse is not determined in healthy children.

To make the test of Ivanisevich the spermatic cord is pressed to the pubic bone at the level of the external inguinal ring in the reclining position. The cord veins in the scrotum are not filled in this position. When the compression of the cord is continued the veins are not filled in taking the vertical position. Varicocele is restored in ceasing pressure on the spermatic cord.

Data of the physical examination allow to detect the presence and degree of dilatation of the spermatic cord veins, to presume the character of hypertension in the

renal vein - stable or periodic, to clear up the presence and degree of testis atrophy on the side of varicocele.

Laboratory studies include urinalysis (to reveal proteinuria and microhematuria) and macroscopic analysis of ejaculate.

Indications to the application of angiographic investigations:

- Bilateral varicocele;
- Recurrent varicocele;
- Rapidly progressing varicocele;
- Combination of varicocele with hematuria, arterial hypertension, pain in the kidney area.

At present a “gold standard” in diagnosis of varicocele is scrotal echodopplerography. The investigation is made in the ortho- and clinostasis using modified test of Valsalva (tension of the abdominal press in the reclining position). It also helps to reveal subclinical forms of varicocele, which are difficult to palpate.

In ultrasound investigation of the scrotum the size of both testes are measured comparing them (in over 20% difference of the circumference we may speak about hypoplasia and hypotrophy of the testis). The vein diameter of the cluster-like plexus is studied on either side at rest and at the height of the modified test of Valsalva; there are registered presence, duration and rate of the reverse blood flow.

Dopplerography also allows to reveal all three main components of the venous reflux in some cases – renotesticular, ileotesticular and their combination (mixed).

Treatment

The treatment is surgical. The aim of the treatment is elimination of the venous reflux.

There are several variants of the surgical intervention:

- Occlusion operations at the different levels of the testicular vein;
- Microsurgical operations – application of different kinds of veno-venous anastomosis.

There are such kinds of surgical approaches:

- Retroperitoneal (operations of Palomo, Ivanisevich, Bernardi);
- Inguinal and subinguinal (operations of Marmara, Yakovenko);
- Laparoscopic (see Fig. 14.4-b);
- Interventional vascular (selective transvenous embolization).

At present the operations of Ivanisevich and Palomo are used for treatment of varicocele, which are performed both using laparoscopic technique and open retroperitoneal approach as well as transvenous embolization.

Control tasks

1. A patient K., aged 74, complains of frequent painless urination, involuntary urine discharge in severe tenesmus. What methods should be used to make a diagnosis? What should it be differentiated with?

Answer: A graph of urinations, urinalysis, ultrasound investigation.

Cystitis, tumor of the bladder.

2. A patient A, of 59 years old has been suffering from hyperplasia of the prostate gland for 5 years. He is troubled by polaciuria (up to 12 times), nocturia (2-3 times). What investigation should be made before administration of cholinolytics?

Answer: US investigation – in great amount of the residual urine cholinolytics should not be administered.

3. Pathogenesis of the nephrogenic arterial hypertension in chronic pyelonephritis.

4. A 35-year-old patient complains of malaise, weakness, periodic pains in the right subcostal area, elevated arterial pressure up to 220/180 mm Hg. She has been ill for 12 years. According to the data of excretory urography and isotope renography the right kidney function is not determined. What is the kind of arterial pressure? What is necessary to clear up the diagnosis?

5. Make a plan of diagnosis of vesico-vaginal fistulas.

6. Make a differential diagnosis of the vesico-vaginal fistula with ureter-vaginal fistula.

7. Make a differential diagnosis of hydrocele with inguinoscrotal hernia.

8. What pathology of the male genitals may develop due to elevated venous pressure in the kidney?

Answer: Varicocele

9. A patient M., aged 14, was revealed to have enlargement of the left half of the scrotum during the prophylactic examination. The patient feels inconsiderable nagging pains in

the left half of the scrotum on physical exertion. The heterogenous, soft, painless formation looking like grapes cluster is palpated over the left testis. It disappears in the horizontal position of the body. Determine the diagnosis and method of treatment.

Answer: Varicocele, the operation of Ivanisev

Modern endoscopic methods in urological diseases treatment

Development of endoscopic equipment and use of different types of energy in medical devices has turned endoscopy from diagnostic into powerful treatment trend. Currently, endoscopic treatment methods are used not only for all areas of the urinary tract, but also dominate in many urological diseases. First of all, it applies to urolithiasis and benign prostatic hyperplasia, where endoscopic techniques have become so-called "golden standard" of treatment. However, rapid development of laparoscopic technologies in urology shifts the emphasis towards minimally invasive treatment even for those diseases that have traditionally been treated by surgeries: kidney and prostate cancer, strictures of pyeloureteral segment.

15.1. Endoscopic methods of urolithiasis treatment

Endoscopic methods of treatment of urinary calculus belong to contact ones as their common feature is optical imaging of calculus and direct impact on it by various forms of

energy. More often, this is the energy of holmium laser because it can be delivered to the calculus even by very thin (3Ch) fibers. In addition, the energy of ultrasonic vibrations, pneumatic and even mechanical efforts of the surgeon are used. The endoscopes for such surgeries also vary as well as the ways of their delivery to the calculus.

Percutaneous nephrolithotripsy (PCNL) is the method of contact lithotripsy of renal calculus (Fig. 15.1). Using this method, the nephroscope is inserted to the cavity system of a kidney through previously created nephrostomic tract. This tract is created by abdominal puncture of kidney cavity system through the lower or middle calyx and is gradually expanded by probes to the size sufficient for the instrument insertion (22-26 Ch). The procedure is performed under X-ray control with the patient in prone position (Fig. 15.2, 15.3).

Ultrasound lithotripters are mainly used for calculus crushing because they are the most successful in combining the process of lithotripsy and suction of flushing fluid providing continuous visibility of the operating field. With these devices, the calculus is fragmented into pieces fitting inner hole of nephroscope and then they are removed with special pincers (Fig. 15.4).

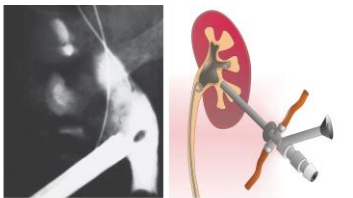


Fig. 15.1. Percutaneous nephrolithotripsy (nephrolithotripsy): A - antegrade pyelography with nephroscope; B - nephrolithotripsy diagram



Fig. 15.2. Puncture of renal cavity system under X-ray control

Fig. 15.3. Surgeon team during percutaneous nephrolithotripsy

Percutaneous nephrolithotripsy is

indicated for the treatment of calculus

larger than 1.5 cm, including multiple

and coral-like renal calculus. Upon

completion of the procedure,

nephrostomic drainage, having

hemostatic function (obstruction of nephrostomic channel) and the function

of urine removal from the kidney through the holes on its

extremities, is installed into renal cavity system. Usually nephrostomic drainage is removed in 2-5 days after surgery. A technique for mini PCNL for treatment of small kidney calculus (under 1.5 cm) is also developed. The

Ureter pyeloscope is inserted in retrograde way through the ureter and urinary bladder, and then along the ureter to the stone that causes its bigger length and smaller outer diameter. While for ureterolithotripsy different types of energy are used, lithotripsy by holmium lasers is preferred (Figure 15.5).

This is actually related to the fact that smaller thickness of fiber provides delivery of sufficient energy for fragmentation of calculus.

In addition, the flexibility of laser fiber allows its use in combination with the use of flexible ureter pyeloscopes. Application of flexible tools provides special advantages for migration during the procedure of calculus extraction from ureter to renal cavity system, which view by rigid tool is very limited. This situation occurs when the calculus is localized in the upper third of the ureter. However, in most cases rigid tool is used for ureterolithotripsy with larger diameter of operational and irrigation channels. Unlike nephrolithotripsy, calculus fragments from the ureter are removed

not through the opening of the tool, but together with ureter pyeloscope (Figure 15.6).

To reduce trauma of urethral mucosa during this process and to facilitate repeated insertion of ureter pyeloscope in the ureter using urethral amplatz.

This is a kind of sheath put on operational part of ureter pyeloscope and inserted together with it into the ureter up to the height of the calculus. If it is necessary to remove the fragments, the amplatz remains in place, and ureter pyeloscope is pulled outside and is re-

technique is similar to conventional PCNL, except for the size of the tool (12Ch),

allowing not to install nephrostomic drainage at the end of the procedure and to make it as "one day surgery".



Fig. 15.4. Evacuation of calculus fragments of renal calculus with pincers during contact lithotripsy by ultrasound probe

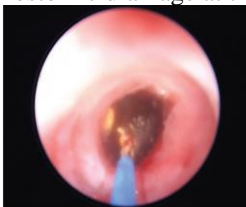


Fig. 15.5. Laser ureterolithotripsy

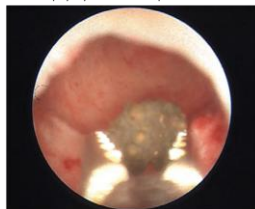


Fig. 15.6. Removing of calculus fragments from ureter with pincers

Ureteropyelolithotripsy is a method of contact urethral calculus crushing. It is performed using ureter pyeloscope, through the working channel of which electrode or fiber is delivered to the calculus. The same lithotripters as for nephrolithotripsy (laser, pneumatic, ultrasound) are used for calculus crushing, but with longer electrodes or fiber of smaller diameter

introduced into the ureter through its lumen. Amplatz is removed together with ureter pyeloscope at the end of the procedure

It is expedient to perform ureterolithotripsy using X-ray control by mobile C-arches. Even in the case of X-ray negative calculus, it helps to pass ureter pyeloscope along the ureter, especially

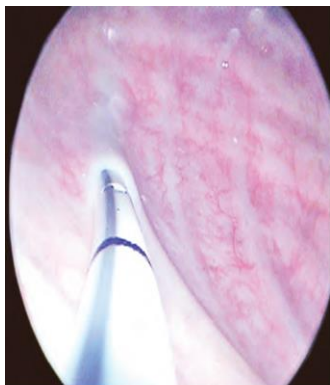


Fig. 15.7. Stenting of right ureter

in cases of its narrowing and deviations. Because of the trauma of ureteral mucosa by calculus and its reactive edema, it is often necessary to terminate contact ureterolithotripsy by drainage of upper urinary tract by means of the stent

(Figure 15.7).

Cystolithotripsy is contact crushing of urinary bladder calculus. One of the first types of lithotripsy was applied in ancient times. Relatively easy access to the bladder and enough space to manipulations, in addition to the types of energy mentioned above, allow using also mechanical one. To do this, special pincers with strong large branches are used on which the efforts of surgeon's hand from the outside handle are transferred with the help of special rods and levers. The size of the tool's branches allows to capture calculus having diameter of 2-3 cm. Mechanical cystolithotripsy, compared with other types, provides rather fast calculus fragmentation. This is especially important because often bladder calculus are multiple and of large size. When the calculus are over 3 cm. their crushing is practiced into large pieces using laser or power hydraulic lithotripsy with subsequent use of mechanical lithotripter.

The process of removal of urinary bladder calculus fragments is also slightly different. Due to their big quantity and sufficient volume of urinary bladder, the fragments are not

removed individually with pincers but are rinsed through cystoscope tube with special evacuator (Ellick evacuator), and if there is none, by 100 ml syringe with wide beak.

Ureterolithotripsy is contact urethra calculus crushing. It is performed in men, because in women the calculus can detain only in diverticula and require surgical correction. The procedure is performed using ureter cystoscope through which an electrode is delivered to the calculus. The methods and types of energy used to fragment the calculus are the same as in ureterolithotripsy. The difference is in larger diameter of the ureter and easier access to the calculus.

15.2. Endoscopic methods of treatment of urinary system and prostatic tumors

Improvement of endoscope structure and their modification led to the creation of special devices and accessories not only for fragmentation of calculus, but for dissection and coagulation of tissues. These achievements are widely used for minimally invasive surgical treatment of urinary system tumors.

Essentially, with this purpose two types of treatment: resection and vaporization (cauterization) are currently used. For this, high-frequency electrosurgery devices and lasers are applied. The first are uses mainly for electroresection, and the second mostly for laser vaporization.

Laser ablation and electroresection of tumors of renal pelvis and ureter. Because of small caliber of the tools which can be manipulated in the ureter and renal pelvis, for removal

of tumors of these areas of urinary system, laser ablation (vaporization) is mainly used. Herewith, the tumor tissue is visualized using rigid or flexible ureter pyeloscope and is

cauterized with laser energy under visual control. Special ureter pyeloscopes with the possibility of electroresection are also designed, but because of their inconvenience and the problem of removing of resected tissue, they are not widely used.

Transurethral resection of urinary bladder tumors. In contrast to renal pelvis and ureter, in urinary bladder for removal of tumors electroresection is mainly used. For this purpose, special device - resectoscope similar to cystoscope by its structure is used. The difference is the presence of special operating element in resectoscope, in which resection or coagulation loops, balls and rollers are installed.

The first provide for the resection of tissues, the second provide for coagulation of tissue with hemostasis purpose. Electroresection may be unipolar and bipolar. In case of the unipolar resection, the voltage is supplied to loop or ball of resectoscope, and passive electrode is put under the patient's body. With this type of resection, special non-saline solutions which are not polarized and not conduct electric current (glucose, turossol, mannitol) are used.

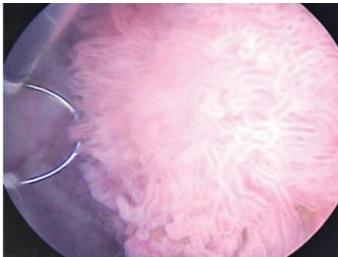


Fig. 15.8. Transurethral resection of urinary bladder

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Resection and coagulation loops for bipolar electroresection are designed to combine active and passive electrodes. This allows you to use 0.9 % sodium chloride as flushing liquid. In the case of transurethral resection of urinary bladder tumors, bipolar technique still has a significant advantage, allowing more accurate monitoring of flow action depth and thereby prevents perforation of its wall during the procedure. Tumor tissue is gradually resected in the area projected into lumen of urinary bladder, and the resection is completed at its base by removing tissue down to the muscle layer of the urinary bladder wall (Fig. 15.8).

Resected pieces of tissue are washed from the lumen of the urinary bladder through the tubes of resectoscope similar to calculus fragments at cystolithotripsy. Sometimes, it is necessary to resect the tissues on entire depth of the wall. In this case, when the wall of

the urinary bladder is perforated, the procedure should be finished as quickly as possible to prevent extravasation of flushing liquid.

Small perforations do not require additional measures in addition to installation of permanent ureteral catheter. Transurethral resection of urinary bladder tumors is used as an independent medical procedure, it may be combined with other treatment (local chemotherapy, immunotherapy, etc.), as well as with tissue sampling for verification and staging of the disease. Laser vaporization of tumors of the urinary bladder is not used as widely as electroresection. This is due to the need of separate sampling of tissue for histological examination, inability to control the exact depth of the laser beam on the wall of the urinary bladder and potential risk of perforation and higher cost of the procedure.

Transurethral prostatic resection is the most common endoscopic surgery in urology and is rightly called the "gold standard" of treatment of benign prostatic hyperplasia. This method also has its indications as a component of comprehensive treatment of prostatic cancer. The tools and methods are the same as for

electroresection of the urinary bladder tumors. The tissue is resected up to the level of spermatic tubercle. Resection of the distal tissue may result in damage of external sphincter of the urinary bladder and occurrence of urinary incontinence.

The use of bipolar prostatic resection is safer than unipolar. But unlike electroresection of the tumors of the urinary bladder, main advantage here is not the accuracy of the resection depth, but the fact that hypoosmolar flushing solution does not get into the bloodstream and prevention of the development of so-called "TUR syndrome". Resected pieces of tissue with flushing liquid flow fall into the cavity of the urinary bladder, where they are washed off at the end of the procedure as described above.

Transurethral prostatic resection, like the one of the urinary bladder, is finished by installation of Foley urethral catheter. However, in the case of prostatic resection, catheter balloon is filled to 30-50 ml and small catheter traction is used. This allows to separate the prostatic bed from the cavity of the urinary bladder and reduce postoperative bleeding. In both cases, if the bleeding is quite intensive, in order to prevent the formation of blood clots in the cavity of the urinary bladder, three-way catheters are applied through which irrigation system is adjusted.

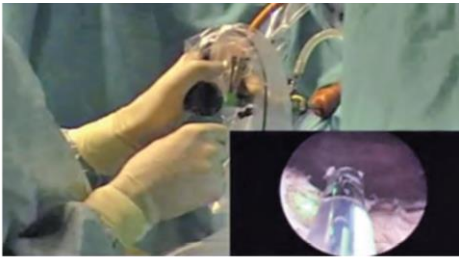


Fig. 15.9. Laser ablation of the prostate

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Laser ablation of benign prostatic hyperplasia is the most advanced method to remove hyperplastic tissue. It is realized using special surgical ureter cystoscope

through the operating channel of which laser - fiber is inserted to prostatic ureter (Fig. 15.9).

For laser vaporization of the prostate, the lasers with various wave lengths (500-2000 nm) and power (80-250 W) are used. The main advantage of laser ablation of the prostate is absolute lack of blood loss during the procedure

chloride is used as flushing liquid.

It should also be noted that in this case 0.9% sodium

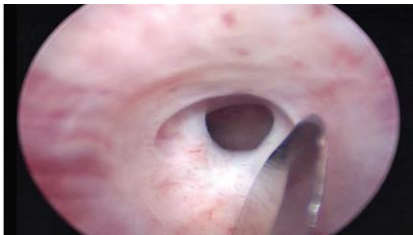


Fig. 15.10. Optical urethrotomy

These features allow to apply this procedure to the patients for whom transurethral prostatic resection is are contraindicated: the patients with pronounced concomitant pathology

Coagulation disorders, after heart valves prosthesis and coronary artery stenting, and other patients categories who regularly take anticoagulants, the patients with prostatic volume over 100 cm³. The catheter for a period of 6-24 hours is installed in the patients after laser prostatic vaporization, and duration of hospitalization is 1 day.

15.3. Endoscopic treatment methods of urinary strictures

Minimally invasive treatment methods have been applied to such complex group of urologic disorders like strictures of pyeloureteral segment, ureter and urethra. The

importance of minimally invasive techniques for the treatment of this category of patients, in addition to the standard benefits over open surgeries, is determined by recurrent nature

of these diseases. This requires periodic repetition of the manipulations that in the case of endoscopic methods is not the problem. Procedure technique is identical for all stricture areas. By narrowing the space under- usual The endoscope gets to the place of stricture through which the conductor string is passed above the stricture.

Then, using this string as a guide, incision itself of the narrowed place of the ureter or urethra is performed. Incision is carried with the blade of special "cold" knife or laser beam for entire thickness of the wall (Fig. 15.10). "Cold" incision is preferred, since it affects less the surrounding tissue and repeated formation of scar tissue at the site of incision is lower. However, for urethral strictures and for the strictures of pyeloureteral

segment this kind of incision is technically difficult and the laser is used more often. The procedure is finished by the installation of splint into the lumen of the ureter or urethra respectively. The role of splint in the first case is performed by permanent urethral catheter, and in the second – by urethral catheter-stent. This prevents the adhesion of dissected tissues and repeated stricture formation.

Another type of minimally invasive endoscopic treatment of urethral and bladder stricture is balloon dilatation. This technique is used when the stricture is not very pronounced, and allows you to pass through it a special catheter with balloon. Appropriate placement of the balloon is visually controlled by endoscope through which the catheter was actually installed, and mobile X-ray C-arc. Next, using a special syringe connected to a manometer, the balloon is inflated to pressure of 2 atmospheres. This is usually enough to expand the lumen of the constricted area. As with strictures incision, the procedure finishes by installation of Foley catheter or urethral catheter - stent.

15.4.Laparoscopic treatment of urological diseases

Laparoscopic surgical techniques is urology area rapidly developing in recent years. As with other endoscopic techniques, technological discoveries were the drive for the development of laparoscopy in urology. In particular, it is applicable to hemostasis technologies: use of ultrasonic knife, methods of high caliber vessel welding, special clips, suturing devices. The use of these scientific and technological

achievements allows to perform safely most of urologic surgeries with laparoscopic technique. In particular:

resection of seminal vein, resection of kidney and nephrectomy, plastic repair of pyeloureteral segment uretero- and pyelolithotomy (Fig. 15.11), ureter - uretero and

ureterocystoanastomosis, laparoscopic prostatectomy, laparoscopic cystectomy. The advantages of laparoscopic techniques of these surgeries compared with open procedures are the following: much lesser injury during intervention, less blood loss, lack of postoperative wound and thus wound infection, reduction of pain feelings in the patients, their rapid rehabilitation, workability recovery, reduction of treatment duration in general and in-patient treatment in particular. Other benefits that deserve our attention, much better visualization of the surgical field and therefore precision of execution of all phases of intervention should be mentioned. This is particularly important in the formation of anastomoses, selection and ligation of main vessels.

There are two types of laparoscopic access to the kidneys, ureters, urinary bladder, and prostate: transperitoneal and extraperitoneal. Both are identical in terms of surgical efficiency. Transperitoneal

access is somewhat easier as required volume for tools insertion is created by the gas filling the abdominal cavity. This procedure is carried out through puncture by special

Veress needle in the area of the navel. Later, in the abdominal cavity filled with gas, 3 to 5 troacars are inserted, one of which is used for lighting and optics, and others – for

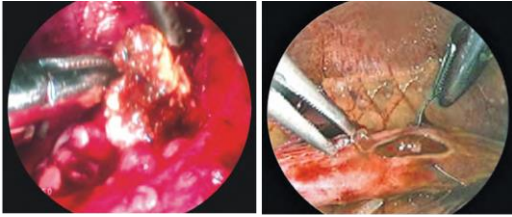


Fig. 15.11. Laparoscopic removal of ureteral calculus: a - calculus removal: b – suturing of the ureter opening

Fig. 15.11. Laparoscopic removal of ureteral calculus: a - calculus removal: b – suturing of the ureter opening various tools. The next step is dissection of parietal layer of peritoneum on the organ projection, on which the surgery will be done. Next steps in most surgeries are identical to those for open surgeries. Laparoscopic surgeries on kidney and ureter are held when the patient is in the lateral position, and on prostate, urinary bladder and spermatic vein resection in the supine position. If necessary, the removed organs or tissues (prostate, kidney, lymph nodes) are placed in the special

containers and removed through widen trocar holes or separate small cut in the iliac region.

Extraperitoneal access is the introduction of the trocar directly into the space where the organ that should be operated is situated. For prostate, it is pelvic cavity, for kidneys and ureters, it is retroperitoneal space. The first phase of the intervention is to create a specific space required for the introduction of instruments. This is achieved by introduction of special trocar with a balloon into interested area and filling the latter with gas in volume of 100-200 ml. After removal of the balloon, in

the space formed by it, the troacars are introduced and the surgery is performed similarly to transperitoneal one. The advantage of extraperitoneal access is the lack of contact with abdominal cavity organs, and respectively the possibility of their damage, impossibility of urine and blood presence in abdominal cavity and prevention of the formation of postoperative adhesions in abdominal cavity. Disadvantages of this access is the need to create space at the initial stage of the surgery and limited volume for tool introduction and manipulation. Control tests

1.28 years old patient referred to a doctor with left-side renal colic attack. She is sick for 2 days. Objective examination demonstrated pain in the left hypochondrium, pain when tapped on the left lumbar area, positive Pasternatsky symptom on the left. The body temperature is normal. Total blood count without deviations from the norm. Urine analysis: microhematuria. According to the ultrasound and plain and excretory urography X-ray contrast calculus in the lower third of the left ureter of $1,2 \times 0,8$ cm has been diagnosed.

What is the most efficient treatment for this patient?

Answer. Contact ureterolithotripsy

2.48 years old patient referred with the complaints of dull pain in the right lumbar are. He is sick for 2 years. Objective examination demonstrated pain in the right upper hypochondrium. The body temperature is normal. Total blood count without deviations from the norm. Urine analysis: microhematuria, leukocyturia. According to the ultrasound and plain and excretory urography X-ray contrast calculus in the right kidney of $3,2 \times 2,8$ cm, which fills the renal pelvis and the lower part of the calyx.

What is the most efficient treatment for this patient?

Answer. Transcutaneous nephrolithotripsy. 3.65 years old patient referred with the complaints of more frequent, difficult urination. He is sick for 5 years. He was treated

conservatively with little effect. In recent months, the complaints has become more pronounced (15 points on IPSS scale). With digital rectal examination, the prostate is enlarged in 1.5 times, smooth, tight elastic consistency, homogeneous, with clear edge. Total blood count and urine analysis are without deviation from the norm. PSA blood test 2.2 ng/ml. According to the ultrasound: the kidney is normal, urinary bladder without calculus, volumetric formations, residual urine of 150 ml, prostate $5,2 \times 4,7$ cm, volume 68 cm³. Pronounced concomitant pathology in patients have not been identified.

What is the most efficient treatment for this patient?

Answer. Transurethral resection of the prostate.

4.78 years old patient referred with the complaints of more frequent, difficult urination. He is sick for 15 years. He was treated conservatively with a satisfactory effect. During the last year, his complaints have become more pronounced (19 points on IPSS scale). With digital rectal examination, the prostate is enlarged in 1.5 times, smooth, tight elastic consistency, homogeneous, with clear edge. Total blood count and urine analysis are without deviation from the norm. PSA blood test 3.2 ng / ml. According to the ultrasound: the kidney is normal, urinary bladder without calculus, volumetric formations, residual urine of 150 ml, prostate $6,2 \times 5,1$ cm, volume 78 cm³. A year ago, the patient underwent surgery for coronary artery stenting, and always takes anticoagulants (Plavix). Currently, there are no contraindications to surgical treatment from the side of cardiovascular system.

What is the most efficient treatment for this patient?

Answer. Laser vaporization of the prostate. 5.Current approaches to the treatment of urinary system strictures.

6.Advantages of laparoscopic treatment of urological disorders compared with open surgeries.

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