Main symptoms in kidney diseases. Symptomology of acute and chronic glomerulonephritis and pyelonephritis

Department of Propedeutics of Internal Medicine and Therapy / Odessa National Medical University

Structure of nephron

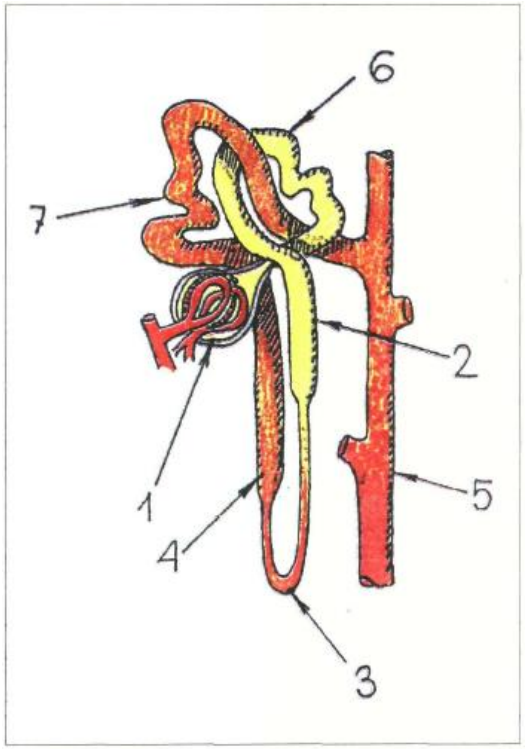


Рис.5.5. Строение нефрона.
1 - почечное (мальпигиево) тельце; 2 - толстый нисходящий сегмент петли Генле; 3 - тонкий (нисходящий и восходящий) сегмент петли Генле; 4 - толстый восходящий сегмент петли Генле; 5 - собирательная трубка; 6 - проксимальный извитой каналец I порядка; 7 - дистальный извитой каналец II порядка.

Kidney's nephrons (cortical and juxtaglomerular)

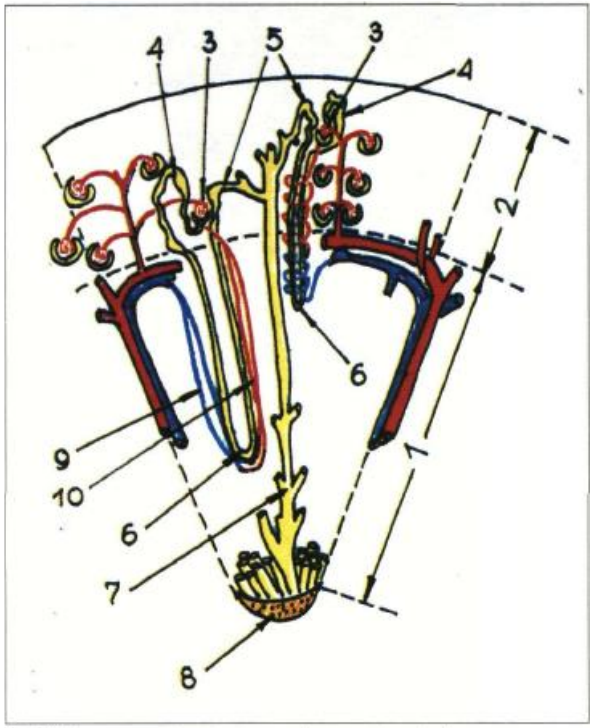
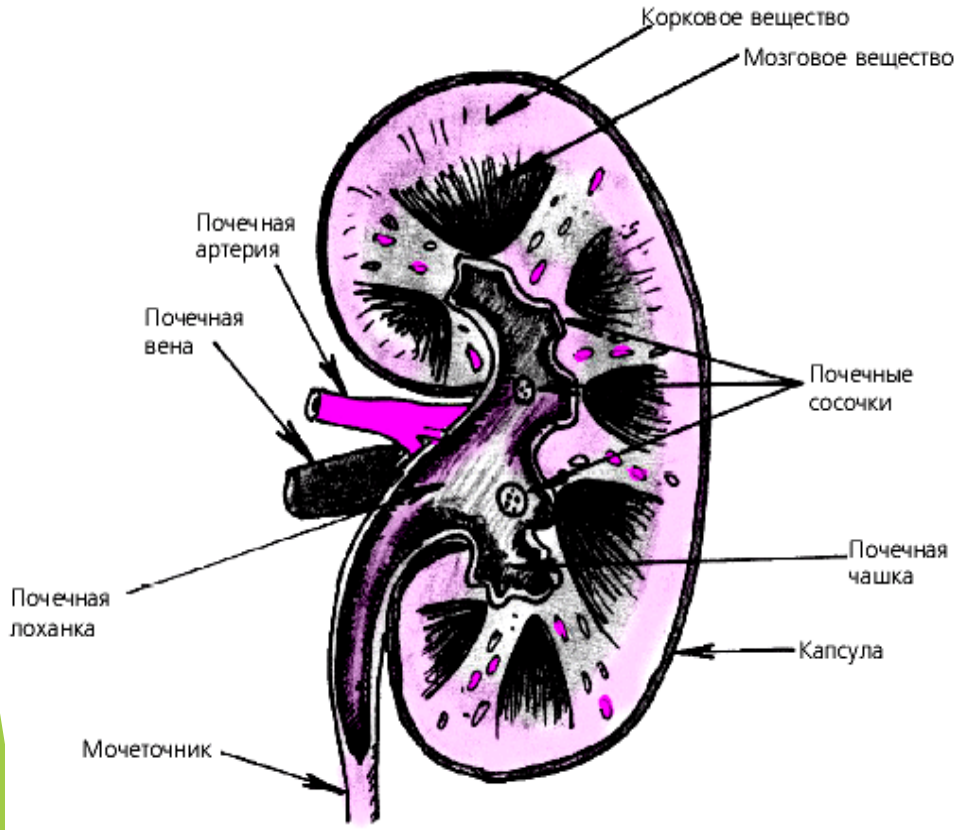
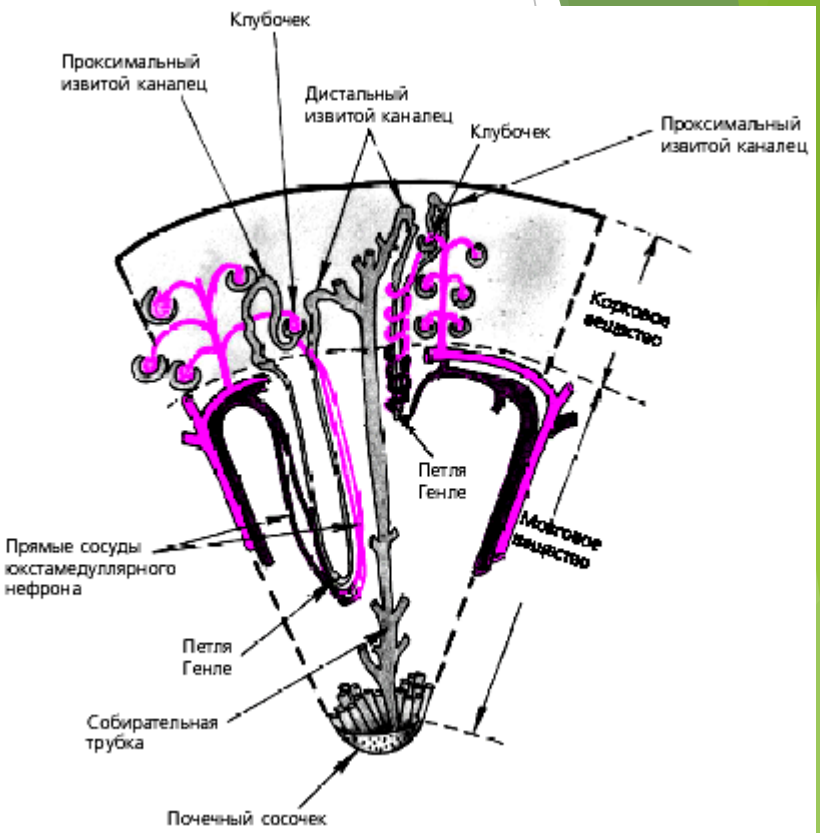


Рис.5.8. *Схема корковой (справа) и юкстамедуллярной (слева) нефронов и их кровоснабжение.*
1 - мозговое; 2 - корковое вещество почки; 3 - почечный клубочек; 4 - проксимальный извитой каналец; 5 - дистальный извитой каналец; 6 - петля Генле; 7 - собирательная трубка; 8 - почечный сосочек; 9 и 10 - прямые сосуды юкстамедуллярного нефрона.


Корковое вещество
Мозговое вещество
Почечная артерия
Почечная вена
Почечные сосочки
Почечная чашка
Почечная лоханка
Капсула
Мочеточник


Клубочек
Проксимальный извитой каналец
Дистальный извитой каналец
Клубочек
Проксимальный извитой каналец
Корковое вещество
Петля Генле
Мозговое вещество
Прямые сосуды юкстамедуллярного нефрона
Петля Генле
Собирательная трубка
Почечный сосочек

Functions of kidneys

- Participation in a hemopoiesis (erythropoetin)
- BP regulation
- Homeostasis maintenance (internal medium of an organism) by regulation of water-electrolytic, nitric exchanges and alkaline-acidic homeostasis

Assessment of urine

- **Physical properties of urine (color, transparency, sp. gravity, pH)**
- **Chemical properties** (protein, sugar, bilirubin, urobilinogen, ketone bodies)
- **Deposit microscopy (epithelium, RBC, WBC, casts, bacterium, salts)**
- **Bacteriological research**

Norm of urine

Amount of urine per 24 hours	**800—1500 мл[1]**
Specific gravity at morning urine	**1020—1026**
Maximal osmotic concentration	**910 mosm/L**
Color	**straw-yellow**
Transparency	**transparent**

1 At physiological condition polyuria rise due to increased water intake and neurotic situation

2 During day deviate too much

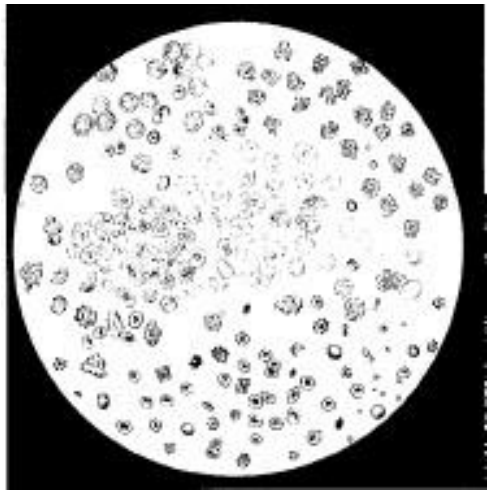
Deposit of urine

Epithelium	**0—3 f/vis**
WBC:	
men	**0—2 f/vis**
women	**1—2 f/vis**
RBC	**Single at specimen**
Casts	**Absent**
Mucous	**Absent**
Bacterium	**Not more 50 000 в 1 ml**
Nonorganize deposit:	
at acidic pH	**Uric acid, oxalates, urates,**
at alkaline pH	**Amorphous phosphates, uric acid ammonium, triply-phosphates**

Chemical composition

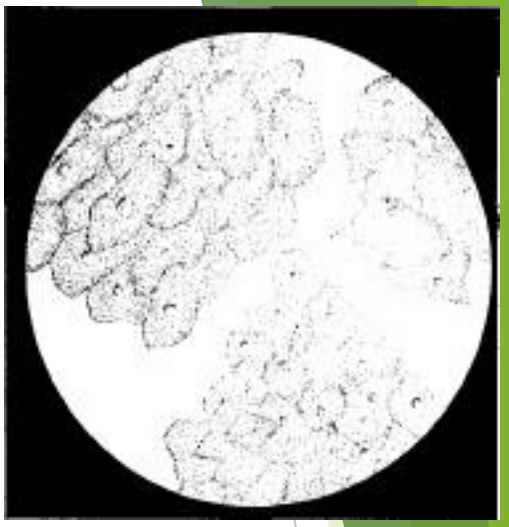
Index	Unite	Unite SI
Reaction	Neutral or slightly acidic [1]	
Protein	Absent, traces (25—70 мг/ day) [2]	0,025—0,070 g/day
Sugar	Absent , traces (not more 0,02%) [3]	
Acetone	Absent	
Ketone bodies	Absent	
Urobiline bodies	Absent	
Bilirubine	Absent [4]	
Urea	20—35 g/day	333,0—582,8 mmol/day
Creatinine:	0,5—2 г/с	4,4—17.6 mmol/ day
α—amilase	20—160 mg of starch/	20—160 g/
Potassium	1,5—3 г/с	38,4—76,7 mmol/ day
Sodium	3—6 г/с	130,5—261,0 mmol/ day

[1] Щелочная реакция появляется на овощной диете, щелочном питье, на высоте пищеварения.
[2] Транзиторная протеинурия возникает в результате мышечной работы, физического напряжения.
[3] Функциональная гликозурия возникает при эмоциональном напряжении, избытке сахара в пище, введении адреналина.



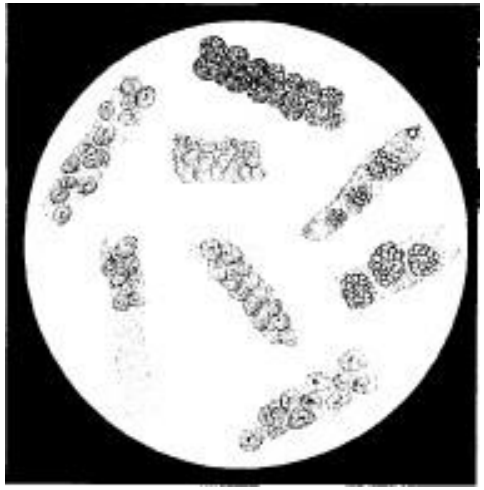
RBC and WBC

Transitional epithelium



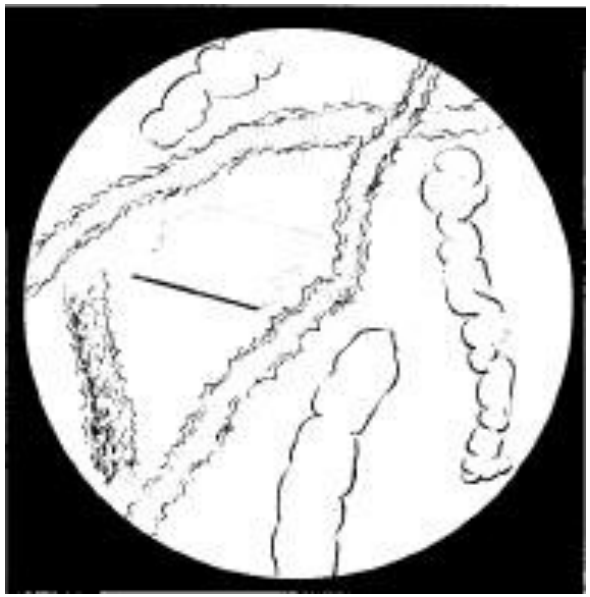
Flat epithelium

Hyaline casts



Epithelial casts

Leucocytes casts



Waxy casts

Uric acid crystals

Sorrel acid crystals (oxalates)

Netchiporenko method

There are at 1 ml of urine :

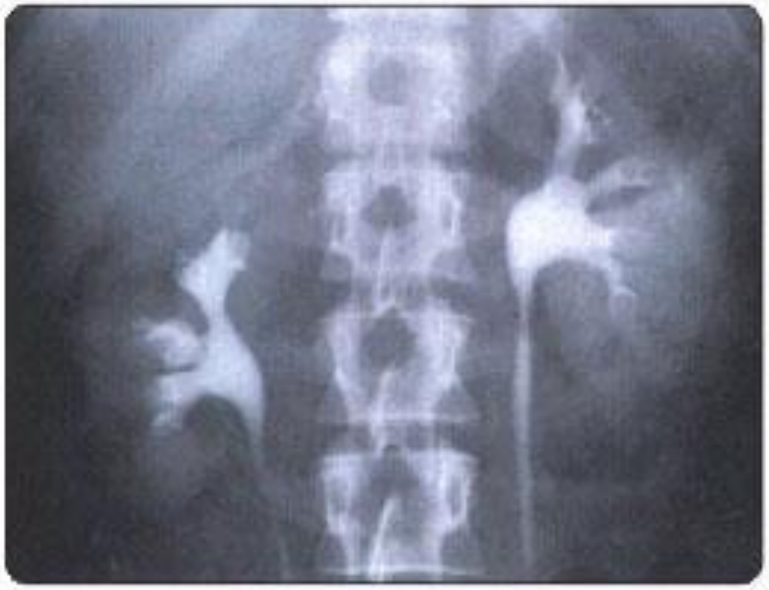
WBC	**up to 4000**
RBC	**up to 1000**
Casts	**0—1 for 4 camera of calculation**

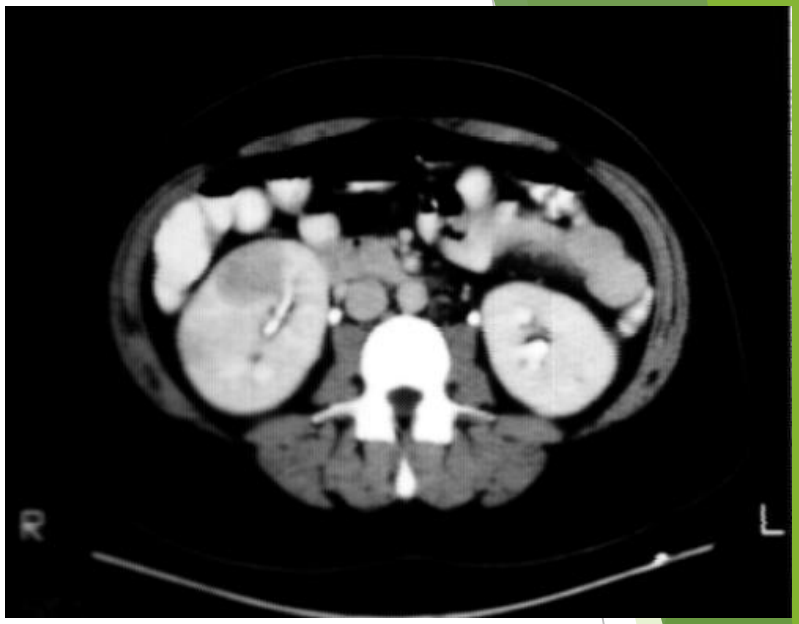
Функциональное исследование почек

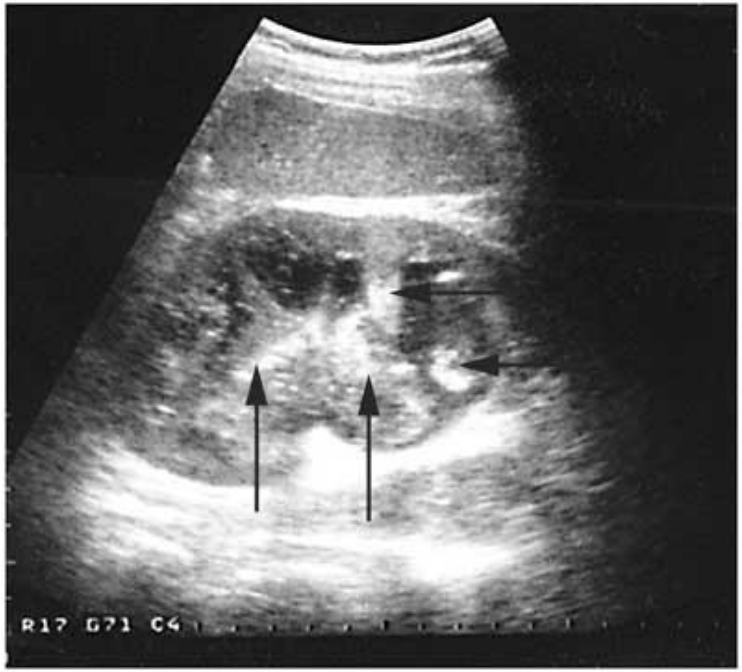
Название пробы	Метод	Показатели
Проба на разведение	По Фольгарду (нагрузка 1,5 л воды)	Больше 50 % выпитой жидкости выделяется через 2 ч, остальная — за 3—4 ч. Относительная плот ность снижается до 1001—1003. Количество мочи в порциях 50—500 мл
Проба на концентрацию	По Фольгарду	Количество мочи в порциях 50—60 мл, относительная плотность через 4—8 ч достигает 1028—1035
Проба Зимницкого		**Суточное количество мочи составляет 65—75 % выпитой жидкости. Дневной диурез составляет 2/3—3/4 суточного. Относительная плотность 1004—1024**
Проба Реберга	**Определение креатинина в крови и моче**	**Клубочковая фильтрация 75—125 мг/мин. Реабсорбция 98,2—98,8%**

Instrumental methods of kidney research

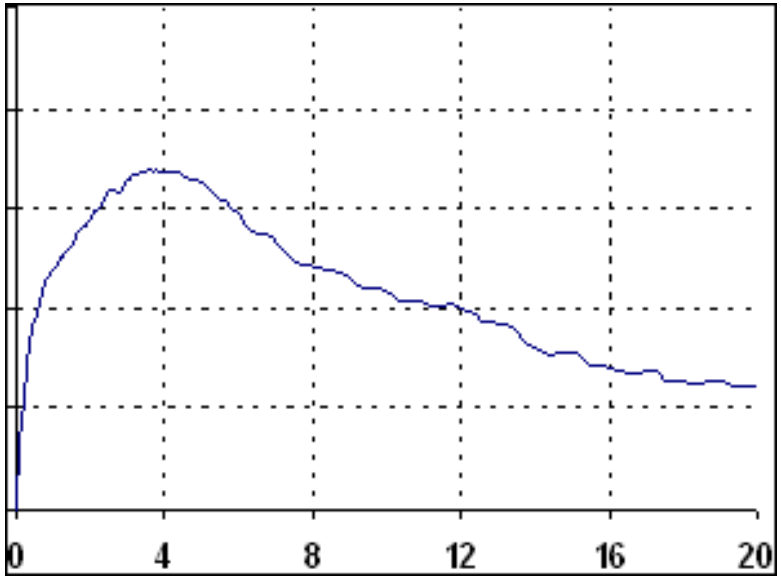
- X-ray (excretory urography, CT)
- Ultrasound
- Endoscopic
- Radiological

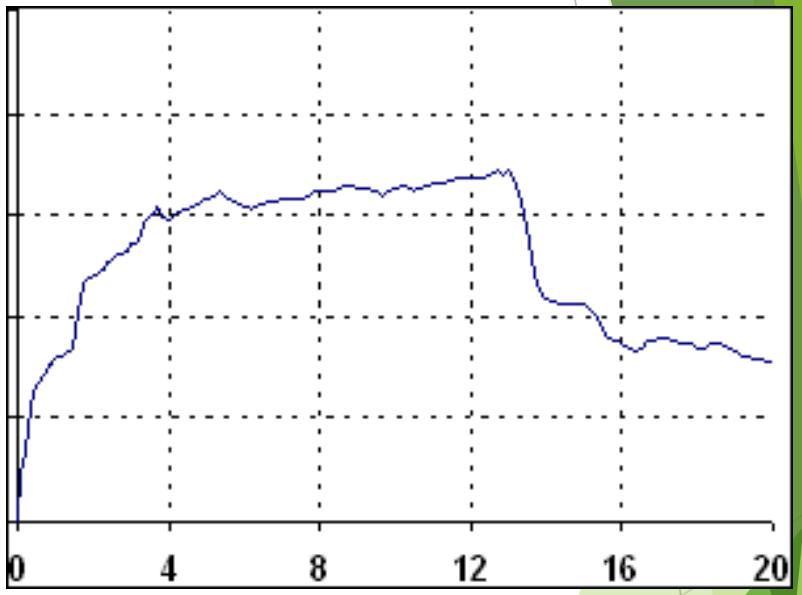



R
L


R17 G71 C4

Isotope renographya

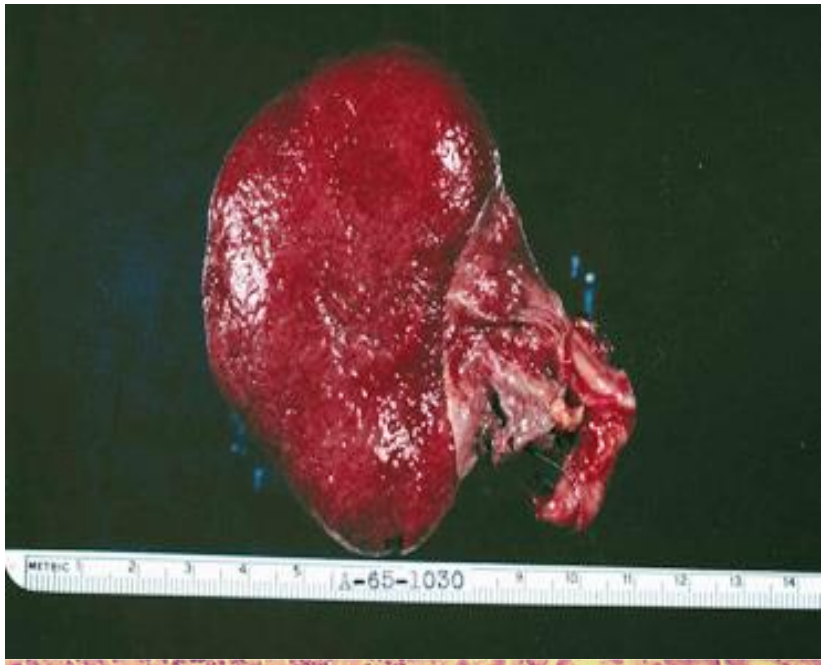


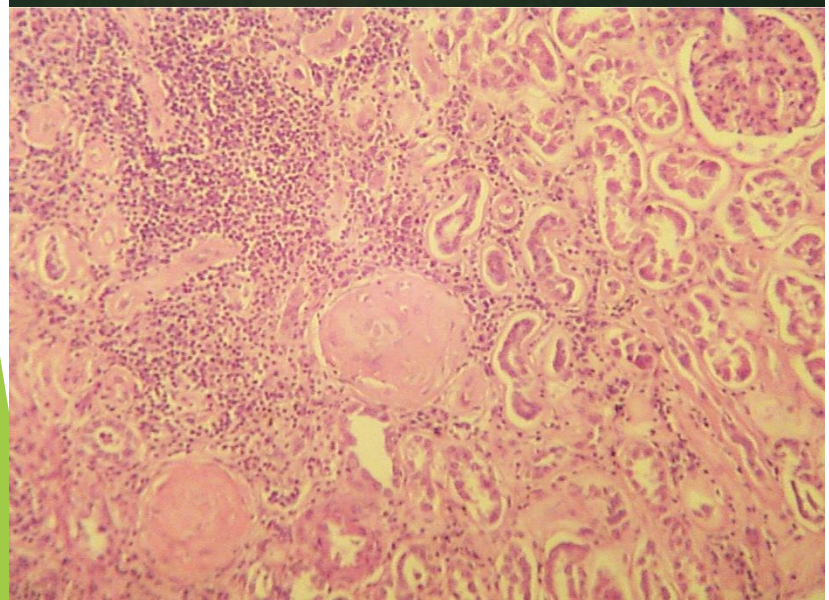


The basic syndromes of kidney diseases

- The urinary
- The edematous
- Syndrome of an arterial hypertension
- The nephrotic
- Renal insufficiency

End stage renal disease





- Small, shrunken and granular
- Misnomer-chronic glomerulonephritis
- D/D Chronic pyelonephritis
- M/E hyalanized glomeruli, tubular atrophy and interstitial fibrosis.

Complains

- Pain syndrome
- Edemas
- Damaged urination
- Arterial hypertension

Pain syndrome

- Spasm of ureters
- Inflammation of mucosa and distension of pelvic
- Distension of kidney capsule

Remember

- If urolithiasis, pain usually has character of attack, acute, p-t is restless, couldn't stay at the same posture, pain localized at loin, radiate along ureter to inguinal area, to scrotum (if men), medial side of hip

Damage of urination

- Polyuria
- Oligouria
- Anuria (secretory - anuria Vera)
- Ishuria (excretory anuria)
- Pollaciuria
- Strangiuria

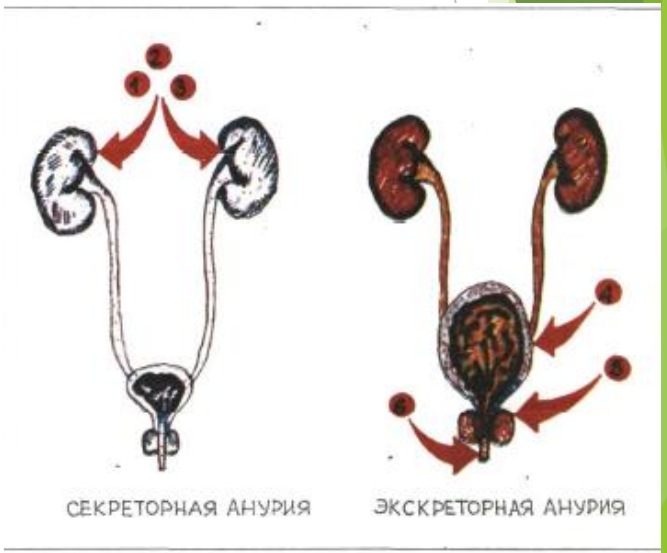


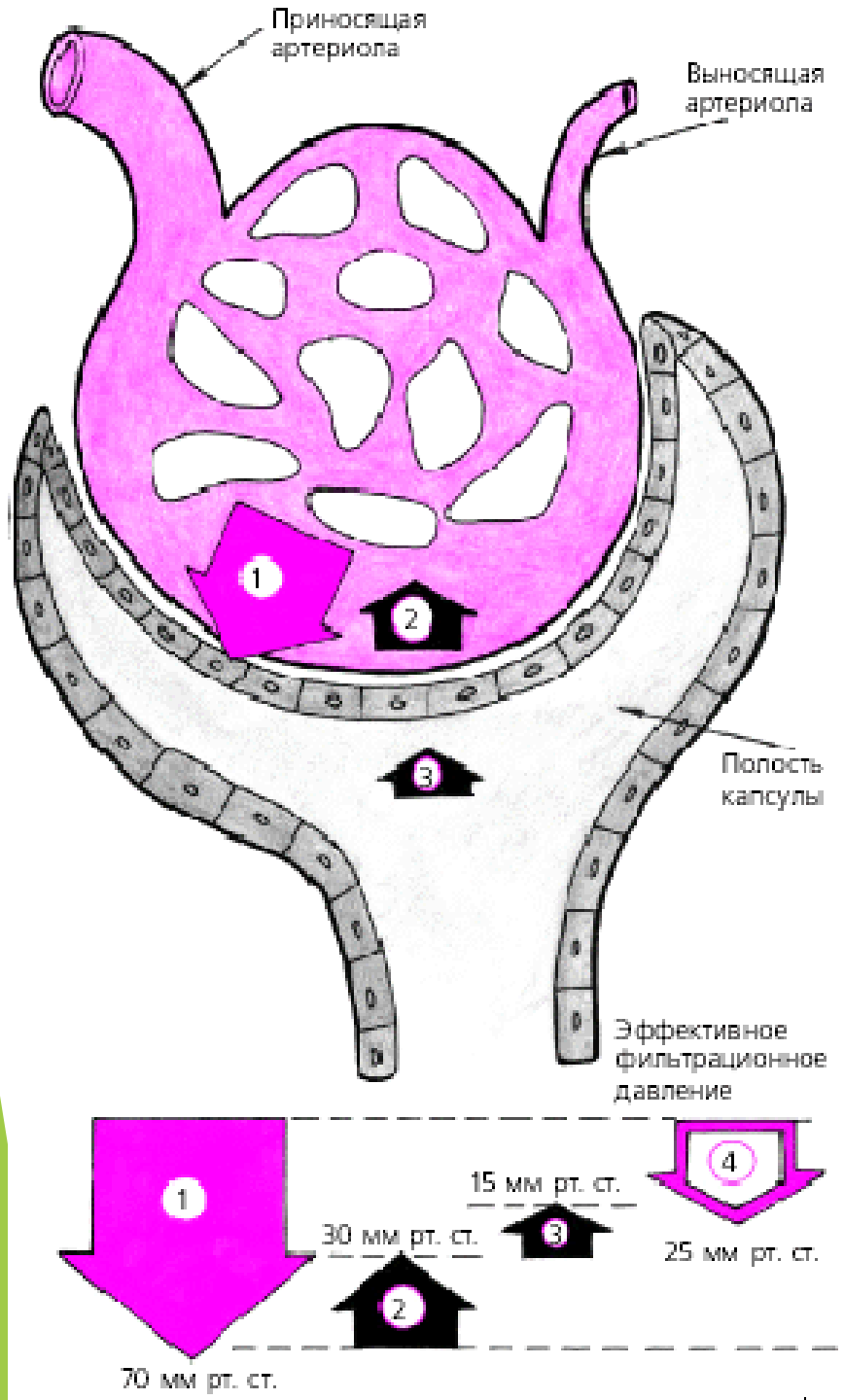
Рис. 5.20. Причины секреторной и экскреторной анурии.
1, 2, 3 - шок, острая кровопотеря, уремия; 4, 5, 6 - парез мускулатуры мочевого пузыря, аденома предстательной железы, стриктура уретры.

Glomerulo - tubular dissociation:

1. Filtration significantly decreased

2. Reabsorbtion is intensive

3. Retention of water and sodium → edema and arterial hypertension

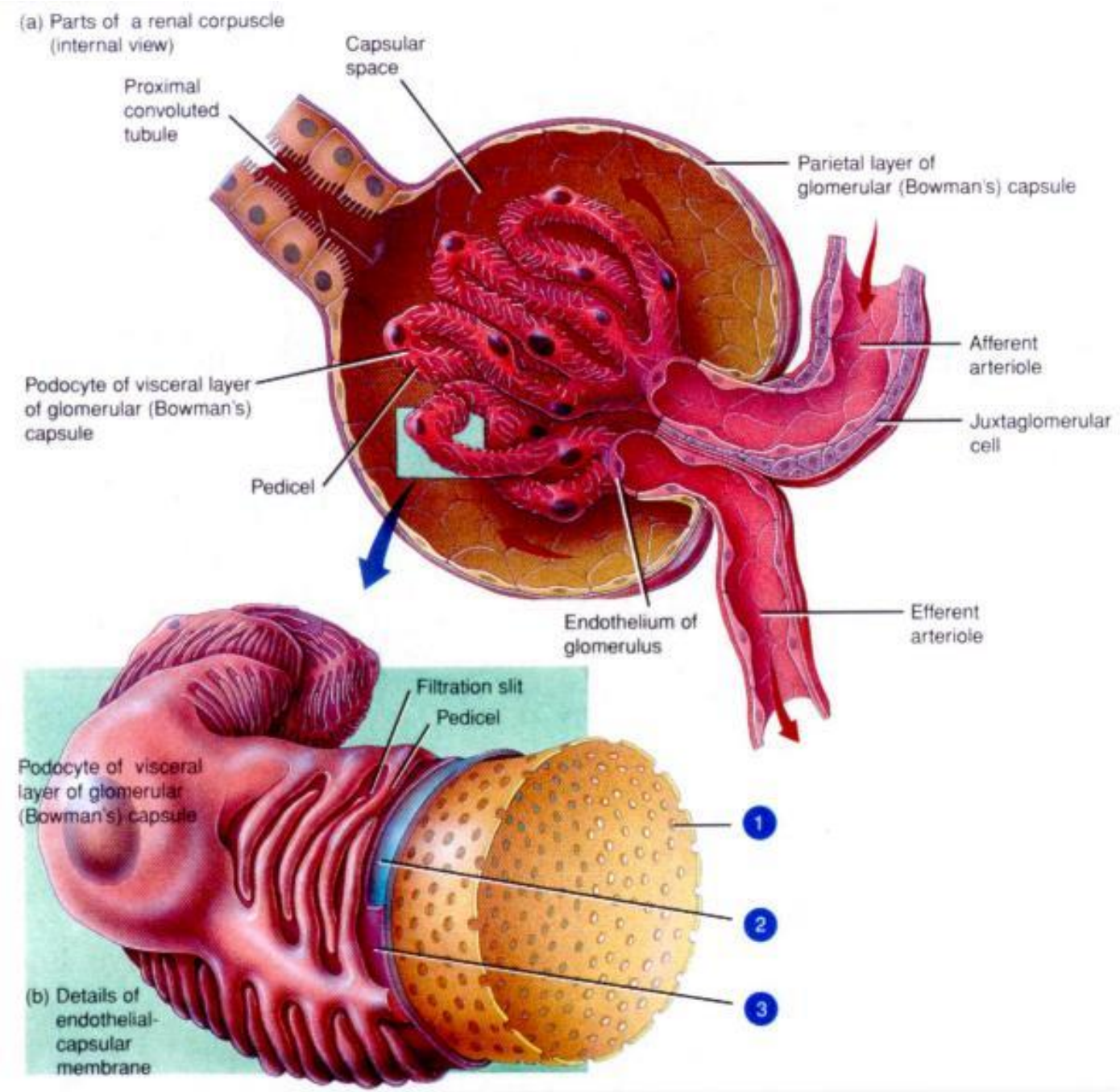


Filtration pressure equal:

1. **Hydrostatic pressure**
2. **Oncotic pressure**
3. **Intrakidney pressure**

Pf = Ph1 - (Po2 + Pc3)

Normal usually is in average 25 mm of Hg


(a) Parts of a renal corpuscle (internal view)
Capsular space
Proximal convoluted tubule
Parietal layer of glomerular (Bowman's) capsule
Afferent arteriole
Podocyte of visceral layer of glomerular (Bowman's) capsule
Juxtaglomerular cell
Pedicel
Endothelium of glomerulus
Efferent arteriole
Filtration slit
Pedicel
Podocyte of visceral layer of glomerular (Bowman's) capsule
1
2
3
(b) Details of endothelial-capsular membrane

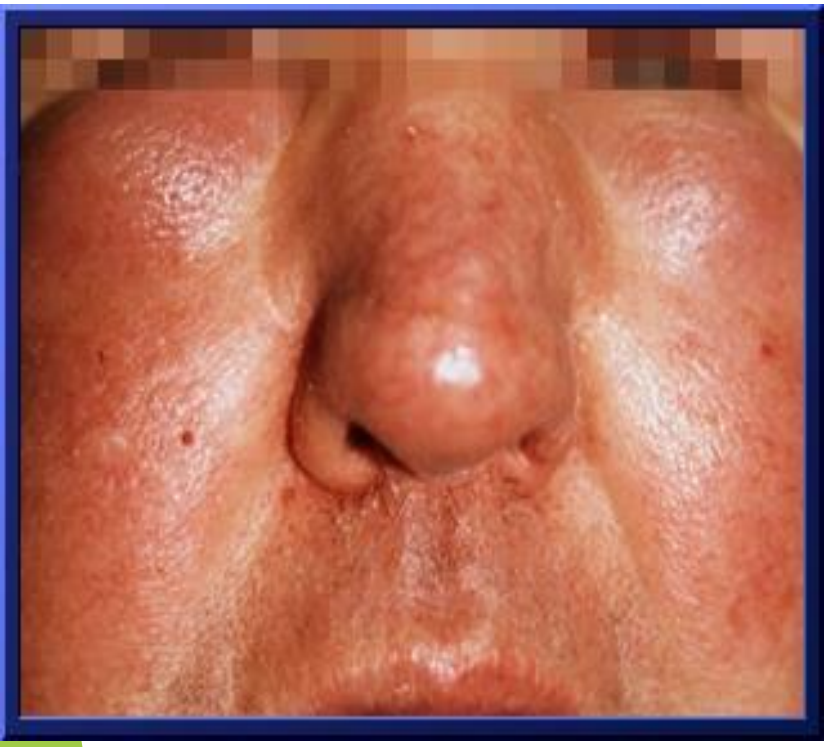
Remember:

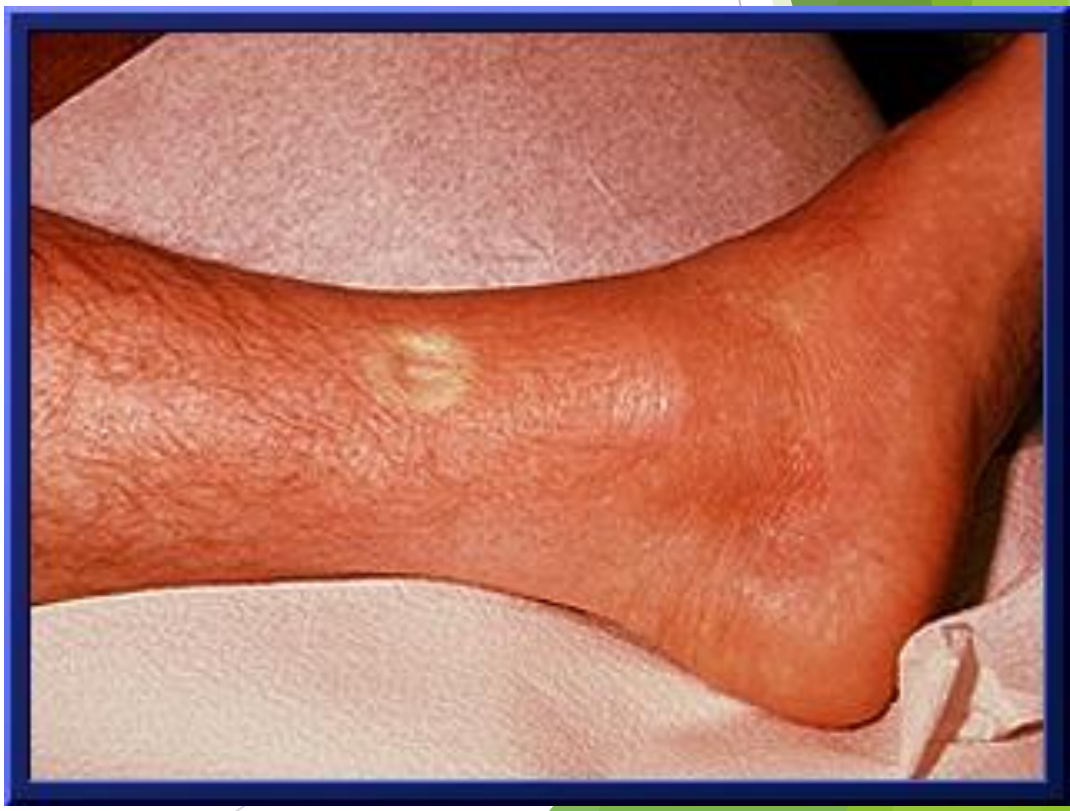
- **Depression of hydrostatic pressure of a blood lead to sharp reduction, and in hard cases to the full stop of a glomerular filtration. The same effect can arise at appreciable elevation of intrarenal pressure (for example, at obstruction of urinary ways).**

Edemas

Edemas have the admixed genesis:

1.decrease of oncotic pressure
2.retention of sodium and water as a result of the raised formation of Aldosteronum





Edemas

Edemas — one of the earliest and frequent symptom of many kidneys diseases. The most important mechanisms of formation of renal edemas are:

- Depression of oncotic pressure of plasma as a result of reduction of total blood protein, mainly albumins;
- Rising of permeability of capillaries as result of risings of hyaluronidasum activity;
- Hypernatriemia

Activation the system renin-angiotensin-aldosteron (RAAS), arising at an ischemia of kidneys, is more exact at depression pulse pressure in a bringing arteriole of a glomerulus of kidneys. Enlargement of aldosteronum secretion conducts to augmentation of sodium and water reabsorbtion;

- Depression of a glomerular filtration in cases of a crushing defeat of kidneys.
- At last, at formation of edemas owing to discharge of waters from a vascular bed decreases of SV and VCB, the hypovolemia that leads to irritation of volume receptors of JGS and intensifying secretion of ADH and aldosteronum develops. It promotes still to a larger delay of sodium and a liquid in an organism and to augmentation of edemas.

Nephrotic syndrome

The symptomocomplex, including consistently developing signs:

- **Massive proteinuria (> 3,0 g/day)**
- **Hypo- and a disproteinemia (with prevalence of hypoalbuminemia);**
- **Hyper- and dislipoproteinemia**
- **Edemas**

Nephrotic syndrome

- S/S
  - Heavy proteinuria (3.5 gm%) and hypoalbuminemia
  - Edema
  - Infections
  - Thrombosis
  - Hyperlipidemia and lipiduria.
- Disorders with thickening of BM and mesangium.
- Associated common glomerular diseases
  - Membranoproliferative glomerulonephritis
  - Membranous glomerulonephritis
  - Minimal change

Urinary syndrome

- Proteinuria (> 0,2 and <3,0 g/day)
- Leukocyturia (abacterial, aseptic)
- Cylindruria
- Hematuria (macro- and a microhematuria)

Hypertensive syndrome

- Includes expressed proof rising of a BP (as a rule - DBP), refractory to medicamental therapy;
- change of vessels of an eye bottom (hypertensive angiopathy) with signs of bad vision;
- Signs of a hypertrophy of a myocardium of a left ventricle

Syndrome of arterial hypertension

- Parenchimatous renal AH (glomerulo - and pyelonephritis, diabetes mellitus, nephropathy of pregnant women, connective tissue systemic diseases, etc.)
- Vaso-renal AH (constriction of kidney vessels)
- AH post kidney transplantation

Syndrome of arterial hypertension (AH)

- Ischemia of renal parenchyma - secretion of renin – angiotensinogen – hypersecretion of aldosteron – stenosis of arterioles – hypertension
- Retention of water and sodium –hyperwolemia - main reason of AH

Nephritic syndrome

- Sudden onset
- S/S:
  - Hematuria, RBC casts.
  - Proteinuria, mild to moderate, not nephrotic range.
  - Hypertension
- Glomerular diseases with cellular proliferation.
- Hallmark disease: post streptococcal glomerulonephritis

Acute Renal failure

- Kidney stops working.
- Oliguria to anuria.
- Reversible
- Common cause- acute perfusion failure
- Gross and M/E – Renal cortical necrosis
- Lab Data: increased BUN and Serum Cr

  Hyperkalemia, metabolic acidosis, urinary sodium loss, same plasma and urine osmolality.

Acute Renal failure

- Initial stage from hours to 6-7 days (main symptoms of disease, which is cause of RF)
- Olyguric stage, can end of patient death or recovery
- Polyuric stage
- Recovery, from 3 to 12 months

Acute Renal failure

- Kidney stops working.
- Oliguria to anuria.
- Reversible
- Common cause- acute perfusion failure
- Gross and M/E – Renal cortical necrosis
- Lab Data: increased BUN and Serum Creat.

  Hyperkalemia, metabolic acidosis, urinary sodium loss, same plasma and urine osmolality.

Chronic renal failure

- Irreversible
- Slow progression
- S/S Uremia, polyuria, bone disease, anemia. Metabolic compensation.
- Common causes: hypertension and diabetes.
- Leads to end-stage renal disease.

There are three clinical stages:

1. Initial
2. Pronounced (IIA and IIB)
3. Terminal

Glomerulonephritis

also known as **glomerular nephritis** and abbreviated **GN'**, is a primary or secondary immune-mediated renal disease characterized by inflammation of the glomeruli, or small blood vessels in the kidneys

Pathogenesis of glomerular diseases

- Immunological:
  1. Antibodies reacting with glomerular antigens
  2. Trapped circulating agent (Membranous)
  3. Anti GBM antibodies (Good pasture's disease)
  4. Circulating immune complexes (Post streptococcal)
- Vascular
  - Hypertension
  - Diabetes
- Foreign material
  - Amyloidosis

Many causes of glomerulonephritis

They include those related to:

infections

immune diseases

inflammation of the blood vessels (vasculitis)

conditions that scar the glomeruli.

Infections:

- Post-streptococcal glomerulonephritis.
- Bacterial endocarditis.
- Viral infections.

Immune diseases

1 Lupus (SLE)
2 Goodpasture's syndrome (GN and interstitial pneumonia with hemoptisis)
3 IgA nephropathy
4 IgG (after overcooling)
5 Viral antigens (Cossacks)
6 Malaria

Vasculitis

- Polyarteritis.
- Wegener's granulomatosis.

Conditions that cause scarring of the glomeruli

- High blood pressure.
- Diabetic kidney disease.
- Focal segmental glomerulosclerosis.

Symptoms

Signs and symptoms of glomerulonephritis may depend on whether has the acute or chronic form, and the cause. Signs and symptoms may include:

- hematuria
- proteinuria
- hypertension
- edema with swelling evident of face, hands, feet and abdomen
- fatigue from anemia or kidney failure
- oliguria
- casts in urine

Hypertension

first 5-15 days touch to:

SBP 140-160 mm Hg

DBP 85-90 mm Hg

AH present days- weeks

High and stable AH is bad prognostic sign, can be sign of

transformation to subacute nephritis

GTD

- Normalization of glomerular filtration, increase of diuresis mark turning-point of disease
- Is main reason of AH, edemas, cardiac insufficiency

AGN

- Clinical course weeks-months
- More 6 month-transformation to ChGN
- Firm proteinuria during year-ChGN

Glomerulonephritis, Chronic

- Nearly all forms of acute glomerulonephritis have a tendency to progress to chronic glomerulonephritis. The condition is characterized by irreversible and progressive glomerular and tubulointerstitial fibrosis, ultimately leading to a reduction in the glomerular filtration rate (GFR) and retention of uremic toxins. If disease progression is not halted with therapy, the net result is chronic kidney disease (ChKD), end-stage renal disease (ESRD), and cardiovascular disease. The diagnosis of CKD can be made without knowledge of the specific cause.

Ist type ChGN

Chronic stage of post streptococcal GN

- More often in young age
- After first bout (attack) latent course, in many years AH, kidney insufficiency

2nd type ChGN

- Arise in adults, latent course
- First signs – massive proteinuria, edemas
- AH arise later, signify terminal stage of disease
- Quickly progress and lead to kidney insufficiency

The National Kidney Foundation of USA defines ChKD as:

(1) evidence of kidney damage based on abnormal urinalysis results (e.g., proteinuria, hematuria) or structural abnormalities observed on ultrasound images or

(2) a GFR less than 60 mL/min for 3 or more months.

Based on this definition, the National Kidney Foundation developed guidelines that classify the progression of renal disease into 5 stages, from kidney disease with a preserved GFR to end-stage kidney failure. This classification includes treatment strategies for each progressive level, as follows:

Stage 1: This stage is characterized by kidney damage with a normal GFR (≥ 90 mL /min).

Stage 2: This stage is characterized by kidney damage with a mild decrease in the GFR (60-90 mL /min).

Stage 3: This stage is characterized by a moderately decreased GFR (30-59 mL /min).

Stage 4: This stage is characterized by a severe decrease in the GFR (15-29 mL /min)

Stage 5: This stage is characterized by kidney failure

Clinical presentations

- Azotemia
- Uremia
- Nephritic syndrome
- Nephrotic syndrome
- Hematuria
- Proteinuria
- Acute renal failure
- Chronic renal failure

Clinical type of ChGN

- Hypertensive or vascular
- Edema – albuminuric
- Mix type

Hypertensive or vascular

1. high and stable AH
2. hypertrophy and dilatation of LV, LVCI
3. changes of eye bottom vessels
4. edema not significant
5. slight proteinuria
6. a few RBC and castles in urine

Edema – albuminuric.

GN with nephrotic s-m, typical:

1. Massive proteinuria
2. Hypercholesterolemia (350-400 mg% and >).
3. Hypoproteinemia
4. Edemas (up to anasarca)

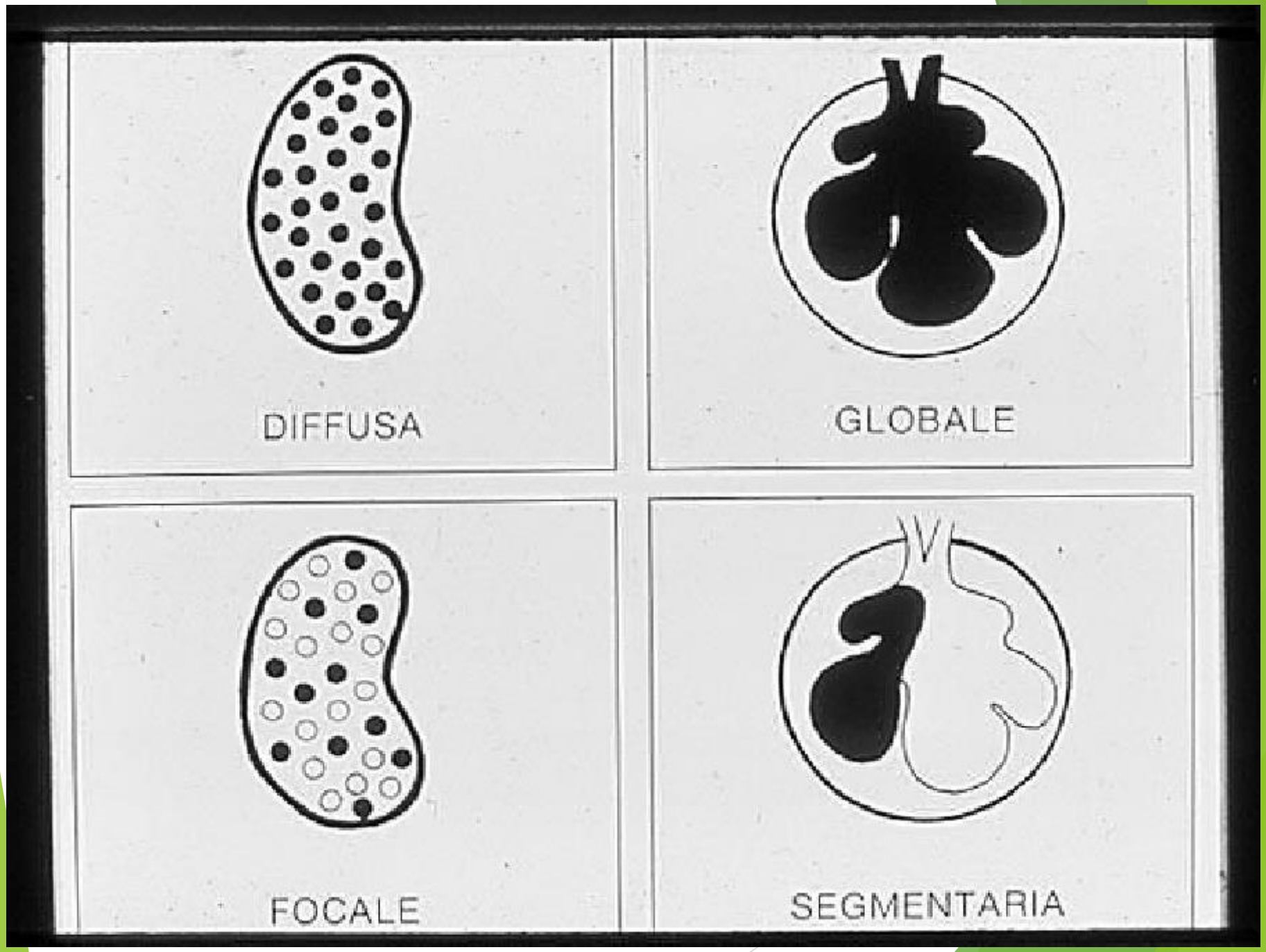
KI uremia

Clinical course to death: 2-3 years.

Glomerular response to damage

Histological changes

- Hypercellularity
- BM thickening
- Hyalinization and sclerosis
- Terminology
  - Diffuse/focal
  - Global/segmental

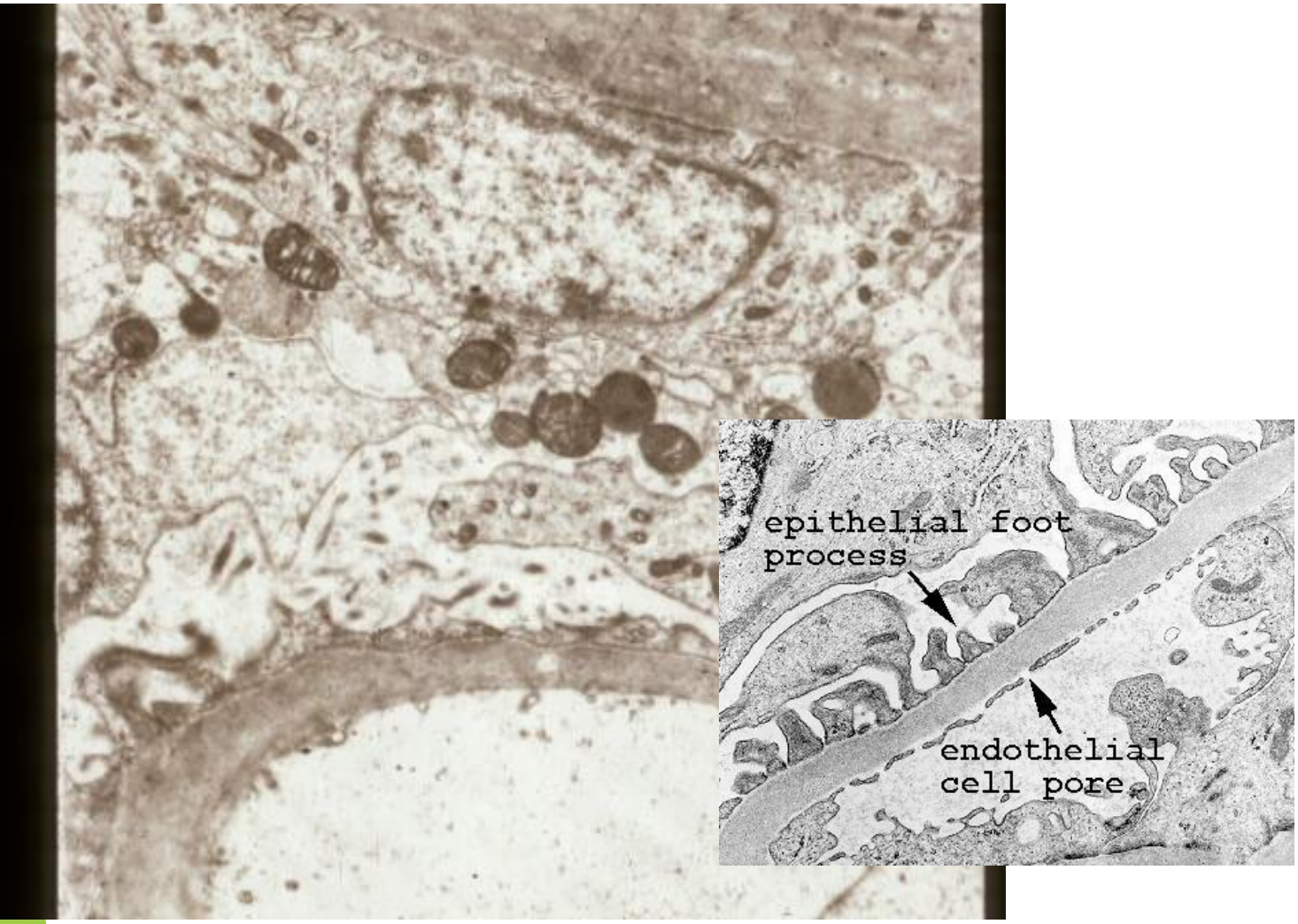

DIFFUSA
GLOBALE
FOCALE
SEGMENTARIA

Morphological types of ChGN

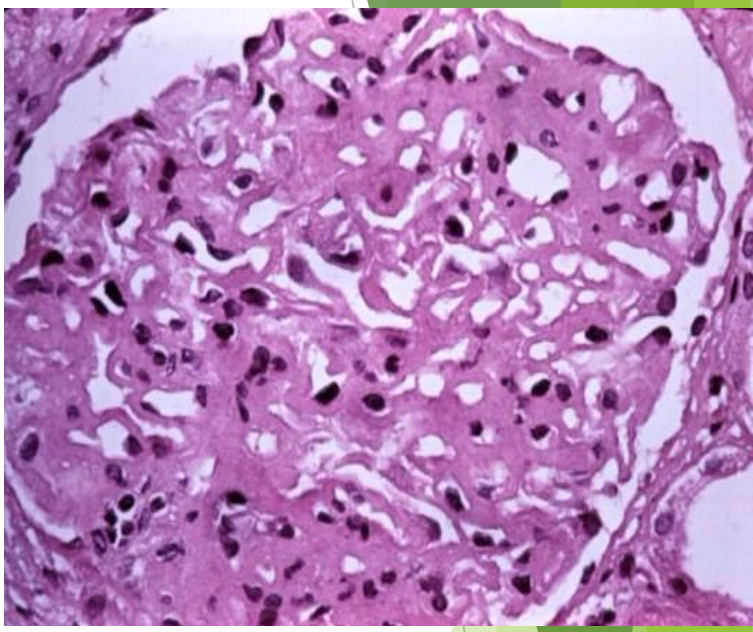
Minimal change disease

CP -Nephrotic syndrome

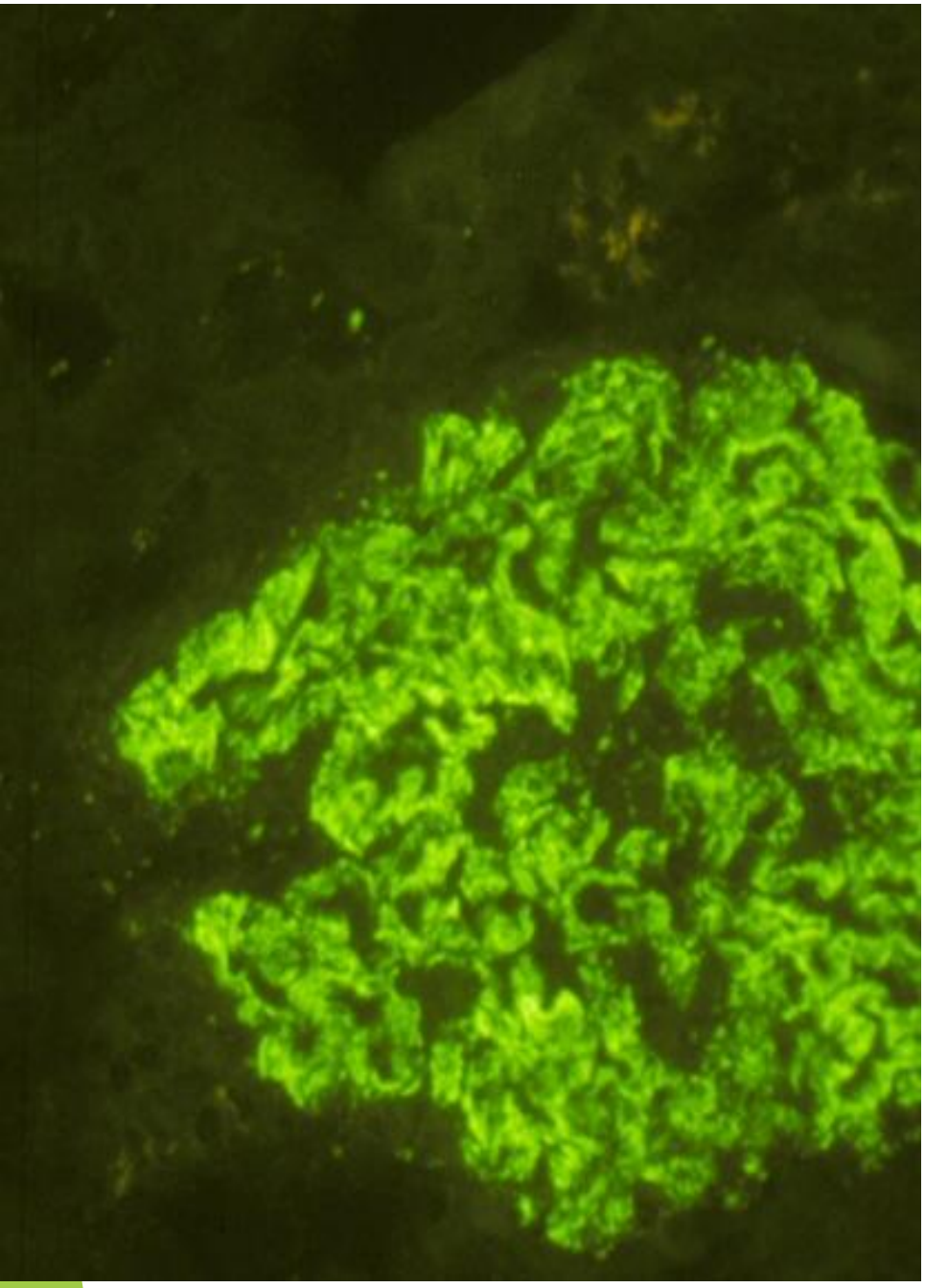
- Histology
  - H and E Normal
  - EM Fusion of foot process
  - IF
- Rx steroids

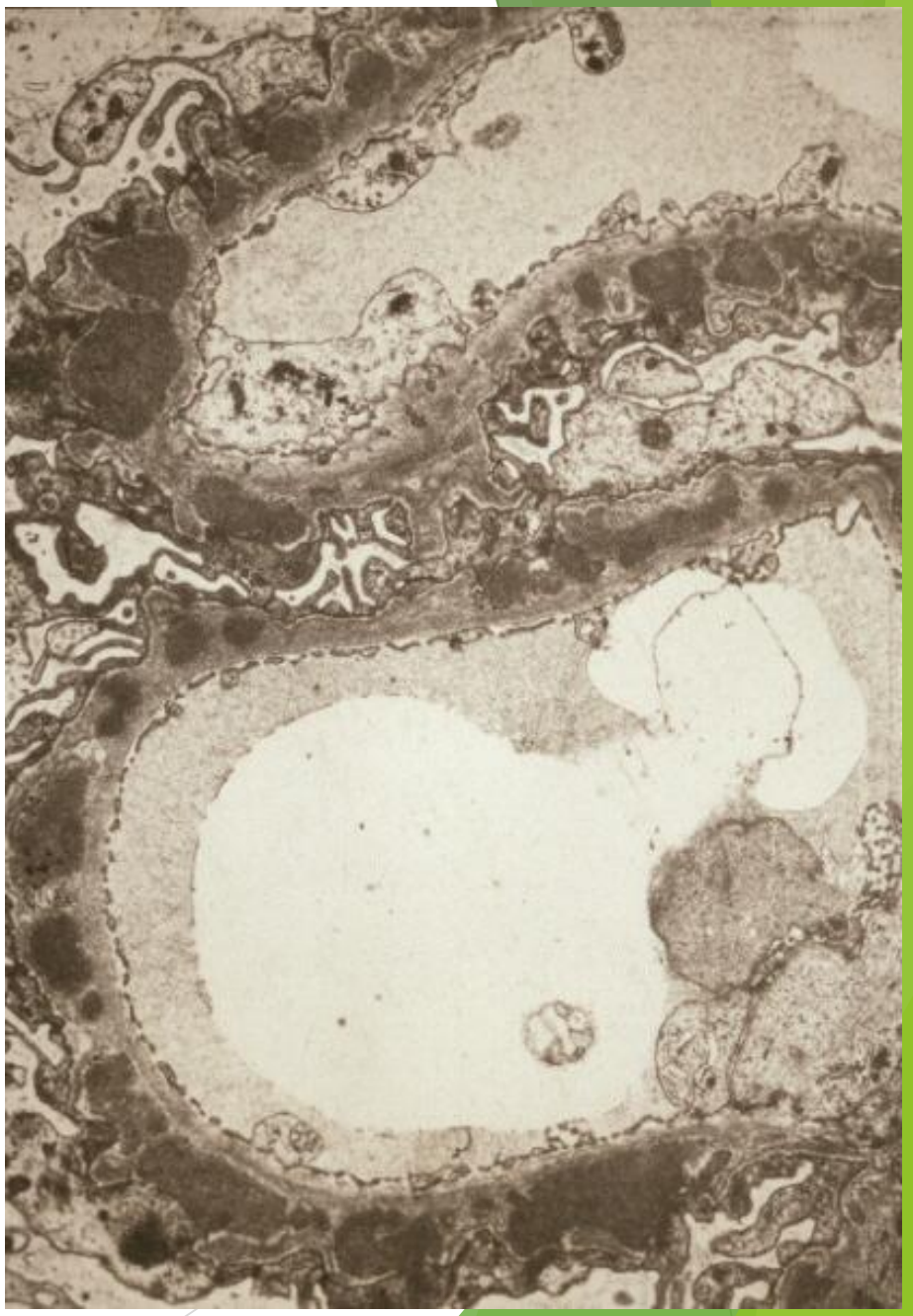

epithelial foot
process
endothelial
cell pore

Membranous nephropathy



- Usually adults
- CP- nephrotic syndrome
- Etiology- idiopathic/ secondary to multiple causes
  - Infective
  - Drugs
  - Tumors
  - SLE
- Diagnosis
  - H and E- diffuse and global, BM and mesangial thickening
  - IF- IgG and complement
  - EM- Subepithelial deposits (spikes)



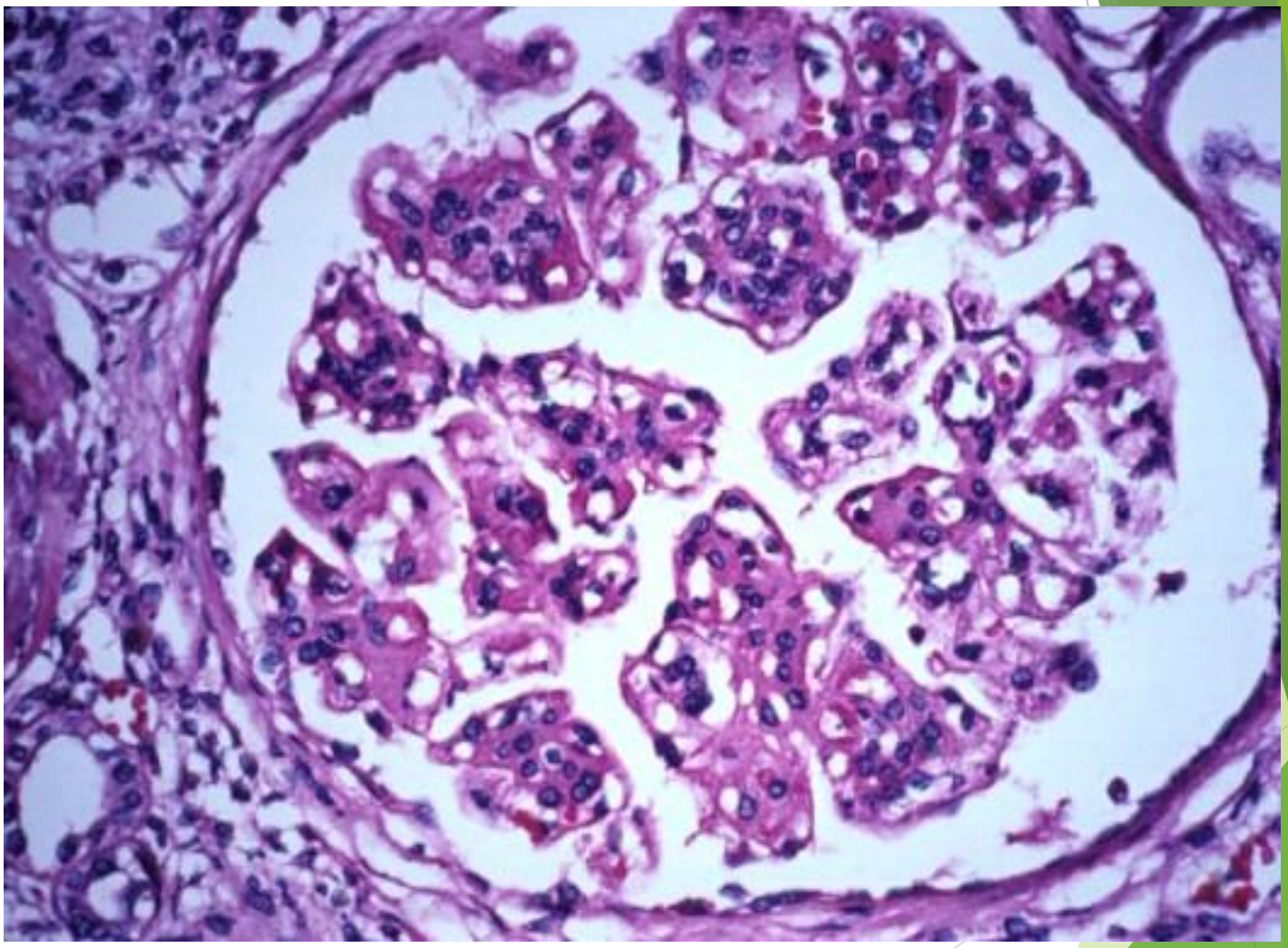


Membranoproliferative GN (the most widely spread)

- Children and adults
- CP- mixed nephrotic and nephritic
- Etiology- idiopathic or secondary e.g. SLE
- Histology- Type 1 and Type 2
  - Type I- increased lobularity of the glomeruli, because of mesangial proliferation (mesangial interposition-tram track appearance)

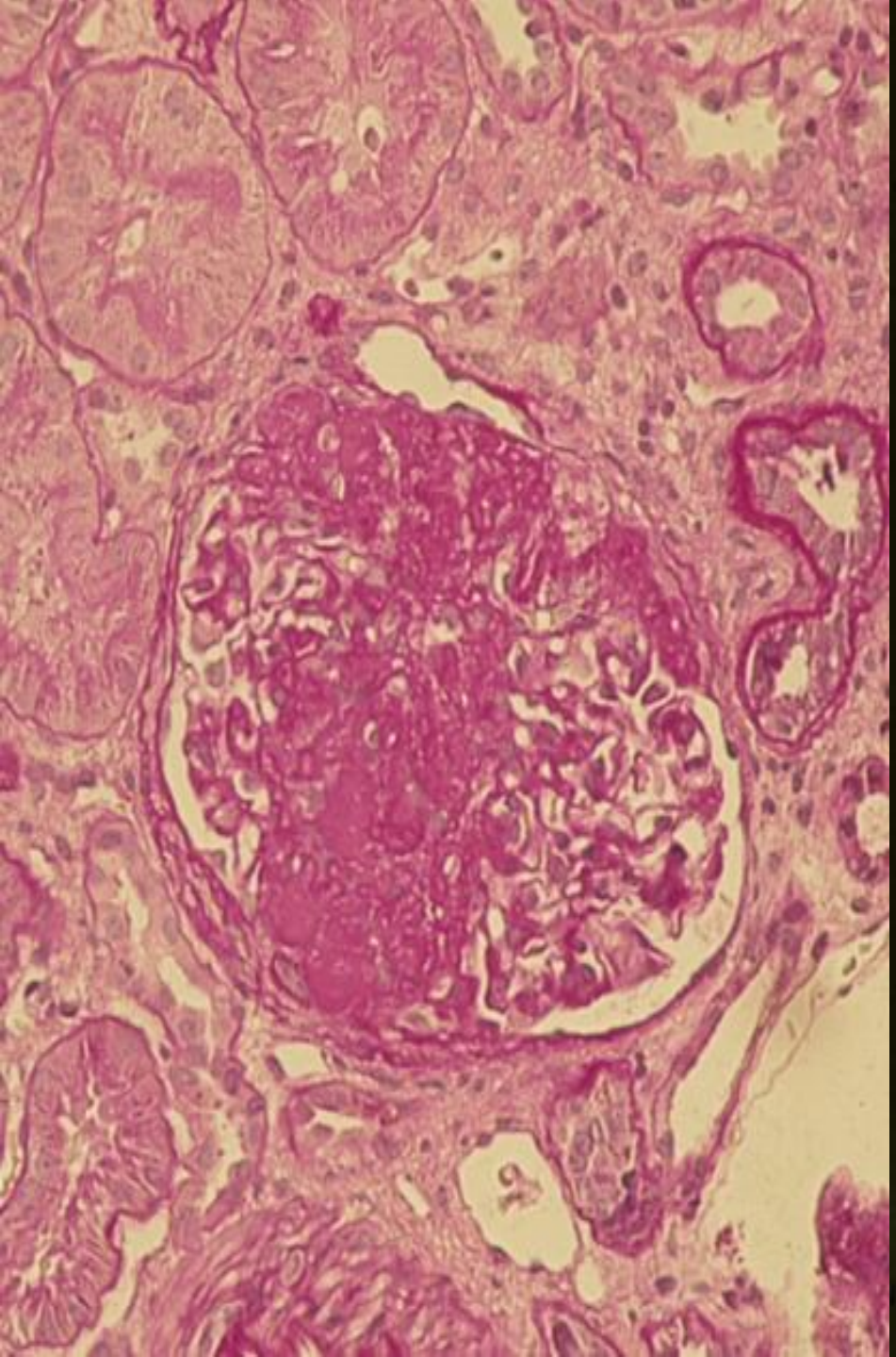
    EM Subendothelial deposits

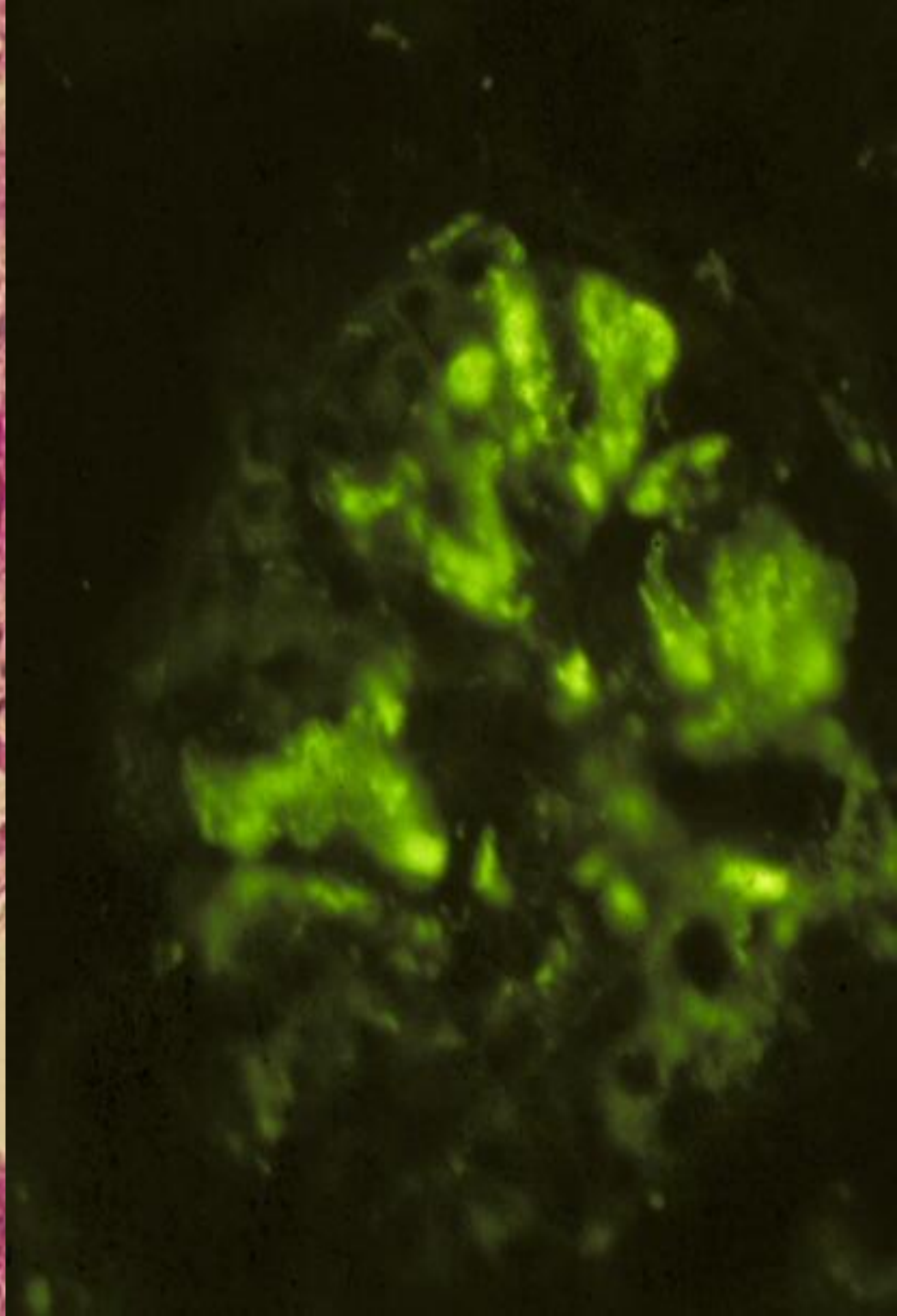
    IF IgG/ IgM and C3
  - Type II- mesangial proliferation not that prominent
    - EM dense deposit disease
    - IF C3
- Course: progressive, poor prognosis



Focal glomerulosclerosis

- Children and adults
- CP- nephrotic syndrome
- Etiology- Idiopathic/ secondary e.g. HIV.
- Poor prognosis

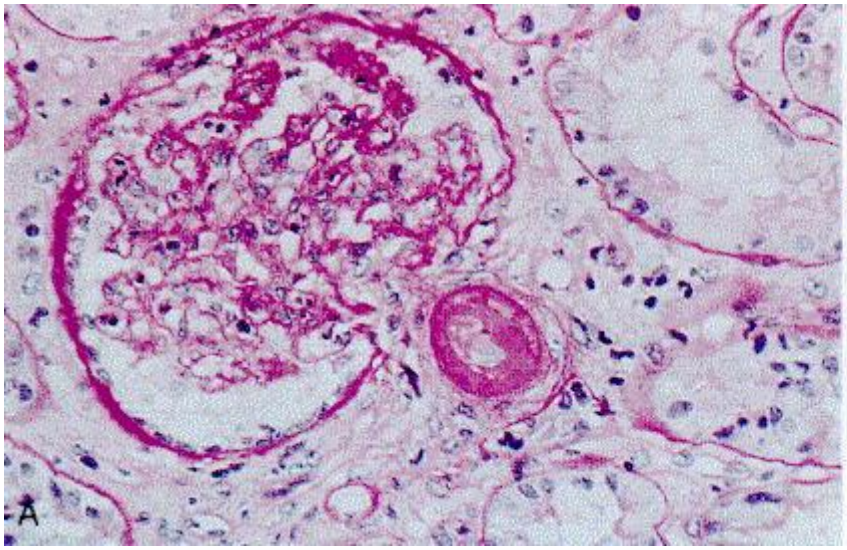


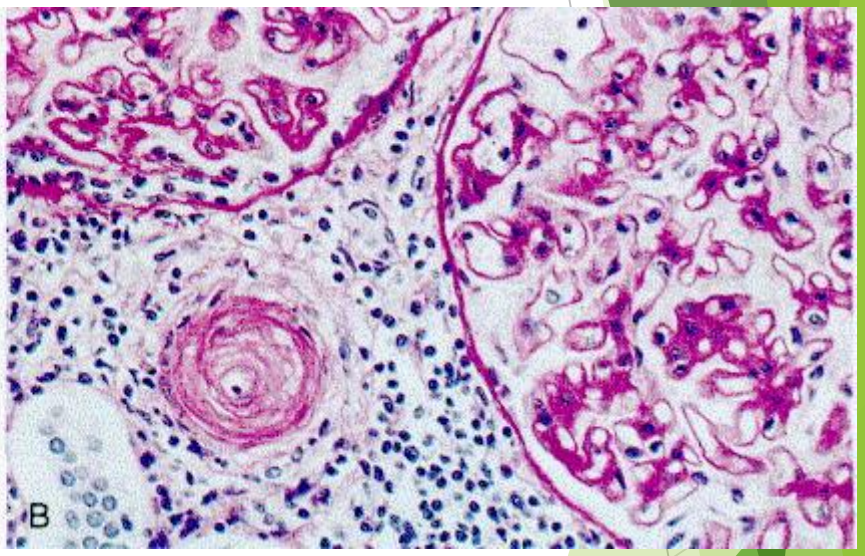


Hypertension and kidney

- Benign hypertensive nephrosclerosis
  - Granular kidney
  - Arteriolar hyalinization
- Malignant hypertension
  - Flea bitten kidney
  - Fibrinoid necrosis of the vessels

Malignant Hypertension



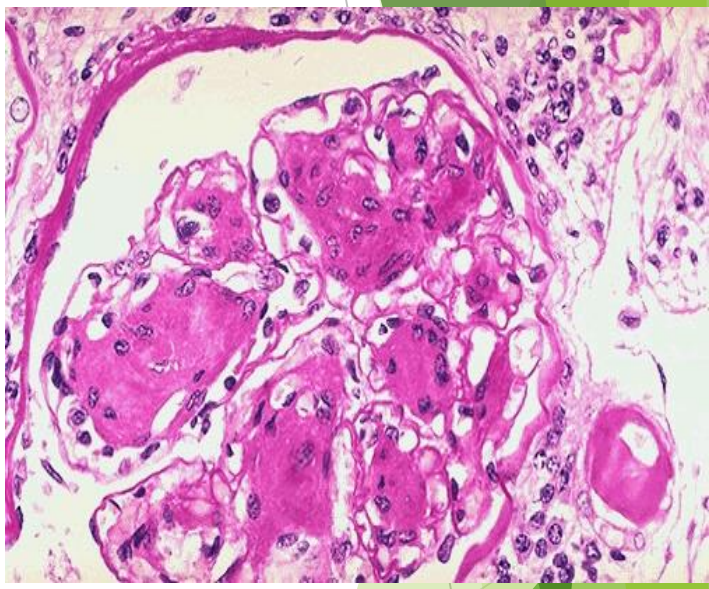


Fibrinoid necrosis

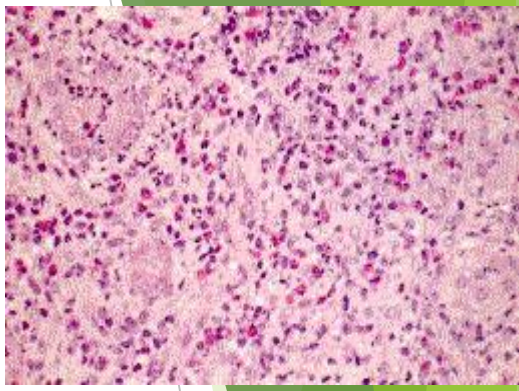
Hyperplasic arteriopathy

Diabetes and kidney

- Diabetes most common cause of end stage renal failure.
- Diabetic vascular disease- AS/hyaline arteriosclerosis.
- Diabetic glomerulosclerosis
  - Mesangial matrix formation
    - Diffuse glomerulosclerosis
    - Nodular glomerulosclerosis (Kimmelstiel-wilson disease)
  - BM thickening
  - Exudative lesions- fibrin cap
- Increased infection- Pyelonephritis
- Papillary necrosis



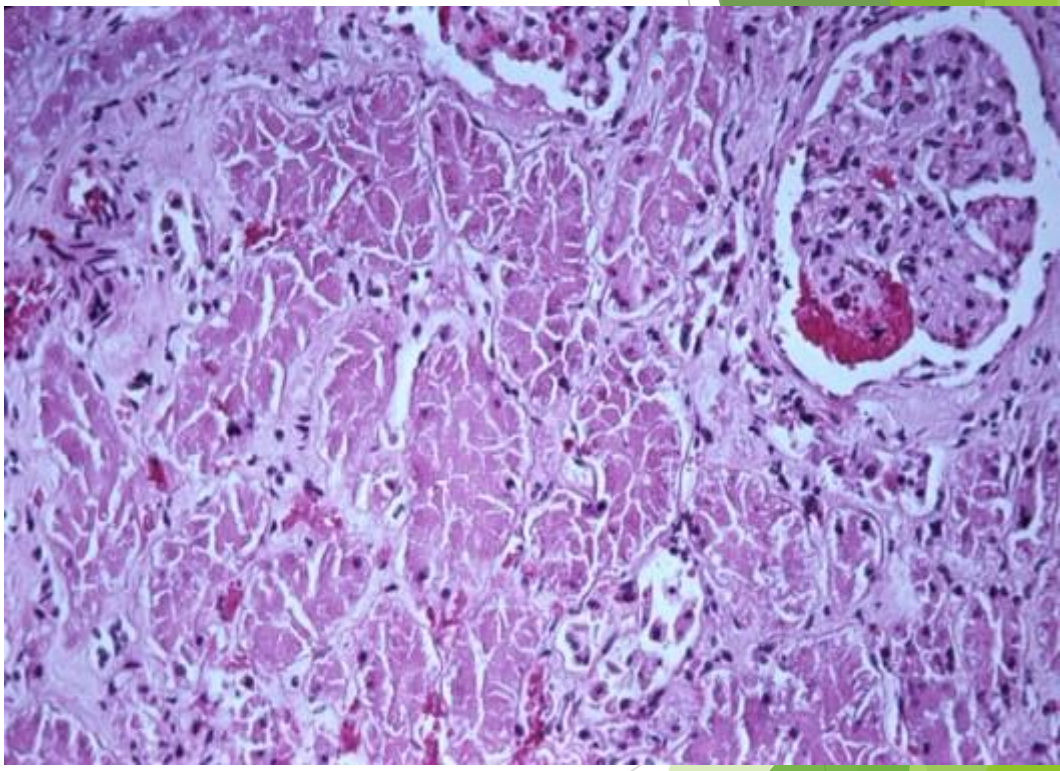
Diseases of renal tubules and interstitium



- Pyelonephritis- acute and chronic
- Acute tubular necrosis
- Interstitial nephritis
  - acute and chronic
  - interstitial inflammation
  - Drugs like analgesics and antibiotics
- Metabolic damage to tubules for eg calcium and urate
- Functional tubular abnormality

Acute tubular necrosis

- Reversible acute renal failure.
- Causes
  - Ischemia
  - Drugs
- Clinical stages
  - Initiating- oliguria
  - Maintenance- polyuria
  - Recovery



What is pyelonephritis?

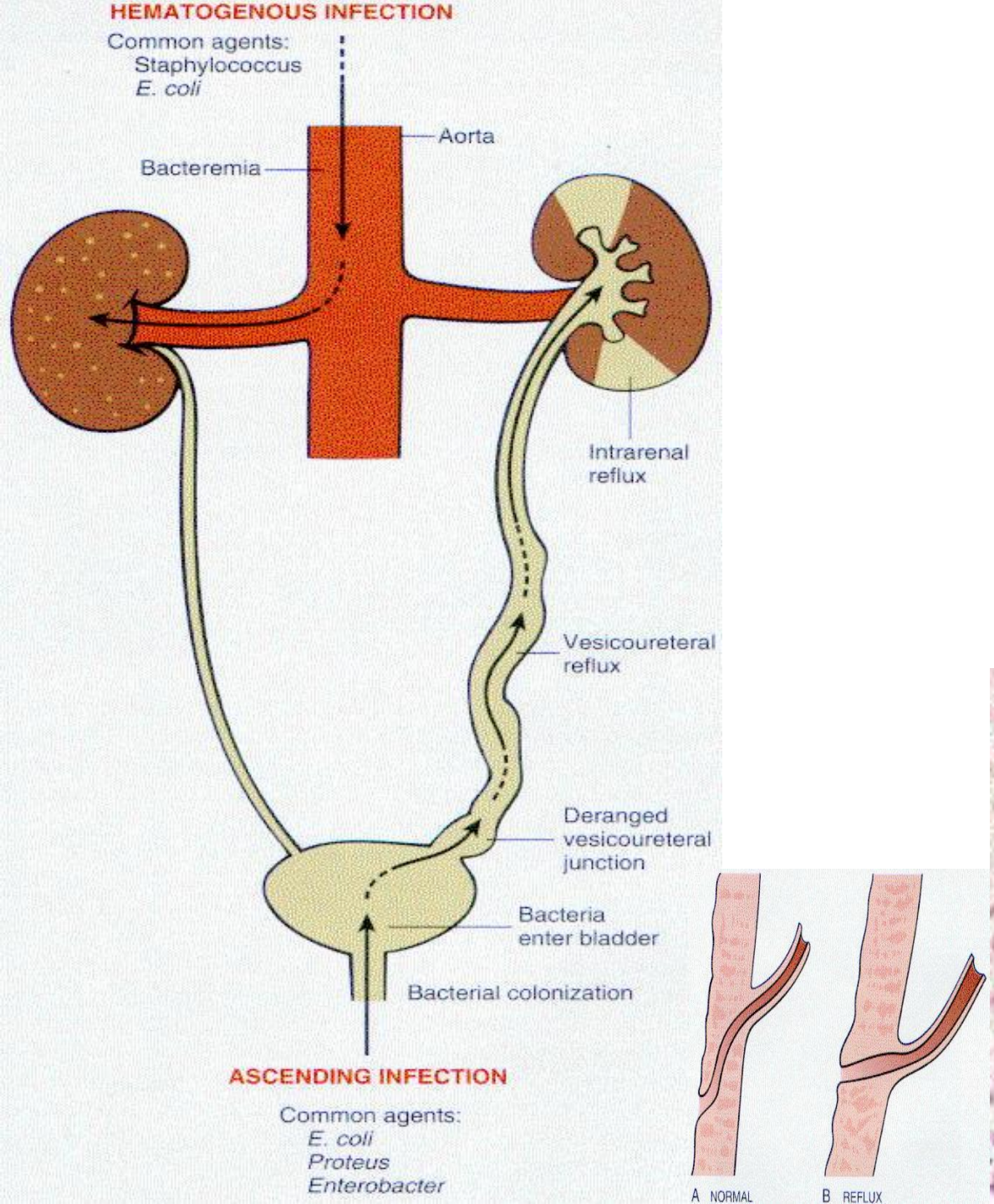
Pyelonephritis is a kidney infection, usually from bacteria that have spread from the bladder.

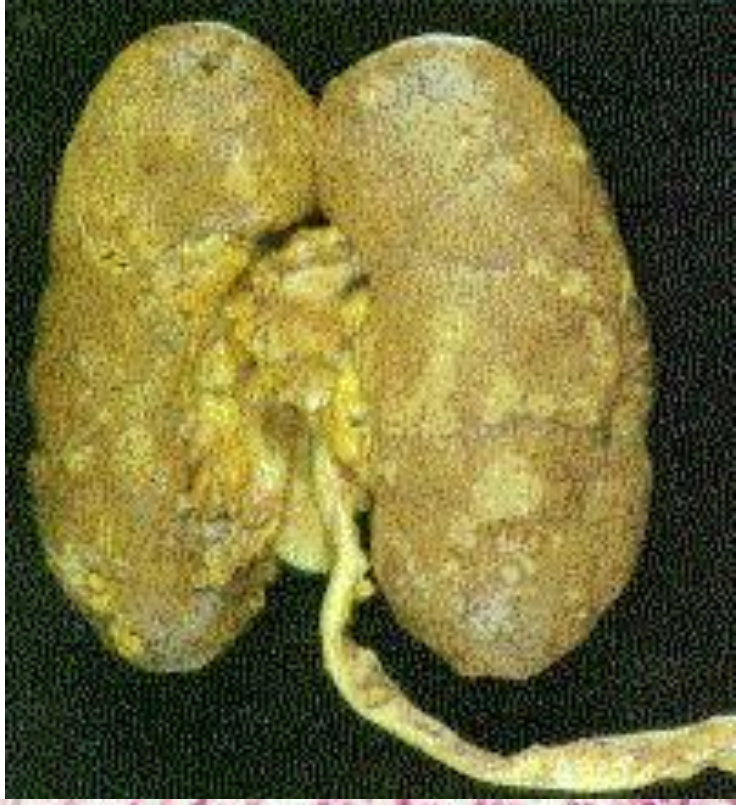
This is infection within the renal pelvis, usually accompanied by infection within the renal parenchyma.

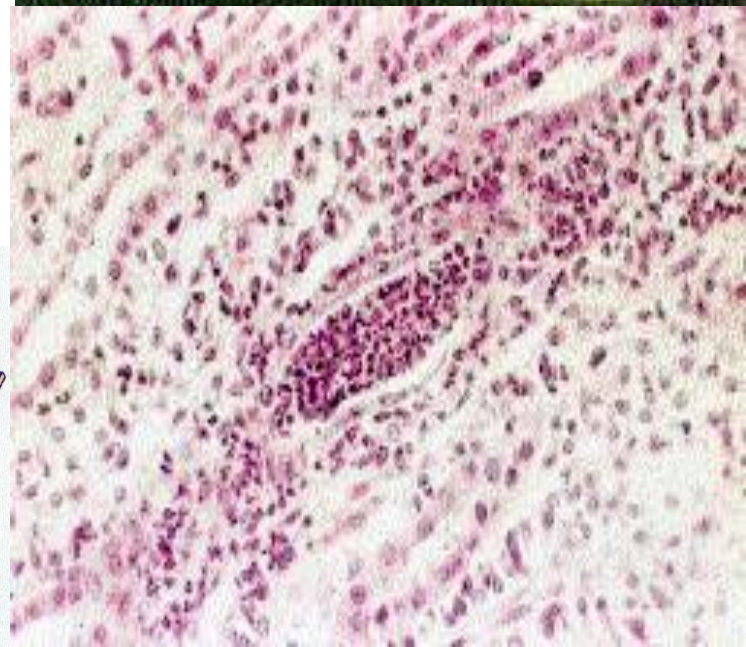
What causes pyelonephritis?
Main reason is urinary stasis!!!

Possible causes of kidney infection include the following:

- infections in the bladder
- use of a catheter to drain urine from the bladder
- use of a cystoscope to examine the bladder and urethra
- surgery on the urinary tract
- conditions such as prostate enlargement and kidney stones that prevent the efficient flow of urine from the bladder
- defects or abnormalities in the urinary tract that block the flow of urine


HEMATOGENOUS INFECTION
Common agents:
Staphylococcus
E. coli
Aorta
Bacteremia
Intrarenal reflux
Vesicoureteral reflux
Deranged vesicoureteral junction
Bacteria enter bladder
Bacterial colonization
ASCENDING INFECTION
Common agents:
E. coli
Proteus
Enterobacter





A NORMAL
B REFLUX

What are the symptoms of pyelonephritis?

Symptoms include the following:

- back, side, and groin pain
- urgent, frequent urination
- pain or burning during urination
- fever (often with shivering)
- nausea and vomiting
- pus and blood in the urine (active WBC –cells of Shtergeimer – Malbin)

Acute Pyelonephritis

- Bacterial infection
- Routes – ascending infection and hematogenous
- Predisposing factors: pregnancy, DM, stones, tumor, vesicoureteral reflux
- S/S – pain, fever (shivering), often with lower urinary symptoms (pollaciuria, stranguria), muddy urine
- Gross: small cortical abscess
- M/E: neutrophils present
- Course: septicemia, papillary necrosis, peri and pyonephrosis.

Clinical picture

Hyperemia of face
Sweating
Muscles pain

Pasternatsky symptom
is sharply positive

Proteinuria up to 1‰
Isohypostenuria
Polyuria
Nickturia
Thirsty

Microbe number (quantity) – tens and hundreds thousands in 1 ml

Incidence

Acute pyelonephritis can occur at any age. In neonates it is 1.5 times more common in boys and tends to be associated with abnormalities of the renal tract. Uncircumcised boys tend to have a higher incidence than circumcised boys. Beyond that age girls have a 10-fold higher incidence. In adult life it reflects the incidence of urinary tract infection (UTI) in that it is much more common in young women. Over 65 years the incidence in men rises to match that of women.

Risk factors

These include:

Structural renal abnormalities

Calculi and urinary tract catheterization

Stents or drainage procedures

Pregnancy

Diabetes

Primary biliary cirrhosis

Immunocompromised patients

Neuropathic bladder

Prognosis

Premature labor can occur in pregnant women.

Most other patients have an uncomplicated recovery, providing there are no significant co-morbidities.

If stay without or improper treatment - ChPN

Chronic Pyelonephritis

- Reflux associated/ obstructive.
- Gross: irregular cortical scarring, distorted renal calyx
- M/E: chronic inflammation, fibrosis and tubular atrophy.
- Specific – Tuberculous pyelonephritis

Chronic pyelonephritis is persistent kidney inflammation that can scar the kidneys and may lead to chronic renal failure.

This disease is most common in patients who are predisposed to recurrent acute pyelonephritis, such as those with urinary obstructions or vesicoureteral reflux.

ChPN and AH

- AH rare and transient
- AH due to increased vascular resistant (but not retention of salt, water etc.)
- Hasn't eye bottom changes

Complications

These occur more often in patients with diabetes mellitus, chronic renal failure, sickle cell disease, renal transplant (especially first 3 months), AIDS and other immunocompromised states. They include:

1. Septicemia
2. Perinephric abscess (more common if urinary tract abnormality)

Renal abscess, including emphysematous pyelonephritis (rare, life-threatening form with tissue necrosis and accumulation of gas in renal parenchyma, perinephric space and collecting systems - particularly occurs in obese, elderly diabetic women with urinary tract obstruction)

3. Acute papillary necrosis is more likely in the elderly and those with diabetes (suggested by associated symptoms of renal colic)
4. Pregnancy - tends to produce a more complicated course with significant risk of premature labor

Pyelonephritis more likely to scar the kidney of a growing child