

**MINISTRY OF HEALTH OF UKRAINE**

**ODESA NATIONAL MEDICAL UNIVERSITY**

**Faculty** Medicine

**Department** of Surgery with Postgraduate Education

**APPROVED BY**

**Vice-Rector for Scientific and Pedagogical Work**



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**METHODOLOGICAL RECOMMENDATION  
FOR PRACTICAL CLASSES OF THE ACADEMIC DISCIPLINE**

Faculty, course Medical 6<sup>th</sup> year

Academic discipline Surgery

*(name of the discipline)*

**PRACTICAL CLASSES**

*Practical class № 22*

**Topic: “Damage to the chest cavity organs.  
Clinic and diagnosis of pneumothorax, hemothorax and  
chylothorax. Therapeutic approaches”**

**Approved:**

At the meeting of the Department of Surgery with Postgraduate Education of Odesa National Medical University

**Odesa National Medical University**

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# PRACTICAL CLASSES

## *Practical class №22*

**Topic: «Damage to the chest cavity organs. Clinic and diagnosis of pneumothorax, hemothorax and chylothorax. Therapeutic approaches» – 6 hours**

- **Relevance of the topic**

Currently, chest injuries rank third after limb and cranial injuries, accounting for 10-20% of hospitalizations.

Up to 25% of chest injuries are severe injuries requiring emergency surgery. The high social significance of chest injuries is determined by the fact that about 90% of victims are of working age, with a significant duration of treatment and rehabilitation, a large number of purulent and septic complications (up to 20%) and high mortality (17 to 30%). This picture is complemented by forensic data, according to which the incidence of chest injuries is 43% among fatal mechanical injuries, with 60.3% of victims dying from severe chest injuries at the scene and 22.4% during transportation. It is noteworthy that even today, up to 15% of victims die not because of the severity and extent of the injury, but from secondary causes that can be eliminated.

Therefore, the study of this pathology is important in the work of a doctor not only in surgical but also in general clinical practice. To this end, the student should be familiar with the issues of chest cavity injuries, in order to timely conduct the necessary additional examination, determine the diagnosis, severity of the injury, as well as the correct and highly qualified assistance to the victim.
- ***Objectives***
- **Learning objectives.**
  - **I level**
    - To draw the attention of the higher education student to the increase in the level of damage to the chest cavity organs: the proportion of open and closed chest injuries, the proportion of severe forms of the course, the presence of severe complications, as well as the mortality rate depending on the treatment tactics.
    - To familiarize the student with the etiopathogenesis of various forms of chest injuries, their classification.
    - To draw the attention of the applicant for higher education to modern objective methods of functional and instrumental research in thoracic surgery (radiography, tomography (CT), spiral CT, fibrobronchoscopy).
    - To study the features of the clinical course of open and closed chest injuries, diagnosis of the degree of damage to internal organs, errors in diagnosis and management of patients.
    - To familiarize the applicant with surgical methods of treatment of chest injuries (various types of transthoracic drainage, organ-preserving operations, including video thoracoscopic, lung decortication, omentoplasty, rib resection, fenestration and open surgical interventions).

- To familiarize the student with various types of complex treatment of chest injuries.

### **II level**

- Higher education students should know the etiopathogenesis of chest injuries;
- Higher education students should know the proportion of open and closed chest injuries, the proportion of severe forms of the course, the presence of severe complications, as well as the mortality rate depending on the treatment tactics;
- Higher education students should master modern objective methods of functional and instrumental research in thoracic surgery;
- To familiarize the applicant with the peculiarities of the clinical course of various types of chest injuries;
- To provide higher education students with the opportunity to master surgical and complex methods of diagnosis and treatment of chest injuries;
- To provide higher education students with the knowledge to properly take anamnesis in patients with chest injuries;
- To provide higher education students with the ability to examine and detect chest injuries;
- To provide higher education students with the ability to correctly interpret the results of modern objective methods of laboratory and instrumental research (ultrasound, radiological studies, ECHO, CT, spirometry, fibrobronchoscopy, diagnostic thoracoscopy);

### **III level**

- Higher education students should be able to correctly identify the constituent elements of the lung roots on anatomical specimens and radiographs.
- Higher education students should be able to correctly interpret the results of functional and laboratory tests, especially gas exchange, acid-base balance, interpret the main radiological signs that occur in case of damage to the chest cavity;
- Higher education students should be able to identify the main etiological aspects in each individual case of chest injury;
- Conduct a complete clinical and instrumental diagnosis of this pathology;
- Have full skills of examination, interview, percussion, auscultation;
- Based on the information received, make a detailed preliminary diagnosis, referring to the recommendations of ICD 10.

- ***Educational objectives***

- To form a deontological understanding when working with patients with chest injuries.
- Develop an understanding of the impact of risk factors for chest injuries.
- Based on the material of the topic under study, develop a sense of responsibility for the timeliness, as well as the correctness and professionalism of actions towards the victim.

- To form an idea of the basis of a psychotherapeutic approach to patients with open and closed chest injuries.
- Master the ability to establish psychological contact with the patient and his/her relatives.

• **Interdisciplinary integration**

<b>Disciplines</b>	<b>To know</b>	<b>To be able to</b>
<b>Previous disciplines</b>		
1. Normal anatomy	Structural development of the chest organs (heart, lungs, esophagus, trachea, diaphragm)	Correctly identify the components of the thoracic organs on anatomical specimens and radiographs.
2. Normal physiology	Normal gas exchange parameters, normal perfusion and oxygenation parameters, basic hemodynamic parameters of the small and large circulation circles	Correctly interpret the results of functional and laboratory tests, especially gas exchange, acid-base balance, spirometry.
3. Pathological physiology	Pathology of gas exchange, typical shifts in perfusion and oxygenation, basic hemodynamic parameters of the small and large circulation	Interpret the results of laboratory tests and spirometry, perform pneumotachometry
4. Radiology	Main types of X-ray examination of chest organs, indications for the use of special techniques	Correctly interpret the results of plain radiography, lateroscopy, tomography, bronchography, the main signs of bronchopulmonary pathology, as well as computed tomography and spiral tomography
5. Propedeutics of internal diseases	Methods of physical examination of the patient, major clinical syndromes. Instrumental studies, laboratory methods of research	Examine the abdominal cavity using methods of palpation, percussion, auscultation. Interpret data from laboratory and instrumental studies.
6. Pharmacology	The main drugs used in the treatment of chest injuries	Write prescriptions.
7. Organization of health care	Know the structure of ICD-10, have skills in navigating ICD-10	Based on the information received, make a detailed preliminary diagnosis, referring to the recommendations of ICD-10.
<b>The following disciplines</b>		

Resuscitation and anesthesiology	Methods of resuscitation in the development of complications that have developed in chest injuries. Intensive care	Carry out resuscitation measures in full, ensure supervision and monitoring of patients in the intensive care unit. Draw up an infusion therapy plan taking into account the patient's background and concomitant pathology.
<b>Intersubject integration</b>		
Suppurative diseases of the lungs and pleura	Stage of the disease, clinical picture of complications, radiological signs	Apply the acquired knowledge in the study of etiology and pathogenesis during differential diagnosis
Damage to abdominal organs	Stage of the disease, clinical picture of complications, radiological signs	
Modern methods of surgical treatment of patients with thoracic pathology	The main endoscopic methods of surgical treatment used in thoracic pathology; indications and contraindications to them; possibilities of the method	

**Content of the class**

***Damage to the chest*** - Isolated or complex damage to the integrity of the skin, bone skeleton, and internal organs of the chest.

***Open chest injuries*** - injuries accompanied by a violation of the integrity of the skin and tissue structures of the chest wall.

***Closed chest injuries*** include: lung contusion without rupture of the visceral pleura; trachea and bronchial injury; heart and pericardial injury; damage to the large vessels of the chest (aorta, vena cava and vena cava); esophagus injury; and diaphragm injury.

***Classification of chest injuries:***

- Unilateral.
- Bilateral.

***Classification of chest injuries:***

- Closed chest injuries.
- Open (wound) injuries to the chest.

***Traumatic chest injuries are divided into:***

- Isolated injuries to the chest and its organs.
- Multiple injuries to the chest and its organs.
- Combined injuries to the chest and its organs.

***Risk factors for chest injuries:***

- acute respiratory failure (inadequate ventilation);
- Hypovolemic shock (chest wall wound that bleeds profusely, intrathoracic vascular injury);

- airway obstruction (vomit, blood and other foreign bodies, inflamed tongue, direct damage to the main airways);
- accumulation in the pleural cavity (hemothorax, pneumothorax, hemopneumothorax);
- damage to the diaphragm;
- parenchymal dysfunction (bruising, aspiration, intrabronchial bleeding):
- presence of damage to the integrity of the skin in the projection and outside the projection of the chest;
- pallor and/or cyanosis of the skin;
- pain, especially in case of damage to the ribs and sternum;
- shortness of breath and difficulty breathing;
- restriction of respiratory movements;
- hemoptysis of varying intensity and duration;
- signs of open pneumothorax;
- hypovolemic shock in case of damage to intrathoracic organs and vessels;
- subcutaneous emphysema;
- emphysema of the mediastinum;
- increasing respiratory and cardiovascular failure;
- physical signs of pneumothorax and hemothorax with mediastinal displacement to the healthy side.
  - ***List of basic diagnostic measures:***
- visual inspection of the chest injury;
- palpation of tissues in the area of injury in the dynamics to determine the presence of emphysema and the rate of its growth;
- chest percussion to determine the presence of pneumothorax and/or hemothorax;
- auscultation to detect lung function on the side of the lesion;
- blood pressure measurement and pulse counting;
- counting the respiratory rate (RR);
- determination of the level of consciousness.

### ***Clinic and diagnosis of pneumothorax, hemothorax and chylothorax***

*Pneumothorax* - accumulation of air in the free pleural cavity. The following types are distinguished: closed, open, valve and tension.

Closed pneumothorax is frequent in rib fractures, spontaneous lung ruptures (lung cyst, emphysematous bulla), and lung abscesses. Air can be sucked into the pleural cavity in penetrating chest wounds at the time of injury, and its further flow into the pleural cavity is stopped due to the wound edges falling off. Closed pneumothorax can also be caused by rupture of the intrapleural segments of the main bronchi.

An open pneumothorax is possible in penetrating chest wounds, when the wound channel is not closed and air can freely enter and exit the pleural cavity.

A valve pneumothorax occurs when the possibility of air exit from the pleural cavity is blocked by a tissue (flap) of the lung in case of its rupture or by a skin valve in case of a penetrating chest wound. In such cases, with the next breath, a new portion of air enters the pleural cavity, due to which the intrapleural

pressure increases rapidly, and a so-called tension pneumothorax develops: internal - in case of lung rupture, external - in case of chest injury.

***Tactics of emergency care:***

- application of an aseptic protective dressing;
- application of a sealing dressing in the presence of an open pneumothorax;
- covering the wound with a sterile towel in the presence of a large chest wall defect with subsequent fixation with a circular bandage;
- drainage of the pleural cavity in the II-III intercostal space along the midclavicular line or in the IV-V intercostal space along the midaxillary line;
- intravenous administration of crystalloid and colloidal solutions to fill the blood volume: if blood pressure is not determined, the infusion rate should be 300-500 ml/min; in case of shock of I-II degree, up to 800-1000 ml of polyionic solutions are administered by IV jet; in case of more severe circulatory disorders, IV jet administration of dextrans or hydroxyethyl starch at a dose of 5-10 ml/kg should be added until blood pressure stabilizes at 90-100 mm Hg
- analgesia to suppress the pain reaction and improve sputum expectoration;
- in case of acute respiratory failure - oxygen inhalation;
- in case of increasing mediastinal emphysema - drainage of the anterior mediastinum;
- tracheal intubation and artificial lung ventilation in case of increasing acute respiratory failure;
- in case of stoppage of effective blood circulation - resuscitation;
- transportation of victims is carried out in a horizontal position with the head end elevated by 30° or in a semi-sitting position

*Hemothorax* - accumulation of blood in the pleural cavity. In addition to the lung, the source of hemothorax is often the intercostal arteries and veins, the internal mammary artery, which are damaged by rib fractures.

According to the volume of blood spilled, there are small (200-300 ml), medium (up to 700-800 ml) and large (up to 1.5-2 liters) hemothoraxes. Unilateral hemothorax, in addition to the symptom complex of acute blood loss, causes a shift in the healthy side of the mediastinal organs, restricts the excursion of the lung, presses it upward, reducing its vital capacity.

*Chylothorax* is an accumulation of lymph in the pleural cavity. It occurs as a result of damage to the wall of the thoracic duct during thoracic surgery, much less often - in chest trauma, as well as due to malformations of the thoracic duct, inflammatory and tumor processes of various organs of the chest cavity, and sometimes - in tuberculosis.

Clinical manifestations are caused by lung compression and mediastinal displacement with symptoms of respiratory failure and hemodynamic disorders.

Differential diagnostics with other types of hydrothoraxes is performed during pleural puncture at typical points (VI-VII intercostal space along the scapula line and IV-V - along the middle axillary), when a milky liquid of thick consistency, cloudy, without sediment is released. It should be noted that lymph has antiseptic and bactericidal properties and does not become infected for a sufficiently long period, thus not turning into empyema.

In case of a prolonged process, surgical intervention may be necessary - intrathoracic ligation of the damaged thoracic duct, which can also be performed videothoroscopically.

***Surgical treatment of chest injuries.***

Regardless of the type of injury and surgical tactics, the treatment of patients should follow a treatment and diagnostic algorithm that includes:

- elimination of pain;
- early and adequate drainage of the pleural cavity;
- measures aimed at rapid straightening of the lung;
- restoration and maintenance of airway patency;
- sealing and stabilization of the chest wall;
- final bleeding control and blood loss replenishment;
- infusion, antimicrobial and supportive therapy.

***Operations performed in case of chest injuries:***

- Drainage of the pleural cavity.
- Video thoracoscopy, lung decortication, bleeding control.
- Video thoracoscopy, coagulation of lung injuries, bleeding control.
- Thoracotomy, suturing of heart, lung and large vessel injuries, bleeding control.

**Plan and organizational structure of the class.**

No	The main stages of the class, their functions and content	Learning objectives in terms of mastery levels	Training and control tools	Materials for methodological support of class visibility, knowledge control	Term as a percentage of total time
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
1	<b>Preparatory</b>	<b>I level</b>			

	Setting learning goals, monitoring the ascending level of knowledge and skills.	To familiarize the student with the etiopathogenesis of chest injuries. To familiarize the applicant for higher education with various types of complex treatment of purulent diseases of the lungs and pleura	Tests of ascending level of knowledge, tests of rectorial control, Krok-2 tests, guidelines for applicants	Tests of ascending level of knowledge, tests of rectorial control, Krok-2 tests, guidelines for higher education applicants, X-rays, extracts from medical records of patients with chest injuries	1 hour
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2.	<p><b>Basic</b></p> <p>Conducting supervision of patients in the Department of Thoracic Surgery and Intensive Care by the applicants</p>	<p><b>II and III levels</b></p> <p>Correct interpretation of the results of functional and laboratory tests, especially indicators of gas exchange, acid-base balance, interpretation of the main radiological signs chest injuries;</p>	<p>Determining the treatment regimen for a patient with chest injuries in a specific case (or cases)</p>	<p>Patient (or several patients) with a typical or atypical clinical picture and course of chest injuries</p>	<p>4 hours</p>
3.	<p><b>Final</b></p>	<p>Control and correction of the level of professional skills, summarizing the results of the class</p>	<p>Tests of the final level of knowledge, tests of rectorial control, Krok-2 tests, guidelines for higher education students</p>	<p>Computer test program ACS - test</p>	<p>1 hour</p>

• **- Materials for methodological support of the lclass**

***- Control materials for the preparatory stage of the class.***

***Questions***

- Define open and closed chest injuries.
- The etiopathogenesis of the main complications arising from chest injuries.
- Name the risk factors for chest injuries.
- Classification.
- Name the variants of the course of chest injuries.
- Describe the clinical picture of the most common complications of chest injuries.
- Describe the open chest injuries.
- Describe closed chest injuries.
- Name clinical and laboratory parameters, their dynamic changes.
- Therapeutic tactics, the purpose of the operation.

*Test control tasks for a practical class on the topic: "Chest injuries".*

Long-term injection of 100% oxygen for the patient:

- Detection of hemothorax is most likely:
  - Percussion and auscultation
  - Fluoroscopy and chest radiography
  - **Pleural puncture and thoracoscopy**
- \*
- Is blood reinfusion necessary for closed and penetrating chest wounds with damage to the lungs, heart and large vessels:
  - No
  - Only when the volume of blood loss exceeds 500 ml
  - By individual indicators
  - **Necessary**
- \*
- In case of complete lung collapse and absence of fluid in the pleural cavity, in which of the intercostal spaces is it more important to perform a pleural puncture
  - 6 - 7 along the scapular line
  - **2 - 3 along the mid-clavicular line**
  - 3 - 4 along the middle axillary line
- \*
- Chylothorax on the right occurs:
  - **If the duct is damaged up to the level of the thoracic vertebra**
  - If the duct is damaged above the Th<sub>3</sub> level
  - In case of damage to the cervical segment of the duct
- \*
- Chylothorax on the left develops when the thoracic duct is damaged:
  - Up to the level of the V thoracic vertebra
  - **Above the level of the third thoracic vertebra**
  - Above the level of the VII cervical vertebra

\*

***Materials for methodological support of the main stage of the class:***

- **A preventive algorithm for mastering skills and abilities.**

The sequence of actions in mastering skills	Indications of occurrence, criteria for self-control
Take anamnesis from a patient with a damaged chest	Pay attention to the clinical picture, <ul style="list-style-type: none"> <li>• complaints that brought the patient to the hospital;</li> <li>• identify the presence of pathology</li> </ul>
Objective research	<ul style="list-style-type: none"> <li>• conduct a general examination of the patient, assess the condition of the skin and mucous membranes</li> <li>• to palpate the chest</li> <li>• examine the characteristics of the pulse</li> <li>• measure blood pressure on the arm</li> <li>• conduct percussion and auscultation of the chest and abdominal cavity</li> </ul>

Appointment of additional methods of follow-up and treatment	Conduct an Rg study and a CT scan of the chest; ultrasound.
Development of a treatment regimen	Determine surgical tactics and intensive care

- Patient for supervision
- Medical history
- Rg-grams.

- **- Control materials for the final stage of the class.**

*Test control tasks for practical training:*

- **What drugs reduce the pressure in the small circle of blood circulation and are used in combination with other drugs in case of pulmonary hemorrhage?**
  - A. Pentamine, benzohexonium, camphor, atropine sulfate, eufiline, No-Spa.
  - B. Calcium preparations, fibrinogen, gelatin, vicasol, amben, contral, ethamsylate.
- **Which of the results of the pleural exudate tests indicates a hemothorax?**
  - A. Pleural fluid hematocrit is more than 50% of the peripheral blood hematocrit.
  - B. Pleural fluid hematocrit is less than 50% of the peripheral blood hematocrit.
- **According to the mechanism of action of the damaging force, bronchial tears are the most common:**
  - A. Indirect.
  - B. Direct.
  - C. Direct and indirect with the same frequency.
- **In case of closed chest injuries, a tear is most often observed:**
  - A. Right main bronchus.
  - B. Left main bronchus.
  - C. Lobar bronchus.
- **What diseases can simulate chylothorax?**
  - A. Tumour or tuberculosis of the pleura.
  - B. Exudative pleural effusion.
  - C. Pleural effusion in lung cancer without pleural involvement.
  - D. Congestive pleurisy.
- **How much blood can accumulate in the pleural cavity in case of massive hemothorax?**
  - A. More than 2 litres.
  - B. Up to 500 ml.
  - C. From 500 ml to 1 litre.
  - D. From 1 to 2 litres.
- **What is chylothorax?**
  - A. Accumulation of lymph in the pleural cavity.
  - B. Accumulation of blood in the pleural cavity.
  - C. Inflammation of the pleura.
  - D. The presence of air in the pleural cavity.
- **What is the main cause of chylothorax?**
  - A. Traumatic injury of the thoracic duct.

- B. Infectious diseases.
  - C. Pneumonia.
  - D. Surgical interventions on the heart.
- **What technique is used to treat spontaneous pneumothorax?**
    - A. **Thorocostomy (drainage of the pleural cavity).**
    - B. Injection of antibiotics.
    - C. Carrying out a biopsy.
    - D. Lymphatic drainage.
  - **What is the main treatment tactic for hemothorax?**
    - A. **Puncture and drainage of the pleural cavity.**
    - B. Conservative treatment.
    - C. Injection of antibiotics.
    - D. Observation without interference.

***Materials of methodological support for self-preparation of higher education applicants.***

Orientation map on the organization of independent work of a higher education student:

Learning objectives	Instructions for the task
1. To study: etiopathogenesis of chest injuries	Name the main complications of chest injuries
2. Learn the classification	Know the classification
3. The main complications of open chest injuries	To list
4. Main complications of closed chest injuries	To name
5. Learn X-ray examination methods	Describe and comment on radiographs
6. Laboratory diagnostics	List the main diagnostic criteria
7. Treatment: surgical tactics and intensive care	Determine the optimal surgical tactics tactics, prescribe infusion therapy

**Literature:**

1. [https://www.saudedireta.com.br/catinc/tools/e\\_books/Oxford%20Handbook%20of%20Clinical%20Surgery,%204th%20Edition.pdf](https://www.saudedireta.com.br/catinc/tools/e_books/Oxford%20Handbook%20of%20Clinical%20Surgery,%204th%20Edition.pdf)
2. <https://www.gutenberg.org/cache/epub/17921/pg17921-images.html>
3. <https://www.gutenberg.org/ebooks/17921>
4. [https://dal.primo.exlibrisgroup.com/discovery/fulldisplay?context=L&vid=01NOVA\\_DAL:DAL&search\\_scope=Everything&isFrbr=true&tab=Everything&docid=alma990052517440107190](https://dal.primo.exlibrisgroup.com/discovery/fulldisplay?context=L&vid=01NOVA_DAL:DAL&search_scope=Everything&isFrbr=true&tab=Everything&docid=alma990052517440107190)
5. [https://dal.novanet.ca/discovery/fulldisplay?context=L&vid=01NOVA\\_DAL:DAL&search\\_scope=Everything&tab=Everything&docid=alma990056009660107190](https://dal.novanet.ca/discovery/fulldisplay?context=L&vid=01NOVA_DAL:DAL&search_scope=Everything&tab=Everything&docid=alma990056009660107190)
6. [https://dal.novanet.ca/discovery/fulldisplay?context=L&vid=01NOVA\\_DAL:DAL&search\\_scope=Everything&tab=Everything&docid=alma990065199090107190](https://dal.novanet.ca/discovery/fulldisplay?context=L&vid=01NOVA_DAL:DAL&search_scope=Everything&tab=Everything&docid=alma990065199090107190)