

Chest injury

Abdominal injuries

Leading clinical syndromes



Методическое пособие для подготовки к практическим занятиям
общая хирургия (3 курс)
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Classification of traumatic injuries

Chest and abdomen injury



Open



Closed



Open wound



Is characterized by the presence of a wound, leading to a violation of the integrity of the skin

- inflicted with cold weapons: stab, chopped, lacerated and bruised wounds;
- inflicted with firearms: bullet, buckshot and shrapnel wounds.



Wounds in relation to serous cavities



NON-PENETRATING

wound –
the integrity of the parietal
pleura or peritoneum is
not violated

PENETRATING

wound –
there is a defect in the
parietal pleura or
peritoneum



Closed traumatic injuries



injuries in which the impact of mechanical energy leads to damage of soft tissues, bone skeleton or internal organs without violating the integrity of the skin



Closed injuries of the chest and abdomen

- 
- bruising of the tissues of the chest, anterior abdominal wall
 - injury of organs of chest and abdominal cavity
 - injury of organs lying in the mediastinum or retroperitoneal space



Injury of tissues of the chest wall



- ❖ wound of the chest wall
 - ❖ bruising of the chest
 - ❖ hematoma of the chest
- ❖ ruptures of muscles and ligamentous apparatus





Bone fractures, forming the frame of the chest

- ❖ rib fracture
- ❖ fracture of the sternum
- ❖ clavicle fracture: up to 80% occurs in its middle third
- ❖ scapula fracture



Rib fracture

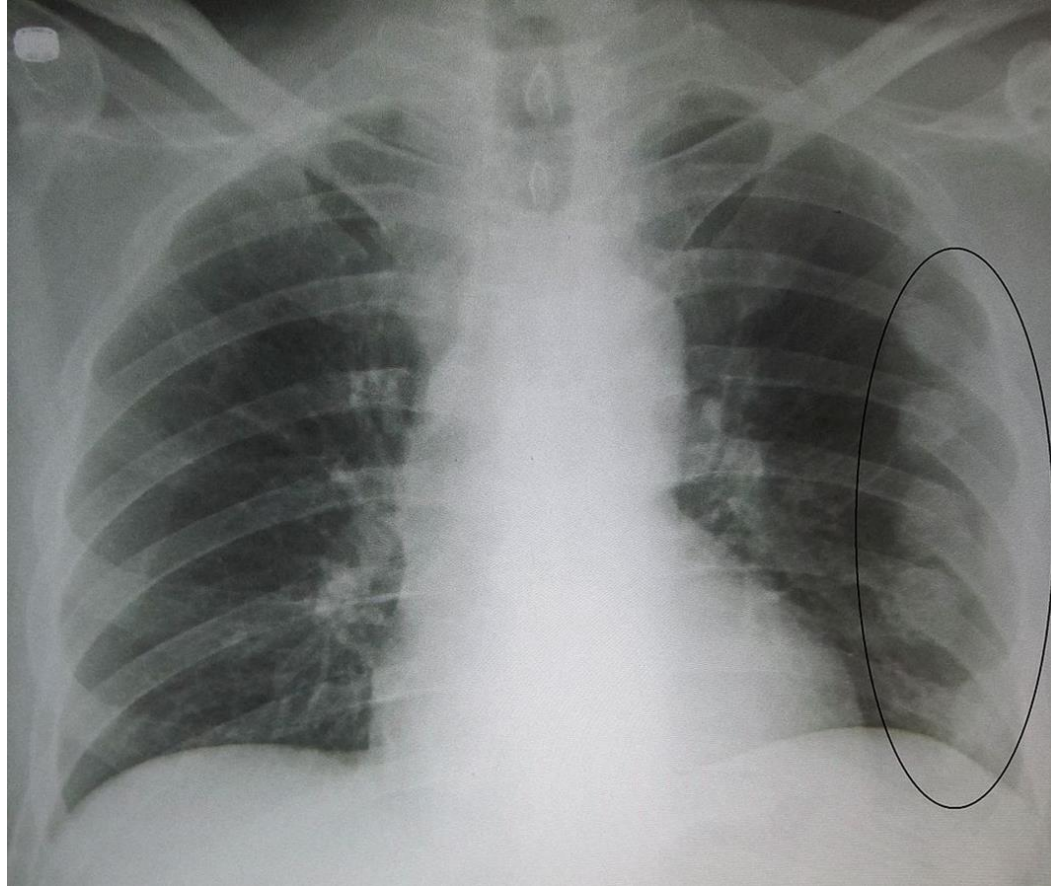
- 
- *single: injury of one or two ribs*
 - *multiple: injury of three or more ribs*

leading clinical symptoms –
pain in chest, aggravated by inhalation, movement and coughing

palpation reveals a sharp local
tenderness, as well as crepitation of bone fragments



Fracture of the 3rd – 6th rib on the left

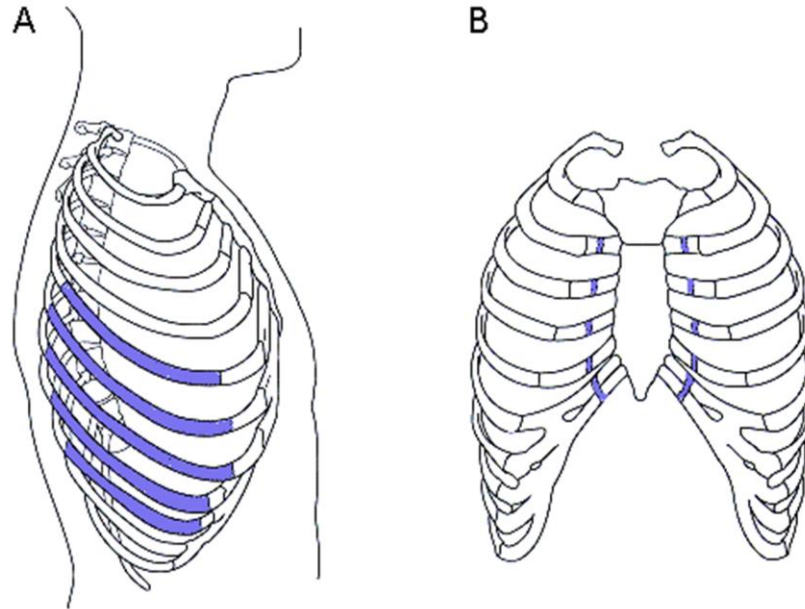


Fracture of the sternum (CT scan of the chest)



Fenestrated rib fracture

*fracture along several anatomical lines,
leading to disruption of biomechanics
normal breathing movements, expressed in
formation of a sash that floats*



Pneumothorax – entrance of air into the pleural cavity

- 
- Open pneumothorax** - the victim has a free connection between the pleural cavity and the environment: through the airways in case of injury of the pulmonary parenchyma or from the outside in case of extensive chest wound with violation of the integrity of the parietal pleura.
 - Closed pneumothorax** - the amount of air that has entered the pleural cavity remains constant and does not change during respiratory excursions of the chest.
 - Valve pneumothorax** - during inhalation, air enters the pleural cavity, and during exhalation, doesn't exit.



Valve pneumothorax



-external: occurs in case of wounds, when during exhalation the communication of the pleural sac with the external environment is disrupted due to displacement of the tissues of the chest wall, or due to lung tissue, which blocks the defect in the parietal pleura and disrupts the exit of air through the wound canal

-internal: develops in case of closed chest injury, when the communication of the pleural cavity with the external environment occurs through trachea or bronches.



Tensed pneumothorax



progressive increase of pressure in pleural cavity in conditions of valve pneumothorax:

- *compression of the main venous vessels of the chest*
- *progressive lung collapse*
- *displacement of mediastinal organs*
- *compression of the intact lung*



General clinical manifestations of pneumothorax

- 
- severe chest pain with a gradual decrease in its intensity
 - increasing shortness of breath
 - pallor skin with bluish tinge
 - decrease of blood pressure
 - rapid pulse with reduced filling and tension



Local signs of pneumothorax

- 
- lag in the act of breathing of the damaged side
 - smoothing of the intercostal spaces
 - box percussion sound over the collapsed lung
 - displacement of mediastinal organs to the healthy side
 - during auscultation, breathing on the side of the injury is sharply weakened or not carried out at all



Radiological signs of pneumothorax



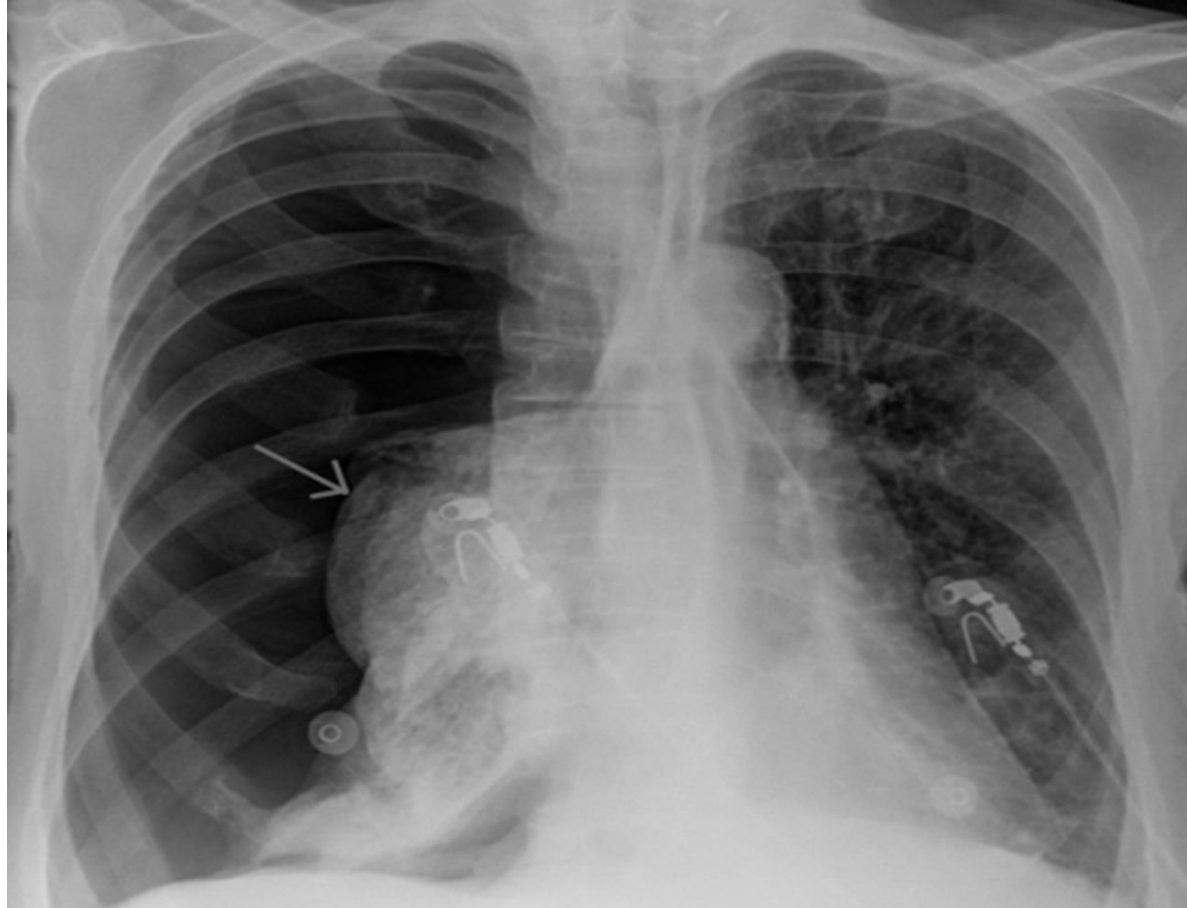
- lung field of increased transparency, devoid of pulmonary pattern on the periphery
- the border of the collapsed lung crosses the shadows of the ribs
- in case of tensed pneumothorax, the mediastinal shadow is shifted to the side of the healthy lung, there is a flattening or deflection of the dome of the diaphragm on the affected side, the intercostal spaces are widened



Right-side pneumothorax



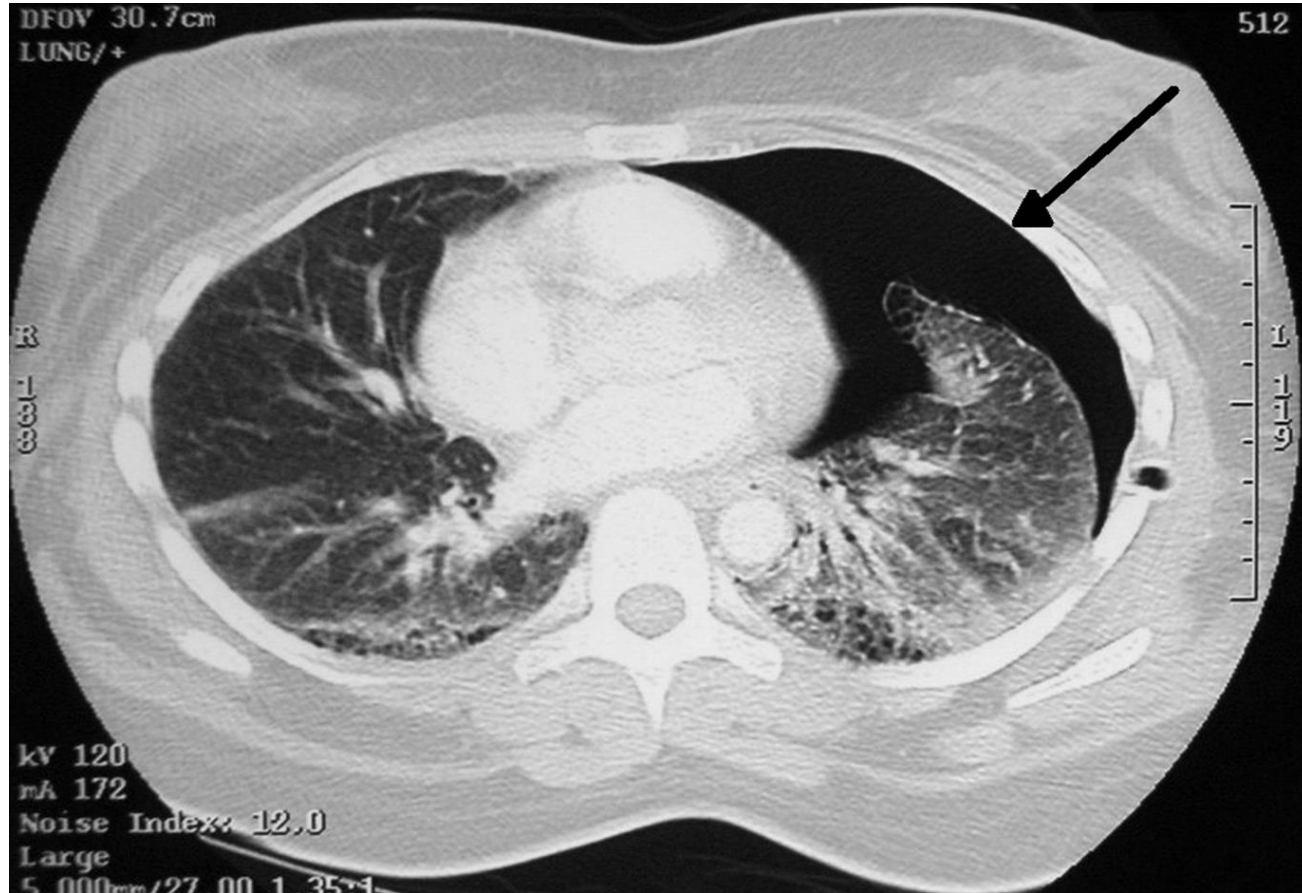
* the arrow indicates the edge of the collapsed lung



Left-sided pneumothorax (CT of the chest)



* the arrow indicates air in the pleural cavity



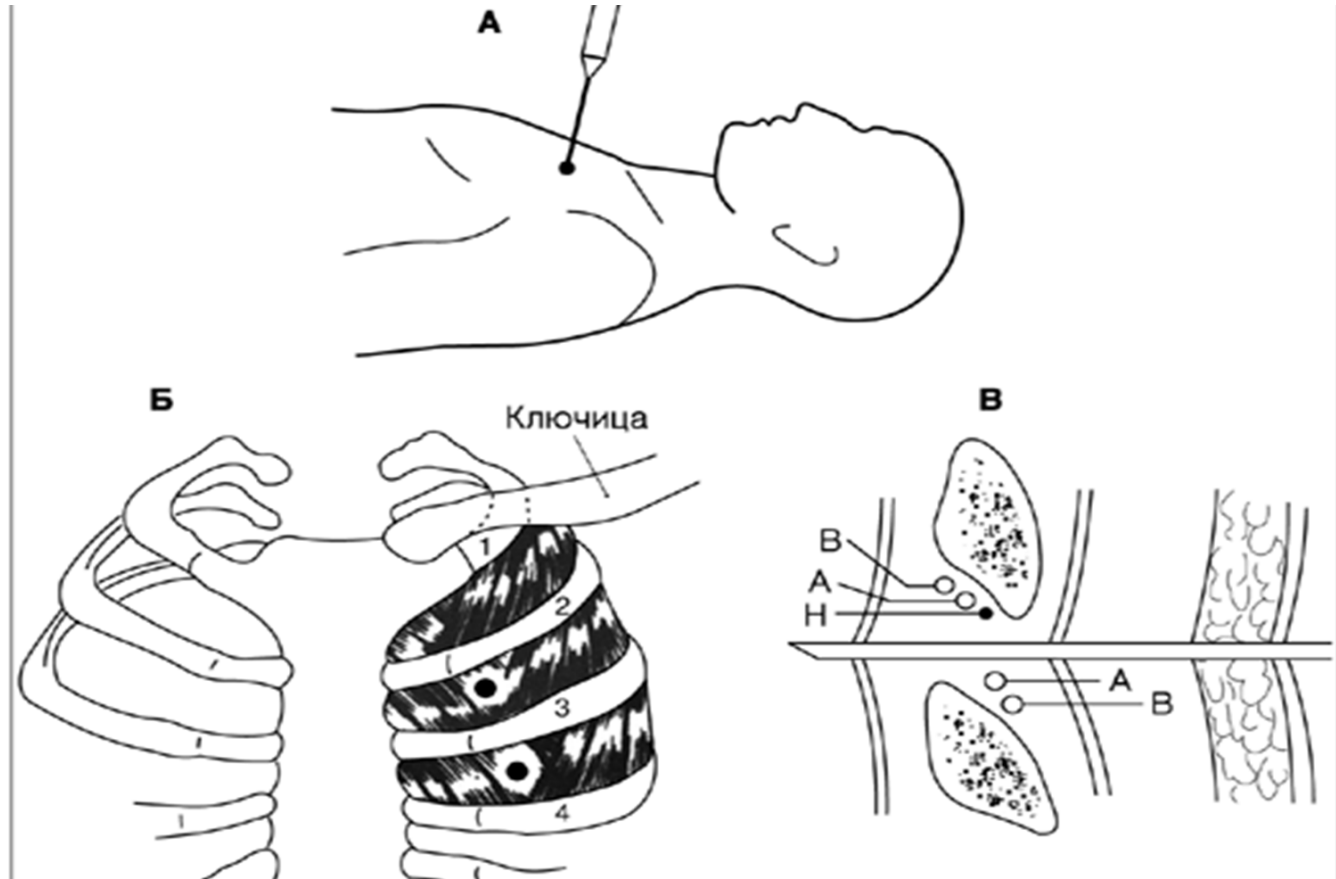
Pleural puncture for pneumothorax



carried out in the second or third intercostal space in midclavicular line
along the upper edge of the underlying rib



Pleural puncture for pneumothorax





**In closed pneumothorax, when
there is a prolonged flow of air
into the pleural cavity**



temporary bronchial obstruction,
chemical pleurodesis



thoracoscopy or thoracotomy, suturing the lung defect



Hemothorax – accumulation of blood in pleural cavity

- small hemothorax – blood volume up to 500 ml
- medium hemothorax - reaches the angle of the scapula, blood volume up to 1000 ml
- large hemothorax - blood occupies most of the pleural cavity, compressing the lung and displacing the mediastinum to the opposite side



Clinical manifestations of hemothorax



- non-localized pain in chest on the side of the lesion, not subsiding with changes in body position
- the patient is restless, there is shortness of breath
- pallor skin with a bluish tinge
- hypotension, tachycardia, pulse of reduced filling and tension
- in case of medium and large hemothorax, the damaged side lags behind in the act of breathing
- dullness of percussion sound over the hemothorax zone
- breathing is weakened during auscultation



Radiological signs of hemothorax



- partial or complete darkening of the lung field
- in case of total hemothorax, the mediastinum shifts to the side opposite to the injury
- blurriness of the contours and high standing of diaphragm dome.



Medium left-sided hemothorax



Total left-sided hemothorax



Pleural puncture in case of hemothorax



carried out in the 8th intercostal space in the posterior axillary line
or in the 5th intercostal space in the anterior axillary line
along the upper edge of the underlying rib



Indications for surgical treatment of hemothorax



- immediately after drainage, > 800 ml of blood was obtained
- more than 500 ml of blood was received through drains in the first hour
- the separation of blood through drains in subsequent hours exceeds 250 – 300 ml/h
- increase in the amount of blood discharged through drains, regardless of the initially obtained volume
- accumulation of blood in pleural cavity, accompanied by clinical symptoms and not amenable to be drained (after radiological confirmation)



Subcutaneous emphysema, mechanism of development



- in case of tensed pneumothorax, an increase in intrapleural pressure is accompanied by the movement of air through traumatic defects in the pleural sac into the intermuscular spaces of the chest wall
- in case of closed pneumothorax, air can enter through intercellular spaces even with an intact parietal pleura



Mediastinal emphysema



- occurs due to the spread of air through the mediastinal tissue through damaged alveoli and bronchi

- tensed mediastinal emphysema is a condition characterized by compression of large venous trunks (the so-called extrapericardial cardiac tamponade)



Clinical and instrumental manifestations of emphysema



- swelling of the soft tissues of chest wall, in the area of the face, neck and jugular fossa
- subcutaneous crepitation
- hoarseness
- the presence of air in the subcutaneous tissue and mediastinum, diagnosed by chest X-ray



Lung contusion



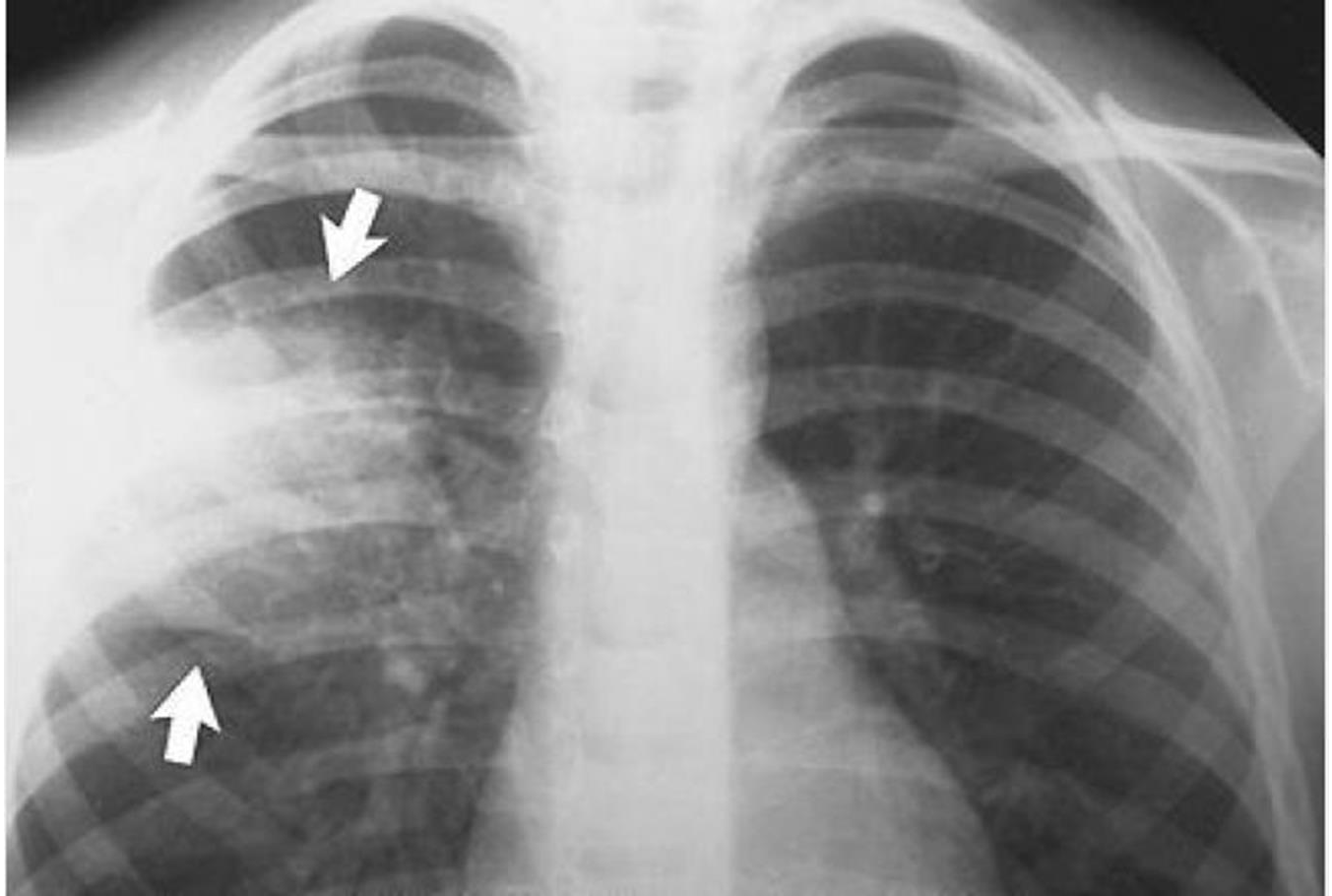
- diffuse impregnation of the lung parenchyma with blood, due to multiple hemorrhages or formation of hematomas



Contusion of right lung

— —

* the arrows indicate
the area of blood
impregnation of the
lung tissue



Traumatic injury of trachea and bronchi



Clinical manifestations:

- hemoptysis
- stridorous breathing
- release of large amounts of air through drains from the pleural cavity
- bronchial obstruction with subsequent atelectasis of a segment, lobe or the entire lung



Damage of domes of diaphragm



If the integrity of the diaphragmatic domes is compromised may occur:

- translocation of abdominal organs into the chest cavity
- formation of traumatic hernias
- compression of the chest organs with subsequent respiratory and circulatory disorders
- strangulation of the hernia at the gate with subsequent necrosis of the organs that have moved into the pleural cavity



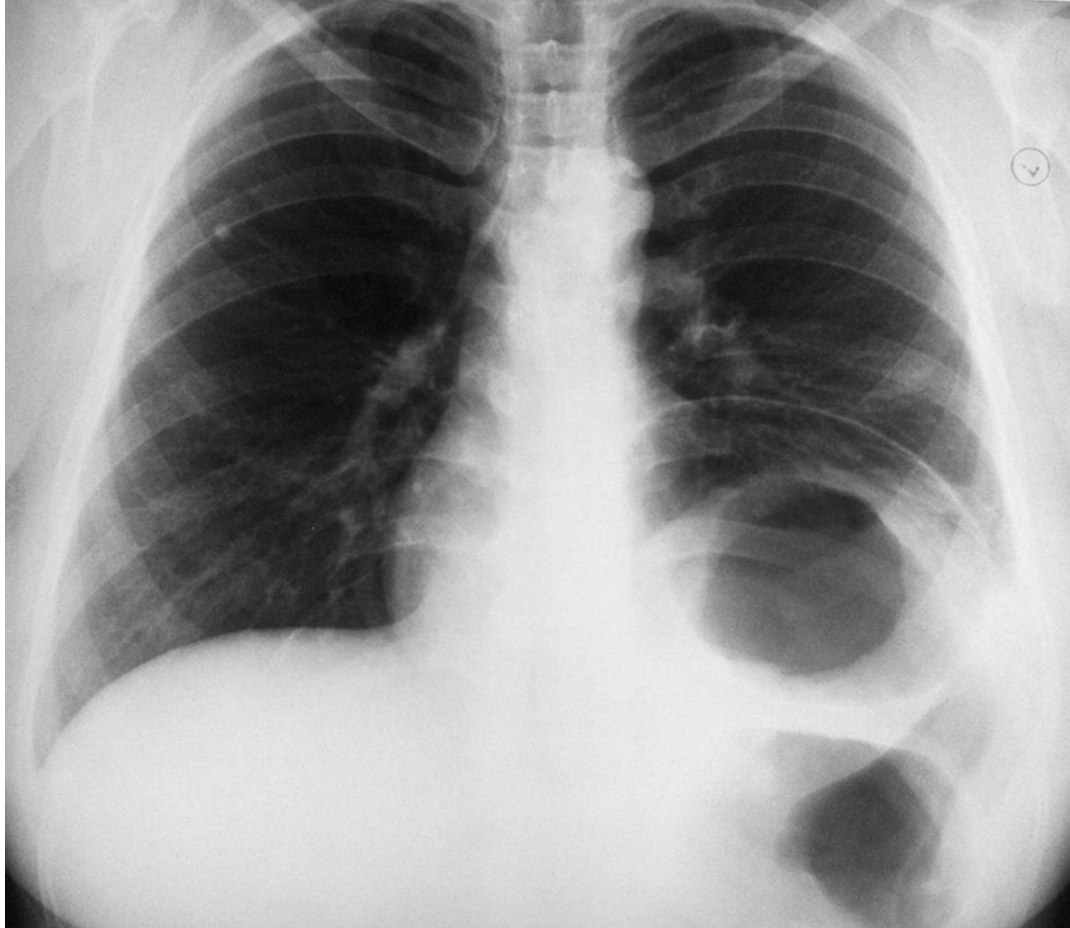
Radiological signs of rupture of the diaphragm



- gas bubble of the stomach and intestines above the diaphragm
- blurred contours of the diaphragm
- high standing of the dome of the diaphragm



Rupture of the left dome of the diaphragm



Heart wound



When the heart is wounded, the main threat to the life of victims is bleeding:

- large-volume hemothorax with outcome in hemorrhagic shock
- rapid accumulation of blood in the pericardial cavity with the development of pericardial tamponade
- Rapid entry of small volumes of blood (about 200 ml) into the pericardial cavity leads to a sharp increase in intrapericardial pressure, followed by compression of the right ventricle and impaired filling during diastole. The result is a decrease in cardiac output, a compensatory increase in heart rate and the force of blood ejection, resulting in myocardial hypoxia and increased damage



Pericardial tamponade

Beck's triad:

- hypotension with a drop in systolic blood pressure to 70 mm Hg. and below
- a sharp increase in central venous pressure (more than 12 cm of water column), accompanied by dilatation of the jugular veins
- sharp weakening of heart sounds

Kussmaul's sign: distension of the jugular veins on inhalation

Echocardiography: visualization of hemopericardium with a capacity of 50 ml or more, as well as signs of hemothorax

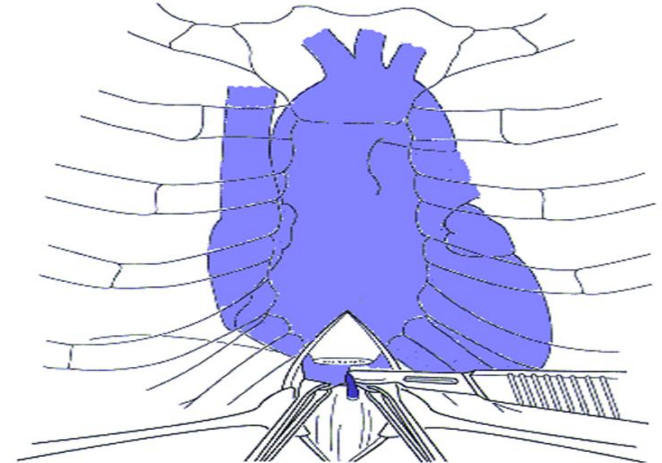
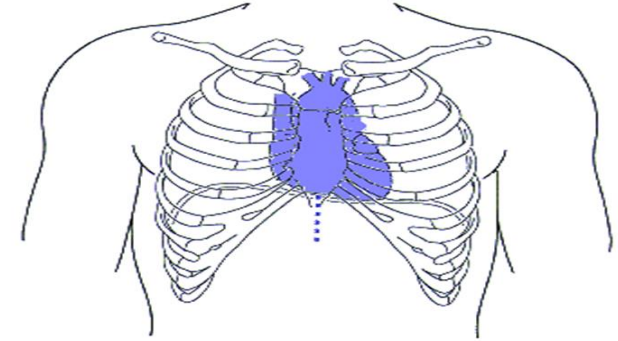
Chest X-ray: widening of the heart shadow, which takes the form of a trapezoid or sphere

ECG: decreased voltage of the waves



Decompression of the pericardial sac subxiphoid approach according to Larrey

is a method of diagnosis (if echocardiography is not possible), as well as emergency care for increasing cardiac depression



Blunt cardiac injury

- myocardial contusion
- rupture of the layers of the cardiac stack
- damage of valves, papillary muscles and chordae tendineae
- commotio cordis syndrome

The clinical picture of closed heart injury has no specific manifestations.

- ECG: rhythm and conduction disturbances, as well as signs of myocardial ischemia
- Echocardiography: visualization of areas of the myocardium with impaired contractility and pathology of the heart valve apparatus.
- Laboratory diagnostics: determination of the level of serum troponin T and I, creatine phosphokinase (CPK) and its myocardial isoenzyme (CPK-MB).



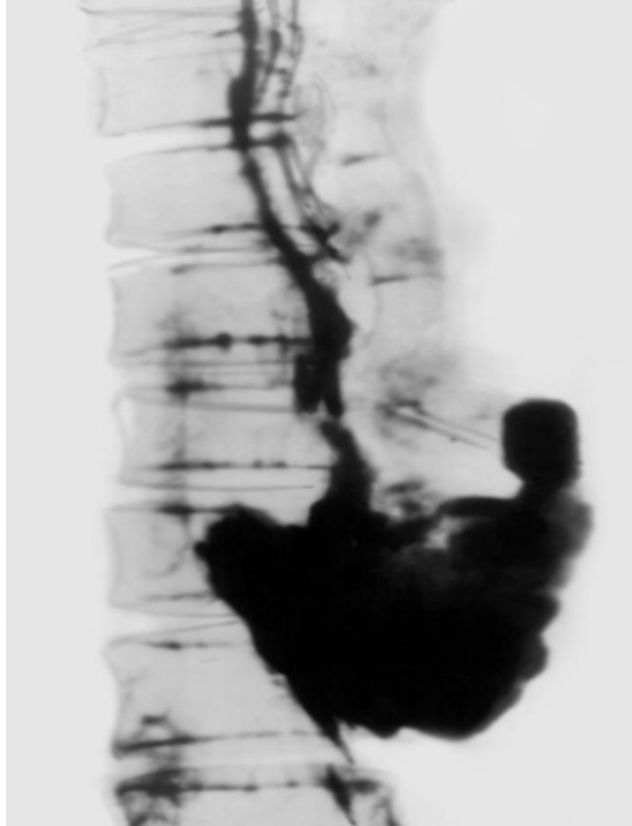
Additional examination methods for traumatic injuries of chest

- ultrasound examination of the chest organs (pleural cavities and pericardium cavity)
- diagnostic video thoracoscopy
- radiological examination of esophagus



X-ray of the esophagus:

Extravasation of contrast agent in the area of its rupture



Complications of chest injuries:



- acute blood loss
- adult respiratory distress syndrome
- pneumonia
- empyema of pleura
- tracheal stenosis, esophagobronchial fistulas
- diaphragmatic hernias



Chest injuries



- in case of chest injuries, the main tasks are to eliminate life-threatening conditions
- treatment of patients with chest injuries should be active, with the use of minimally invasive methods to eliminate pathological syndromes and justified thoracotomy



Abdominal injuries



Direct signs of a penetrating abdominal injury

- prolapse of internal organs from the wound of the abdominal wall: greater omentum, intestinal loops
- discharge of gastric or intestinal contents, bile, urine from the wound of the abdominal wall



Abdominal injuries

- 
- In case of absence of direct signs of the penetrating nature of the wound of the abdominal wall, primary surgical debridement of wound is performed
 - in case of presence of signs of violation of the integrity of the parietal peritoneum, detected during surgical treatment, is an indication for laparotomy or laparoscopy



Non-penetrating abdominal injuries

- 
- damage of no more than 24 hours ago – primary surgical debridement is indicated/
 - if more than 24 hours have passed since the moment of injury and there are no signs of a penetrating nature of the wound, or signs of significant traumatic damage of the organs of the retroperitoneal space, primary surgical debridement of wound is not performed. Wounds are treated with antiseptic solutions, covered with a sterile bandage and kept open



Closed injury of abdomen



Is accompanied by the development of two main pathological syndromes:

- HEMOPERITONEUM
- PERITONITIS



PERITONITIS



- intensive abdominal pain, worsening with changes in body position of the patient
- nausea and vomiting , that does not bring relief
- no gas or stool passage
- pallor skin, cyanosis of the nails and lips
- dry, coated tongue
- body temperature is elevated
- facies Hyppocratica
- rapid pulse, arterial hypotension



PERITONITIS

- 
- the abdominal wall does not participate in the act of breathing
 - percussion reveals free fluid in the abdominal cavity
 - percussion disappearance of liver dullness due to the accumulation of gas under the right dome of diaphragm (in case of violation of the integrity of hollow organs)
 - passive defense
 - Shchetkin-Blumberg's symptom
 - auscultation reveals a weakening of bowel sounds up to their complete absence
 - severe pain on palpation of the inflamed peritoneum in the region of the Douglas space (rectal investigation)



HEMOPERITONEUM

- 
- pallor skin and visible mucous membranes
 - cold clammy sweat
 - feeling of fear
 - rapid shallow breathing
 - rapid pulse of reduced filling and tension
 - arterial hypotension
 - the abdominal wall is limitedly involved in the act of breathing
 - percussion reveals free fluid in the abdominal cavity
 - passive defense is practically not expressed
 - Kulenkampf's symptom
 - weakening of peristaltics during auscultation



Catheterization of the urinary bladder

- 
- ☐ minor hematuria - kidney contusion or rupture of the urinary system within the mucous membrane is likely.
 - ☐ urine is intensely colored with blood - kidney or bladder rupture is likely.
 - ☐ significant difficulty or impossibility of catheterization, the appearance of a small amount of fresh blood from the urethra, urethral trauma is likely.



X-ray examination of abdominal cavity

- 
- ❖ a strip of free gas under domes of diaphragm (patient's position - standing)
 - ❖ in severe patients, radiography is performed in the lateral position with horizontal direction of X-rays (laterography), a strip of free gas is detected in the lateral canals
 - ❖ free fluid in the abdominal cavity: parietal ribbon-like shadows in the lateral canals and expanded inter-loop spaces
 - ❖ retroperitoneal hematoma: a diffuse shadow, against the background of which the contour of the iliopsoas muscle disappears



Free gas under the dome of diaphragm



Cystography

- 
- ❖ in case of violation of the integrity of the intraperitoneal part of the urinary bladder, signs of contrast spreading through the free abdominal cavity are detected
 - ❖ in the presence of an extraperitoneal rupture of the urinary bladder, the contrast spreads within the perivesical tissues
 - ❖ leakage of contrast agent beyond the contour of the urethra - its traumatic rupture



X-ray contrast cystography no pathology revealed



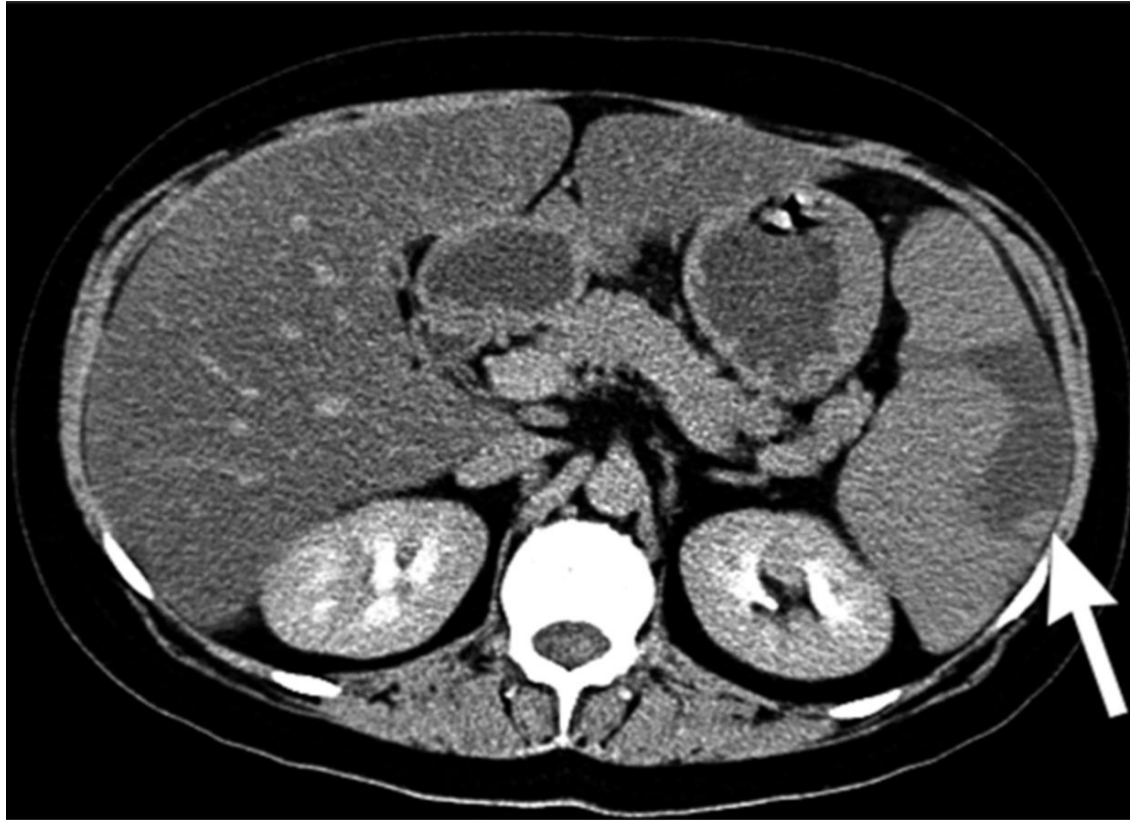
Ultrasound examination of abdominal abdominal cavity and retroperitoneal space

in the presence of traumatic injury, the following may be visualized:

- free fluid in the abdominal cavity
- signs of damage of parenchymal organs: blurring, unevenness of their contours, as well as the presence of subcapsular and central hematomas
- hematomas of the retroperitoneal space



Subcapsular hematoma of the spleen (CT scan of the abdominal organs)





Invasive diagnostic methods of traumatic injury of abdomen and retroperitoneal space

- ✓ laparacentesis
- ✓ videolaparoscopy
- ✓ ureterocystoscopy



Conservative therapy of closed abdominal trauma

Is indicated in the following clinical situations:

- bruise of the anterior abdominal wall
- kidney contusion, pancreas contusion
- small intraorganic hematomas in parenchymal organs without a tendency to increase
- small stable subcapsular hematomas
- non-increasing retroperitoneal hematoma



Conservative therapy of closed abdominal trauma

Treatment and diagnostic algorithm

- ✓ physical rest
- ✓ prophylactic antibacterial therapy
- ✓ prevention and treatment of organ failure
- ✓ anti-shock measures
- ✓ blood loss replenishment
- ✓ hemostatic therapy
- ✓ dynamic laboratory and instrumental monitoring of the course of the disease



Indications for emergency surgical treatment in case of closed abdomen injury:

- 
- ❖ the presence of obvious signs of intra-abdominal bleeding
 - ❖ the presence of obvious signs of rupture of a hollow organ
 - ❖ the presence of clear clinical and instrumental signs of severe kidney damage (rupture, crushing) or prolonged massive hematuria accompanied by an increase of anemia



Stages of surgical intervention for abdominal trauma

- 
- processing of the everted organ
 - performing surgical access
 - temporary hemostasis, evacuation of blood and other pathological fluid
 - blood sampling for its reinfusion
 - revision of the abdominal organs
 - start of blood reinfusion (in the absence of contraindications)
 - performing surgical assistance on damaged organs;
 - sanitation and draining of the abdominal cavity
 - the final stage of the operation is suturing the laparotomy wound



Thoracoabdominal trauma



- if there are signs of life-threatening intra-abdominal bleeding, surgery is usually started with laparotomy
- the pleural cavity is drained at this time and the nature of the discharge and its amount are monitored
- if there are signs of cardiac tamponade and profuse bleeding into the pleural cavity, begin with thoracotomy
- if necessary, the patient undergoes simultaneous intervention on the chest and abdominal cavity by two teams of surgeons

