MINISTRY OF HEALTH OF THE REPUBLIC OF UZBEKISTAN

TASHKENT MEDICAL ACADEMY

METHODS OF EXAMINATION OF PATIENTS WITH RESPIRATORY SYSTEM DISEASES

Study guide

(on the subject of propaedeutics of internal medicine)

Knowledge Area: 900000 - *Health and Social Care*

Field of Education: 910000 - Healthcare

Education direction: 60910200 - Medical Faculty

Tashkent 2025.

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The textbook contains the classical basics of physical examination methods (questioning and examination) in the course of propaedeutics of internal medicine. The textbook details clinical, laboratory and instrumental methods of examination of patients with diseases of the respiratory system. The publication is intended for teachers of medical universities, a wide range of doctors, masters, clinical residents and students.

INTRODUCTION

This textbook is designed to master the basic knowledge on propaedeutics of internal diseases, which will complement the existing textbooks used by students in our country. The textbook presents basic questions on methods of examination of patients with respiratory system diseases, which are considered relevant in modern medicine. The list of questions agrees with the program of training of students at the medical faculty of higher educational medical institutions.

The presentation of the textbook material is based on the experience of the author who taught the propaedeutics of internal medicine. In addition to the theoretical section, the manual contains a description of practical skills, a set of radiographs, questions on the topic, tests and situational tasks.

TABLE OF CONTENTS

ABBREVIATIONS

HR - respiratory rate;

SVC - superior vena cava;

PE - pulmonary embolism;

COPD - chronic obstructive pulmonary disease;

HF - heart failure;

DM - diabetes mellitus;

ERF - external respiration function;

VC - vital capacity of the lungs;

FEV1 - Forced expiratory volume in 1 second

SPO2 - the level of oxygen saturation in the blood;

PaCO2 is the partial pressure of carbon dioxide in arterial blood;

PaO2 - partial pressure of oxygen in arterial blood;

PH of the blood is the acidity of the *blood*;

LV - the left ventricle;

CT - a computed tomography scan;

MRI - magnetic resonance imaging.

GLOSSARY

Alveoli -	The end part of the respiratory apparatus in the form of a vesicle opening into the lumen of the respiratory bronchioles that make up the respiratory compartments in the lung.
Anamnesis -	information about the patient's medical history, living conditions, illnesses, etc.
Apnea -	Delayed breathing in sleep.
Asthenic -	the longitudinal dimensions of the body predominate over the transverse ones.
Asthma -	Asthma is a major non-communicable disease (NCD) that affects both children and adults and is one of the most common chronic diseases in children. Inflammation and narrowing of the small airways in the lungs cause the symptoms of asthma, which may include coughing, wheezing, shortness of breath and tightness in the chest in any combination.
Auscultation -	A physical method of medical diagnosis that involves listening to the sounds produced by the respiratory system.
Bifurcation -	division of a tubular organ (vessel, bronchus) into 2 branches of equal diameter, branching off to the sides at equal angles.
Bradypnea -	infrequent inhalations and exhalations.
Bronchi -	An element of the human respiratory system that connects the trachea and lungs.
Bronchial breathing -	Bronchial breathing is formed when air passes through the pharynx, vocal cleft and epiglottal space.
Vesicular breathing -	A soft murmur, audible over the entire surface of the lungs throughout the inhalation and weakening to inaudible in the first third of the exhalation, resembles the "f" sound.
Visceroptosis -	is a collective term that refers to the prolapse of abdominal and renal organs in various combinations.
Hemoptoe -	is the discharge of a significant amount of blood from the respiratory tract during coughing, either pure or as an abundant admixture to the sputum
Hemoptys -	is a slight admixture of blood to the sputum (streaks, specks).
Hyperventilation -	Intense breathing that exceeds the body's oxygen needs.
Hypercapnia -	A condition caused by excessive amounts of CO_2 in the blood.

Hypersthenic -	transverse body dimensions are larger than in normostenics and astenics.
Hypoxemia -	A condition in which tissues and organs are not supplied with enough oxygen to allow them to maintain normal vital functions.
Hypoxia -	A condition that is manifested by insufficient oxygen in a person's blood.
Vocal tremor -	palpable chest vibration due to the subject's voice conduction.
Gram-negative -	bacteria that don't Gram stain.
Gram-positive -	bacteria that give a positive result in the Gram stain test.
Kyphoscoliosis -	a complex type of pathological process, curvature of the spine. Kyphosis is a curvature in the anteroposterior projection, while scoliosis is in the lateral projection.
Coagulogram -	complex hematologic study aimed at assessing the state of the hemostasis system.
Crepitation -	a distinctive crunching sound.
Bronchoalveolar lavage -	Injection of a neutral solution into the bronchi and lungs, followed by its removal.
Megakaryocytes -	Bone marrow cells from which platelets arise in the process of hematopoiesis.
Mucociliary clearance -	non-specific mechanism that provides local protection of the respiratory mucosa from external influences.
Nebulizer -	a device in which, thanks to a compressor or ultrasonic mechanism, a non-hot cloud of finely dispersed medicine is formed, which is easy to inhale, and due to the small particles, easily penetrates into the lungs and bronchi.
Normosthenic -	proportional body size and proper body proportion.
Oxyhemometry -	a non-invasive method of determining the degree of oxygen saturation in the blood.
Orthopnea -	Forced sitting, with the patient's legs down, in a position that facilitates breathing.
Percussion -	a method of medical diagnosis consisting in tapping certain parts of the body and analyzing the sound phenomena arising therefrom.
Pollutant -	Any agents of a physical, chemical or biological nature present in the environment and having an adverse effect on human health and quality of life
Regidity -	not malleability, not elasticity.
Respiratory distress -	is a severe form of respiratory failure in which noncardiogenic pulmonary edema occurs,

	provoking a hypoxia formation.
Reception -	Perception and transformation (transformation) by the organism of mechanical, thermal, electromagnetic, chemical and other stimuli into nerve signals.
Saccadic breathing -	characterized by intermittent inhalation, is caused by uneven contraction of different parts of the diaphragm.
Hemosiderin-Laden Macrophages -	are immune cells that convert the iron released from red blood cells into the protein hemosiderin after hemorrhage.
Stridor -	Wheezing noisy breathing caused by turbulent airflow in the airways.
Surfactant -	a mixture of surfactants lining the pulmonary alveoli from the inside. Prevents alveolar walls from collapsing during respiration by reducing the surface tension of the tissue fluid film covering the alveolar epithelium.
Tachypnea -	rapid shallow breathing.
Wheezing -	respiratory noises heard on inhalation and exhalation.
Cyanosis -	bluish or grayish tint of the skin as a result of insufficient oxygen in the blood.

1.ANATOMO-PHYSIOLOGICAL FEATURES OF THE RESPIRATORY SYSTEM

The respiratory system is a set of organs that provide gas exchange between inhaled air and blood circulating through the small circle of blood circulation. Gas exchange is carried out in the alveoli, and in normal conditions is aimed at capturing oxygen from the inhaled air and the release of carbon dioxide formed in the body into the external environment.

The respiratory system includes the air-conducting organs: the nasal cavity, pharynx, larynx, larynx, trachea, bronchi and the lungs themselves, which carry out gas exchange. Airways have a solid base of bones and cartilage, thanks to which these pathways do not collapse, and through them freely circulates air during breathing. From the inside, they are lined with ciliated epithelium and cystic cells. The ciliated epithelium has a mechanical protective function, while the goblet cells secrete mucin.

Mucociliary clearance is a natural process of airway clearance. In the pathogenesis of bronchopulmonary diseases, an important place is given to disorders of MCC,

which causes mucociliary dysfunction. The problem of MCI in various diseases of the respiratory tract is not sufficiently studied.

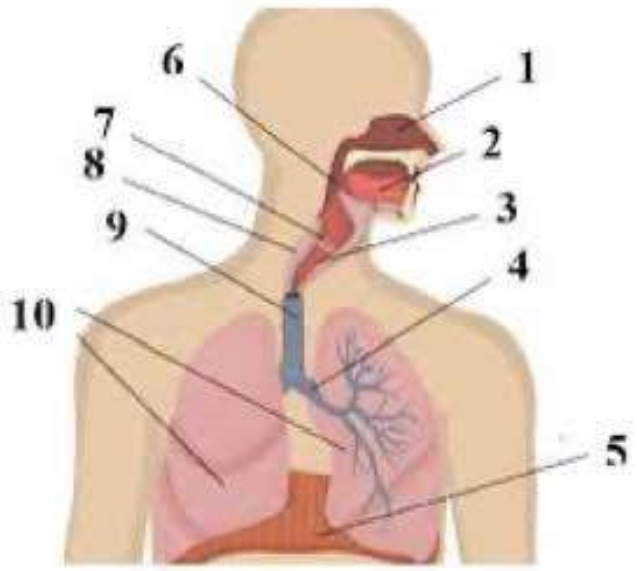


Figure 1: Structure of the respiratory system.

1-Nasal cavity; 2-tongue; 3-larynx; 4-bronchi; 5-diaphragm; 6-pharynx; 7-rima glottidis; 8-esophagus; 9-trachea; 10-lungs

As air passes through the respiratory tract, it is purified, moistened, warmed, and perceived by olfactory, thermal, and mechanical stimuli occurs.

Gas exchange does not occur here, and therefore this space **is called dead** space. During quiet breathing, the volume of air in it is 140-150 ml.

The nasal cavity (cavitas nasi) together with the external nose is an elevation formed by the nasal bones, frontal processes of the upper jaws, nasal cartilages and soft tissues (skin, muscles).

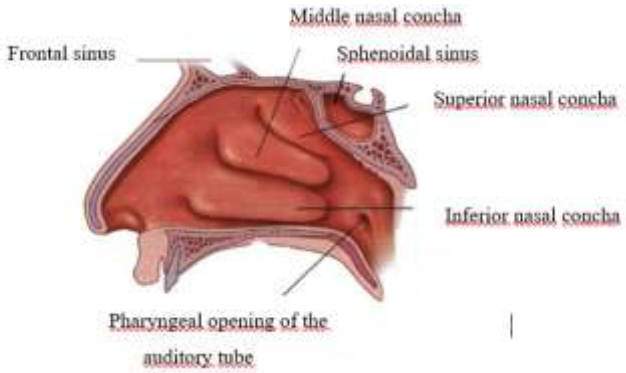


Figure 2: Nasal cavity.

The nose communicates with the external environment through two entrance openings, the nostrils, which connect the nasal cavity to the nasopharynx.

In turn, the nasopharynx communicates with the middle ear cavity through the auditory (eustachian) tubes.

Blood vessels, forming dense venous plexuses, help warm the inhaled air (cavernous venous plexuses).

The **larynx (larynx)** is the initial part of the windpipe; for air passage, vocalization and protection of the lower respiratory tract from foreign particles, it is the narrowest point in the entire airway. In adults, the larynx is located in the anterior neck at the level of the IV-VI cervical vertebrae and passes into the trachea.

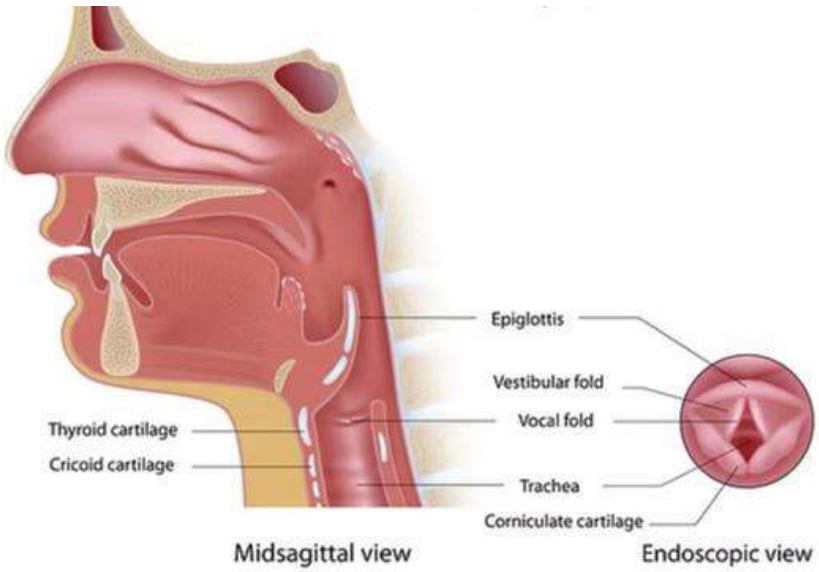


Figure 3: **Larynx.**

The trachea (trachea) or windpipe is an unpaired organ. It has the form of a tube with a length of 9-15 cm and a diameter of 15-18 mm. It is located in the neck region - the cervical part and in the thoracic cavity - the thoracic part.

It starts from the larynx at the level of VI-VII cervical vertebrae, and at the level of IV-V thoracic vertebrae it divides into two main bronchi - right and left. This place is called the tracheal bifurcation (bifurcation, fork).

The trachea consists of 16-20 cartilaginous hyaline semicircles connected by fibrous annular ligaments.

The posterior wall of the trachea adjacent to the esophagus is soft and is called the membranous wall. It is composed of connective and smooth muscle tissue.

Inflammation of the mucous membrane of *the trachea* is called *tracheitis.*

Bronchi (bronchi). There are main bronchi: right and left bronchi and the bronchial tree, which is part of the lungs.

The right main bronchus is 1-3 cm long and the left main bronchus is 4-6 cm long.

Above the right main bronchus runs the unpaired vein, and above the left - the aortic arch. The right main bronchus is not only shorter, but also wider than the left, has a more vertical direction, being as if an extension of the trachea. (Therefore, the right main bronchus more often than the left one gets infections and foreign bodies). Their skeleton is cartilaginous semicircles: in the right bronchus - 6-8, in the left - 9-12. The main bronchi in the area of lung gates are divided into lobular bronchi: the right bronchus into 3, and the left bronchus into 2.

The lobular bronchi within the lung are divided into segmental bronchi, segmental bronchi are divided into subsegmental bronchi, or medium bronchi (5-2 mm in diameter), and medium bronchi are divided into small bronchi (2-1 mm in diameter).

The smallest in caliber bronchi (about 1 mm in diameter) enter one into each lobe of the lung under the name lobular bronchus.

Within the pulmonary lobe, this bronchus divides into 18-20 terminal bronchioles (about 0.5 mm in diameter).

Each terminal bronchiole divides dichotomously into respiratory bronchioles, passing into extensions - alveolar passages and alveolar sacs. It is estimated that from the trachea to the alveoli airways branch dichotomously (bifurcate) 23 times. And the first 16 generations of respiratory tracts - bronchi and bronchioles perform conductive function (conductive zone). Generations 17-22 - respiratory (respiratory) bronchioles and alveolar passages constitute the transitional (transitory) zone.

The 23rd generation consists entirely of alveolar sacs with alveoli - the respiratory or respiratory zone.

Multilayered ciliated epithelium of the mucous membrane of large bronchi in small bronchi changes to single-layer cubic ciliated epithelium. And only the thickness of the muscular lamina of the mucous membrane in small bronchi does not change. Prolonged contraction of the muscular lamina in small bronchi, for example, in bronchial asthma, causes their spasm and difficulty breathing.

Consequently, the small bronchi have the function of not only conducting but also regulating the flow of air into the lungs.

Alveoli (Latin alveolus "cell, cavity, vesicle") is the end part of the respiratory apparatus in the form of a vesicle opening into the lumen of respiratory bronchioles. Pulmonary surfactant is a mixture of surface-active substances lining the pulmonary alveoli and bronchial tree from the inside. Alveoli participate in the act of breathing by performing gas exchange with pulmonary capillaries. There are about 300,000,000 alveoli in one lung.

The respiratory bronchioles as well as the alveolar passages, alveolar sacs, and alveoli of the lung form the alveolar tree (pulmonary acinus), referring to the respiratory parenchyma of the lung.

Questions on the topic:

1. What is the respiratory system?

2. Functions of the respiratory system.

3. organs that make up the respiratory system.

4. what does mucociliary clearance consist of and function?

5. Structure of the main bronchus.

6. Structure of the bronchial tree.

7. Structure of the alveoli.

2. METHODS OF EXAMINATION.

2.1 QUESTIONING.

Diseases of the respiratory system are second in frequency after CVDs and serve as a frequent reason for visiting a doctor and determine a significant frequency of disability and mortality.

To diagnose diseases of the respiratory system, the patient is questioned, examined, laboratory and instrumental methods of examination are performed and the obtained data are entered into the medical history.

Passport part

- Surname, first name, patronymic

- Age (it is important, as there are diseases that predominantly affect children, and there are diseases that are mainly characteristic of older age).
- Education.
- Occupation (relevant because it is associated with the development of occupational diseases).
- Place of employment, position.
- Home address (place of residence is important due to the environmental impact on human health).
- Date of admission to the clinic.
- Diagnosis on admission.

Complaints. The main complaints in diseases of the respiratory system are: (**cough, character of sputum, dyspnea, chest pain**).

Additional complaints may include fever, weakness, sweating.

Cough is the most common complaint of patients.

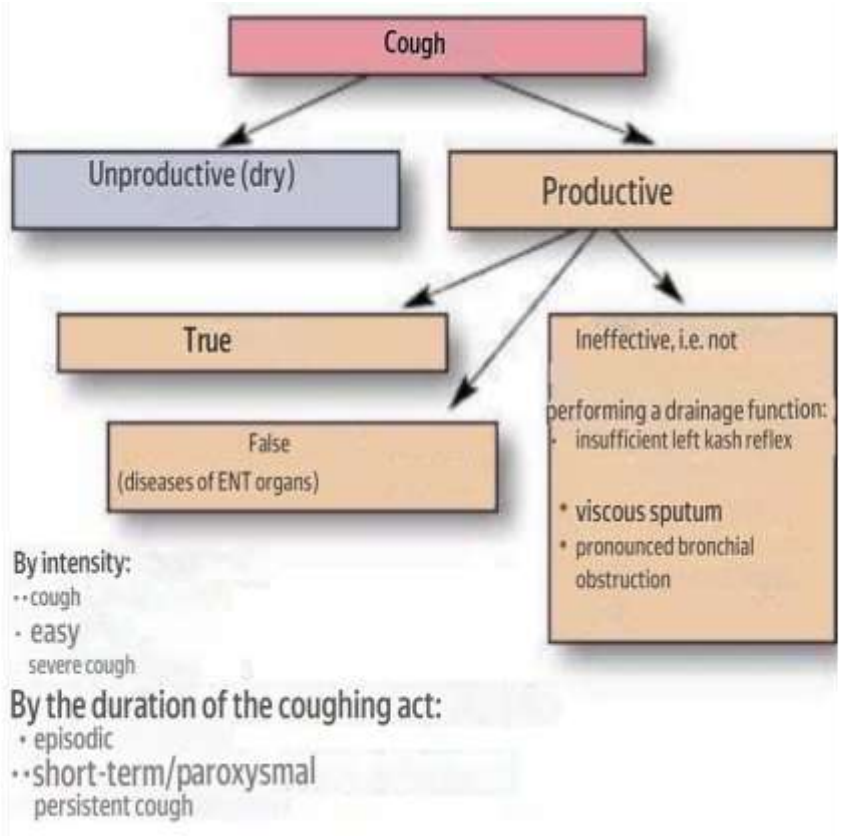


Figure 4: Characterization of cough.

Cough is dry (non-productive) and wet (productive) with sputum. In the initial stages of inflammation of the mucous membrane of the bronchi, for example, in acute

respiratory viral infections, there is an excruciating dry cough, which over time turns into a wet cough.

Glands of the mucous membrane of the respiratory tract in normal produce a small amount of secretion, which is removed by the ciliated epithelium of the bronchi. In case of increased production of mucous secretion or when foreign particles enter the bronchi, the ciliated epithelium triggers the coughing act. Coughing includes a phase of short and deep inhalation with closure of the larynx and a phase of rapid, sharp short exhalation with sputum or other irritating substance.

It is necessary to ask about the duration of the cough (hours, days, weeks), as well as to find out in detail its characteristics: dry or productive with sputum (wet), short-term or paroxysmal, at what time of day it occurs (night or morning) and, finally, what are the features of its sound.

Cough is categorized into acute (lasting less than 2 months) and chronic (lasting more than 2 months).

Acute coughing is caused by:

-infections

-allergic reactions;

-reactions to irritants;

- Infections of the respiratory system are often accompanied by a sore throat, fever and chills (not always). Sputum is mucopurulent (thick, white or yellow in color). Laryngitis or laryngotracheitis occurs with hoarseness of voice. A sore throat is characteristic of pharyngitis or laryngitis, chest pain for tracheitis.

Viral infections, especially acute respiratory diseases, are much more common than bacterial infections.

In viral pneumonias, there is initially a prodromal period with the development of general symptoms (such as tiredness, malaise, myalgias, fever) and only later respiratory symptoms.

Allergic cough is often accompanied by sneezing, watery nasal discharge after contact with an allergen.

Irritative cough occurs after inhalation of an irritant (irritant) and is characterized by the absence of sputum (non-productive cough).

Chronic cough is inherent in many bronchopulmonary diseases.

Factors that provoke or increase coughing: physical activity, cold weather, eating;

Common causes of chronic cough are:

- Chronic inflammation of the nasal mucosa or sinuses;
- Chronic obstructive pulmonary disease (COPD);
- Cough in smokers (chronic bronchitis due to chronic irritation of the bronchial mucosa);
- Bronchial asthma
- Pulmonary tuberculosis.

Less common causes are:

-bronchiectasis

-lung cancer;

-Heart failure.

A cough due to inflammation of the larynx is often barking. Tumors of the mediastinum or aortic aneurysms may put pressure on the trachea and cause a cough with a metallic, difficult to characterize timbre. The tumor may affect the recurrent laryngeal branch of the vagus nerve and thus disrupt the proper movement and closure of the vocal cords, in which case the cough loses its explosiveness and acquires a puffing character (bull cough). A tumor of the larynx may be suspected by the appearance of a hoarse cough (stridor). A cough that occurs immediately after eating or the first sips of liquid indicates the presence of a tracheoesophageal fistula in patients with cancer of the upper esophagus. A wet cough is accompanied by sputum production.

Sputum can be serous, mucous, mucopurulent or purulent. By the character of the sputum one can presumably speak of a disease. The diagnosis is made at the "bottom of the sputum".

Coughing up sputum is seen in acute infections involving any part of the respiratory tract, from nasopharyngitis to laryngotracheitis to pneumonia. Chronic sputum expectoration often accompanies chronic rhinitis, chronic sinusitis, and COPD. In certain diseases, sputum acquires a specific character. For example, anaerobic lung infection is accompanied by the separation of sputum with an unpleasant, malodorous

odor. For bronchiectasis is characterized by periodic coughing up a large volume of mucopurulent sputum. With cardiac asthma, patients emit frothy sputum, colored with blood in pink. In pneumococcal (croup) pneumonia at the stage of stupor, the sputum released has a "rusty" color.

Sputum can be serous (frothy, pink), mucous (viscous, clear), mucopurulent and purulent (dense, yellow-green in color).

- serous is characteristic of pulmonary edema.
- purulent is characteristic of suppurative lung diseases
- mucous often occurs in allergic diseases
- mucopurulent for chronic bronchitis and COPD.

Hemoptysis is characterized by sputum stained with blood (hemoptysis). Hemoptysis is seen in lung cancer, pulmonary embolism (PE), bronchiectasis, mitral stenosis, hemophilia, and anticoagulant use. Sometimes blood stains frothy sputum pink. Scarlet blood may indicate fresh, intense bleeding, blood of darker shades on seepage in places of damage to the mucous membrane.

Evaluation of the coagulation testing helps in recognizing hemorrhagic diathesis and therapeutic use of anticoagulants--heparin, warfarin, direct thrombin inhibitors.

Patients with hemoptoe due to pulmonary embolism or heart failure (HF) require urgent therapy. In all patients with unclear hemoptoe or hemoptys, a Multislice Computed Tomography (MSCT)-lung study and bronchoscopy should be performed to rule out lung cancer.

Dyspnea is perceived as a feeling of shortness of breath
It occurs:

- if the lung isn't participating in gas exchange,
- if the chest or pleura is pathologically rigid,
- if the pleural cavity is filled with fluid or air,
- if the airway resistance is elevated,
- if the lungs are less distensible

Respiratory effort increases with the appearance of hypoxia, anemia, acidosis, with paralysis of respiratory muscles (poliomyelitis, peripheral neuropathy, myasthenia gravis).

Care should be taken to assess the severity of dyspnea at rest or during minor exertion (undressing, walking down one flight of stairs). Attention should be paid to the patient's ability to perform routine activities at work or at home. Dyspnea may be a consequence of bronchial, pulmonary, pleural chest disease, CH, or the result of psychogenic factors.

Dyspnea due to respiratory disease is usually caused by exercise or severity of condition.

Dyspnea that occurs suddenly at rest occurs with pulmonary embolism or pneumothorax.

Dyspnea in HF occurs against the background of increasing stiffness of the lungs due to their overflow of blood (mitral valve defects, left ventricular insufficiency). Dyspnea appears at physical effort and decreases at rest. It depends on the patient's position: in the supine position, gravity increases blood stasis in the lungs, which causes dyspnea. Patients are forced to take an upright position (orthopnea), sitting in bed or in a chair. Further increase in left ventricular insufficiency may be accompanied by the development of severe attacks of suffocation at night or upon awakening (paroxysmal nocturnal suffocation). Such attacks of suffocation may be accompanied by widespread cyanosis and the secretion of large amounts of pink, liquid frothy secretion stained with blood (cardiac asthma).

Dyspnea can be the result of increased demand of the body in intensive breathing and with an unchanged heart, lungs and chest. It occurs with stimulation of receptors of the respiratory center in conditions of hypoxia (high altitude, anemia), acidosis (DM, uremia), increased metabolism (fever, thyrotoxicosis). Then it is necessary to look for other symptoms of the above diseases and conditions. For example, pallor in anemia often helps to understand the nature of dyspnea. The idea of psychogenic nature of dyspnea should be considered only after excluding other causes of dyspnea.

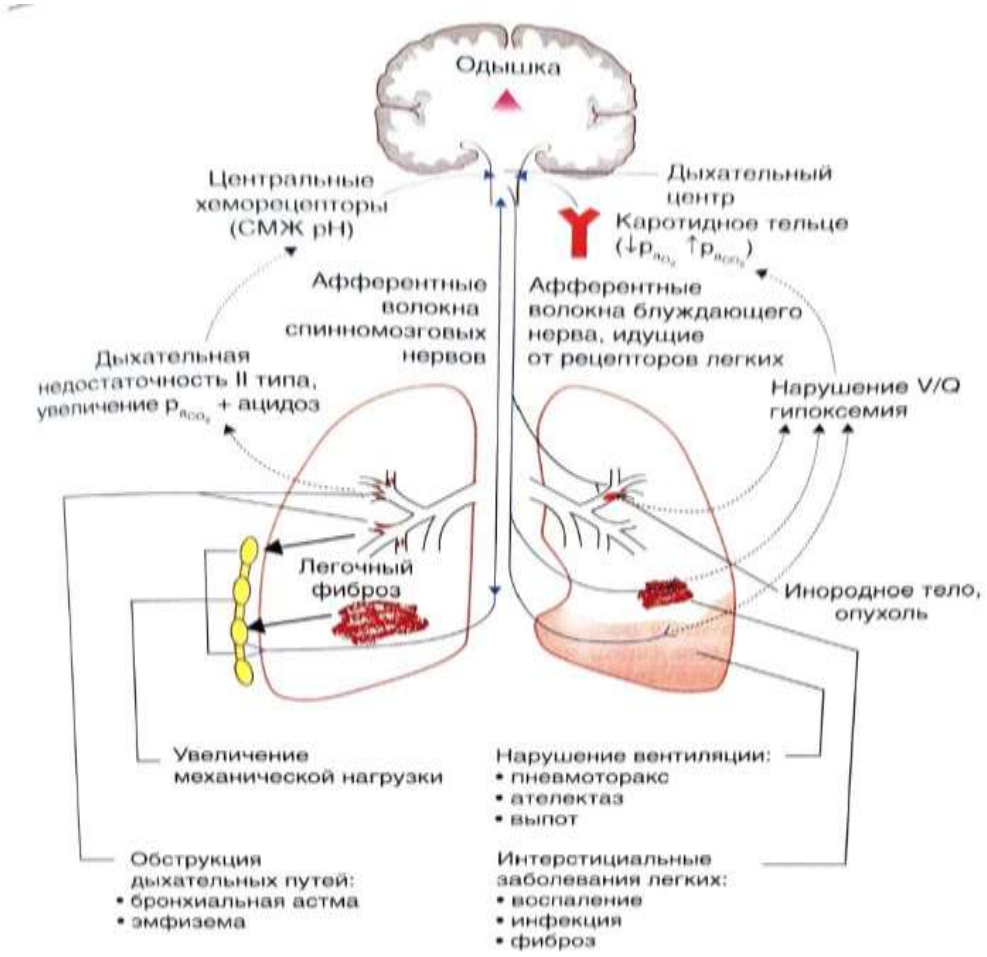


Figure 5: Characterization of dyspnea.

The severity of dyspnea can be assessed according to the criteria of functional class (FC), American Heart Association classification:

-FC 1 - dyspnea only on heavy physical exertion;

-FC 2 - dyspnea at moderate physical load (walking at a moderate pace);

-FC 3 - dyspnea with minimal physical activity (slow walking);

-FC 4 - dyspnea at rest.

Simultaneous dyspnea and the presence of dry wheezing indicate bronchial asthma or COPD.

It is important to assess the duration and variability of dyspnea: if it increases over weeks, months or years, pulmonary fibrosis is likely. Dyspnea with rapid or sudden onset raises the possibility of acute respiratory infection (including bronchopneumonia or lobar pneumonia). Dyspnea that varies in intensity throughout the day is characteristic of bronchial asthma. Sudden onset of dyspnea combined with sudden onset of chest pain indicates pneumothorax. Dyspnea that occurs with increased exercise in overweight patients is likely to be evidence of a lack of physical fitness

(not an uncommon combination of symptoms). Dyspnea described by the patient as a feeling of incomplete inhalation, manifested by deep breaths, may be due to psychogenic factors.

Chest pain

There are no pain receptors in the lung tissue, and therefore chest pain in pulmonologic patients indicates the presence of changes in the tissues surrounding the lungs (Table 1).

Table 1.

Differential diagnosis of chest pain

Causes of pain	
central	peripheral
Heart • Myocardial ischemia and infarction. • Myocarditis. • Pericarditis. • Mitral valve prolapse. Aorta • Aortic aneurysm. • Aortic dissection. Esophagus • Esophagitis. • Esophagospasm. • Mallory-Weiss syndrome[1]. Pulmonary embolism. Mediastinal • Tracheitis. • Malignant tumors. Psychogenic	Lungs/pleura • Pneumonia. • Pulmonary infarction. • Pneumothorax. • Tumors. • Tuberculosis. • Diseases of connective tissue. Musculoskeletal system • Osteoarthritis. • Rib fracture/damage. • Tietze's syndrome[2] (costochondritis) • Intercostal muscle damage. • Epidemic myalgia. Neurology • Intervertebral disc prolapse. • Herpes zoster. • Thoracic outlet syndrome

When the pleura is involved, chest pain can be extremely intense. It is described as stabbing, stabbing or tearing with a characteristic increase in intensity with deep breathing and coughing.

Pain in pleural lesions usually has a limited localization and is most often felt in the axilla or under the chest. There may be cases where pleuritic pain due to irradiation is perceived outside the chest, such as in the right subcostal region or left shoulder, and mimics acute gallbladder or coronary pain. The parietal pleura, including the part lining the diaphragm. is innervated by thoracic roots (intercostal nerves) of the spinal cord. Of these, the lower six innervate the skin of the anterior abdominal wall and back. This is why pleuritic pain is often reflected on the abdominal and lumbar surface

of the body and may be mistaken as a sign of an acute abdomen or renal colic. The central field of the diaphragm is innervated by the diaphragmatic nerve, coming from the cervical plexus of the III and IV cervical spinal nerves. Therefore, sometimes in diaphragmatic pleurisy there is reflected pain in the neck or shoulder region. Bronchial carcinoma affecting the apex of the lung (Pancoast cancer) and innervated by VII cervical and 1 thoracic nerve root of the spinal cord, causes the development of Horner's syndrome and the appearance of pain in the arm, corresponding to the localization of the pulmonary tumor. It should also be remembered that pain of different localization and varying intensity in the chest is more often caused by extrapulmonary pathology, in particular, diseases of the heart and vessels. esophagus, the presence of spondylitis and osteoarthritis of the spine, lesions of the ribs, sternum and intercostal muscles, the development of breast tumors, infectious disease (herpes zoster).

History of illness (Anamnesis morbi)

Patients should be inquired of:

- when these complaints came to light,
- what she attributes their appearance to,
- if you've seen a doctor,
- what kind of examination was done
- what the diagnosis was,
- that was recommended,
- what the result was.

Life history (Anamnesis vitae)

Includes:

- Brief biographical information (how you grew up, developed, studied).
- Material and social living conditions (satisfactory, not satisfactory).
- Family history
- Dietary regime and its characterization (rational, abuse of salt, fats, etc.)
- physical activity (walks, sports).
- Illnesses suffered.
- Childhood immunizations and annual immunizations.

– Harmful habits (smoking, alcohol abuse, drugs, how often and from what age).

– Allergic anamnesis: intolerance to medicines, food products, etc.

When taking a history, it is important to ascertain the patient's current or previous exposure to toxic substances, namely various pollutants: dust, aromatics, chemical agents. Substances that can cause respiratory dysfunction include a wide range of agents from stale hay (farmer's lung) to various metals (e.g., titanium). In a pollutant-contaminated work atmosphere, pulmonary symptoms (e.g., bronchospasm) are manifested and intensified on weekdays and greatly diminished or disappear altogether on weekends. A detailed occupational history helps to identify the causative factor of the pulmonary disorder and provides the key to a correct diagnosis. Work in coal mines, if hygiene standards are not met, may be accompanied by the development of pulmonary fibrosis-pneumoconiosis of miners. Work with asbestos carries a risk of asbestosis and serves as a risk factor for lung cancer and malignant pleural mesothelioma. Carrying out welding work should be considered as a possibility of alveolitis development.

Data on contact with patients with influenza, tuberculosis allows you to assess the possibility of infection with this disease.

Some previous or current diseases and medications may contribute to the development of bronchopulmonary pathology. Measles and pertussis carried in childhood are risk factors for bronchiectasis. It should be remembered that animals can cause respiratory disease by transmission or through the development of hypersensitization. In a patient with pneumonia, it is necessary to clarify the possibility of contact with birds, since some species of birds can be a vector of the pathogen Chlamydia psittaci, causing a special form of pneumonia psittacosis. This is extremely important for drug therapy, as this infectious agent responds better to tetracycline than to penicillin antibiotics. Psittacosis is suspected if, for example, a pet parrot or canary has died after a short episode of illness. In patients with chronic dyspnea, possible contacts with pigeons should be investigated, as these birds may be responsible for the development of hypersensitivity pneumonitis (pigeon lung). Pets, especially cats and dogs, by licking the hair and applying saliva, which is an allergic agent, can exacerbate

the course of bronchial asthma. Amiodarone, often prescribed for the treatment of arrhythmias, causes pulmonary fibrosis in a number of patients. Another common cardiac drug β-adrenoreceptor blocker causes deterioration of bronchial patency in patients with bronchial asthma and COPD.

ACE inhibitors are widely used in the treatment of patients with AH. Some patients experience a side effect in the form of a dry cough, sometimes painful. Cough is usually not accompanied by sputum separation and can appear at any time of the day, mainly in the first year of treatment.

Questions on the topic:

1. what does the questioning of patients consist of?

2. What should I pay attention to in the passport part?

3. What are the chief complaints of patients with diseases of the respiratory system?

4. What kind of cough is there?

5. The nature of the sputum.

6. What is shortness of breath?

7. What is chest pain associated with respiratory system diseases?

8. Additional complaints of patients with diseases of the respiratory system.

9. Questions to ask when collecting anamnesis morbi.

10. What does anamnesis vitae consist of?

2.2. PHYSICAL EXAMINATION.

Traditionally, the medical physical examination is performed in the following sequence: general examination, chest examination, palpation, percussion, auscultation.

General inspection

The general examination is performed in a warm, bright room. The general examination allows you to assess the patient's breathing effort, hear stridor and hoarseness of voice, notice cyanosis, and locate a nebulizer, oxygen mask, or sputum collection jar near the patient. A nebulizer is used by patients with bronchial asthma or COPD to inhale high-dose bronchodilators.

Moderate or severe respiratory failure (respiratory distress) manifests as noisy or labored breathing, which is induced or intensified by minor physical activity (removal of clothing, change of body position); and forced body position (orthopnea).

A long, noisy breath with tension of all auxiliary respiratory muscles (stridor) indicates upper airway obstruction. The sudden onset of stridor requires immediate action to remove the obstruction or to place a tracheostomy.

Causes of acute stridor:

- inhalation of a foreign body;
- anaphylactic reaction.

Causes of gradually developing stridor:

- tumors of the larynx, pharynx, or trachea;
- compression of the trachea from the outside by enlarged lymph nodes or thyroid gland.

The patient may speak with a hoarse voice, which is often a manifestation of laryngitis. It should be remembered that hoarseness of voice may be due to lung cancer causing paralysis of the laryngeal nerve or laryngeal cancer.

Thickening of the terminal phalanges of the fingers and toes is due to an increase in the amount of connective tissue. With significant fibrosis, the terminal phalanges look like "drumsticks". The process is symmetrical, and the fingers are more often involved than the feet. Thickening of the terminal phalanges was first described by Hippocrates, hence the name "Hippocrates' fingers".

Figure 6. Hippocratic fingers and hour-glass-shaped nails in a patient with chronic obstructive pulmonary disease.

Hippocrates' fingers are found in 95% of patients with congenital blue heart disease, 75% with idiopathic pulmonary fibrosis, 30% with bronchiectasis, and 25% with lung cancer.

Currently, the phenomenon of end phalangeal thickening is considered from the perspective of the megakaryocytic theory. In norm megakaryocytes, the precursors of platelets, released from the bone marrow into the bloodstream, are captured by the endothelium of pulmonary capillaries and do not go into the systemic circulation. In lung disease, dilatation of pulmonary capillaries and formation of pulmonary arteriolovenous shunts, megakaryocytes exit into the bloodstream, are captured by finger capillaries, where they release growth factor into surrounding tissues.

In patients with pulmonary pathology can be detected:

-Small finger tremor as a side effect of bronchodilators in bronchial asthma and COPD;

-yellowish-brown staining of the fingers, in smokers. The degree of skin staining does not correlate with the number of cigarettes smoked.

Figure 7: Nicotine staining of skin and nails in a smoker. The formation of the "drumstick" symptom is also observed.

-Raspy, abrupt movements of the hands indicate the development of hypercapnic, hypoxemic respiratory failure and is most commonly seen in COPD.

The patient's hands should be monitored for at least 15 seconds before concluding whether or not a symptom is present. β-adrenoreceptor agonists prescribed to patients with bronchial asthma and COPD may cause a low-amplitude tremor of the fingers, which is quite different from the sharp, sweeping movement of the hands in clapping tremor.

The normal respiratory rate (RR), according to numerous measurements, ranges from 14 to 18 respiratory movements per minute. Respiration is frequent in children and rare in the elderly. In newborns, HR reaches 40-45 per minute, by 5 years of life it decreases to 25-30, and during puberty to 20 per minute. In women, breathing is slightly more frequent than in men. In the supine position and especially in sleep, breathing becomes more infrequent. Respiratory movements are normal rhythmic, medium depth, both halves of the thorax are evenly involved in the act of breathing, inhalation is active and relatively short, exhalation is passive and longer. Noise created by the air jet in both phases of breathing, barely audible. The ratio of HR to heart rate (HR) is 1:4 and is constant in every person.

HR increases (tachypnea) in patients with pneumonia, pleurisy, bronchial asthma, and COPD. Tachypnea may also occur in patients with fever or anxiety. An HR greater than 25 per minute in patients with a bronchial asthma attack indicates severe severity and respiratory failure.

HR is shortened (bradypnea) in drug overdose or in neurologic emergencies, particularly in acute cerebral circulatory failure or increased intracranial pressure. In these situations, Cheyne-Stokes respiration is often recorded.

The HR can change randomly. If patients see that the physician is watching them closely, they will begin to control their heart rate.

Facial edema may indicate lung cancer due to tumor blockage of the superior vena cava (SVC) or its paracancrotous thrombosis. The SVC receives blood from the head, neck, and arms. When it is blocked, the veins of the head and neck swell, the normal pulsation of the jugular veins disappears due to increased passive venous pressure in them, independent of the pulse. The face and neck swell much more than the arms, because venous outflow from them can be carried out through an alternative collateral network to the inferior vena cava system.

In SVC blockade, dilated veins are often seen on the anterior surface of the chest, indicating collateral venous outflow from the arms. The face is edematous and cyanotic, the external jugular veins are dilated and non-pulsatile, and there is an unusual venous pattern on the chest.

Horner's Syndrome Horner J., (1831-1886, Swiss ophthalmologist) may be noted to include the following symptoms:

- unilateral decrease in pupil diameter (miosis);
- Sagging of the upper eyelid in the same eye (ptosis);
- decreased sweating (anhidrosis) on the same side of the face.

Normally, the pupils may differ slightly in size. Usually the difference does not exceed 1 mm. Real miosis means constriction of the pupil on the affected side more than 1 mm compared to the pupil on the healthy eye. Horner's syndrome is caused by unilateral damage to the sympathetic innervation of the eye and face. Normally, sympathetic nerves dilate the pupil, while parasympathetic nerves constrict it. A tumor of the apex of the lung may damage second-order sympathetic neurons, leading to the development of Horner's syndrome. Similar symptoms (miosis, ptosis and anhidrosis) may occur due to damage to first-order neurons in patients with acute cerebral circulatory failure.

Cyanosis causes bluish coloration of the skin and mucous membranes when there is an excessive concentration of reduced (deoxygenated) hemoglobin in the blood (usually more than 2.5 g/100 ml). Cyanosis may be peripheral or central.

Peripheral cyanosis is caused by insufficient blood transport mainly in the periphery, namely in the area of fingers, nose tip, earlobes. Due to a decrease in the rate of volume blood flow, tissues take up most of the blood oxygen, which leads to an increase in the content of deoxygenated hemoglobin and the appearance of bluish skin color.

In central cyanosis, all arterial blood is insufficiently oxygenated, cyanosis is diffuse, and even tongue tissue that retains high blood flow becomes cyanotic.

Cyanosis can occur acutely in patients with pneumonia or PE and in chronic lung disease (COPD, pulmonary fibrosis). Cyanosis is most clearly seen in areas with thin epidermis and developed subepidermal blood flow on the lips, nose, ears, and oral mucosa. At the same time, cyanosis is most clearly visible on the mucous membrane under the tongue, around its frenulum.

Chest exam

The chest is examined from all sides under direct and lateral illumination. The patient frees the chest from clothing. Its shape is judged by the ratio of anteroposterior and transverse dimensions (as a rule, they are determined visually). In norm, the lateral diameter of the chest is greater than the anteroposterior diameter (approximate ratio 4:3).

The expression of supra- and subclavian fossa, width of intercostal spaces, the direction of ribs in the lower-lateral areas, the size of the epigastric angle is evaluated.

There are three main types of chest: normosthenic, asthenic and hypersthenic. To characterize them, it is necessary to determine the type of the subject's physique. With a correct physique, the chest circumference is approximately half of the height, both halves of the body are symmetrical, the size of the body and its individual parts are proportional, there are no physical injuries, physical defects and developmental anomalies.

A very important indicator for determining the type of the thorax is the value of the epigastric angle. In order to determine its value, it is necessary to press the palm surfaces of the thumbs against the rib arches, pressing their ends against the parietal process (Figure 3).

Thus, in the norm, the rib cage has a regular, symmetrical shape.

In normosthenic it has the form of a truncated cone, facing upwards; its anteroposterior size is 2/3-3/4 of the transverse one, intercostal spaces, supra- and subclavian fossae are not sharply expressed, the direction of ribs in the lower-lateral parts is moderately oblique, epigastric angle is close to straight.

In asthenics the thorax is narrow and flattened due to uniform reduction of its anteroposterior and transverse size, supra- and subclavian fossae are deep, intercostal spaces are wide, ribs go steeply downward, epi gastral angle is acute.

In hyperstenics, the anteroposterior and transverse dimensions of the thorax, on the contrary, are uniformly increased, so it appears wide, the supra- and subclavian fossae are barely outlined, the intercostal spaces are narrowed, the direction of the ribs is close to horizontal, the epigastric angle is obtuse.

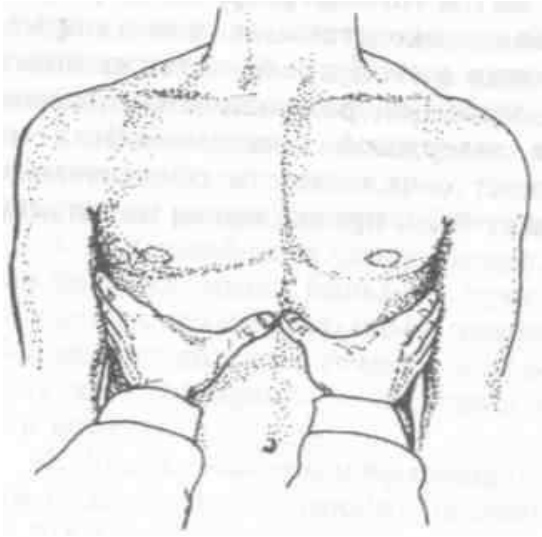


Figure 8: Determination of the epigastric angle.

Changes in the shape of the thorax may be the result of very different etiologic factors. For example, in patients with a **barrel** chest (pectus emphysematosis), the anteroposterior dimension increases to a 1:1 ratio with the lateral dimension. A barrel chest is a symptom of pulmonary emphysema and is formed as a result of increased tone of the accessory respiratory muscles, which shift the ribs upward. The presence of a barrel chest is an indicator of long-term COPD, although the degree of chest deformity does not always correlate directly with the severity of the disease.

Other chest deformities are less common, such as the funnel-shaped "pectus excavatum"; the term is derived from the presence of sternal recession or depression below the frontal surface of the chest. It is usually an idiopathic congenital deformity, but in some cases it is associated with connective tissue dysplasia syndrome, such as Marfan syndrome (Marfan A., 1858-1942, French pediatrician). The deformity is mainly of cosmetic significance and very rarely can act as a cause of dyspnea.

Chicken chest, or keel chest (pectus carinatum), is characterized by a deformity in the form of a sternum that protrudes significantly forward. This skeletal defect is formed in childhood as a result of vitamin D deficiency (rickets) or due to severe heart or lung disease. In diseases of internal organs, this displacement of the sternum may be due to strong contractions of the diaphragm during childhood, when the child's chest has a high plasticity. The deformity is only cosmetic and has no effect on respiratory function.

Kyphoscoliosis is a spinal deformity with the simultaneous presence of anteroposterior kyphosis and lateral scoliosis.

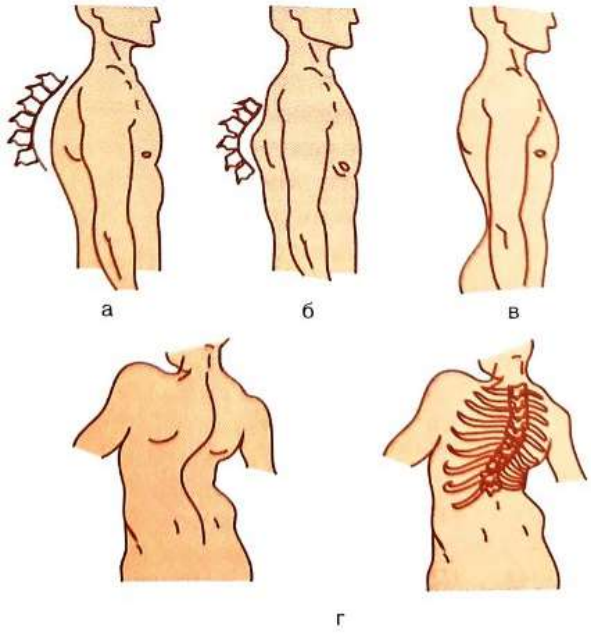


Figure 9. **Variants of spinal deformity: а - б - angular kyphosis;**

в - lordosis; г - scoliosis kyphosis;

Severe deformity of one side of the chest indicates the possibility of past thoracoplasty for tuberculosis. The operation involves removal of several ribs, which significantly deforms the affected side of the chest and reduces the breathing capacity of the lung. Later on, as the patient ages, such intervention on the lung is often accompanied by respiratory failure.

Evidence of prior radiation therapy may be evidenced by sharply circumscribed areas of erythematous thickened skin, indicating the possibility of a tumor process, particularly lung cancer or lymphoma.

The shape of the chest and its movements are assessed in an upright position, preferably with the patient standing next to the bed. Additional muscle involvement and exhalation through compressed lips indicate increasing respiratory failure, most commonly in patients with COPD.

Examination of chest movements can help in detecting one-sided pathologic process in the lungs.

In severe dyspnea, additional muscles are included in the act of breathing. In the inhalation phase there is a contraction of the sternoclavicular-papillary and other muscles of the neck, expansion of the external nasal passages by raising the wings of the nose (especially in children) and the appearance of grasping movements with the mouth.

Patients with COPD often clench their lips when exhaling. This occurs mainly during physical exertion (climbing stairs, accelerated walking) and during exacerbations of the disease. This technique increases exhalation pressure, which contributes to dilatation of the bronchi and improves blood oxygenation. In the norm, the diaphragm independently provides the process of inhalation, the process of exhalation is carried out passively. In patients with dysfunction of respiratory muscles, for example, in COPD, during the exacerbation of the disease, additional muscles are involved: the anterior superficial muscles of the neck - sternocleidomastoid (mm. sternocleidomastoidei) muscles are involved in the maintenance of inspiration, for lifting and maintaining the chest - deep neck muscles (mm. scaleni) and posterior muscles of the neck and back (mm. trapezii). Exhalation in patients with respiratory failure is supported by the anterolateral abdominal muscles (m. external oblique). In addition to the inclusion of additional muscles, patients with exacerbation of COPD often adopt a forced position of leaning forward, resting their hands on their knees to relieve the painful feeling of shortness of breath.

Note the amount of movement on each side of the chest and decide whether both sides are moving equally or whether one side is lagging behind in breathing. Pathologic types of breathing may be noted on examination.

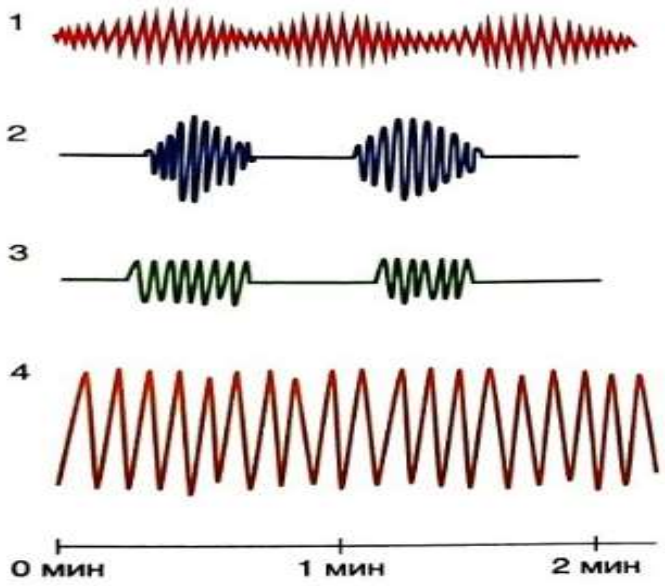


Figure 10. Pathologic types of respiration (spirograms): 1 - Grocco's respiration; 2. - Cheyne-Stokes respiration; 3 - Biot's respiration; 4 - Kussmaul's respiration.

Pathologic Cheyne-Stokes respiration (Cheyne J., 1777-1836, British physician, Stokes W.; 1804-1878, Irish physician) may be observed:

- in patients with congestive HF with combined right heart (cor pulmonale) and respiratory insufficiency, in persons with impaired consciousness (in case of drug overdose, acute cerebral circulation disorder or craniocerebral trauma).

In this type of breathing, the respiratory cycle includes a phase of increasing depth of breathing, a phase of gradual shortening and decrease in the amplitude of breathing down to superficial, apnea phase with cessation of breathing for a few seconds and subsequent resumption of the cycle.

Grocco's breathing (Grocco P., 1857-1916, Italian therapist) is a similar type of breathing, but without the long pauses of apnea. This type of breathing is also called dissociated breathing, because the coordination of breathing of the intercostal muscles and diaphragm is disturbed.

Agonizing patients are characterized by Biot's breathing (Biot C., 1850-1918, French therapist), in which periods of several consecutive regular, regular-depth respiratory movements are interrupted by pauses of apnea lasting from a few seconds to 30 s.

In respiratory failure, patients' breathing is frequent (tachypnea) and shallow, often superficial.

In other situations, patients breathe deeply as well as frequently. Such breathing indicates a state of **hyperventilation**, in which there is excessive removal of carbon dioxide from the blood. Examination shows low levels of CO2 in the blood. Hyperventilation accompanies various conditions: CH, bronchial asthma, hypoxia, pain, fever, and anxiety. Due to CO2 washout, hyperventilation causes metabolic alkalosis. The increase in pH contributes to a decrease in the concentration of ionized calcium in the blood. Hypocalcemia may be manifested by tingling of fingers and skin around the mouth.

Hyperventilation may be a compensatory response to metabolic acidosis, and occurs in patients with decompensated DM (diabetic ketoacidosis) or severe renal failure (uremia). Such deep, noisy acidotic breathing is called Kussmaul's respiration

(Kussmaul A., 1822-1902, German physician). In Kussmaul's respiration, unlike hyperventilation, there is no alkalosis, hypocalcemia in the blood, and there is no tingling of the skin of the fingers and face.

Palpation of the chest

Palpation of the chest identifies painful points, chest rehydration, and vocal tremor.

Identification of pain points. Palpation begins with the trachea. The trachea is palpated gently with the middle finger of the right hand, 2 cm above the suprasternal notch along the midline. Palpation is also performed on the left and right sides of the trachea to decide whether it is central or displaced.

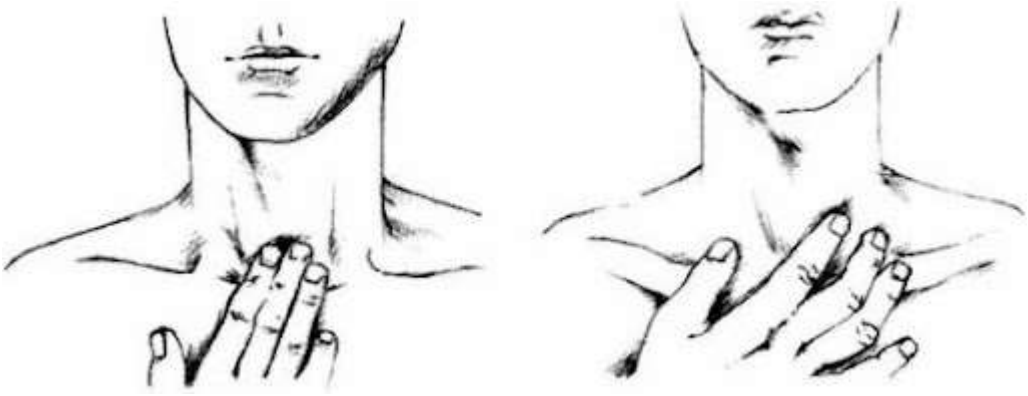


Figure 11. **Palpation of the trachea**

Rib fracture or intercostal neuralgia is identified by pain points on palpation. Pain may be combined with a crunching or crepitation sensation when the broken ends of the ribs are displaced. Rib fractures are usually associated with trauma and may be complicated by pneumothorax or hemothorax. Less common are pathologic rib fractures that are caused by cancer metastasis to the bone. Diffuse subcutaneous emphysema of the upper chest and neck, which produces a characteristic rustling sensation under the hand on palpation, indicates a possible pneumothorax. The upper 1/3 of the posterior surface of the chest is overlying the upper lobes, and the lower 2/3 are overlying the lower lobes.

Palpation of cervical and supraclavicular lymph nodes is performed standing behind the patient, using the palm surfaces of the fingers and (for clearer perception) the fingertips. Palpation of the neck lymph nodes is performed to determine if they are enlarged. The patient should be asked to tilt the head slightly forward to relax the neck muscles.

About 20% of lung cancer patients have enlarged lymph nodes in the neck. Initially they may be very small, but gradually they coalesce and form conglomerates with indistinct borders, adherent to the underlying tissues and dense to the touch. Enlarging lymph nodes tend to be located in the supraclavicular regions deep between the pectoralis major and the sternoclavicular-papillary muscle.

Lymphatic drainage from the lungs is primarily through the cervical lymph nodes. The axillary lymph nodes drain the mammary glands and pleura. Normally, small axillary lymph nodes (less than 0.5 cm in diameter) can be palpated. Large nodes (more than 1 cm) almost always indicate a pathologic condition. Dense (woody) to the touch lymph nodes are suspicious for breast cancer or, less commonly, mesothelioma.

Before palpating the axillary lymph nodes, the patient should be asked to spread the arms apart. During palpation, the doctor should support the patient's right arm at the elbow with his left hand, which helps to relax the shoulder muscles. Next, the doctor palpates the axillary region with the palm of the fingers of the right hand in the following sequence: medial, anterior, lateral, posterior and apical.

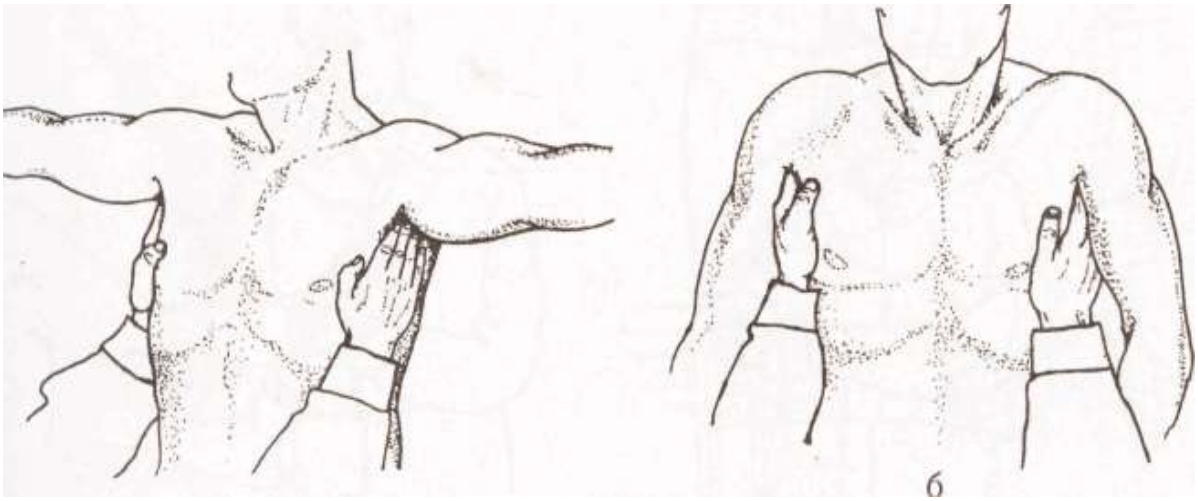


Figure 12. Palpation of axillary lymph

The doctor's attention should be focused on looking for rounded masses. For this purpose, palpation is performed with the fingertips.

Other common causes of enlarged lymph nodes are lymphoma, tuberculosis, and sarcoidosis. In lymphoma, enlarged lymph nodes are dense and elastic, not fused into a mass and not adherent to surrounding tissues. In tuberculosis, the lymph nodes merge with each other. Less often, an increase in supraclavicular lymph nodes is a consequence of other forms of cancer, localized, in particular, in the head and neck.

Cancer of the stomach or pancreas may manifest as an enlarged lymph node in the left supraclavicular region, known as the Virchow node (Virchow R., 1821-1902, German pathologist). In the neck, lymph node enlargement is most often due to localized upper respiratory tract infections and tonsillitis of enlarged submandibular nodes.

Other causes leading to generalized lymph node enlargement include acute and chronic lymphocytic leukemia, viral diseases (infectious mononucleosis, cytomegalovirus infection, and infection caused by HIV), bacterial infections (syphilis, brucellosis), and toxoplasmosis.

When lymph nodes are detected, their size, consistency (dense or solid), separation or fusion into conglomerates, presence or absence of their adhesion to the underlying tissues are assessed.

Use the index, middle and ring fingers to gently palpate both supraclavicular fossae and use the ends of the index fingers to palpate between the heads of the sternoclavicular-papillary muscles. It is better to examine both of these muscles separately, avoiding possible bilateral, unintentional pressure on the carotid sinus, which may cause the patient to faint.

With the right fingers (index, middle and ring fingers) slowly palpate the right muscle up to the angle of the lower jaw. The left hand performs the same procedure on the left muscle. The submandibular areas are palpated with the index, middle and ring fingers of both hands simultaneously, first at the corners of the lower jaw and then moving forward until they meet at the chin.

Chest rigidity (elasticity)

In norm the thorax is elastic, flexible, i.e. pliable. Violation of the elasticity of the thorax occurs in the form of an increase in its resistance. The resistance of the chest is determined by the resistance of its compression in different directions. The physician places the palm of one hand on the interscapular space just to the right of the spine, and the palm of the other hand to the right of the sternum over the location of the ribs. Both palms should be parallel to each other and at the same level. Push the chest in the direction of the hands towards each other (in the anteroposterior direction). Then compress to the left of the sternum in the same way. After that, place the palms of the hands on symmetrical areas of the lateral parts of the chest and squeeze it in the

transverse direction. Increased resistance (stiffness) of the chest is observed in emphysema of the lungs, in effusion pleurisy, pleural tumor, and in the elderly.

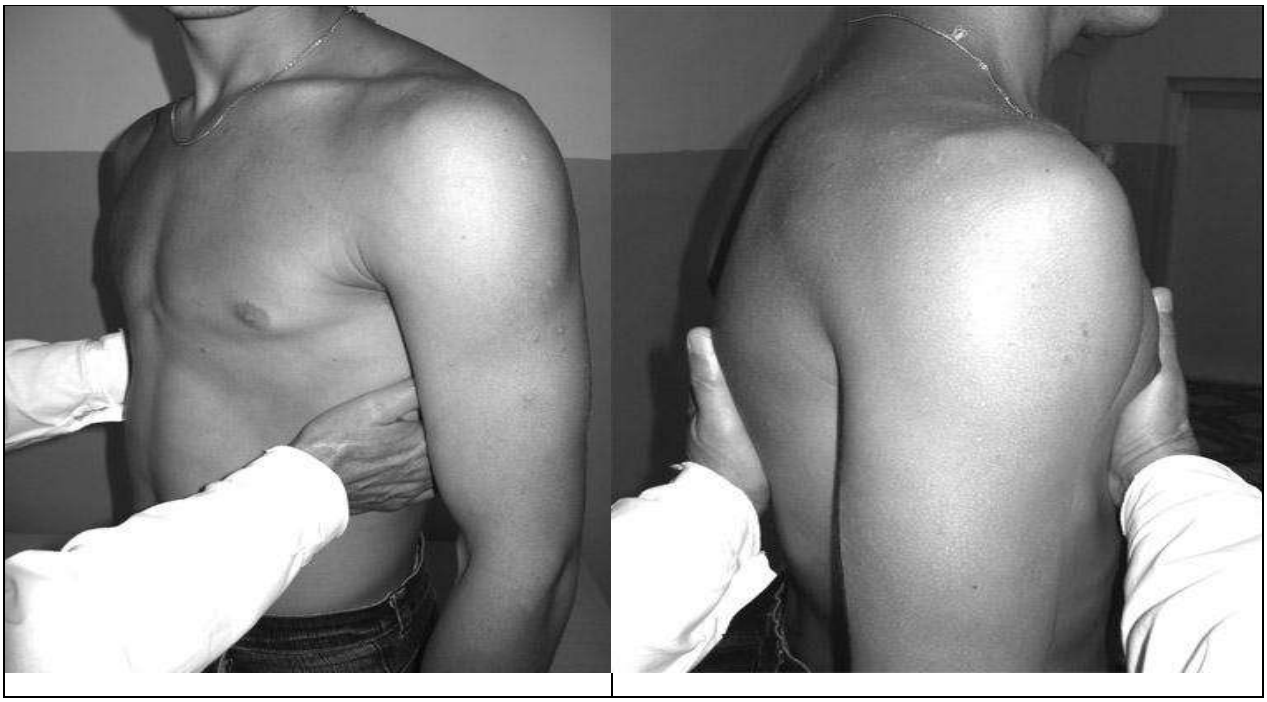


Figure 13. Determination of chest elasticity in different planes.

Vocal tremor

Why is vocal tremor testing used? Low-frequency vibrations (100-200 Hz) can be felt on the surface of the chest by hand palpation. The majority of the vocal tremor spectrum is low-frequency sound (less than 300 Hz). The severity of vocal tremor depends on the thickness of the chest wall and is reduced in persons with overdevelopment of chest muscles or subcutaneous fat. Vocal tremor is easier to detect in men than in women because the low-frequency vibration produced by a low voice is easier to palpate because it is better transmitted through the normal lungs.

The method of vocal tremor determination is as follows. Initially, the vocal tremor of the top of the lungs is determined, for this purpose the vibration of the clavicles is evaluated: the ulnar edge of the right palm is pressed to the right clavicle of the patient and the patient is asked to pronounce and repeat a word combination containing ringing consonants, for example, "thirty-three", while the doctor's attention is focused on the vibration transmitted to the edge of the palm. Then the right hand is moved to the left clavicle and the patient is asked to say "thirty-three" out loud once

again and the vibration transmitted to the hand is assessed again. In norm the character of vibration of the lung tops is the same on both sides.

The vocal tremor of the upper lobes of the lungs is examined by first placing the palm of the hand on the upper part of the right side of the patient's chest, just below the clavicle. The patient is asked to say "thirty-three" loudly, concentrating on the vibration transmitted to the hand. Repeat the same technique on the left side of the patient's chest and compare the sensations on both sides. In norm the character of vibration transmitted by both upper lobes of the lungs does not differ.

Vocal tremor of the lateral lung regions is determined after the patient moves the right arm aside at the request of the physician. The palm of the doctor's hand is placed flat on the lateral surface of the chest, in the right axillary region. The patient is asked to say "thirty-three" while the physician pays attention to the vibration transmitted from the surface of the chest to his palm.

When determining the vocal tremor of the upper lung lobes on the posterior surface of the chest (on the back), the doctor places the palm of the hand on the right supra-scapular area and performs the entire diagnostic procedure in the same way as on the anterior surface of the chest. In the interscapular space, the fingers should be placed vertically during palpation.

Vocal tremor of the lower lobes of the lungs is assessed when the palm of the hand is placed below the corner of the patient's right scapula, comparing the sensations obtained on both sides of the chest.

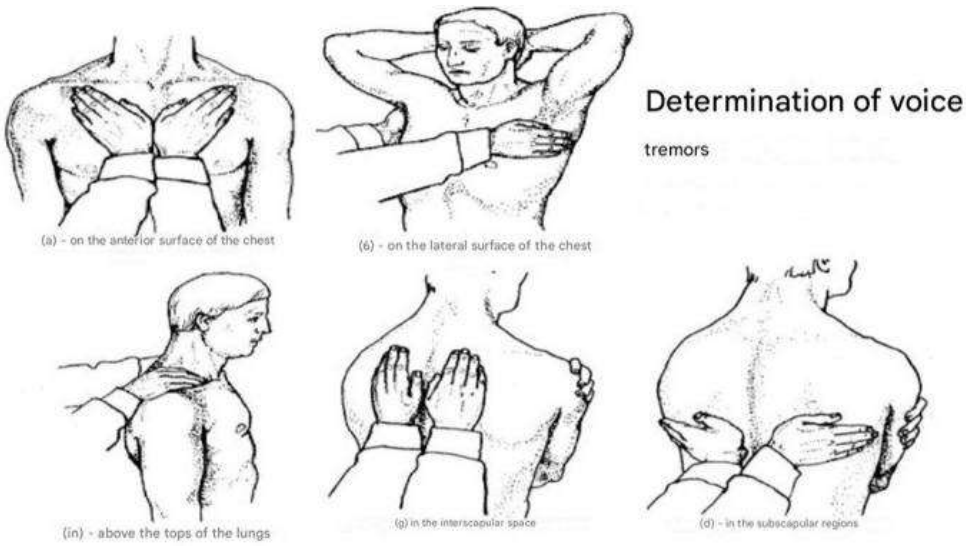


Figure 14: Determination of vocal tremor of the lungs.

In norm, vocal tremor is moderately pronounced, generally equal on symmetrical parts of the chest. However, due to anatomical features of the right bronchus, vocal tremor over the right apex may be slightly stronger than over the left.

In some pathological processes in the respiratory system, vocal tremor over the affected areas may increase, weaken or completely disappear. Vocal tremor increases in case of thickening and decreased airiness in case of croup pneumonia, lung infarction or incomplete compression atelectasis. Vocal tremor can be amplified over a cavity in the lung (abscess, tuberculous cavern), but only if the cavity is large, located superficially, communicates with the bronchus and is surrounded by dense lung tissue. Uniformly weakened vocal tremor is observed in patients with pulmonary emphysema.

Chest percussion

Percussion of the chest and other organs and masses belongs to one of the great arts of medicine. Constant practice helps to attain a high degree of skill, and then the physician gains valuable diagnostic information.

Percussion as a method of examination of the patient was first described in 1761 by the Viennese physician L. Auenbrugger, and then by the great French physician R. Laennec.

Percussion is an important diagnostic achievement in pulmonology. In Russia, percussion was introduced by S.P. Botkin, who mastered this method. Percussion is still an important diagnostic method when meeting a patient for the first time. When examining the respiratory system, percussion is performed to detect pathologic changes in the lung tissue (**comparative percussion**), as well as to determine the boundaries of the lungs (**topographic percussion**). It is important to perform percussion in compliance with all known technical features. To do this, place the palm surface of the left hand on the patient's chest wall parallel to the ribs and the middle finger between the ribs. Next, the fingers should be slightly spread apart and the left middle finger, which acts as a plexímeter, should be pressed firmly against the chest wall. The right hand is held in an extensor position and the middle finger is slightly flexed so that the distal phalanx of the middle finger is at right angles to the left middle finger. The extension of the right hand is then increased to strike the left middle finger.

The blow is made (after a sharp bending of the right hand) with the flesh of the right middle mallet finger on the back side of the middle phalanx of the left middle finger. After the percussion blow, the mallet finger is immediately withdrawn back, and a second blow is made with a rapid rebound of the mallet finger from the pleximeter finger. When making percussive blows, attention should be paid to the tone caused by the blows and the sensation of the meeting of the two fingers, since the percussive tone is both heard and felt. During percussion, the tightness of the left middle finger against the chest wall should be monitored.

In some cases, comparative percussion of the clavicles is performed directly with the right hand. The standard percussion technique is used, except that the right middle finger is struck directly on the clavicle, which in this case acts as a pleximeter, without the left middle finger. Percussion of the clavicles can be painful, so the strength of the percussion blow should be balanced against the patient's reaction. The percussion technique should be practiced by the students on each other.

Comparative percussion

Comparative percussion is used to compare the right and left sides of the chest. Normal percussion tones/sensations that the physician can distinguish:

-clear pulmonary sound - appears over unchanged lungs;

-dull sound - appears over dense organs such as the liver, heart;

-tympanic sound - appears over the abdomen.

At percussion of healthy lungs from top to bottom up to VI rib inclusive on the anterior chest wall, up to VIII rib in the axillary region and up to X rib behind along paravertebral lines, a clear pulmonary sound is heard. A dull sound is heard above the heart in front and above the liver.

The percussion tone changes if the lung tissue loses airiness, for example, when it is thickened (consolidation), atelectasis (collapse) or when the lung tissue is displaced from the chest wall by fluid, air, pleural adhesions. Pleural effusion, lung consolidation and atelectasis most often change the percussion tone over the lower lobes.

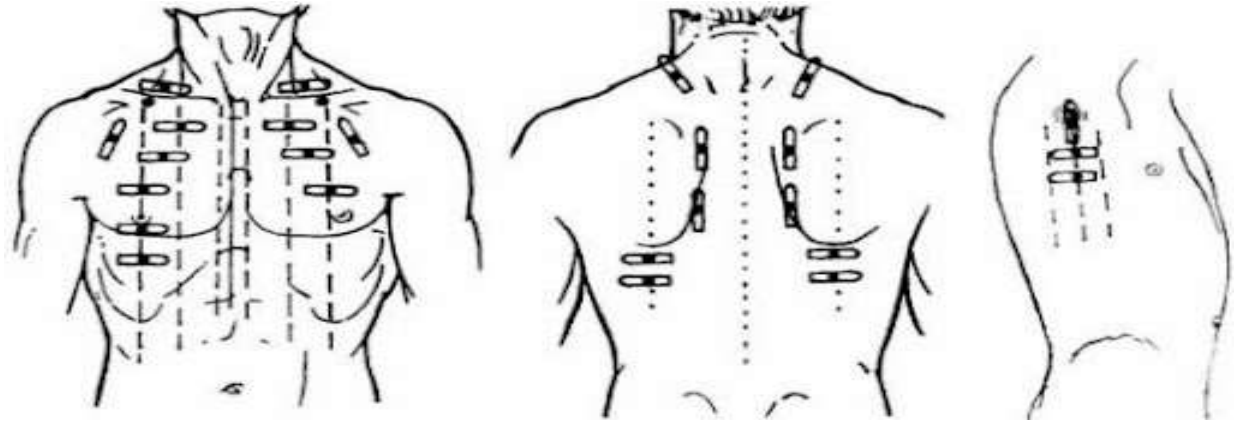


Figure 15. Comparative percussion.

Comparative percussion of lungs is carried out sequentially on the anterior, lateral, axillary and posterior surface of the chest. In this case, alternately percuss on symmetric areas of both halves of the chest. Determine the nature of the sound at each point of percussion and compare it with the percussion sound on the opposite side, as well as with the sound in neighboring areas of the lungs. The reliability of the results of comparative percussion depends largely on the conditions:

- in symmetrical areas;
- the position of the pleximeter finger on the chest wall;
- the pressure exerted on the percussion surface;
- the strength of the percussive blows.

First, percuss alternately in both supraclavicular fossae. To do this, place the pleximeter finger directly above the clavicle and parallel to it. Then percuss the right clavicle above its medial third with a mallet finger. Remember that only the medial third of the right clavicle is above the lung tissue. Then percuss the left clavicle with the same force and compare tones and sensations: does one side sound more blunt than the other?

Then percussion of the anterior chest wall along the median clavicular line with the middle pleximeter finger of the left hand placed in the intercostal spaces, alternating blows on the left and right sides: the first intercostal space on the right, then the first intercostal space on the left; the second - on the right, the second - on the left; the third - on the right, the third - on the left, etc.

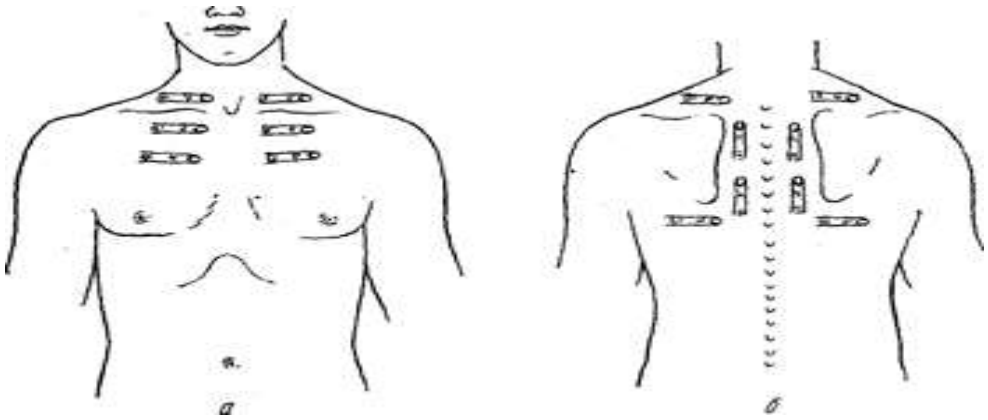


Figure 16. Percussion of the lungs.

The force of the blows applied should be the same. When using this technique, it is necessary to compare the extracted sounds by the degree of resonance. In women, mammary glands make the percussion tone blunt, so when conducting percussion, you can limit yourself to the upper intercostal spaces. In the lower parts of the anterior surface of the left side of the chest percussion is not carried out, because on the left, below the second intercostal space, is located cardiac bluntness. Then ask the patient to take the right arm aside (or raise the hands behind the head) and percuss the upper part of the right axillary region; then repeat the same on the left side, putting the finger - pleximeter vertically; subsequently, along the course of intercostal spaces percuss the lower parts of the right and left axillary regions. The tones heard over the left and right subaxillary regions are compared.

The patient should be seated, slightly bent forward, head down and arms crossed over the chest, with the palms resting on the shoulders, while the physician performs percussion standing a short distance behind the patient. In this position, the shoulder blades are spread apart, expanding the interscapular space. At first, percussion is performed in the supra-scapular regions. For this purpose, the pleximeter finger is placed above the scapula and parallel to it. Then the doctor consistently conducts percussion on symmetrical areas of the upper, middle and lower parts of the interscapular space, placing the finger pleximeter alternately to the right and left of the spine and parallel to it (above the scapulae percussion is not conducted). After that, percussion is performed on both sides in the subscapular regions, in particular in the seventh, eighth and ninth intercostal spaces, first along the periorbital, then along the scapular lines. In this case, the pleximeter finger is placed transversely along the course of the intercostal spaces. It is important to remember that during percussion the

same force of both percussive blows is applied and the character of the percussive tone is compared.

Topographic percussion

Topographic percussion of the lungs includes:

-determination of standing height and width of the lung tips;

-determination of the inferior border and mobility of the inferior margin.

Each parameter is assessed first on one side and then on the other. In all cases, the finger pleximeter is placed parallel to the lung border to be determined, with the middle phalanx of the finger lying perpendicular to the line along which percussion is performed. Using quiet percussive blows, percuss from the area of clear lung sound to the place of its transition to blunt (or dulled), which corresponds to the border of the lung. Fix the found boundary with a finger pleximeter and determine its coordinates. In this case, the edge of the finger-pleximeter, facing to the area of clear lung sound, is taken as the boundary of the organ.

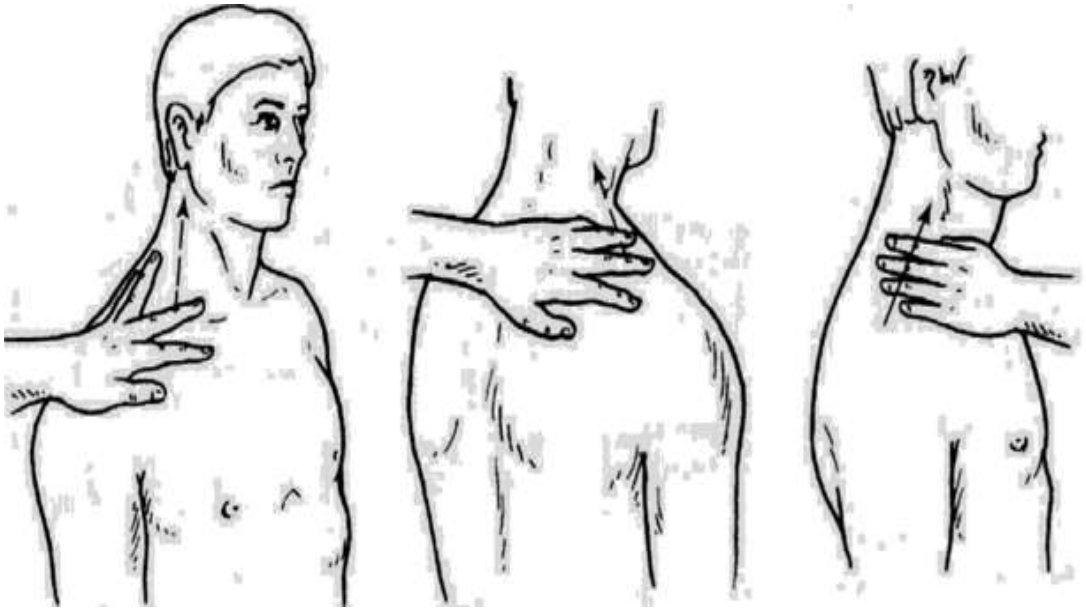


Figure 17. Topographic percussion (Determination of upper lung borders).

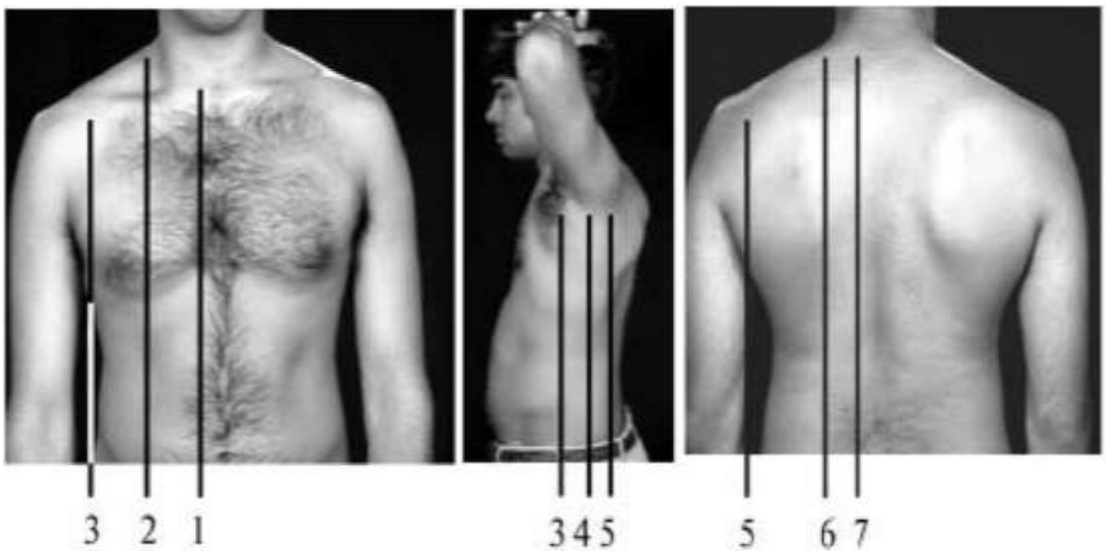


Figure 18. Topographic percussion (Determination of lower lung borders).

Lung apex height

This index is determined first from the front and then from behind. The finger pleximeter is placed in the supraclavicular fossa parallel to the clavicle. Percuss from the middle of the clavicle upwards and medially, in the direction of the mastoid end of the sternocleidomastoid muscle, shifting the finger pleximeter by 0.5-1.0 cm after each pair of percussion blows and keeping its horizontal position.

Having found the boundary of the transition of clear lung sound to dull, fix it with a pleximeter finger and measure the distance from its middle phalanx to the middle of the clavicle. In norm this distance is 3-4 cm. When determining the height of the apex of the lungs from behind, the doctor stands behind the patient, puts the pleximeter finger directly above the tip of the scapula and parallel to it. Percuss from the middle of the scapula axis upwards and medially, in the direction of the mastoid end of the sternocleidomastoid muscle, shifting after each pair of percussion blows finger-pleximeter by 0.5-1.0 cm and keeping its horizontal position.

The found boundary of transition of clear lung sound to blunt is fixed with a finger pleximeter and ask the patient to tilt the head forward, so that the most protruding backward spinous process of the VII cervical vertebra was clearly visible. Normally, the lung tips from behind should be at its level.

Width of the apex of the lungs (Kronig's fields)

The width of Kronig's fields (Kronig G., 1856-1911, German physician) is determined by the slopes of the upper arms. The doctor stands in front of the patient

and places the pleximeter finger on the middle of the upper arm so that the middle phalanx of the finger lies on the anterior edge of the trapezius muscle, perpendicular to it (Figs. 5.27, 5.28).

Keeping such position of the finger-pleximeter, percuss first towards the neck, shifting the finger-pleximeter by 0.5-1.0 cm after each pair of percussion blows. Having found the boundary of transition of clear lung sound to blunt, mark it with a dermograph or fix it on the lateral side of the finger pleximeter. Then similarly percuss from the starting point on the middle of the upper arm to the lateral side until the appearance of a dull sound and fix the found boundary with the finger- pleximeter on its medial side. Having measured the distance between the found internal and external percussion boundaries, the width of Kronig's fields is determined (in norm it is 3-8 cm).

Increased apex elevation is usually combined with widening of Kronig's fields and is observed in pulmonary emphysema. On the contrary, low apex elevation and narrowing of Kronig’s fields testify to a decrease in the volume of the upper lobe of the corresponding lung (for example, as a result of its scar shriveling or resection). In pathologic processes leading to compaction of the lung apex, a dull sound is detected above it already at comparative percussion. In such cases, it is often impossible to determine the height of the apex and the width of Kronig’s fields on this side.

Lower lung border

It is determined by vertical identifying lines. Percussion is started at the right midclavicular, then successively percussed along the anterior, middle and posterior axillary lines (with the patient's arms out to the sides or behind the head). The finger pleximeter is placed parallel to the ribs, and percussion is carried out along the ribs and intercostals in the direction from top to bottom until the boundary of the transition of a clear lung sound to a dull one is detected.

After that, the doctor stands behind the patient, asks him to lower his arms and similarly conducts percussion along the scapular line, starting from the lower corner of the scapula, and then percussion along the periorbital line from the same level.

It should be borne in mind that determination of the lower boundary of the left lung along the anterior axillary line can be difficult due to the close location of the

tympanic sound area in Traube's space. For designation of localization of the found lower borders of lungs ribs (intercostal ribs) are used, counting which is conducted from clavicle (in men - from a nipple which is on V rib), from the lower corner of a scapula (the seventh intercostal rib) or from the lowest, free-lying XII rib. The localization of the lower border of the lungs along the periorbital lines is usually marked relative to the spinous processes of the vertebrae, because the back muscles interfere with probing the ribs here. When counting the spinous processes of the vertebrae are oriented to the fact that the line connecting the lower corners of the shoulder blades (with arms down), crosses the VII thoracic vertebra. In patients with hypersthenic physique the lower boundaries of the lungs are located one rib higher than in normosthenia, and in asthenics - one rib lower.

Percussion point (by lines)	Right lung	Left lung
Parasternal line	5th intercostal space	—
Midclavicular line	6th rib	—
Anterior axillary line	7th rib	7th rib
Median axillary line	8th rib	8th rib
Posterior axillary line	9th rib	9th rib
Scapular line	10th rib	10th rib
Paravertebral line	spinous process of the 11th thoracic vertebra	spinous process of the 11th thoracic vertebra

Table 2. Lower lung limits.

Uniform lowering of the lower borders of both lungs is more often observed in pulmonary emphysema, less often in significant lowering of abdominal cavity organs (visceroptosis). Lowering of lower borders of one lung can be caused by unilateral (vicarious) emphysema, developing as a result of scar shriveling or resection of the other lung, the lower border of which, on the contrary, is displaced upwards. Scarring of both lungs, increased intra-abdominal pressure (e.g., in obesity, ascites, flatulence) can lead to uniform upward displacement of the lower borders of both lungs.

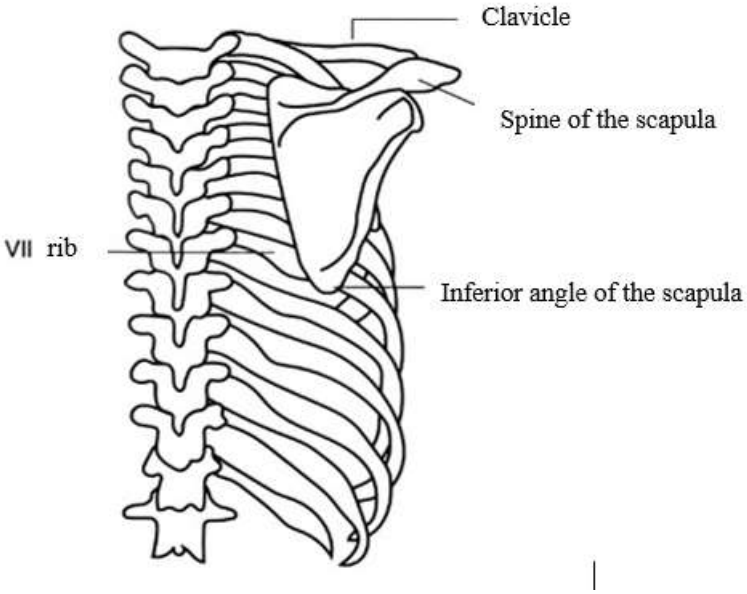


Figure 19: **Major anatomical landmarks used in delineation.**

Mobility of the lower edge of the lungs

This index is determined by the distance between the lower border of the lung during exhalation and deep inhalation. In patients with pathology of the respiratory system, the study is carried out along the same vertical identification lines as in the establishment of the lower lung boundaries.

The patient stands with arms raised behind the head. The physician places the pleximeter finger on the lateral surface of the chest, about a palm width above the lower lung border found earlier. The middle phalanx of the pleximeter finger should lie perpendicular to the posterior axillary line. The patient is offered first to inhale, then to make a full exhalation and hold the breath, after which the doctor percusses along the ribs and intercostals in the direction from top to bottom until the detection of the boundary of the transition of a clear lung sound to dull. Mark the found boundary with a dermograph or fix it with the finger of the left hand above the pleximeter finger. Then the patient is offered to inhale as deeply as possible and hold the breath again, in this case the lung descends, and below the boundary found on exhalation the area of clear pulmonary sound appears again. Continue percussing in the direction from top to bottom until a dull sound appears and fix this boundary with a finger pleximeter or make a mark with a dermograph. By measuring the distance between the two boundaries found in this way, the mobility of the lower lung margin is found (in norm it is 6-8 cm).

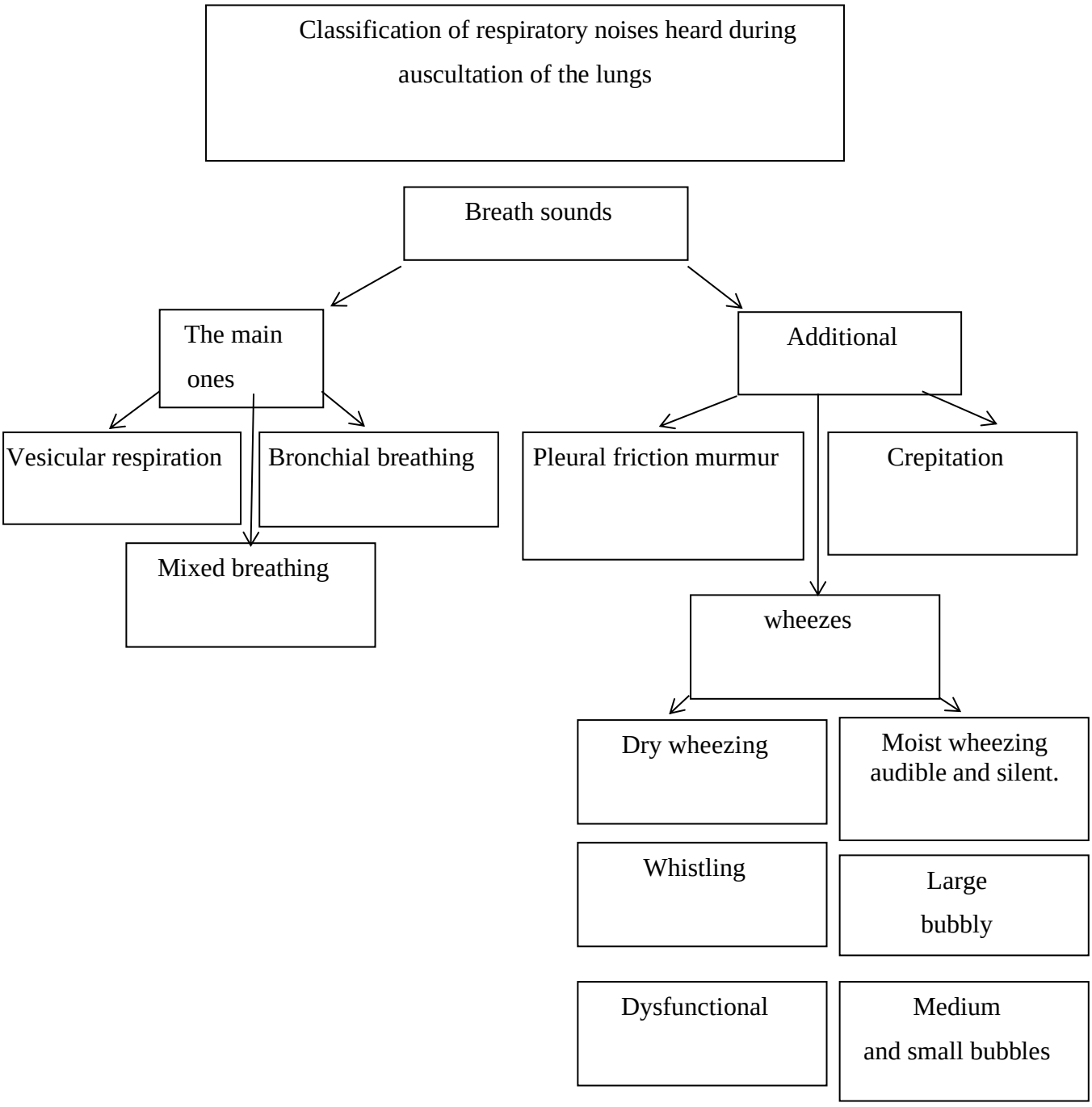
Reduced mobility of the lower lung margin on both sides in combination with lower borders lowering is characteristic for pulmonary emphysema. In addition, decreased mobility of the lower lung margin may be caused by processes of inflammatory, tumor or scar origin, lung atelectasis, pleural fusions, diaphragm dysfunction or increased intra-abdominal pressure. In the presence of pleural effusion, the lower edge of the lung pressed by fluid remains immobile during breathing. In patients with pneumothorax, the lower border of tympanic sound on the side of the lesion during breathing also does not change.

Auscultation of the lungs

In 1816, Laennec invented the stethoscope and developed a new technique for listening to patients. Auscultation of the lungs is one of the basic and important examinations used for diagnostic purposes. With the help of auscultation it is possible to listen to normal respiratory sounds in healthy people, pathological respiratory noises arising from various diseases of the respiratory system.

Rules of auscultation. Auscultation is performed in the sitting position. Standing auscultation is performed only in healthy individuals, as the others have a risk of dizziness. The chest is freed from clothing up to the waist, performing auscultation through clothing leads to the appearance of additional pathologic noises. Auscultation should be performed in absolute silence!!!! The stethoscope should be warm, if it is cold, the doctor should warm it with his hand. Because a cold stethoscope causes contraction of the patient's muscles, which leads to irregular breathing rhythm. The stethoscope is held with the II and III fingers and placed firmly against the chest. A stethoscope tube that is not placed tightly creates additional noise, and one that is placed too tightly creates an unpleasant sensation in the doctor's ear. And it should not touch clothing. In case of severe hairiness, the skin should be moistened with water or petroleum jelly, as dry hair produces a sound similar to pathological noises.

Figure 20. Classification of respiratory noises.



The patient should breathe through the nose calmly, evenly, of moderate depth, with the mouth half-open. If the patient has difficulty breathing through the nose, he/she breathes through the mouth. Above the lungs can be heard the main and additional respiratory sounds or noises. Vesicular breathing is normally heard above the lungs.

Mechanism of occurrence of vesicular respiration.

Vesicular breathing is a soft blowing sound "FFFF". throughout the entire respiratory phase, due to the stretching of the elastic alveolar wall. Normal vesicular breathing is heard during the first 1/3rd of exhalation, when the alveolar wall begins to close. There are several types of vesicular breathing. It can weaken and strengthen, be rigid or intermittent. Weakening or disappearance of vesicular breathing is noted in:

Pulmonary emphysema;

Hydrothorax-fluid in the pleural cavity prevents breath sounds from getting through;

Pneumothorax--air in the pleural cavity;

Fibrothorax;

Obturation atelectasis;

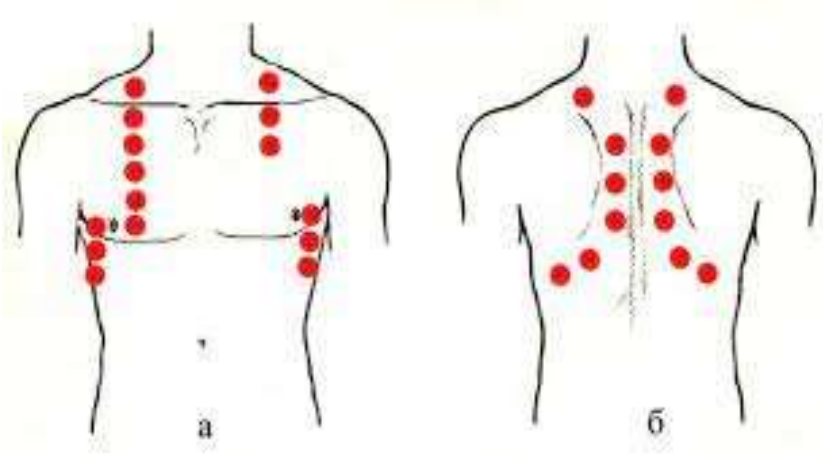
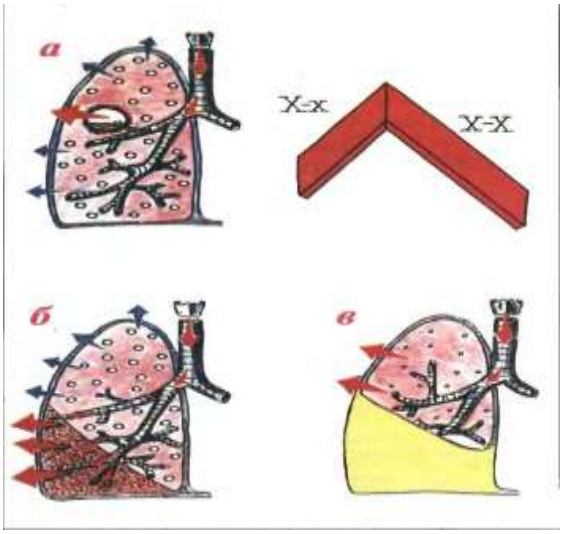


Figure 21. Lung auscultation points: a- anteriorly, b- posteriorly.

Decrease in the amplitude of alveolar oscillations, occurs with a decrease in the elasticity of lung tissue, with emphysema and pulmonary edema. Bronchial or laryngo-tracheal breathing is normally heard above the jugular fossa.

The mechanism of appearance of laryngo-tracheal (bronchial) breathing. Rough laryngo-tracheal breathing resembles the sound of X-X. This sound is caused as a result of turbulent airflow by the vibration of dense tissue in its path. Turbulent airflow occurs in the larynx and upper trachea throughout the inhalation and exhalation phases. The duration of laryngo-tracheal breathing is heard relatively longer in the exhalation phase than in the inhalation phase. Because the vocal cord is narrower in the exhalation phase than in the inhalation phase, a louder X-X sound is heard throughout the exhalation phase.



The main 3 causes of abnormal bronchial breathing are as follows
а. A cavity in the lung that communicates with the bronchus.
б. A lobular inflammatory thickening
в.Atelectasis

Figure 22. Causes of pathologic bronchial breathing

Increased or hard breathing is heard in very thin people and in children.

Hard breathing is considered a type of vesicular breathing. In bronchospasm and swelling of the bronchial mucosa and viscous exudate in the bronchial lumen, the sound of turbulent air movement through the bronchi is added to the usual noise, which has irregularities and roughness. Vesicular breathing, caused by vibration of the alveolar wall, is more rigid and is heard during inhalation and exhalation.

Saccadic breathing (intermittent breathing) occurs with uneven narrowing of bronchioles, as a result of which the air flow meeting on its way an obstacle in the form of unequally expressed narrowing of different bronchi, penetrates first into one part of the lungs, then into another. It is heard usually in the lesion of the respiratory tract of tuberculosis pathology. Sometimes saccadic breathing occurs due to irregular contraction of muscles, in their lesions or in violation of their regulation.

Mixed breathing (bronchovesicular) is characteristic of focal pneumonia. In this case, due to the small size of inflamed and thickened bronchi, they produce a bronchial sound on the surface of the chest. Bronchovesicular breathing results from breathing from healthy alveoli around the inflamed area of the lungs.

Pathologic breath sounds. In norm, pathologic respiratory noises are not heard. Hoarseness is heard when the bronchi and trachea are affected, crepitation when the pathological process is localized in the alveoli. As a result of inflammation and

roughness of the pleura sheets there is a murmur of pleural friction or in some cases pleuropericardial murmur.

Mechanism of dry wheezes. There are dry, buzzing or whistling wheezes and wet wheezes - coarse, medium, fine bubbling, audible and silent. Buzzing wheezes occur due to the presence of viscous sputum in the cavity of the trachea and large bronchi. Buzzing and whistling dry wheezes occur when passing air vibrates viscous sputum during inhalation and exhalation. A characteristic feature of dry wheezes is their inconstancy, they are heard and disappear. They may disappear completely after coughing.

Mechanism of dry wheezing. Dry wheezing rales appear due to the presence of viscous sputum, spasm, and swelling of the mucous membrane of the small bronchi. Dry wheezing wheezes are better heard with deep exhalation and horizontal position. Appearance of dry wheezing wheezes is a sign of latent bronchoobstruction of small bronchi of the respiratory tract.

Mechanism of wet wheezing. Moist wheezing is caused by the presence of liquid secretion in the trachea, bronchi or cavities connected to the bronchi. Liquid secretion is usually located in the respiratory tract in the vestibule. During the inhalation and exhalation phases, the flow of air bubbles the liquid secretion, resulting in a sound resembling the bursting or compression of bubbles. The appearance of moist rales depends on the localization of the liquid secretion. In the trachea, large bronchi appear large-bubbled moist rales, in segmental bronchi and bronchiectasis medium-bubbled, in small bronchi - small-bubbled. If wet wheezes occur in an area with less damaged lung tissue, the wheezes will be muffled or slightly muffled because the sound is absorbed by healthy lung tissue. The sound of moist wheezes occurs when the conditions for better conduction to the surface of the lung tissue sounds occurring in the bronchi in the presence of a cavity in the lung, connected to the bronchus and filled with air and partially pus, as well as in the presence of inflammatory thickening of the lung around the bronchus - focal pneumonia. A characteristic feature of rales is that they are heard on inhalation, change their character or disappear after coughing.

Mechanism of crepitation. Crepitation occurs as a result of filling of the alveoli with liquid secretion. This condition is observed in croup pneumonia, compression

atelectasis and pulmonary infarction. In these pathological processes, the alveoli are in a closed state for most of the respiratory phase. In the presence of exudate, the walls of the alveoli during exhalation stick together, and during inhalation open and give the sound of sticking alveoli spilling. The main characteristic feature of crepitation, it is heard only at the height of inhalation, while wet wheezes in both phases. After coughing, the wheezing changes, may disappear, but the crepitation does not change.

Mechanism of pleural friction noise. A sound similar to snow squeaking or paper rustling caused by the friction of inflamed and coarse pleural sheets during inhalation and exhalation is called a pleural friction sound. A pleural friction sound is usually heard in acute inflammation of the pleural sheets. This sound does not change after coughing and increases when the stethoscope is pressed harder against the chest. Auscultation of the lungs is completed by bronchophony. The patient is asked to whisper words containing the letter "Sh". When the patient pronounces the words, the doctor conducts auscultation at symmetrical points of the chest with a stethoscope. Conducting bronchophony is considered to be the same method as determining palpatory vocal tremor.

Table 3. Variety of vesicular respiration

Nature of change	Mechanism	Syndrome or disease
Weakened	Obstacle syndrome.	-hydrothorax -pneumothorax -fibrothorax
	Reduced elasticity of the alveoli	-emphysema of the lungs -the initial period of inflammation of the lung parenchyma -interstitial pulmonary edema.
	Large bronchial obstruction	-obturator atelectasis
Reinforced	Hyperthermia Hyperthyroidism Physical activity In children.	- hyperventilate
Hard	Swelling of mucous membranes, exudate in the bronchial cavity, narrowing of the bronchial cavity due to smooth muscle spasm	- bronchitis
Saccaded	Irregular narrowing of the	-tuberculous bronchiolitis

	small bronchi	-Respiratory muscle damage and regurgitation or inhalation and exhalation disorders due to chest trauma

Table 4: Distinction of incidental respiratory noises

Difference	Pathologic breath sounds			
	Dry wheezing	Moist wheezing	Crepitation	Pleural friction murmur
Relationship to respiratory phase	On the inhale and exhale	On the inhale and exhale	At the height of inhalation	On the inhale and exhale
After coughing.	Changing	Changing	No change.	No change.
Acoustic feature	More often than not, a variety of sounds	More often than not, a variety of sounds	Monotonous sounds	Different sounds
When you press with the stethoscope	Not amplified	Not amplified	It's not getting any stronger	It's intensifying

Table 5. Pathologic respiratory noises and their features

Pathologic breath sounds	Characteristic signs of abnormal respiratory noises			
	Acoustic feature	Place of manifestation	Conditions of manifestation	Disease and syndromes
Dry, buzzing wheezes	Low, buzzing, heard during the exhalation phase	In the trachea, in the large and medium caliber bronchi	Viscous strands of sputum	Tracheitis bronchitis
Dry wheezing	High-pitched, whistling, heard on inhalation and exhalation	Small bronchi	Viscous sputum, narrowing due to swelling of bronchial mucosa, bronchospasm	Bronchiolitis, bronchial asthma.
Coarse bubbling silent moist rales	A variety of inhalation and exhalation sounds are heard,	Trachea, large bronchi	Liquid secretion, sputum or blood in the bronchial cavity	Pulmonary edema

	resembling the sound of a large bubble bursting			
Coarse bubbling audible moist wheezing.	An amplified and distinct noise is heard, on inhalation and exhalation, resembling the sound of a large bubble bursting	A large space in the lung that connects to the bronchus	A large cavity containing liquid (blood, pus) secretion and air	Lung abscess, cavernous tuberculosis.
Medium bubbly moist rales	Can be heard on inhalation and exhalation, resembles the sound of a burst bubble	Medium-caliber bronchi, bronchiectasis.	Liquid secretion in bronchi and bronchiectasis (blood, pus)	Bronchiectasis disease, bronchitis.
Fine bubbling silent moist rales	Varied, slightly muffled sound resembling the bursting of a small bubble, audible on inhalation and exhalation	Small bronchi, bronchioles	Liquid sputum in the bronchial cavity surrounded by intact lung tissue	Congestion in the small circle of blood circulation
Fine bubbling audible moist rales	A varied, amplified, clearly audible sound resembling a burst bubble is heard on inhalation and exhalation	Small bronchi, bronchioles	Liquid sputum in the bronchial cavity surrounded by thickened lung tissue	Bronchopneumonia
Crepitation	During the peak of the deep breathing phase, hearing a sound resembling the bursting of a small bubble	Alveoli	Swelling of the alveolar wall due to accumulation of transudate or exudate leads to crepitation	Croup pneumonia, compression atelectasis, pulmonary infarction
Pleural friction murmur	Various noises are heard on inhalation and exhalation, like rustling or rustling of papers, creaking of snow	Pleural sheets	Inflammation of pleural sheets and fibrin accumulation in them	Dry pleurisy, pleuropneumonia, schwarts (rare cases)

Table 6: Table of sound changes during percussion and auscultation over normal and altered lungs

Sound changes	Percussion sound	Breathing	wheezes	Vocal tremor
Above the air-containing lungs	Loud, low, long	Vesicular (low)	-	Normal
Above the compacted lung	Quiet, tall, short	Bronchial	Ringing	Reinforced
Above the pleuritic exudate.	Totally dumb	Absent	Absent	Absent
Over a large cavern	Loud, high, tympanic	Amphoric	With a metallic tint	Reinforced
Above the pneumothorax	Low and loud	Absent (or quiet)	Absent	Absent

Questions on the topic:

1. What is included in the physical examination of patients?

2. What should I pay attention to during the general inspection?

3. What changes are seen on chest examination?

4. Pathologic types of respiration.

5. What does palpation determine?

6. Identification of pain points and lymph nodes.

7. How is chest rehydration determined?

8. How is vocal tremor investigated and what does it provide?

9. Methods of percussion.

10. What is the percussion sound?

11. Types of percussion and how do they differ?

12. Comparative percussion technique.

13. Technique of topographic percussion.

14. Determination of the apex of the lungs.

15. Lung Excursion.

16. Auscultation of the lungs, normal breath sounds.

17. Changes in basic breath sounds.

18. Additional breath sounds.

19. Characteristics of dry rales and mechanism of their formation.

20. Characteristics of moist rales and mechanism of their formation.

21. Characterization of crepitations and mechanism of their formation.

22. Characteristics of pleural friction noise and mechanism of its formation.

2.3. LABORATORY METHODS OF EXAMINATION

Sputum examination

Sputum is a pathologic secretion of the respiratory tract secreted by coughing or active expectoration. The mucociliary apparatus of the bronchi is involved in the formation of sputum. Expectoration of sputum occurs when it irritates receptors located at the sites of bronchial dichotomy. Examine morning sputum collected on an empty stomach after thorough brushing. If the isolated sputum cannot be examined immediately, it is stored in the refrigerator.

Clinical analysis of sputum is carried out using macroscopic and microscopic methods, if necessary, bacteriological examination is used.

Macroscopic examination allows to determine the total amount of sputum delivered, its character: color, consistency (viscosity), odor, presence of pathological impurities. To determine the nature of sputum, it is placed in a petri dish and examined alternately on a light and dark background. In most pathologic processes in the respiratory system is allocated a relatively small amount of sputum. One-stage separation of a large volume of sputum (up to 200 ml or more) - is a sign of a breakthrough lung abscess, and the systematic release of a significant amount of sputum (sputum full mouth in the morning) is observed in bronchiectasis disease, cavernous pulmonary tuberculosis, chronic lung abscess.

Colorless or whitish, moderately viscous sputum is called mucous and indicates catarrhal inflammation in the respiratory system.

Mucous and extremely viscous (vitreous) sputum is separated in patients with bronchial asthma.

If the inflammatory process in the respiratory system becomes purulent, sputum due to the admixture of pus becomes grayish, yellowish or greenish.

Bloody sputum indicates decay of lung tissue, which may be due to tuberculosis, cancer, abscess, gangrene, infarction or trauma of the lung. Note that in pulmonary hemorrhage, scarlet, frothy blood is separated, whereas in gastric bleeding, the blood is dark cherry-colored, often with an admixture of food masses.

In a sharply pronounced stasis in the small circle of circulation, complicated by pulmonary edema, there is abundant, liquid and frothy, like whipped protein, sputum of a faint pink color.

Brown (rusty) color of sputum is due to the presence in it impurity hematoidin, formed by the decay of hemoglobin of red blood cells, penetrated into the alveoli by diapedesis. "Rusty" sputum is observed in mitral defects, croup pneumonia, pulmonary infarction and pulmonary tuberculosis with decay.

Black-colored sputum occurs when there is an admixture of coal dust.

Patients with abscess, bronchiectasis disease, and pulmonary gangrene usually have liquid and purulent sputum, which becomes stratified on settling. Thus, the upper, frothy layer of sputum is mucus, the middle, watery layer serous fluid, and the lower, sedimentary pus and detritus. In the vast majority of cases, freshly expectorated sputum has no distinct odor. Unpleasant odor is characterized by sputum in bronchiectasis disease, abscess and decay of lung tumor. Stinking, putrid odor appears in gangrene of the lung.

Microscopic examination is used to identify cellular and non-cellular elements in sputum. Microscopic examination is used to look at minute particles such as blood cells, bacteria, viruses, minerals, and other microscopic structures. Noncellular elements of sputum include varieties of crystals, spirals, and fibers.

Various types of leukocytes have diagnostic value. Increased content of neutrophilic leukocytes in sputum indicates the inflammatory nature of the pathological process in the respiratory system. If among the epithelial cells predominates alveolar epithelium, we can assume pneumonia, and if the predominant cylindrical mesenteric epithelium - bronchitis.

Detection of a large number of eosinophils in sputum indicates the allergic nature of the inflammatory process (acute bronchitis with asthmatic component, bronchial asthma, eosinophilic infiltrate in ascariasis). In patients with bronchial asthma in vitreous sputum along with eosinophils are often detected spiral-shaped clots of mucus from small bronchi (Kurshman spirals) and components of disintegrated eosinophils (Charcot-Leiden crystals). Increased content of lymphocytes in sputum is characteristic

of pertussis and pulmonary tuberculosis. A significant number of red blood cells in sputum is a sign of pulmonary hemorrhage due to destruction of lung tissue.

Hemosiderin-Laden Macrophages in sputum are found in mitral stenosis, such phagocytes are called "cardiac malformation cells". Along with Hemosiderin-Laden Macrophages, hematoidin crystals are sometimes found in sputum.

In patients with lung cancer, atypical cells characterized by anisopoikilocytosis, disproportionate size of nuclei and cytoplasm, unequal size and shape of nuclei, increased content of nuclei in them, as well as multinucleation can be detected in sputum.

In the destruction of lung tissue (cancer, tuberculosis, abscess) in the sputum contains elastic fibers, for the detection of which are used fuchsin staining according to Weigert.

Bacteriologic study.

Bacteriologic testing reveals the presence and type of bacterial infection in the patient.

In bacteriologic examination, a culture for pathogenic microorganisms is performed, sensitivity to antibiotics is determined.

The result of bacteriologic examination is important for the physician, as it allows to accurately diagnose the etiology of the disease, confirm the bacterial infection and determine the treatment strategy. Also the study reveals possible resistance to antibiotics, which helps to avoid prescribing ineffective therapy and reduce the risk of antibiotic resistance. The nature of the microflora in sputum is studied on Gram stained preparations. Among Gram-positive bacteria in sputum can be found surrounded by a capsule diplococci pneumococci, located in the form of chains of streptococci, clusters of cocci in the form of bunches of grapes staphylococci. Gram-negative pathogens in diseases of the respiratory system are much less common. In patients with acute pneumonia etiopathogenic value have some enterobacteria, such as Klebsiella (Friedlander's bacillus).

Blood tests.

Blood test results for acute pneumonia can vary depending on the severity and etiology of the disease.

Leukocytosis: White blood cell (white blood cell) levels are often elevated in the blood in pneumonia due to inflammation in the lungs. A normal white blood cell count is usually between 4,000 and 9,000 cells in a microliter of blood.

Erythrocytosis or erythropenia: Depending on the degree of dehydration or the presence of complications, the level of red blood cells in the blood may be elevated or decreased. This is due to the body's response to the infection.

Hemoglobin and hematocrit levels may be normal or altered depending on the patient's general condition and how they respond to pneumonia.

Blood gases: This test helps determine the level of oxygen and carbon dioxide in the blood. Oxygen levels (PaO2) may be decreased due to decreased gas exchange in the lungs due to inflammation and stagnation of secretions. Carbon dioxide (PaCO2) levels may be elevated due to complications such as hypoxia or acute respiratory failure. Normal oxygen levels are 80-100 mmHg and carbon dioxide levels are 35-45 mmHg.

Hypoxia is a condition in which the body experiences a lack of oxygen. It can occur for a variety of reasons, including insufficient oxygen in the air, problems with the lungs, heart or circulatory system, and other medical conditions. Hypoxia can be temporary and reversible, or serious and potentially life-threatening. Treatment for hypoxia usually focuses on eliminating the cause of the lack of oxygen and providing enough oxygen to the body.

Hypoxemia is a condition in which the level of oxygen in the blood drops below normal levels. It can be caused by a variety of reasons, such as lung disease (e.g. asthma, chronic obstructive pulmonary disease), cardiovascular disease, and high altitude conditions or breathing disorders. Symptoms of hypoxemia may include shortness of breath, rapid breathing, blueness of the skin or lips, and fatigue. Treatment for hypoxemia depends on the cause and may include treating the underlying condition, using oxygen therapy, or other methods to increase oxygen levels in the blood.

Hypercapnia is a condition in which the level of carbon dioxide (CO2) in the blood rises above normal. It can result from various breathing problems such as COPD, obstructive sleep apnea syndrome (OSAS), or other conditions that can lead to

impaired gas exchange in the lungs. Hypercapnia can be an indicator of the severity of respiratory failure, especially when it is combined with hypoxia. This can lead to serious effects on the body, such as organ and tissue dysfunction. Doctors can use various clinical indicators such as blood CO2 levels, O2 levels to assess the severity of the disease.

Blood pH is a measure of the acidity of a solution, there can be alkalosis or acidosis. The normal blood pH is 7.35-7.45.

This data helps to determine the degree of respiratory failure and develop a treatment plan to improve the patient's condition.

Questions on the topic:

1. What does a clinical sputum examination include?

2. Macroscopic examination.

3. The nature of the sputum.

4. When there is "rusty" sputum.

5. When does bloody sputum occur?

6. When does mucous sputum occur?

7. When does purulent sputum occur?

8. When does mucopurulent sputum occur?

9. When does serous sputum occur?

10. Diagnostic value of macroscopic examination of sputum.

11. sputum in an inflammatory process.

12. sputum in patients with bronchial asthma.

13. Diagnostic value of bacterial examination of sputum.

14. Diagnostic value of the general blood test.

15. Blood gases are normal.

16. Significance of blood pH.

2.4. INSTRUMENTAL METHODS OF EXAMINATION

Non-invasive methods.

Each diagnostic test has its own characteristics, methodology and indications for use. The doctor chooses the necessary test depending on the diagnosis and the purpose of the study.

Diagnostic tests most commonly used in daily practice include the study of ERF (oxyhemometry, spirometry and peak flow measurement).

Examination of external respiratory function

The data of ERF studies help in making a diagnosis, assessing the functional state of the respiratory system and monitoring the effectiveness of treatment and the course of the disease.

The ERF study can quantify airway obstruction, lung volumes and gas exchange, and compare the obtained values with the proper values, taking into account the patient's age, sex and height

Oximetry is a method of measuring blood oxygen saturation (SpO2) using a pulse oximeter (normal ≥95%). A pulse oximeter is usually worn on the finger and measures blood oxygen levels through changes in light absorption.

Figure 23. Oximetry.

Peak flow measurement is a method of measuring maximal expiratory flow rate that assesses the volume and velocity of airflow in the lungs. This method helps in the diagnosis of bronchial patency disorders and indicates lung diseases such as bronchial asthma or chronic obstructive pulmonary disease.

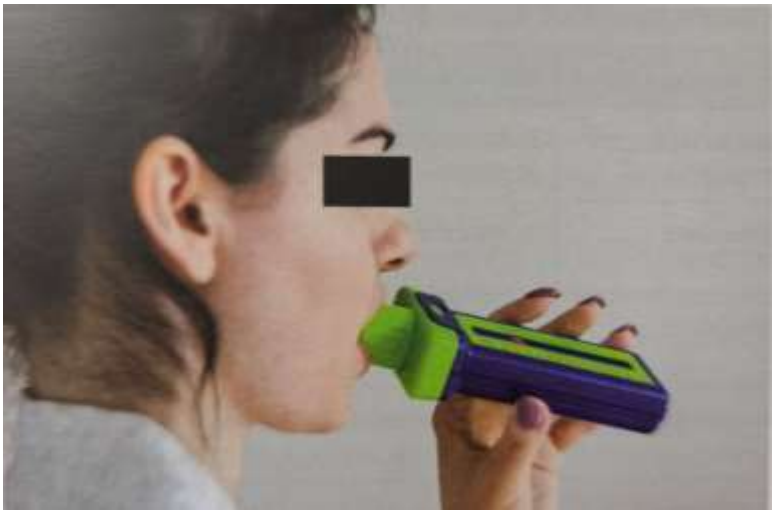


Figure 24. Peak flow measurement.

The patient begins to exhale after a maximal inhalation. Exhale as strongly (vigorously) as possible. The device measures the maximum expiratory flow rate, which decreases with small bronchial obstruction. The measurement is convenient for regular monitoring of the severity of bronchospastic reaction in patients with bronchial asthma. The obtained index is compared with the proper individual one in each patient (counted according to the table).

Figure 25. Peak flow measurement.

Spirometry is a widely used method of assessing breathing volumes and velocities. It includes measurement of lung volumes such as vital capacity (VC), forced expiratory volume (FEV1) and other parameters that allow assessment of the respiratory system and detection of possible disorders such as obstructive and restrictive lung diseases.

A spirometer is an instrument that measures the volume of exhaled air. It is important to know and evaluate two parameters: VC and FEV1.

VC - is the volume of air that a patient exhale from the end of a full inhalation to the end of a full exhalation.

FEV_1 is the forced expiratory volume in the first second from the end of a full breath.

The greatest information is provided by the ratio of the values of FEV1 and VC. In the norm it is 70%. This means that during the first second a healthy person exhales 70% of the maximum inspiratory volume during forced exhalation (in young people this indicator may be slightly higher).

In small bronchial obstruction, both indices (FEV and VC) decrease, but FEV1 decreases more significantly, so the ratio of FEV1 to VC becomes lower than normal values.

In pulmonary fibrosis there is also a decrease in both indices of both FEV1 and VC, but the values of FEV1 decrease to a greater extent, so the ratio of FEV1 and VC increases.

Radiologic examinations of the chest

Radiologic examination

One of the key diagnostic tests is chest X-ray examination, performed in patients with a wide variety of pathologies.

Chest X-ray examination is physiologically important because it allows you to assess the condition of the lungs, heart, pleura, ribs and other structures in the thoracic cavity. It is a non-invasive diagnostic method that helps to detect various pathological processes such as inflammation, tumors, trauma and other diseases.

Chest x-rays are often used to diagnose lung diseases such as pneumonia, tuberculosis, lung cancer, emphysema, and others.

Fluoroscopy is a method of medical examination that uses X-rays to create images of a person's internal organs or structures. This method allows doctors to assess the condition of organs, detect various pathologies, tumors, injuries, infections and other changes.

Fluoroscopy can be performed to examine different parts of the body such as the chest, abdomen, spine, joints, etc. Depending on the purpose of the examination,

fluoroscopy can be done in different projections such as frontal, lateral or in a special pose.

Radiography is a medical procedure that uses x-rays to create images of a person's internal organs or structures. It is done to diagnose various conditions such as broken bones, lung disease, infections and many other pathologies.

Radiographs are often taken in various projections to provide a complete image of the areas needed. Once the images are obtained, they are analyzed by radiologists or other qualified specialists to detect abnormalities or changes. This method has high resolution and is widely used in medical practice to diagnose and monitor the condition of patients.

Tomography

Tomography is the layer-by-layer visualization of internal organ structures. There are several types of tomography. For example, X-ray tomography, computed tomography, magnetic resonance tomography. Today, computed tomography and magnetic resonance tomography are widely used in medicine.

Computed tomography (CT) imaging of internal organs can be performed in 0.5 mm thick slices. On average, a chest CT takes 6-10 seconds. One of the disadvantages of the method of CT examination is strong radiologic exposure (radiation is 150 times more than the radiation received during X-ray examination). CT is used for diagnostic and screening purposes. Pregnancy and very heavy weight are (above the weight indicated in the device) contraindications for CT scans.

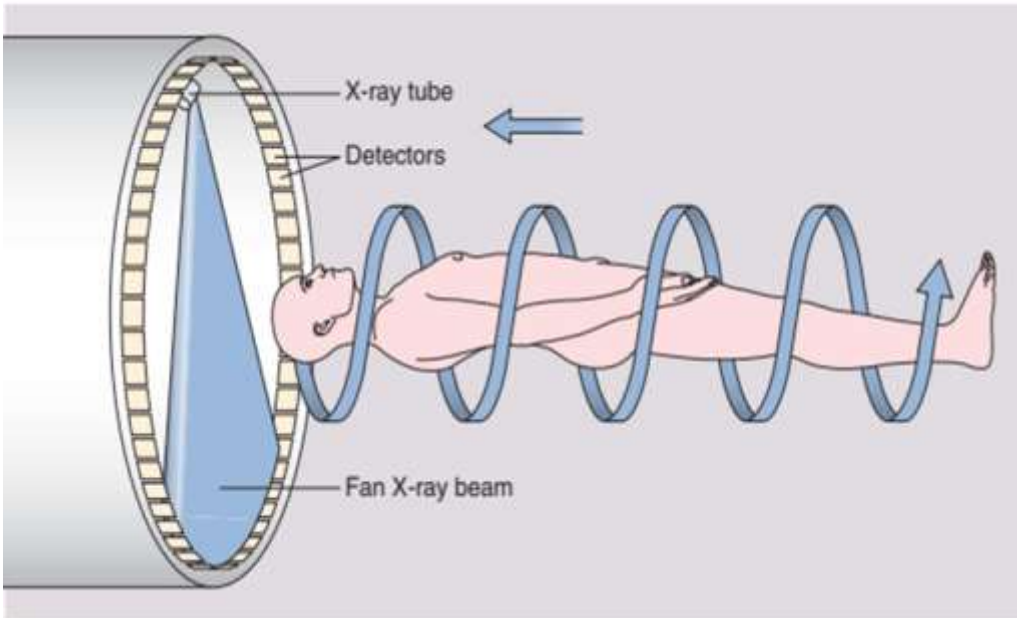


Figure 28. Tomography.

Magnetic resonance imaging **(MRI)** is a technique for imaging pulses of radio waves generated in a strong magnetic field, usually in the range of 0.2-1.5 Tesla. The return signal for anatomical analysis of MRI depends on the amount of water inside the cells. Of primary importance here are the hydrogen ions in the intracellular water. Therefore, depending on the amount of water in the cells, MRI imaging creates a contrast difference between organs and tissues.

MRI examination is time-consuming compared to a simple X-ray or CT examination, as a result, the advantage of CT in emergency cases is obvious and it is considered the method of choice. MRI is used for diagnosis and screening.

Invasive examination methods

Bronchoscopy

The term bronchoscopy is derived from the Greek, bronchos-breath throat, skopos-seeing, examining. With the help of bronchoscopy, the upper and lower respiratory tracts can be examined, and therapeutic procedures can be performed through a special device called a bronchoscope. The first bronchoscopy was performed by Gustav Killian in 1897. As a result of technological development, bronchoscopy has become the main diagnostic method for lung diseases in the field of therapy and diagnostics. Especially, after the invention of flexible fiber-optic bronchoscopy in 1967, a wide range of possibilities became available in medicine. By the 1980s, the development of video bronchoscopy led to a dramatic increase in the quality and specificity of this examination method.

Bronchoscopes are divided into rigid and flexible bronchoscopes.

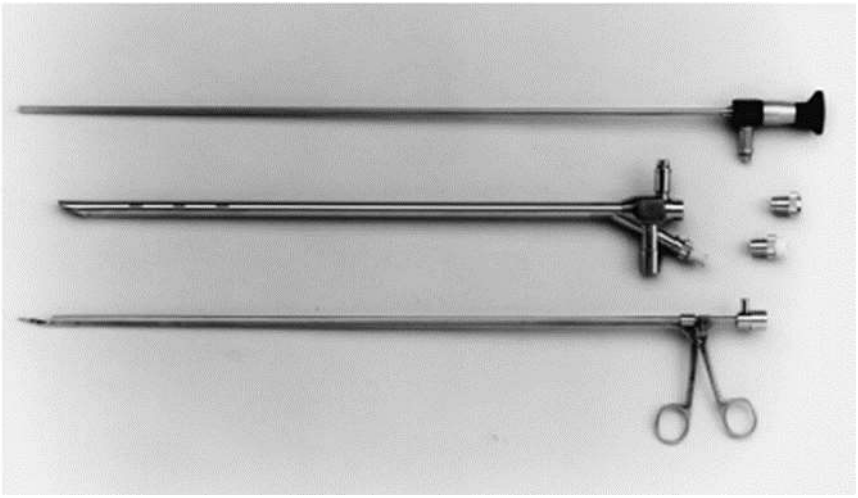


Figure 26. Rigid bronchoscope

Today, both bronchoscopes are equipped with optical devices. Rigid bronchoscopy has the following options: laser photoresection, endobronchial stenting, balloon dilatation, electrocauterization (dissection with high-frequency electric current), coagulation and cryotherapy using argon gas flow. Rigid bronchoscopy is also used to advance a flexible bronchoscope into the distal airways.

Before bronchoscopy, all patients should be examined: collect anamnesis, undergo physical and radiologic examination of the lungs. Usually before bronchoscopy patients are premedicated with sedatives.

Technique of performance. The flexible brochoscope can be inserted through the nose, mouth, endotracheal tube, or tracheostomy. Nasal access is often chosen because the nasal passage acts as a stent for the bronchoscope and provides easy control during airway exploration. When the bronchoscope is inserted through the mouth, a special anti-bite device (a bite block) is placed there to prevent damage to the bronchoscope. In cases of lung disease, supplemental oxygen is administered because most patients are hypoxemic during bronchoscopy.

Bronchoscopy allows to evaluate possible morphological changes in the bronchial tree. Bronchoscope is used to examine the proximal parts of the bronchial tree up to the level of lobular and segmental bronchi. If altered tissues are detected during bronchoscopy, biopsy is performed for histologic (histochemical, immunohistochemical, etc.) analysis. Aspirated bronchial fluid is used to obtain bacterial culture and cytologic examination. Bronchoscopy can also perform a

sanitizing role, as it removes mucous plugs and thick secretion that interfere with respiratory function.

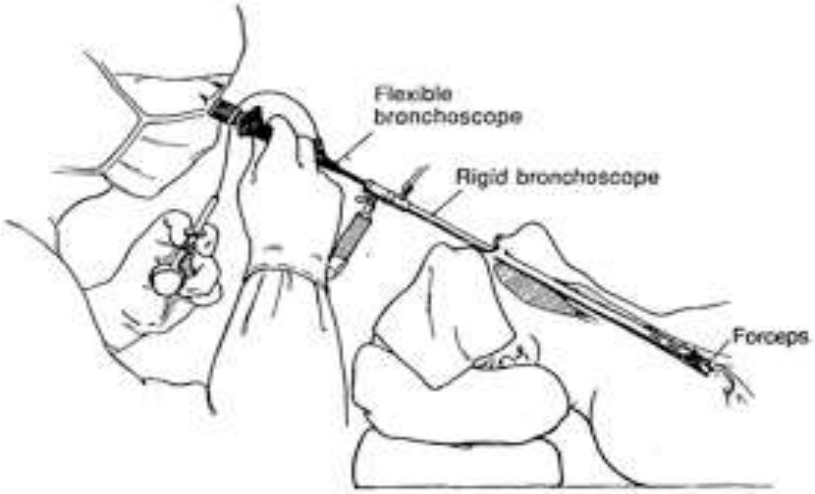


Figure 27. Bronchoscopic examination.

Bronchography

Bronchography is one of the radiologic methods by injecting a contrast agent into the airways. The bronchography method is now considered to be one of the outdated methods. It has been replaced by computed tomography and MRI.

Thoracoscopy is a modern method of diagnosis and treatment, which consists of inserting a flexible endoscope into the pleural cavity. The endoscope is equipped with a miniature video camera with backlighting, which allows you to get an accurate picture of the disease, assess the condition of the lungs, and perform surgical intervention (including biopsy)

Questions on the topic:

1. How is ERF determined?

2. Normal oximetric index.

3 Methodology and indicators of peak flow measurement.

4. Spirometry scores.

5. Diagnostic value of VC and FEV1.

6. Clinical indicators of the fluoroscopic method of examination.

7. Algorithm for analyzing chest radiography.

8. Feature of CT of the thorax.

9. The peculiarity of MRI of the thorax.

10. Diagnostic value of bronchoscopy.

11. Diagnostic value of bronchography.

12. Diagnostic value of thoracoscopy.

APPENDIX

Analyzing radiographs is normal

When evaluating a radiograph, it is necessary to carefully and thoroughly examine all structures visible on the image. An approximate algorithm for analyzing an X-ray image includes a certain sequence:

- an assessment of the quality of the image;
- obtaining patient information;
- bone inspection;
- tracheal exam;
- cardiac exam;
- mediastinal exam;
- an examination of the root of the lung;
- lung exam;
- an examination of the intertrochanteric fissures;
- soft tissue exam;
- diaphragm examination;
- examination of the gastric gas bladder (Fig. 3).

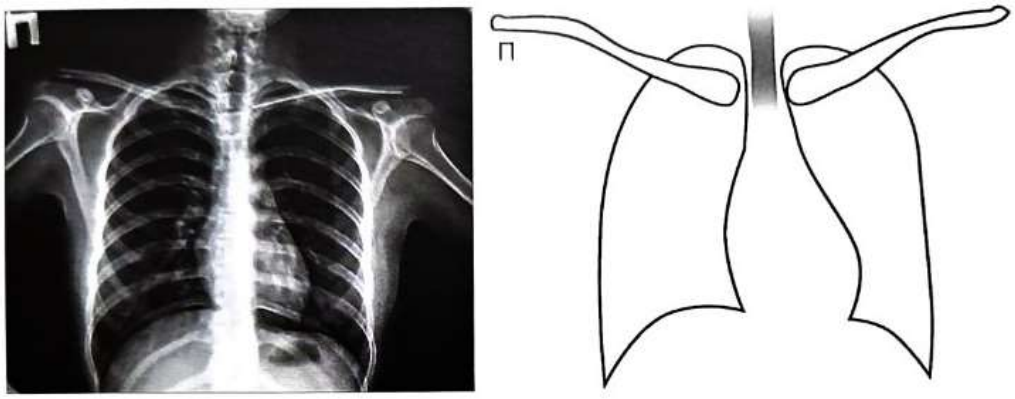


Figure 29. Cardiac shadow on a normal radiograph

Outlines of diaphragm, upper edges of ribs, heart should be clear. Blurred contours are caused by movements or breathing of the patient at the moment of imaging, in particular, during prolonged exposure.

It should be remembered that there are patients with different constitution and organ arrangement.

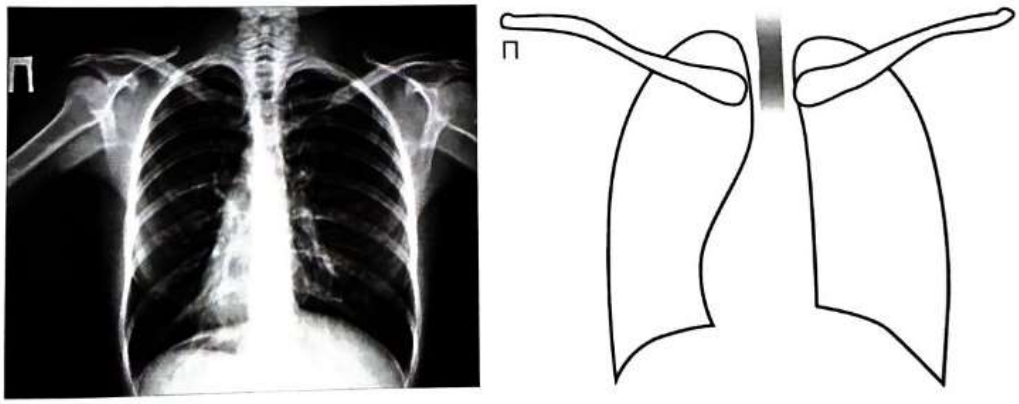


Figure 30. Dextrocardia

The unchanged, normal lung field on the radiograph looks dark gray. It should be remembered that the right lung has three lobes, the left lung has two lobes. For convenience in interpreting radiographs, the lung fields are divided into sections and zones: from the clavicles to the II rib - the upper section, from II to V rib - the middle section, from V and below - the lower section; the part of the lung fields located above the clavicles is called the lung apex. Two vertical lines drawn from the clavicle can divide the lung fields into three zones (root, central and peripheral). Transparency of lung tissue directly depends on the filling of the lungs with air, so the study is carried out at the height of deep inhalation with breath-holding. The structures that can be visualized in normal lungs are: 1) blood vessels; 2) interlobar fissures; 3) walls of large bronchi. Due to these structures it is possible to enhance the pulmonary pattern.

Visualization of blood vessels is due to their relative density compared to the surrounding radiopaque lungs.

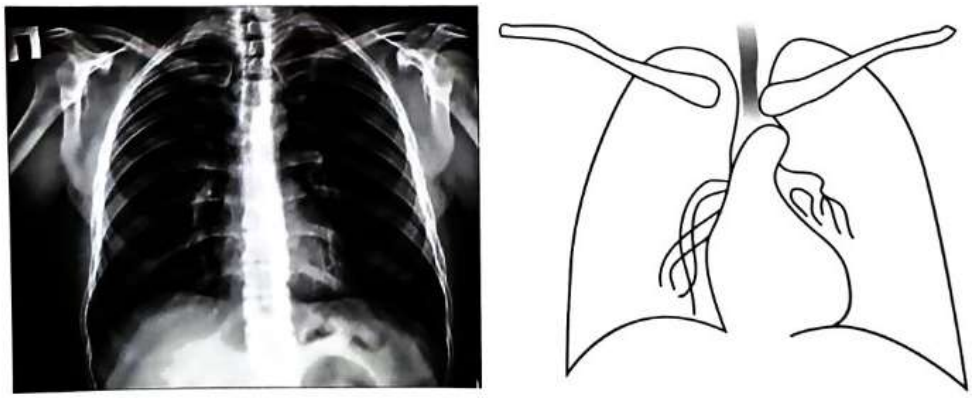


Figure 31. Normal chest radiograph

When analyzing a woman's radiograph, it should be remembered that the shadow of the mammary glands overlaps the lower zones of the lungs and makes them less transparent. If the alveoli fill with fluid, the lung fields lose transparency. When analyzing a radiograph, it is important to compare not only the same area on both sides, but also different areas to each other on each half of the chest.

The lung lobes are separated by interlobular gaps. On X-ray in direct projection in the right lung a horizontal slit can be seen, which runs from the root of the right lung at the level of the IV rib to the anterior axillary line. It divides the upper and middle lobes. The oblique interval separating the upper lobe of the left lung from the lower (or middle right) lobe can be seen only in lateral view.

The right dome of the diaphragm is 2 cm higher than the left one and at the height of inspiration is located at the level of the anterior segment of the VI rib. Blurred contour of the diaphragm indicates inflammatory changes in the lower lung lobes. Normally, a homogeneous shadow of the liver is determined in the subdiaphragmatic space on the right side, and the gas bubble of the stomach is located on the left side.

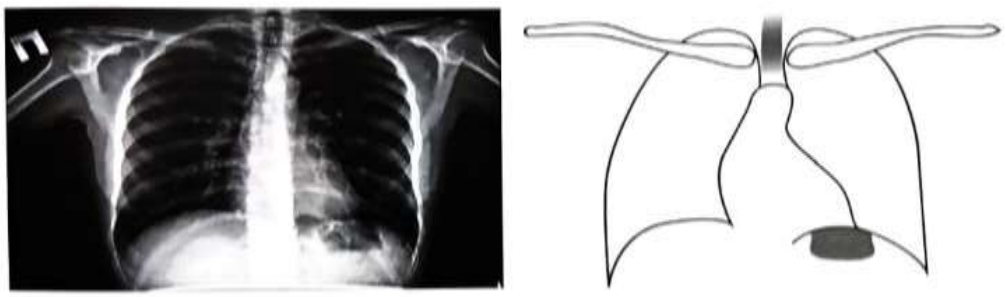


Figure 32. Chest radiograph in direct projection. On the left, under the dome of the diaphragm, an irregularly shaped lumen with an irregular contour, a gastric gas bubble, is determined

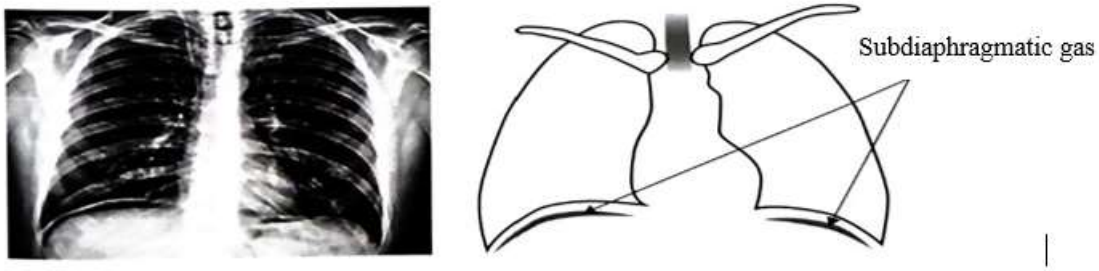


Figure 33. Pneumoperitoneum. Under the right and left dome of the diaphragm, gas with a maximum layer thickness of up to 10 mm is detected.

The main radiologic syndromes: darkening of the lung field or part of it, circular or ring-shaped shadow, focal shadows, dissemination of foci.

1. The darkening of the lung field can be total and subtotal, homogeneous and heterogeneous, based on the airlessness of the lung tissue. The position, size and shape of the darkening depend on the volume of the lesion. Causes of total darkening can be atelectasis, absence of a lung or its part, hydrothorax. Causes of limited darkening are more often infiltrative changes, segmental atelectasis, sclerosis of lung tissue.

2. A circular shadow in all projections will retain the shape of a circle. Such shadow is given by cysts, tuberculoma, neoplasm.

3. Ring-shaped shadow is a representation of a cavity containing gas or liquid. The obligatory requirement for distinguishing this syndrome is the closedness of the ring on radiographs in different projections. Possible causes: open cyst, abscess, tuberculous cavern, peripheral lung cancer with decay.

4. Focal shadows are round or irregularly shaped shadows that vary in size from 0.5 to 1.0 cm, foci up to 2 mm are conventionally considered miliary, 2-4 mm in size are considered small, 4-8 mm medium and 8-12 mm large. A single foci larger than 1 cm refers to the round shadow syndrome. Possible causes: tuberculosis, sarcoidosis, secondary changes, dust changes in the lungs.

5. Syndrome of fluid and air accumulation in the lungs. Causes: hydrothorax and pneumothorax.

Pleural effusion

Cause	Main Features
Pleural effusion	Homogeneous opacification, concave meniscus of fluid in the costophrenic angle, the apex of the dome of the diaphragm occupies a central position on the lung field, the mediastinum is pushed to the opposite side
Lung atelectasis (collapse)	Homogeneous darkening, mediastinum shifted towards atelectasis, distortion of radiographic landmarks (including decreased lung volume), tracheal deviation towards collapse
Compaction of lung tissue (consolidation)	Heterogeneous opacification, air bronchogram, similar changes on previous radiographs are characteristic of fibrosis

Table 7. Differential clinical and radiologic signs of pulmonary darkening.

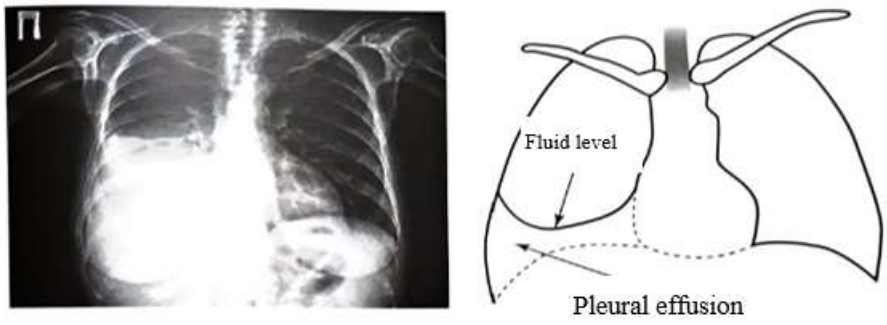


Figure 34. Right-sided pleural effusion.

Cause: pleural effusion, atelectasis of the lung (collapse). Homogeneous darkening, concave meniscus of fluid, mediastinum pushed to the opposite side.

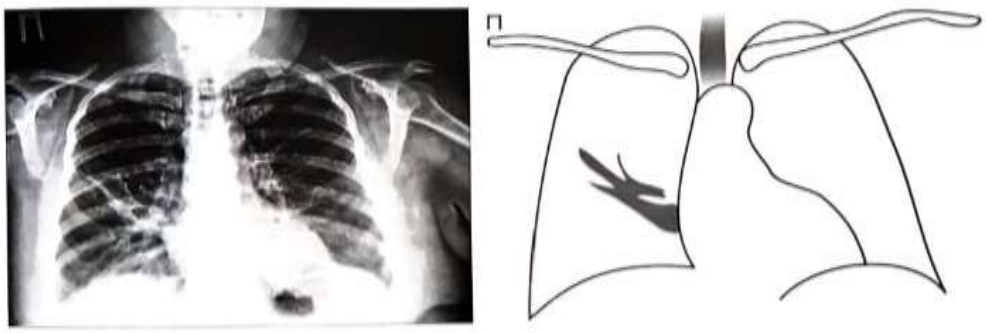


Figure 35. Fibroatelectasis: in the middle lobe of the right lung there is an irregularly shaped area of decreased transparency of the lung tissue with indistinct, heavy contours.

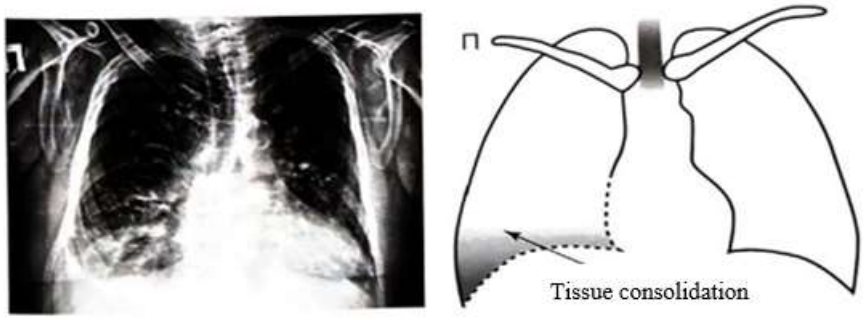


Figure 36. Radiologic picture of right-sided polysegmental pneumonia, right-sided hydrothorax. Decreased transparency of the lung tissue in the lower parts of the right lung (middle lobe) without clear contours and borders is noted. The right root is poorly structured. Fluid is detected in the right pleural cavity, in the anterior cardiodiaphragmatic sinus.

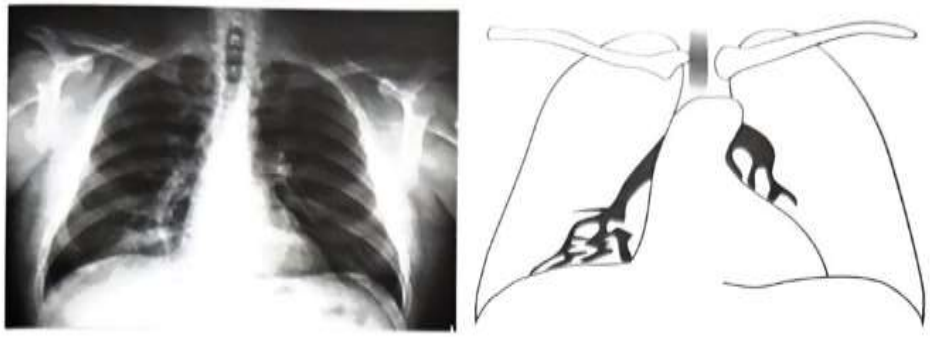


Figure 37. Radiologic picture of right-sided middle lobe bronchopneumonia. Focal root darkening on the right side.

Focal lesions in the lung

Focal lung injury is a condition in which a focal process in the lungs forms in the form of inflammation or infection. This process can cause symptoms such as coughing, chest pain, difficulty breathing, and sputum production. Treatment for a focal lung lesion depends on its cause and may include taking antibiotics, anti-inflammatory medications, and rest and supportive care regimens. It is important to contact a doctor at the first signs of the disease to make a diagnosis and prescribe effective treatment.

The foci may be single or multiple and are often round in shape. These white foci may be found in different parts of the lungs. In case of multiple focal lesions, primary cancer or metastases should be excluded. Other possible causes of focal lung lesions

include benign tumor (hamartoma), focal pneumonia (focal consolidation), pulmonary infarction (pulmonary embolism), and granuloma (rheumatoid nodules).

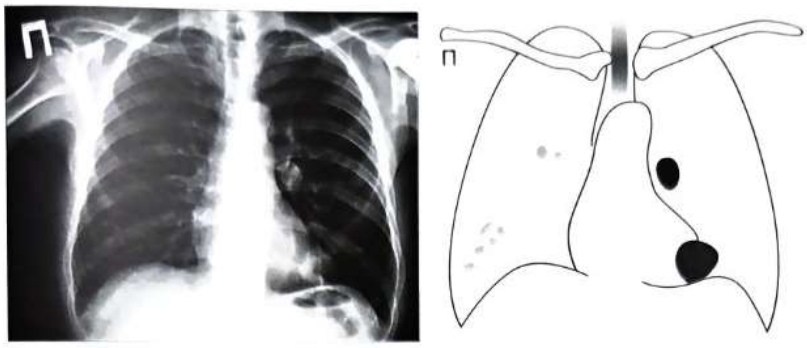


Figure 38. Multiple foci of both lungs, probably of secondary genesis.

Certain radiologic characteristics can help clarify the cause of focal lesions. For example, irregular shape, radiality, lobular character of the lesion (several foci, large and small, merge into one) serve as a manifestation of malignant processes. The presence of calcification (dense white inclusion within the foci) indicates a benign process. Cavitary cavernous changes (darker center) are characteristic of tuberculosis. Air bronchogram within the lesion area is a sign of consolidation.

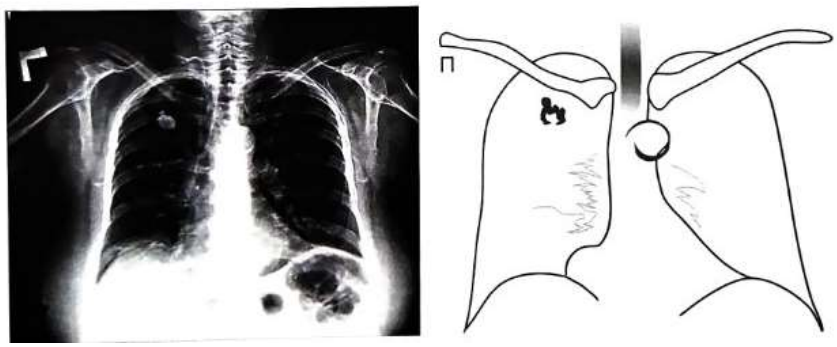


Figure 39. In the upper lobe of the right lung there is a dense, irregularly intense shadow of irregular shape, 23x16 mm in size (tuberculoma).

Patient data can also help to interpret the changes found. For example, a young woman with severe symmetric deforming arthritis has focal changes in the lungs due to rheumatoid nodules, whereas in the elderly and smokers, the focal mass would be highly likely to be primary bronchogenic carcinoma.

A cavity in the lung

A lung cavity is a mass in the lung tissue that is filled with fluid or pus. A cavity in the lung can be the result of various conditions such as lung abscess, tuberculosis, gangrene, and other infectious diseases. Symptoms of a cavity in the lung may include

coughing up phlegm, chest pain, fever and weakness. Treatment for a lung cavity depends on the cause and may include taking antibiotics, draining the cavity, and supportive therapy. It is important to see a doctor if you suspect a lung cavity so that treatment can begin quickly and prevent possible complications.

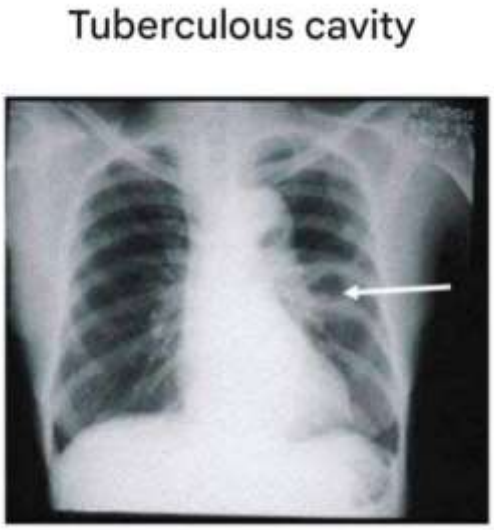


Figure 40. Cavity in the lungs.

A cavity in the lung appears as a focal area with a dark center that is air or fluid, sometimes with a well-defined fluid level. Causes of lung tissue destruction and cavity formation may include: pneumonia, especially with Staphylococcus aureus infection, with abscess formation; malignant tumor; pulmonary infarction with pulmonary embolism; and true tuberculosis cavity (cavernous). Cavity formations should be monitored dynamically to determine the rate of cavity enlargement or shrinkage during treatment (Fig. 24).

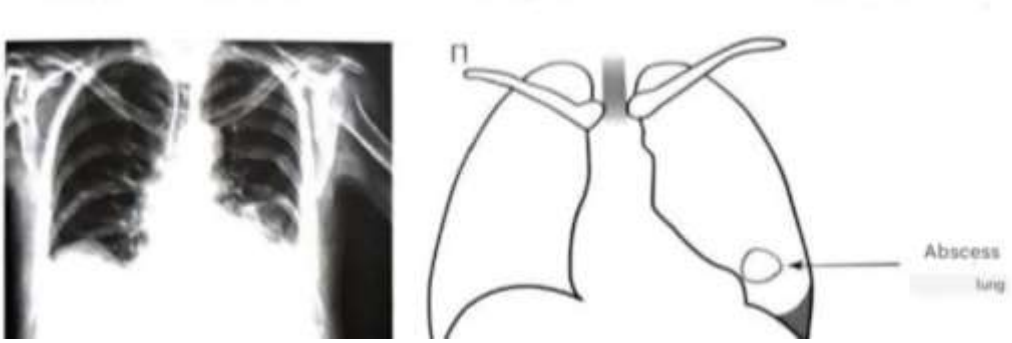


Figure 41. In the left lung, in the lower lobe, a cavity with thin walls, up to 6 cm in diameter (abscess) is defined. Below the cavity there is consolidation of lung tissue. The left sinus is rounded (fluid).

Pulmonary fibrosis less often appears as a "white" lung. It is a chronic process, so it can be detected during follow-up on a series of radiographs. More often fibrosis is formed bilaterally in the lower lungs. With unilateral fibrotic process there is a shift of the mediastinum to the side of fibrosis.

Radiologically, pulmonary fibrosis is described as reticulonodular. The appearance of a fine grid of lines and rings gives the involved areas of the lung the appearance of frosted glass. In later stages, the frosted glass transforms and takes on the appearance of a honeycomb lung.

Chronic obstructive pulmonary disease

Patients with COPD have a barrel-shaped chest. The diaphragm becomes flatter, with more than seven ribs in the front and 10 in the back.

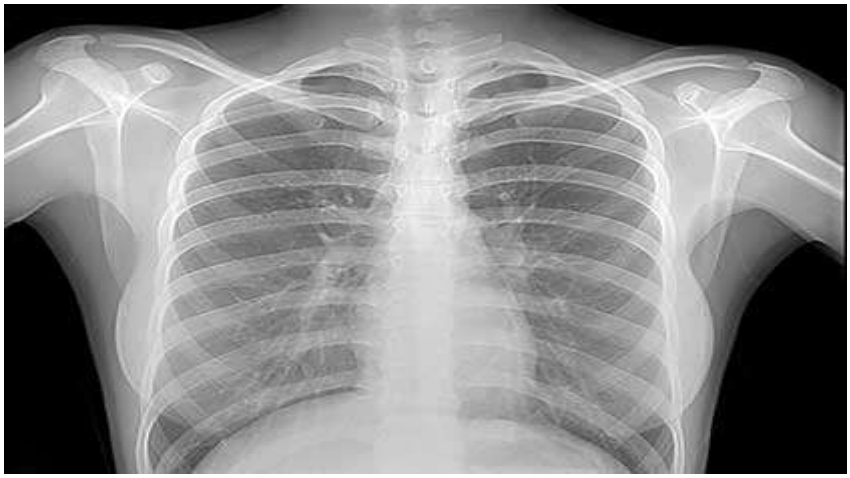


Figure 42. Barrel-shaped thorax: horizontal position of ribs, diffuse increase in lung tissue transparency.

If you draw an imaginary line between the rib-diaphragmatic and cardiodiaphragmatic angles, the apex of the diaphragm will be no more than 1 cm up from this line.

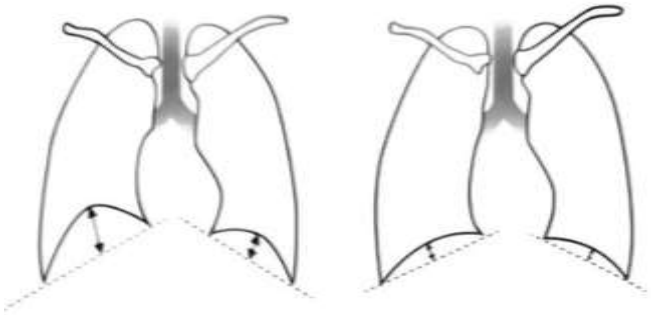


Figure 43. Imaginary lines used to assess normal or flattened diaphragmatic dome position.

The heart appears smaller in relation to the size of the chest. An enlarged or even normal-sized heart in patients with COPD is a sign of a pulmonary heart (cor pulmonale).

Emphysematous bullae are often visualized on x-rays. They appear as round "black" areas surrounded by a thin line and are thin-walled air spaces.

Pneumothorax

A darker, almost black lung field on one side of the chest serves as a radiologic sign of pneumothorax.

"Black" lung field

There are far fewer causes leading to a "black" lung field than to a white one. The most common causes are COPD and pneumothorax. COPD is characterized by bilateral radiologic signs, while pneumothorax and embolism are more often unilateral.

There is no lung pattern on the side of the pneumothorax, but massive air accumulation is usually easy to detect. If air accumulation is insignificant, it is often difficult to visualize it on X-ray. In this case, images are taken on inhalation and exhalation, the lung flattens slightly and then returns to its normal position, and the pneumothorax becomes more obvious.

All areas of the lung should be analyzed. The edge of the compressed lung should be sought. If there is a large volume of air in the pleural cavity, it often rushes to the upper-lateral regions and accumulates in the apical region.

In some cases, pneumothorax may be caused by rupture of an emphysematous bulla with preserved pulmonary pattern. Pneumothorax can be spontaneous, traumatic (for example, during catheterization of the subclavian vein or aspiration of pleural fluid), can be a manifestation of cystic fibrosis of the lungs, occur in connective tissue dysplasia in patients with Marfan syndrome or Ehlers-Danlo syndrome.

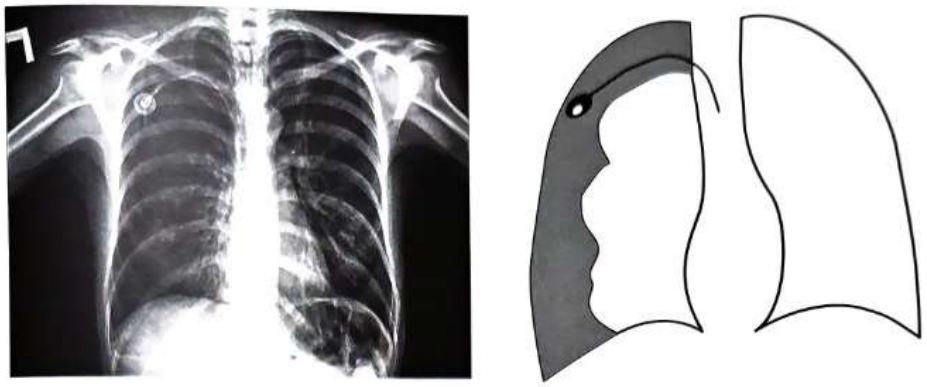


Figure 44. Apical pneumothorax (the apex of the right lung has no pulmonary pattern).

Changes in the roots of the lungs

The lung roots can be enlarged in bronchogenic lung cancer, intrathoracic lymphadenopathy (malignization, lymphoma, infections), and pathologic changes in blood vessels (e.g., dilated pulmonary arteries).

Altered roots are enlarged, become dense, acquire a heavy structure. To avoid errors in the definition of enlarged lung roots, the results obtained should be compared with earlier radiologic studies.

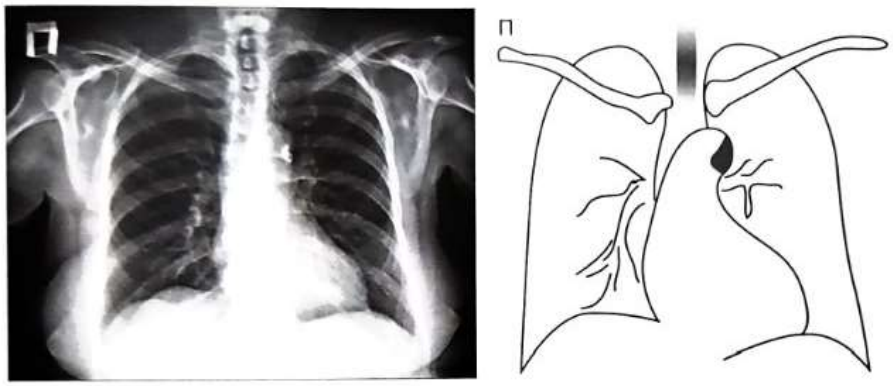


Figure 45. Calcified lymph nodes up to 15 mm in size are detected in the root region on the left side.

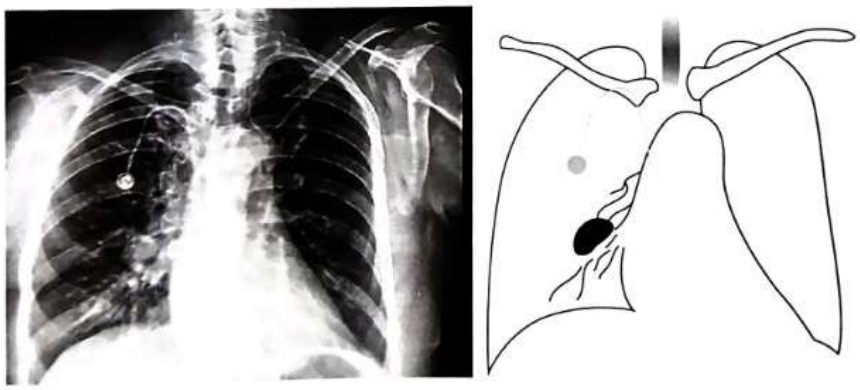


Figure 46. In the projection of the right root there is a shadow with convex contour, 33x26 mm in size, volumetric mass

In the projection of the subclavian vein the shadow of the port-system catheter is determined, the proximal end of which is located in the projection of the superior vena cava.

Tests

1. Main complaints of patients with respiratory diseases
+all right
-dry cough
-breath
-chest pain
-cough with phlegm
2. What kind of sputum is characteristic of community-acquired pneumonia?
+"rusty"
-serosal
-mucopurulent
-rotten
-mucous
3. Which sputum is characteristic of chronic bronchitis?
+mucopurulent
-serosal
- putrefactive
-mucous
- "rusty"
4. What is included in the questioning?
+ all right
- passport part
- complaints
- anamnesis
- anamnesis vitae
5. What is the vocal tremor in exudative pleurisy?
+ attenuated

-no correct answer
- intermittent
- enhanced
- unchanged
6. Complaints of patients with respiratory system diseases
+ fever
-difficulty swallowing
-heartburn
-nausea
-burping
7. Chest palpation findings in dry pleurisy ?
+ sensation of a pleural friction noise
- soreness
- vocal tremor
- vocal tremor
- intercostal protrusion
8. Palpation of the thorax in intercostal nerve lesions?
+ soreness along the intercostal spaces
- pleural friction noise
- pain on palpation in a limited area of the thorax
- all answers are correct
- rib soreness
9. Percussion findings in exudative pleuritis
+ stupidity
- box sound
- tympanite
- clear lung sound
- blunting
10. Percussion findings in dry pleurisy
+ clear lung sounds
- box sound
- stupidity
- tympanite
- percussion dulling
11. Percussion findings in patients with acute catarrhal bronchitis?
+ clear lung sounds
- stupidity
- dulcet tympanic
- tympanic sound
- box sound
12. Percussion findings in patients with croup pneumonia in the tidal stage?
+ dulling
- dull sound
- tympanic sound
- box sound
- clear lung sound
13. What are the changes on examination in COPD patients?

+ all right
- acrocyanosis
- "drumsticks."
- emphysematous chest
- breathlessness
14. Changes on chest examination in bronchial asthma?
+ emphysematous chest.
- increase in the size of one half of the chest
- reduction in the size of one half of the chest
- paralytic chest
- supraclavicular depression
15. Changes on chest examination in community-acquired pneumonia?
+ lagging of the affected half of the chest when breathing
- reduction in the size of the affected half of the chest
- paralytic chest
- emphysematous chest
- supraclavicular bulging
16. What changes in the examination can be found in croup pneumonia?
+ all right
- side position
- "herpes".
- chill
- breathlessness
17. Percussion changes in patients with croup pneumonia in the lung thickening period
+ stupidity
- box sound
- tympanic sound
- clear lung sound
- dull tympanicus
18. What are the features of pulmonary cyanosis?
+ diffuse, warm, present on the tongue, oral mucosa
- diffuse, cold
- localized to a limited area of the body, warm.
- on the distal part of the body, cold.
- none of the answers are right.
19. Nature of sputum in acute bronchitis
+ mucous
- serous
- purulent
- purulent
- putrefactive
20. What is the name of an attack of suffocation caused by stasis of blood in the lungs ?
+ cardiac asthma
- bronchial asthma attack

- asphyxia
- tachypnea
- dyspnea

21. Mechanism of dry wheezing?
+ viscous sputum in the bronchi
- liquid sputum in the bronchi
- pleural fluid
-fluid in the alveoli
- alveolar recession

22. Mechanism of crepitation formation
+ fluid in the alveoli
- liquid sputum in the bronchi
- viscous sputum in the bronchi
- bronchoconstriction
- alveolar recession

23. What are the different types of moist wheezing
+ all right
- ringing
- inaudible
- bubbles
- large bubbles

24. When the width of Kronig's margins is 9 cm.
+ pulmonary emphysema
- pneumofibrosis
- pneumonia
- pulmonary tuberculosis
- lung cancer

25. Is the width of Kronig's margins normal?
+ 5-6 cm
- 1-2 centimeters
- 2-4 cm.
- 4-5 centimeters.
- 6-8 cm.

26. What should be evaluated in a chest examination?
+ all right
- its shape and symmetry
- chest excursion
- breathing pattern
- one half lagging behind

27. What is determined by compressing the chest anteroposteriorly and laterally
+ chest resistance
- chest symmetry
- a lower lung excursion
- vocal tremor
- crunching in the rib fracture zone

28. What is examined by placing the palms of the hands on symmetrical areas of the chest wall and asking the patient to say words with the "p" sound.

+ vocal tremor
- chest symmetry
- a lower lung excursion
- crunching in the rib fracture zone
- chest resistance
29. When a pleural friction murmur is heard
+ dry pleurisy
- exudative pleurisy
- pneumothorax
- focal pneumonia
30. What percussion sound will be heard over the area of effusion?
+ blunted tympanitis
- clear lung
- tympanic
- dumb
- boxed
31. What is the normal percussion sound over Traube's space?
+ tympanic
- clear lung
- dumb
- boxed
- dull tympanicus
32. During chest percussion, the normal percussion sound is ?
+ clear pulmonary
- tympanic
- dumb
- boxed
- dull tympanicus
33. A patient suffers from severe dyspnea. To alleviate it, he has to
+ sit
- lie flat
- Lie on your left side
- walk
- right side up
34. What wheezes change with coughing
+ dry
- crepitation
- damp
- pleural friction murmur
- no right answer
35. What is the respiratory murmur heard on inhalation?
+vesicular
-bronchial
-rigid
-saccaded
-intermittent
36. When a boxy sound is detected above the lungs:

+ emphysema
- pulmonary atelectasis
- exudative pleurisy
- croup pneumonia
-lung cancer
37. Chest pain when breathing
+ dry pleurisy
- exudative pleurisy
- pleurofibrosis
- atelectasis
- focal pneumonia
38. The excursion of the lower lung margins is reduced at:
+lung emphysema
-acute bronchitis
-chronic bronchitis
-bronchopneumonia
-lung abscess
39. Upward displacement of the lower lung border occurs in exudative pleuritis:
+pleurisy
- bronchiectasis disease
-emphysema
- atelectasis
- lung cancer
40. Normally, the maximum lung excursion is equal along the axillary line:
+6-8 cm
-8-10 centimeters
-7 to 9 centimeters
-8 to 9 centimeters
-7-8 centimeters
41. The respiratory system consists of:
+all right
-larynx
-alveoli
-trachea
-bronchi
42. Percussion is used to determine the width of the apex of the lung:
+quietly
-all right
-loud
-average
-anything
43. Normal lung sounds over the lungs are as follows
+ vesicular breathing
- bronchial breathing
- dry rales
- wet wheezing
- crepitation

44. Normally, the trachea is heard above the trachea
+ bronchial respiration
- vesicular
- weakened
- rigid
- dry rales
45. Pulmonary darkening syndrome occurs in:
+ all right
- pneumonias
- atelectasis
- exudative pleurisy
- pulmonary infarction
46. Vocal tremor is attenuated at:
+exudative pleurisy
-atelectasis
-tuberculosis
-infarction of the lung
-focal pneumonia
47. There is vocal tremor over the area of fluid accumulation in exudative pleurisy:
+undefined
-reinforced
-weakened
-conducted unevenly
-unchanged
48. Increased vocal tremor is observed in:
+croup pneumonia
-acute bronchitis
-dry pleurisy
-bronchial asthma
-pulmonary emphysema
49. Chest with a depression in the lower third of the sternum:
+crow's-feet
-emphysematous
-rachitic
-paralytic
-asymmetrical
50. Chest shape with expansion of transverse and anteroposterior dimensions:
+emphysematous
-paralytic
-rachitic
crow's-feet
-all right

Task Nº 1.

Patient S., 49 years old, was admitted to the department. He complains of choking attacks, cough with small discharge of viscous vitreous sputum.

On examination: severe condition, forced position. Chest emphysematous. Expiratory dyspnea. Sputum analysis: Quantity: 15 ml; colorless, transparent. Consistency: thick, very viscous, mucous, odorless. Microscopic examination: a large number of eosinophils, Charcot-Leiden crystals, Kurshman spirals. No BK was detected.

1. Which: disease are we talking about?
2. What are Kurshman spirals?
3. What is Charcot-Leyden crystals?

Task Nº 2.

Patient A., 56 years old, was admitted to the department. Complains of choking attacks, cough with a small discharge of viscous vitreous sputum. He works as a pharmacist.

On examination: condition of average severity, forced position. Chest barrel-shaped. Expiratory dyspnea. A mass of dry, wheezing wheezes is heard. Bronchophony is weakened.

1. Which: disease are we talking about?
2. What are we going to determine by palpation?
3. What are we going to determine in percussion?

Task Nº3

A 60-year-old patient with acute respiratory infection complains of cough with mucopurulent sputum. Body temperature is 38, which has not decreased for 10 days. At auscultation in the root zone on the left side the breathing is weakened, dry and moist fine bubbling wheezes. Vocal tremor and bronchophony are amplified.

1. What pathologic process can we think of?
2. What is the mechanism of formation of moist wheezing?
3. What will a lung x-ray reveal?

Task Nº 4

A patient was admitted to the clinic with complaints of fever up to 39-40, chills, cough. Cough with a small amount of "rusty" sputum. The right half of the chest lags in the act of breathing. Vocal tremor and bronchophony are increased.

1. What pathologic process can we think of?
2. What will we determine in auscultation?
3. What does a lung X-ray show?

Task Nº 5

A 44-year-old man, a locksmith, sought help due to dyspnea, low-productive cough. He had a history of smoking for many years. Smoker's index is 20 packs/year. At auscultation scattered dry buzzing rales. On review radiograph the lung fields are

highly transparent. The diaphragm is flattened and shifted downward. The ribs are located horizontally.

Justify your answers to the following questions:

1. What shape is the rib cage
2. What would be the percussion sound
3. What disease does the patient have

Task Nº6

The patient coughs accompanied by discharge of purulent sputum with unpleasant putrid odor up to 250 ml per day. Sputum discharge increases in the position of the patient on the left side. The fingers have the appearance of "drumsticks".

1. Name the disease accompanied by this cough.
2. Indicate the localization of the process in this case.
3. Auscultation findings.

Task #7

Patient A., 46 years old, was admitted to the department. He complains of choking, cough with small discharge of mucopurulent sputum. He often catches colds. On examination: condition of average severity. Chest barrel-shaped. Expiratory dyspnea. Auscultation is heard a mass of dry, whistling and buzzing wheezes. Bronchophony is weakened.

1. Which: disease are we talking about?
2. What are we going to determine by palpation?
3. What are we going to determine in percussion?

Task #8.

The patient is bothered by a cough with green-colored sputum, which is separated throughout the day. The chest is regular in shape, actively participates in the act of breathing. At percussion on the left under the clavicle from II to IV ribs along the midclavicular line there is a tympanic sound, breathing in this area is amphoric, moist wheezes. Bronchophony and vocal tremor are sharply increased here.

1. Amphoric breathing is a variation of which respiratory noise?
2. What pathologic process are you thinking of?
3. List the types of breathing that exist

Task #9.

A 19-year-old patient, a student, complained of chest pain on the right side, which increases with breathing, coughing, subfebrile temperature. Asthenic, skin pale, moist, pulmonary sound above the lungs, vesicular breathing. On the right below the angle of the scapula there is a noise of friction of the pleura.

1. What kind of disease can you think of?

2. What will the bronchophony be like?

3. How to distinguish pleural friction murmurs from moist wheezes?

Task #10.

A 34-year-old patient complains of dyspnea, his condition is severe. Orthopnea, acrocyanosis, respiration rate 32 per minute, the left side of the chest swells. Percussion on the left side is dull, respiration is absent.

1. What pathology are we talking about?

2. What will the bronchophony be like?

3. Your tactics.

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