Saint Petersburg State Pediatric Medical University
Public Health Ministry of Russian Federation

Department of Propaedeutics of Internal Diseases

METHODS

OF MEDICAL EXAMINATION

OF A PATIENT

(part I)

Instructions for 3d year medical students

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INTRODUCTION

Propedeutics of internal diseases is a most important part of internal medicine. The word “Propedeutics” comes from the Greek word “Propaideo”, which means “to teach preliminarily, prior to”. Propedeutics is an introductory course to clinical medicine; it provides teaching students the principles and techniques of recognizing diseases. That is why propedeutics, in the narrow sense, is also called diagnostics. We are not going to belittle the significance of laboratory or instrumental methods of investigation for diagnosis in any way. However, it is quite evident that the main methods of modern diagnostics are still questioning, inspection, palpation, percussion and auscultation of the patient, i.e. so-called immediate examination.

Apart from that, the course of propedeutics includes instruction in the skills of giving medical doctor’s aid to patients. But the most important task of this discipline is to develop clinical thonking in future doctors.

Propedeutics is primarily a course of the clinical technique, as it contains methods of clinical examination based on various sense organs perception. It is clear that one can examine patients and get reliable information about the state of the patient’s body organs and systems only on having exercised oneself repeatedly and for a long time.

Every practicing physician should know that diagnostic errors most frequently happen due to inadequate, incomplete and not thorough enough examination of the patient. That is why an examination should always follow a strictly defined pattern, and particular methods and techniques should be used. It is while studying at the department of Propedeutics of Internal Diseases that students gain the knowledge and skills required for them to understand the interconnection between pathological processes and their symptoms.

THE EXAMINATION PATTERN

Questioning (Interrogatio)

Finding out the complaints.

Investigation into the history of appearance and development of the present illness (Anamnesis morbi – the memory of the disease).

Investigation into the history of the patient’s life (Anamnesis vitae – the memory of the life).

Additional questioning on the state of the patient’s body functioning (Status functionalis).

Physical Methods of Examination

Inspection (Inspectio).

Palpation –feeling with one’s fingers (palpatio).

Percussion – knocking with one’s fingers (percussio).

Auscultation – listening to (auscultatio).

- Initial diagnosis. – A plan for differential diagnostics.

Laboratory and Instrumental Methods of Examination

Clinical laboratory, electrographic, radial, endoscopic, radioimmunological etc.

- Final diagnosis.

CONDITIONS OF THE EXAMINATION PERFORMANCE

Physical examination should be performed so that it would not make the patient suffer more, but at the same time it should be the most thorough. The examination of a patient should be carried out in a warm room with the natural light, isolated from any outside noise. The patient's position depends on his or her state and the examination aims. Before starting an examination the doctor should wash his or her hands and put on a clean medical coat. The doctor's hands should be warm, dry, without any cuts or abscess (boil), with the doctor's fingernails being short-cut. Examining doctors should not eat any strong-smelling food.

To carry out an examination in a clinic of internal diseases a doctor needs a stethophonoscope, a sphygmometer, a clean spatula, a thermometer, a soft tape-measure and a dermograph. A coloured piece of chalk, a feltpen or a ballpen, a disposable needle in a case can be used as a dermograph.

THE TECHNIQUE OF QUESTIONING

The main techniques of questioning had been used as early as by Hippocrates. The method was later developed and improved by G.A.Zaharyin (1829-1897) who worked out a principal scheme of interrogation (questioning) which has still been employed.

Questioning may go by one of the two alternatives:

1.Let the patient speak out freely on various stages of his case history, finding out only some details more precisely.

2.Ask the patient to answer the questions put to him or her in the short and exact manner.

The questions you ask a patient should be clear, precise and understandable. The second technique is preferable as in this way the doctor will not be overloaded with any meaningless information that does not concern the case itself. Thus the doctor will get concentrated data about the progress of the disease.

Interrogation is a subjective method of examination based on the patient's sensations and feelings, but it is very significant for:

- early diagnosing of a disease not yet recognizable clinically;
- diagnosing a disease with typical clinical manifestations (e.g. ischemia of the heart, angina pectoris);
- determining any functional disturbances and the psychic nervous state of the patient in the case when objective methods of diagnosis give give little information;
- defining a link between the given disease and the patient's working and living conditions or any association with the diseases suffered earlier;

- studying the patient as a personality and finding a better way of interaction between the patient and the doctor.

Complaints

An interrogation starts with making the patient's complaints clear according to the following scheme:

- location (e.g. of the pain), its area,its irradiation;
- time of occurrence (day or night);
- duration (short-lasting or constant sensations);
- amount (how much? (e.g. of urine) or intensity (of pain);
- quality or character (e.g. of pain): lancinating or cutting pain etc;
- cause of the painful sensations (e.g. somemovement or some special position of the body, breathing or eating etc);
- accompanying events – vomiting or diarrhea in case of a stomachache, general weakness, sweating, fear, high temperature etc).

Correct evaluation of the complaints may be decisive for definition of the case.

Case History

Questioning of the patient about the progress of the disease is also carried on according to a definite scheme:

- onset of the disease (when and how it began, acutely or gradually), what its first signs were;
- further course of the disease – the main stages of its progress;
- the treatment taken previously – what measures and remedies were admin iatered? How were they applied? What were the results of the treatment?

The case history of a chronic disease must mention:

- the year of the disease onset (or how many years has the patient considered him or herself ill?);
- first signs of the disease;
- further progress of the disease chronologically described from the moment of its diagnosing till the present time;
- periods of remission and exacerbation;
- preventive and curative measures being taken.

Here it is necessary to make clear every detail:

a) what treatment did the patient get?(including the one before the hospitalization);
b) effectiveness of the curative and preventive measures;
c) the day dose of the medicine taken;
d) what symptoms disappeared and which ones appeared as a result of the medicine taking;
e) the length of the individual remedies intake (days, weeks, years);

- the immediate cause of the present hospitalization or of the application to the doctor:

a) worsening of the condition;
b) ineffectivness of the previous treatment;
c) admission for emergency aid;
d) complications developed requiring more diagnostics and medical correction.

Having questioned the patient about the present disease thoroughly and in detail, one passes on to questions about all the previous life of the patient, with the special attention being paid to the facts that could directly affect the disease development.

Life History

Interrogation about a patient's life is performed according to a certain sequence, too, so that it let the doctor compose a "medical biography" of the patient.

Biography data. Defining the place of birth and the length of living in a certain area will allow the doctor to determine the duration of the patient's stay in an endemic area or in a region with an unfavourable ecology as to a certain disease.

It is important to define the parents' age at the time of the patient's birth. How the patient grew up and developed in his or her childhoodand adolescence. The patient's education, the start and the character of his or her work. Occupational harm is determined: stress, staying in the cold, high-frequency devices, radial energy, vibration, acids, alkali, metals etc. that may cause internal diseases (e.g. chronic bronchitis in the foundry, pneumoconiosis in mines).

Heredity factors play a significant part in the development of many diseases (e.g. polycystosis of kidneys, hypertension, diabetes mellitus etc). That is why it is necessary to find out the presence of such diseases in the patient's parents, siblings and also in the patient's children.

The diseases, injuries or operations suffered by the patient in the past must be carefully got into, as quite a few diseases (e.g. rheumatic fever, diphtheria) leave the person with a heart trouble. So the knowledge of the patient's life history data simplifies and speeds up the correct diagnostics. For instance, a trauma of the skull and brain frequently precedes the development of hypertension.

Habitual intoxication can be the cause of the disease, as well as it may be a factor provoking exacerbation of a chronic condition already existing (e.g. stomach or chronic ulcer, chronic bronchitis, chronic hepatitis etc). This is why it is important to ascertain whether the patient abuses alcohol. If he was treated for alcohol addiction, when was it and what was the result? In what amount and how often does the patient use alcohol (daily, from time to time, by chance)? As to smoking, one should determine, since what age the patient has been smoking. What is the number of cigarettes smoked a day? Does the patient use any drugs, and which ones? When did the patient start using them? How large is his or her day dose and whatis the method of the drug use?

Allergology history. It is significant to find out if the patient suffers from any form of allergy: skin rash, bronchial asthma, nettle rash, swelling of the face or larynx, anaphilactic shock. Has the patient had any allergic reactions to a definite food, smell, medicine, especially antibiotics, (which ones exactly?), sulfanimides, iodine preparations, vaccination. The data about any allergic complications must be givenon the title page of the case record.

Epidemiology history. It comprises making any exposure to an infection or the patient's stay in an epidemiologically dangerous area clear. Has the patient had any blood transfusion? Has he or she visited a dentist for the previous six months? Has the patient been ill with tuberculosis, hepatitis, any venereal disease? If a relative or a neighbour of the patient is ill with tuberculosis, one should fix the group this person belongs to at the dispensary.

Family life and *gynicological history* (for females). The time of the patient's creating a family, the state of his or her children's health, interrelations in the family. The start of menstruations, their regularity and duration, the blood loss amount, whether the menstruations are painful. The number of pregnancies, deliveries, abortions. The time of climacterical start (if any) and specific signs of its progress. One should find out the date of the last gynecological examination.

Living conditions. It is necessary to take into consideration the patient's residential conditions: his or her living in a separate or in a so-called "communal" (common) flat, its heating, lighting etc. Also one should notice the patient's eating habits (how many times a day does he or she take food? Does the patient have his or her meals at home or out in a café? Does he have much food before going to bed at late hour?) The patient's living conditions are closely linked to the character of his work and rest (walking after work, going to the country every weekend, the kind of rest during holidays and vacations).

Insurance history. For an acute disease – since what date has the patient been on a sick-leave? For a chronic disease – what is the date of the last sick-leave? How many days was the patient on the sick-leave due to this particular disease during the year? What disability (invalidity) group has the patient had and since what time (if any)? What disease has caused this group of disability? When was the patient last re-examined for this disability?

Having determined the patient's complaints and the case history one should carry out a cursory interrogation of the patient again, asking him or her about the main body functions. One must do this before passing on to an objective examination. This interrogation will help the doctor to evaluate the patient's general condition as a whole, and to avoid missing something. It is called an examination of the patient's *functional condition* (*status functionalis*). This examination includes:

- general manifestations of the disease: any weakness, losing weight, fever;
- central nervous system: any headaches, fainting, convulsions, the sleep pattern disturbance;
- cardio-vascular system: any pains in the heart, intermissions, breathlessness, swelling of lower limbs;

- respiratory system: any chest pains in breathing and coughing, dry or productive cough, breathlessness;
- alimentary system: any lack of appetite, nausea, vomiting, belching, constipation, diarrhea (bowel looseness);
- urinary system: any swelling, aches in the small of the back, painful urination, colour changes of urine;
- blood system: any enhanced bleeding and hemorrhages on the skin and mucous membrane in the hemorrhagic syndrome, abnormal taste and difficulty in swallowing in the sideropenia syndrome, pains in the bones, neurologic complaints (paresthesia, numbness and impaired sensitivity of the limbs in the B12 or folic acid deficiency anemia;
- endocrine system: any thirst, mouth dryness, change in the body weight, convulsions, increased excitability, marked weakness, headache, high blood pressure.

General Visual Examination (Inspection)

Carrying on a general examination of a patient one applies the visual method. It is performed in the following sequence: one determines the **general condition** of the patient, state of the patient's **consciousness**, his or her body **position in bed**, his **body build**, the condition of his skin, visible mucous membranes and skin derivatives, subcutaneous fat layer, lymphatic nodes, muscular-skeletal system and inspection of body parts

The *patient's state* is evaluated after examining every body system; however, it is the first point described in the case record. There may be the following grades of the patient's state: satisfactory, relatively satisfactory, average severity, extremely severe (pre-agonial one), and terminal (agonial).

The satisfactory state is determined when the vital systerms functions are compensated, subjective and objective manifestations of the disease are not well-marked, the consciousness is clear (the patient is alert), the body position is active, the feeding is not impaired, the temperature is normal or subfebrile.

The relatively satisfactory state can be observed in the stable, relatively compensated functioning of every body system and organ.

The state of average severity is determined when vital systems functions are de-compensated, though there is no immediate threat to the patient's life. Subjective and objective manifestations of the disease are marked, the patient is conscious or somewhat confused. The patient's motor activity is limited, the position in bed is enforced, but the patient usually can serve him- or herself. Chill, high fever, emaciation (wasted appearance) and swelling are possible.

Severe state as a rule results from decompensation of the vital body systems. It can threaten the patient's life or can cause severe disability. The consciousness is inhibited (stupor or sopor), delirium is possible. The patient's position in bed is passive or enforced, he can't serve himself. Cachexia, anasarca, ascites, diffuse cyanosis, hypo- and hyperthermia are possible. Symptoms of the disease are well-

marked, you can see signs of complications of the main disease. Sometimes complications progress so rapidly that they shadow clinical manifestations of the main disease (e.g. the clinical symptoms of the brain circulatory damage in patients with hypertension.

Extremely severe (pre-agonial) state can be observed in acute damage of vital systems functioning, with this being so well-marked that the patient can die in the nearest future unless some urgent curative measures are taken.

Terminal state (agony) is characterized by fading away of the consciousness, muscles weakening, disappearing reflexes; the cornea becomes dull, breathing gets periodical (of the Kussmaul-Chayne-Stocks, Biot type). The pulse4 can't be felt even on the carotid arteries. Agony may last minutes or hours.

The patient's *consciousness* may be clear or confused which may be marked by stages:

- the 1st stage – numbness, stupification (Stupor). The patient is indifferent to the environment and to his own condition, he is slow in answering questions, responses in momosyllables, often without any sense, as if being sound asleep and coming out of it for short periods;
- the 2nd stage – dullness (torpor), somnolence (sleeping sickness) (Sopor). The patient does not answer any questions, or answers only with "yes" or "no". He does not react to anybody's presence, but he still preserves his reflexes;
- the 3d stage – (Coma). Completely inhibited consciousness, absence of the tendon reflexes. Coma can be caused by various reasons. Hyperglycemical (diabetic) or hypoglycemical coma may happen in diabetes mellitus. Hepatic coma develops in liver troubles, uremia (nitrogenous) coma occurs in kidney troubles. Cerebral coma may appear in brain circulation impairment, severe cranial cerebral injuries.

Disturbances of consciousness may also show as excitement, in the form of delirium, hallucinations. The states like these may develop in inflammatory processes accompanied by severe intoxication.

The patient's *position in bed* may be active, passive and forced.

In the active one the patient can easily and naturally change his or her position and can walk without any limitation.

In the passive one the patient does not move, his posture is often uncomfortable. This usually happens when the patient is unconscious due to a severe disease.

In the forced position , the patient takes a posture which lets him feel better.There are the forced lying supine (on his back) position – usually it is associated with an acute pathology of the abdominal cavity organs; the forced prone (on his stomach) position – in destructive processes in the spine, pancreas tumour; the position on the affected side – in croupous pneumonia; on his healthy side – in any rib fracture; the sitting position - at attacks of bronchial or cardiac asthma, chronic circulatory insufficiency; the knee-elbow position – in pericarditis; the unsettled position, when the patient frequently changes his position – sits

down, lies down,gets up, walks - this is due to various colics (liver or kidney colic); the forced standing position – at an attack of angina pectoris.

Correct estimation of the patient's position makes diagnosing quicker thanks to the following goal-directed examination.

Body build is a proportion between the height and the horizontal measure of the body, its symmetricity and proportionality; also it is a type of constitution. A person's height (stature) is determined by a special device called "staturemeter", while the person is standing. The average stature is 160-180 cm in males and 155-170 cm in females. Deviations from this average height are due to hereditery constitutional peculiarities. The height over 200cm in males and over 190 cm in females is called gigantism (giantism). It is often associated with an endocrine pathology (increased production of the growth hormone). Insufficient production of the growth hormone results in dwarfism which ic diagnosed when the stature is below 135 cm.

The chest size is found out with the help of a tape-measure. The tape-measure is applied under the lower angle of the scapulae and at the levet of the 4th rib in front.

Estimating the proportionality of separate body parts structure one pays attention to the symmetricity of both sides of the trunk, the shape and size of the head , the length of the neck and limbs, the correlation of the thoracic and abdominal parts size, the size of the epigastric angle. According to M.V. Chernorushkiy (1949) they distinguish three alternative proportions of the body bulk, or *three constitutional types*:

- The normosthenic (regular) constitution is characterized by the average height and proportional correlation between the vertical and horizontal measures of the trunk, neck, head and extremities. The thoracic and abdominal divisions are approximately equal.The epigastric angle is right.
- The asthenic constitution is characterized by the predominance of vertical measures over horizontal ones. The limbs (extremities) are long, the chest is long and flat. The epigastric angle is sharp. Asthenic people are distinguished by low daiphragm, visceroptosis and hypotonia.
- The hypersthenic constitution is characterized by short height and the definite predominance of horizontal over vertical trunk measures. The neck is short and stout, the arms are relatively short, the epigastric angle is obtuse. Hypersthenics are characterized by high diaphragm, hypertonia, ischemic heart disease and gallstones.

Thus, evaluating the patient the doctor should take into account the diseases specific to the given constitutional type. It is important to keep in mind that the same disease may have different symptoms and take a specific course in people with different body build types (e.g. such diseases as artherosclerosis, lung tuberculosis, diabetes mellitus, gallstone disease etc).

Estimation of Outer Phenotypical Signs of the Connective Tissue Dysplasia

Apart from the estimation of constitutional peculiarities great attention has lately been paid to distinguishing external phenotypical signs of connective tissue dysplasia which are often associated with clinically significant disfunction of internal organs.

In 1989 M.J.bGlesby and R.E. Pyeritz proposed a special card for revealing so-called "mixed" phenotype, where known phenotypical signs are ranged, with 16 principal phenotypical signs described.

The Main Outer Phenotypical Signs of the Connective Tissue Dysplasia

1. Asthenic type of constitution
2. Loss of normal posture
3. Scoliosis
4. "Straight back"
5. Keel-like deformity of chest
6. Funnel-like deformity of chest
7. Arachnodactilia
8. Flat foot
9. High "arch-like" palate
10. Hypermobility of joints
11. Increased stretchability of skin
12. Multiple pigment spots
13. Positive symptom of wrist
14. Positive symptom of thumb
15. Myopia
16. Ectopia of crystalline lens .

It is known from experience that detailed clinical and instrumental examination of persons having three or more outer phenotypical signs of the connective tissue dysplasia makes it possible to reveal clinically significant connective tissue dysplasia, dysfunction of the central nervous system and/or of one or a few inner organs in such persons in the majority of cases.

Estimation of the Condition of Skin and Visible Mucous Membranes

It includes revealing the colour of the skin, its moisture, any skin rashes, scales and scars. Inspection is performed in the following order: face, neck, trunk, limbs.

It is quite frequent that the results of inspection of the patient's *head* and face point to a certain disease. In severe abdominal conditions the patient has a specific face expression described by Hippocrates (Facies Hippocratica): sharpened features, expression of suffering, deeply sunken eyeballs, pallor of the skin, cold sweat in big drops.

Mitral face (Facies mitralis) is characteristic of mitral stenosis. It is swollen (puffy) with congestive (cyanotic) flushed cheeks because of dilated subcuteneous veins and with signs of acrocyanosis (cyanosis of lips, earlobes, the tip of the nose).

Cardiac face (face of Corvisar) is characteristic of chronic heart insufficiency: flaccid features, dull sleepy expression of the face, the complexion is yellowish pale, with signs of acrocyanosis, running eyes and the mouth half open.

The face characteristic of a kidney trouble (Facies nephritica) is puffy or swollen, pale. It has a sleepy indifferent expression.

The face of the patient with thyrotoxicosis (Facies Basedovica) has bulgy glistening unwinking eyes giving the face an expression of fright or terror, it is characteristic of diffuse toxic goiter.

One-sided exophthalmos is characteristic of toxic adenoma of the thyroid.

Mixedematous face (Facies mixedemica) is broad, round, with rough features, dull indifferent expression, swollen eyes deeply set.

Acromegalic face has rough features due to the growth of soft tissues, there is disproportionately big nose, lips, tongue, large lower jaw and chin.

In croupous pneumonia the face is red and somewhat swollen. There is well-marked hyperemia of the cheek on the affected side. The face expression is excited and worried, with a grimace of suffering during coughing, with floating nose wings and herpetic rash on the lips.

In active lung tuberculosis the face is thin, with high cheekbones, pale, but with bright-red cheeks,wide open eyes, half open mouth, dry lips.

The face of a "wax doll" is characteristic of the patients with the Addison-Biermer anemia. It is very pale, puffy, with the yellowish tint and transparent skin.

Falling out of *eyebrows* in their lateral third part may be a sign of hypofunction of the thyroid, and complete fall out of the eyebrows is a manifestation of fresh syphilis.

Swollen eyelids may be the first sign of kidney failure.

Eyelid pigmentation happens in thyrotoxicosis, chronic adrenal glands insufficiency.

Eyelid xanthoma is due to the disturbed fat metabolism (increased blood cholesterol level).

Upper eyelid ptosis usually results from a gross brain pathology (syphilis, a tumour-like process).

Reaction of the pupils to light is of great diagnostic importance: they become narrow in a drug intoxication, uremia, brain tumours, intracranial hemorrhages. In contrast, they become wide with overdosage of atropin or poisoning with atropin containing remedies.

In inspecting a *neck* it may be important to notice its irregularities associated with the thyroid enlargement (endemic, diffuse toxic, nodular goiter) or with the cervical lymphatic nodes enlargement (in tuberculosis, lymphogranulomatosis, leucosis, a metastasing tumour).

One evaluates the condition of the **skin** in the following order: its complexion (colour), how damp it is, any skin rashes, scales, scars.

The skin *colour* depends on its thickness, on how full the cutenuous blood vessels are, and on the skin pigments' presence.

Pallor of the skin may result from a vascular spasm (e.g. skin pallor in the heart aorta defects or in a hypertension (high blood pressure) crisis. It may also be

due to a low level of hemoglobin in the blood (in case of anemia or a blood loss), with the mucous membrane getting pale-rose at the same time with the skin. Pallor of the skin can have different shade: “white coffee (coffee with milk) in the infectious (septic) endocarditis; with a growth and intoxication skin gets a sallow shade.

Skin gets red when there is an extra amount of erythrocytes in the blood (erythremia).

Skin cyanosis results from an increase of the restored hemoglobin in the blood. There is central and peripheral cyanosis. Central cyanosis arises when the lungs gas exchange is disturbed, while peripheral cyanosis is caused by a circulation failure and slow blood flow, which results in the increased oxygen utilization and the restored hemoglobin being collected in the blood.

Skin jaundice develops thanks to the increased blood bilirubin content: as a result of erythrocytes hemolisis (superhepatic jaundice), of hepatocytes damage (hepatic jaundice) or of bile outflow impairment (subhepatic jaundice). It should be kept in mind that skin jaundice is not the earliest sign of a disease. It is the jaundice of the sclerae, the hard palate and the tongue bridle that comes first.

Bronze complexion appears in chronic insufficiency of the adrenal cortex.

Patches of thick pigmented skin occur in sclerodermia. Depigmented patches are a sign of vitiligo.

Skin *rashes* are discriminated by: their colour, spread, shape, size, persistence. They can be due to a certain skin disease or a sign of collagenosis, a blood disease, an allergy and, also, of an infection (measles, rubella, smallpox, scarlet fever etc).

Roseolous rash consists of light pink macules 2 – 3 cm in diameter, disappearing when pressed, as their formation is associated with inflammation and dilatation of vessels. Roselous rash occurs in typhoid fever, typhus, paratyphus and syphillis

Erythemic rash consists of risen above yhe skin surface hyperemic (red in colour), clearly defined round skin patches. Erythemic rash appears in people sensitive to certain food or medicine. Besides, erythemic rash may be a sign of erysipelas inflammation and a septic process.

Vesicular rash, or nettle rash appears as risen above the skin white formations without any cavities accompanied with strong itching. The vesicular rash is a manifestation of an allergy.

Herpetic rash appears as small vesicles filled with serous or serous – hemorrhagic fluid. On bursting they leave drying scabs (crusts). Herpetic rash may be found on lips, near the nose wings, on the skin along the intercostal nerves. It is observed in croupous pneumonia, or it may be a manifestation of a viral infection.

Skin hemorrhages are formations of various size (from punctate ones to large confluent areas), they don’t disappear when pressed and they change colour with time. They emerge in disorders of blood coagulation (clotting) – in hemophilia, acute radiation disease – or in increased brittleness of cappilaries (the disease of Schönlein-Henoch).

Skin *scars* are formed after operations, injuries, wounds and burns. Sometimes pregnancy may leave scars on abdominal skin because of its overstretching – these are white striae. Rose striae usually located on abdomen and shoulders may be a sign of Itzenko-Coushing disease.

Scaling of skin, so-called branlike one – occurs when the skin is not well cared for, and also in tuberculosis, diabetes mellitus and after infections (like measles, typhoid fever). Plate scaling develops after scarlet fever and erysipelas inflammation.

Inspection of **breasts** is carried out with the patient being in the vertical position, with her arms raised. Attention is paid to the configuration simmetricity of the glands, to the presence of any deformity, to any change of shape or of the position of nipples.

Inspection of *lower extremities*. First, one should pay attention to the symmetricity of the length and volume of thighs, shanks and feet. Enlargement of the volume in a particular part of the limb may occur in thrombophlebitis of deep veins. Diminished volume of one of the extremities (most often of a shank) may point to obliterating atherosclerosis. In this case the skin on the affected side is usually pale.

As a rule, varicose dilated veins of lower limbs and swelling of feet and shanks can be well seen.

GENERAL PALPATION

The term “palpation” comes from the Latin word “Palpatio” – feeling with one’s hands. The physiological basis of this method is the sense of touch arising with pressure and movement of the palpating hand (one’s fingers and palm). Touching sensations change depending on the thickness of the tissue, topography of the organ and temperature fluctuations.

Since the time of Hippocrates they have studied physical qualities of skin, muscles, bones, joints and pathologic formations in the abdominal cavity with the help of palpation. In the 19th century the method of palpation was further developed, special techniques of palpating cardio-vascular system and the topographical palpation of the abdominal organs were worked out. General palpation, as well as general visual examination of a patient is performed in a definite sequence.

Palpation is started from the patient’s **head**. With the thumbs of both hands one palpates symmetrically the point of the exit of the fifth cranial nerve on the face, in the area of the supercillary arches, the dog’s pits and the chin. Then the skin, subcuteneous cellular tissue and bones are palpated in the region of face and hairy part of the head. During this procedure one estimates the condition of the cranial sutures, родничков, presence of any deformity, lipoma or scar is revealed.

Palpation of **lymphatic nodes** is performed in the following order: occipital, pericervical, anterior cervical, of the chin, super- and sub-mandible, super- and sub-clavicular, axillary, of the elbow, of the groin, and under the knee. One palpates lymphatic nodes with one’s finger-tips gathered together (a”cat’s paw”),

quite softly and carefully. Normally, lymphatic nodes cannot be felt at all, or some single ones may be found to be of elastic consistency, mobile, up to 1 cm in size; they are in the armpit, in the groin and under the jaw. If enlarged, the lymphatic nodes size should be marked, their tenderness, consistency, mobility and adhesion to skin are determined.

In the region of the frontal surface of the neck one performs palpation of the **thyroid**, evaluating its size. The presence and equal enlargement of its lobes is determined, also, its consistency, displaceability on swallowing, presence of pulsation is estimated (see the technique of the thyroid palpation in the part "Investigation of the endocrine system")

Palpating the **skin** one defines its elasticity\resistence (turgor), moisture and temperature. The skin turgor is defined by taking the skin of the frontal abdominal wall or on the unbending surface of the hand as a fold, between the index finger and the thumb. When the turgor is normal the skin fold disappears at once on straightening out the fingers. When the elasticity is lowered the skin fold does not disappear for a long time.

The skin dampness depends on perspiration (sweating). Increased dampness (hyperhidrosis) can be revealed by running the back of one's hand over the patient's chest, palms, the flexing arm surfaces. Surplus skin dampness is a manifestation of such conditions as hypoglycemic coma, croupous pneumonia in its resolution stage, collapse.

Skin dryness, its scaling may be a symptom of vitamin defficiencies, dehidration of the body, hypothyreosis.

Body temperature may also be determined by palpation. To estimate it the examiner's hands are put flat on the symmetrical regions of the patient's trunk and extremities. In a healthy person the skin is felt warm. High temperature results from fever of infectious or non-infectious genesis. Infectious fever develops in various inflammatory diseases (pneumonia, diphtheria, scarlet fever etc.). Non-infectious fever may be due to a malignant tumour, myocardial infarction, a central nervous system disease. In any fever at the moment of temperature rise the skin becomes hot and dry, and when the temperature falls down the skin gets warm and damp.

To determine whether the tone of parasympathetic or that of sympathetic nervous system predominates the technique of estimation of dermographism (i.e. evaluation of the skin colour change) is used. This change occurs after running a hard object (e.g. the blunt tip of a pen) over the skin surface. The dermographism of the frontal upper chest surface is evaluated. The red or rose dermographism shows an increased tone of the parasympathetic nervous system, and the white one points to the predominance of the sympathetic nervous system.

Palpation can also show the patient's **nutritional status** to some extent. The degree of the subcutaneous fat layer development can be judged by the thickness of the skin fold. For this one takes the skin and subcutaneous cellular tissue into a fold with one's index finger and the thumbed measures its thickness. The patient's nutrition is considered satisfactory if the transverse skin fold under the clavicle is 1 cm thick, under the scapula it is 2 cm thick, in the umbilical area it is 3-4 cm thick.

If these measures are smaller the nutritional status is considered diminished (malnutrition), sometimes the person is extremely undernourished which is called cachexia. When the measures are larger the nutrition is considered surplus; it is called obesity (adipositas).

However, nutritional status can be described more exactly by opposing the patient's body weight and his or her height, the correlation of these parameters is defined by the body mass index (BMI): body weight (kg) \ height (m)2

The nutrition is believed satisfactory if BMI ranges from 20 to 25. A smaller BMI shows insufficient nutrition, a bigger BMI shows surplus one.

Swelling (oedema, edema) is a major clinical manifestation of many diseases. It results from fluid leaking through cappilary walls into the tissues and intercellular space. General and local swelling may be distinguished. Local swelling of subcutaneous cellular tissue is usually due to a local impairment of blood and lymph circulation in the area of venous thrombosis. General swelling involves diffuse accumulation of fluid in the subcutaneous tissue. It tends to progress gradually. In cardiac failure swelling first appears near the feet, later on shanks and thighs; in kidney troubles swelling develops under the eyes. Minor swelling is called "*puffiness"*. At an early stage of heart failure it appears in the evening and disappears by the morning. As the condition progresses, the swelling becomes constant and spreads, the skin at the swollen site gets puffy, distended and tense. If pressed with a finger in the region of bone formations (the inner surface of the shin, ankle, sacrum), a pit is usually formed, the pit does not disappear within 1-2 minutes.

There is also soft swelling (which is total as it is caused by lowering of the oncotic pressure) and there is hard swelling, associated with the accumulation of mucin in the subcutaneous tissue in case of myxedema, due to this mucin accumulating, when pressed, no pit is formed.

When palpating the **muscular system** it is important to determine the degree of its development and its symmetricity. This may depend on the patient's professional activity, going in for sports and exercise and the diseases he or she has had.

If there is any assymetry of the mascular system development observed, it is necessary to measure the circumference of the limbs in order to compare them on the affected and healthy side. Besides that, one should define the patient's muscle power. The patient is offered to squeeze the examiner's hand, with the patient's left hand pressing the examiner's left hand and the patient's right hand pressing the examiner's right one. Dinamometry is employed for more precise evaluation of the muscle power.

Palpation of **mammalian glands (breasts)** is carried out with the patient being in the vertical and horizontal positions. Palpating a patient in the vertical position the doctor sits on a chair, with the patient standing, her arms raised up. Both mammalian glands are examined by quadrants. When a pathology is visible, palpation is started from the healthy side. Generally, one palpates pressing the mammalian gland to the chest with the palmar surface of the examiner's fingers. If the mammalian glands are big and hanging the doctor's left palm is placed between

the gland and the chest, and the palpation is performed with the right hand in the usual sequence (clockwise).

Palpating in the horizontal position one employs the technique of subsequent palpation of mammalian glands to find out any consolidations. The mammalian gland palpation is completed by looking for König symptom: the examiner's palm presses the mammalian gland to the chest so that the region of consolidation should turn out in the depression between the tenor and the hypotenor. If there is any growth the sensation of consolidation persists, whereas in mastopathy it disappears.

Palpating **joints** the examiner places his or her hands on the symmetrical joints. One palpates shoulder joints, elbow, radiocarpal, hip, knee and ankle joints consequently. Then small joints (of hands and feet) are palpated.

EXAMINATION OF THE CARDIO-VASCULAR SYSTEM
Questioning

Patients with a cardio-vascular pathology most often complain of: pains in the chest, breathlessness (dyspnea), fainting (syncope), palpitation (heartbeating), cardiac irregularities (arrhythmia), swelling (edema), cough and bloody expectoration (hemoptysis), weakness, rapid fatigue.

Estimating the **pain** syndrome it is necessary to determine the exact localization of the pain (one should ask the patient to point to it with his or her finger); to reveal the character of the pain (it may be quite bad in myocardial infarction and in the dissecting aortic aneurysm, or it may be dull in a heart defect (vices) or pericarditis); to define its irradiation (in angina pectoris and in myocardial infarction pains irradiate to the left scapula and left arm); to find out the duration of the pain syndrome (it will last a few minutes in angina pectoris, a few hours in hypertension crisis, a few days in hypertension and heart defects); to disclose the provoking factors (physical exertion, stress, a change in the body position); to make clear the effect of some medicine on the pain (e.g. of nitroglycerin in angina pectoris).

Breathlessness (**dyspnea**) occurs in many patients with heart diseases. In contrast to healthy people, in a disease of cardio-vascular system breathlessness appears on minor physical exertion, and in a severe condition it is seen on rest. In the chronic heart failure breathlessness progresses slowly during weeks or months.

Sudden onset of breathlessness may be due to cardiac asthma (in the swelling of the lungs), to pneumothorax or to thromboembolism of the pulmonary artery. Breathlessness in cardiac diseases is always of inspiratory character (difficulty on breathing in, i.e. on inspiration), in contrast to patients with a pathology of a respiratory organ, it develops before any cough appears.

Usually breathlessness occurs more often in the lying (recumbent) position, it lessens in the vertical or sitting position of the patient – this is the orthopnea symptom.

Faintness (**syncope**) may be a manifestation of many diseases. For instance, repeated fainting when loss of consciousness lasts for 1-2 seconds suggests an

attack of Morgagni - Adams- Stokes syndrome. A gradual onset and a longer duration of syncope characteristic of the vasopressor faintness developing under the influence of emotions or pain.

Loss of consciousness occuring on physical exertion or immediately afterwards is characteristic of the aortic heart defect (stenosis and insufficiency) and of the hypertrophic cardiomiopathy.

Palpitation accompanies tachycardia (accelerated heart rate), as a rule.

Irregularity in the heart beat (**arrhythmia**) may be due to various disorders of rhythm, such as extrasystole or ciliary arrhythmia.

The swelling (**edema**) predominating on legs and increasing towards evening is characteristic of cardiac and venous insufficiency. In severe heart failure edema spreads, and ascites, hydrothorax, hydropericardium can develop.

The **cough** due to a cardio-vascular pathology appears in the diseases characterized by the development of high pressure in the pulmonary veins system, e.g. in the interstitial or alveolar edema of the lungs. In mitral stenosis cough is usually dry and irritating, it occurs most frequently at night. The cough accompanied by foamy sputum expectoration is characteristic of pulmonary edema.

Hemoptysis – coughing up blood or bloody sputum – may be caused by (apart from a pulmonary pathology):

a) diapedesis of erythrocytes into the alveoli (in the pulmonary hypertension, lung edema);
b) disruption of the dilated endobronchial vessels forming collaterals between the pulmonary and bronchial venous systems (in mitral valve stenosis);
c) necrosis and bleeding (hemorrhage) into the alveoli (in the lung infarction).

Weakness, rapid **fatigue** are characteristic of patients with myocarditis, heart defects, with such patients suffering from exhaustion on physical exertion.

Studying a present case of a cardio-vascular pathology it is very important to determine the time of the first symptoms' appearance, any association of the disease with any previous infection, stay in the cold environment for a long time (chilling), any physical or emotional overstrain and, also, whether the treatment given was effective.

One must get some information on the patient's living or working conditions being unfavourable, on his or her harmful habits. One should enquire about any cardio-vascular diseases in the closest relatives of the patient. Dealing with female patients it is reasonable to find out how their previous pregnancies, deliveries or climacteric went on as those are the periods when their cardiovascular system suffers from the largest burden.

Visual Examination

The cervical vessels' pulsation is evaluated in the vertical and horizontal position of the patient. The carotid arteries' pulsation ("the carotids' dance) is an important sign of the aortic insufficiency. The cervical (jugular) veins' pulsation

(the symptom of "the positive venous pulse") is found in the tricuspid valve insufficiency. Besides that, swelling of the cervical veins is seen in other diseases as well, which are accompanied by high pressure in the system of the superior vena cava: these are the exudative and adhesive pericarditis, the "pulmonary heart", cardiac insufficiency.

Examining the region of the heart one can find local bulging (bellying) of the chest – the "cardiac hump" which is formed in congenital (inborn) heart defects or in the defects acquired in childhood when the chest is still pliable. Pathologic bulging associated with pulsation occurs in post-infarction aneurysm of the heart or aorta.

One should pay attention to the character of the apex beat, it can significantly bulge during the systole at the expense of the increased pulsation (in the left ventricular hypertrophy) or it may retract during the systole (the negative apex beat) in the patients with adhesive pericarditis.

The right ventricular hypertrophy is manifested by the presence of the cardiac beat usually associated with the epigastral pulsation. Visible epigastric pulsation is observed in people of the asthenic body build, it may also be a sign of the abdominal portion of aorta aneurysm. Retrosternal pulsation may be caused by the aortic arch aneurysm, or it can be due to the overstretch of aortic walls by blood in aortic defects.

Palpation

Palpating the arteries one should estimate the character of the pulse and the condition of the vessel wall outside the pulse wave. **Pulse** is fluctuation of the arterial wall arising under the influence of the blood pressure wave at every heart contraction. As a rule, pulse is estimated on the radial arteries, however, it is necessary to palpate other arteries: temporal, carotid, subacromial, femoral, subpatellar, back tibial and the foot back arteries – to reveal the lowered pulsation in them, which may be seen in the diminished lumen of a vessel or when it is supressed from the outside.

The radial artery is palpated with the tips of the 2nd,3d and 4th fingers. The patient's pulse is examined both in the patient's lying and standing position, with the standing patient holding both of his or her hands approximately at his or her heart level. The following pulse qualities are defined: *its symmetricity in fullness, its rhythm, its rate, the character of fullness, the tension, and its size, shape, the condition of the vascular wall outside the pulse wave.*

Normally, the pulse is **symmetrical in fullness**. However, when the vascular permeability is impaired the fullness at the affected side is decreased and the pulse becomes unequal in fullness (pulsus differens). In this case one continues palpation on the radial artery where the pulse is felt better.

Pulse rhythm may be regular (pulsus regularis) and irregular (pulsus irregularis), when the intervals between the pulse waves are different.

If, on palpating, one gets the impression of certain pulse waves being dropped out, one should suspect extrasystole. In the absence of any regularity (rhythm) in

the rise of the pulse waves one should suppose the atrial fibrillation in the patient. To estimate the *pulse deficiency* on revealing an arrhythmia one should count the difference between the number of the heart contractions per minute and that of the pulse waves per minute.

The **pulse rate** (in the absence of its deficiency) is estimated by counting the pulse waves during 15 or 20 seconds and by multiplying the sum obtained to 4 (or 3), correspondingly. If the pulse is irregular, one must count it during a minute. The normal pulse rate is 60 – 90 pulse waves per minute. If the pulse rate is less than 60 per minute the pulse is called rare – *bradycardia* - (pulsus rarus), when it is over 90 per minute it is called accelerated, or frequent – *tachycardia* - (pulsus frequens).

The character of the **pulse fullness** corresponds to the oscillations of the artery diameter. It depends on the size of the systolic output. As to the character of the pulse fullness they distinguish the full pulse (pulsus plenus) – in normal, and the pulse of poor volume (pulsus vacuus).

The **pulse tension** depends on the height of the arterial blood pressure, it is determined by the effort required for the palpating fingers to stop the pulse wave altogether. Doing this one must press the radial artery not only with the 4th finger, but also with the 2nd finger, to prevent the retrograde pulsation, whereas the 3d finger registers the moment the pulse waves are stopped. By tension they distinguish the hard pulse (pulsus durus) and the soft – in normal - pulse (pulsus mollis).

The **pulse's size** is determined by the impression got from both the character of fullness and the tension. The pulse's size depends on the height of the arterial blood pressure and the amount of the systole output. By the size they distinguish the big or high pulse (pulsus magnus, altus) and the small pulse (pulsus parvus).

The **shape of pulse** is defined by the rate of rise and fall of the pulse wave. The pulse giving quick rise and quick fall of the pulse wave is called triphammer (pulsus celer), and the one with a slow rise and gradual fall is called slow (pulsus tardus).

The triphammer and high pulse (celer et altus) is characteristic of aortic insufficiency, and the slow and small one (parvus et tardus) is a sign of the aorta mouth stenosis.

In shock, collapse, heart insufficiency the size of pulse waves can be very small, but their rate can be high. This pulse is called thready (pulsus filiformis).

Patients with severe myocardial damage have rhythmical pulse with alternating big and small waves. Such pulse is called intermittent (pulsus alternans).

Normally, during an inspiration (breathing in) fullness of the right heart increases and the fullness of lungs somewhat decreases, so the left ventricle blood output somewhat decreases as well (systolic pressure becomes aqpproximately 10 mm Hg lower). In some diseases (exudative pericarditis. status asthmaticus) the pressure oscillations increase which leads to the paradoxal pulse (pulsus paradoxus) when the pulse cannot be defined at the height of inspiration at all

To evaluate the condition of the vascular wall one's finger tips are rolled over the artery and run along it. Normally, arteries are elastic. In a pathological condition arteries can become twisted and hard (in atherosclerosis, hypertension)

Palpating the region of the heart one defines the character of the apex beat, the presence of the cardiac beat, systolic and\or diastolic fibrillation, "clapping" 1st sound and accentuated 2nd sound, additional pulsation.

It is necessary to carry out palpation in different positions of the patient: standing, lying on the back and on the left side. It especially concerns estimation of the apex beat as, with the body turned to the left, the heart apex gets displaced 2 – 3 cm closer to the chest and becomes easier to palpate.

Palpating the **apex beat** one examines its following features: its localization, area and force. Normally, it is located in the 5th costal interspace, 1.0 – 1.5 cm medially from the midclavicular line, it has an area of 1-2cm^2, average height and force.

The *apex beat force* is estimated by the resistance of the heart apex to the examiner's fingers when the examiner tries to "supress" the apex beat. The strong apex beat is called rising. It is usually found in hypertrophy of the left ventricle. In dilated left ventricle there is marked displacement of the apex beat to the left and down.

Palpating the area of the heart apex one can find the presence of *diastolic* ***thrill*** of the chest. It is equivalent to the low frequency diastolic murmur in mitral valve stenosis. In the case of marked calcinosis of the mitral valve one may sometimes palpate the *systolic thrill* corresponding to the mitral regurgitation, but it is not frequently defined.

Placing one's palm in the region of breastbone and somewhat to the left one can palpate the ***cardiac beat*** located in the 3d – 4th costal interspace. Normally it is absent. It appears due to the hypertrophy of the right ventricle.

The *"clapping" 1st sound* at the heart apex, characteristic of mitral stenosis, can also be palpated. As in this heart defect hypertension of the pulmonary circulation develops resulting in the *accentuated 2nd sound* at the pulmonary artery, the latter can also be felt with the finger tips placed in the 2nd costal interspace. Defined on palpation simultaneously, the clapping 1st sound at the heart apex and the accentuated 2nd sounds at the pulmonary artery are called Nesterov symptom, or the symptom of "two hammers": one "hammer" beats the palm, the other – the finger tips.

Placing one's palm perpendicularly to the breastbone at the level of the 2nd costal interspace one can palpate the accent of the 2nd sound at the aorta and feel the *systolic thrill* as well (in aortic stenosis), which is better found on complete expiration (breathing out).

To find out the **retrosternal pulsation** an index or a middle finger is put into the supersternal pit. To make palpating easier the patient is asked to raise his or her shoulders and to drop his head. Then well-marked pulsation (the positive Gegar symptom) is found in aorta aneurysm, arterial hypertension, stenosis and insufficiency of the aortic valve.

Epigastric palpation is carried out in the patient's lying and standing positions. The examiner's palm is placed flat along the midabdominal line, and the tips of the examiner's 2nd, 3d and 4th fingers are placed under the xiphoid process, the fingers being put there on expiration. If pulsation can be felt with the finger tips it is associated with the hypertrophy or dilatation of the right ventricle. In a pathology of the abdominal aorta (aneurysm) pulsation is felt by the palm. The pulsation felt from the right to the left may be due to the hepatic pulsation which occurs in the tricuspid valve insufficiency.

Percussion

Percussion is used to reveal the heart borders of relative and absolute dullness, of the vascular bundle size and of the heart configuration.

The area of *relative dullness* is located over the heart portions covered by the lungs, it coincides with the true size of the heart. The *absolute cardiac dullness* is formed by the heart areas not covered by lungs. It refers mostly to the right ventricle.

To determine the **borders** of relative cardiac dullness the technique of average or low intensity percussion is generally used. The middle finger of the left hand (the finger-plexor) is placed parallel to the border looked for and then it is moved in short steps, going from the clear sound, until the dullness is reached.

First, the diaphragm level should be determined on the right, by percussing along the right midclavicular line downwards, until the dullness is reached. Normally, it is defined in the 5th intercostal space. Then the finger-plexor is rotated to 90 degrees and moved to the 4th intercostal space to reveal the relative dullness right border. Normally it is formed by the right ventricle and corresponds to the right margin of the sternum in the 4th intercostals space.

To determine the superior (upper) heart border one should percuss downwards, deviating 1 cm laterally to the left margin of the sternum (between the left sternal and parasternal lines).The finger-plexor is placed parallel to the patient's ribs. Normally, the superior border of a heart is formed by the left atrium auricule and it is located on the level of the 3rd rib.

The left border of relative cardiac dullness usually coincides with the situation of the apex beat, that is why its localization should be defined first. After identifying the location of the apex beat one percusses in the same intercostal space where the apex beat was found, starting from the anterior axillary line towards sternum. The finger-plexor is placed at a 90 degree angle to the ribs. Normally, the left border is located 1-1,5 cm medially to the left midclavicular line.

To determine the *borders of absolute cardiac dullness* one should apply low or super low percussion. The right border corresponds to the left sternal edge, the upper one lies at the lower margin of the 4th rib. The left border typically coincides with the left border of relative cardiac dullness when the person is standing straight. In case of pulmonary emphysema absolute cardiac dullness tends to diminish.

The vascular bundle percussion is performed in the 2nd intercostal space going from both midclavicular lines towards the sternum. The borders do not normally extend beyond the sternum edges.

Auscultation

Auscultation is used to examine heart sounds and to reveal murmurs. For the proper interpretation of sound phenomena appearing during the work of the heart it is helpful to keep to a certain auscultation plan and have a clear idea of the principles underlying it.

For heart auscultation it is better to use both stethoscope nozzles: the so called “bell" (the stethoscope) and the one with a rigid membrane (the phonendoscope). High-frequency sounds such as the 1st sound, the 2nd sound, the systolic click, the regurgitation sound, are better evaluated with the phonendoscope, because its rigid membrane has a high frequency modulation and muffles low-frequency sounds. To reveal these the bell" is generally used. It should be applied to the chest without pressing it to avoid skin tension and formation of a diaphragm assimilating sounds of low frequency. Usually the 3d sound, the 4th sound, the diastolic murmur of mitral valve stenosis and other murmurs are heard only when the “ bell" is used.

Auscultation should be performed in a quite room while the patient is sitting, lying (on his back, on his right or left side). Besides, auscultation can also be carried out with the patient leaning forward and after physical exertion.

Points used during heart auscultation are standard; their numeration corresponds to the proper auscultation order:

1. cardiac apex and the area of the apex beat (the point of mitral valve auscultation);
2. 2nd intercostal space just at the right sternal edge (the point of aortic valve auscultation)
3. 2nd intercostal space just at the left sternal edge (the point of pulmonary arterial valve auscultation);
4. at the xiphoid process basement (the point of tricuspid valve auscultation)

While auscultating the points mentioned above, one should remember they don't coincide with the valves anatomic projections, they are used generally because of sound traveling through the blood flow. Nevertheless some auscultation points correspond to the true heart valves localization. They are:

the 5th point (Botkin's point-II) that is determined near the place of the 4th rib fixation to the left sternal edge (the mitral valve location);

the 6th point (Botkin-Erb's point) that is located in the 3rd intercostal space to the left of the sternal edge and coincides with the aortic valve projection.

In addition to the points mentioned above areas of possible cardiac murmurs conduction should be also auscultated: axillary area, infra- and supraclavicular area, carotid arteries area, interscapular area.

In any case, estimating the work of the heart (its auscultative picture) it is important to begin with the assessment of the heart sounds.

Heart Sounds

Estimating heart sounds one must try to listen to every component of the cardiac cycle separately. One should begin with the 1st sound and the systolic interval, then go to the 2nd sound and the diastolic interval. After that the examiner's attention is paid to the intensity of the sounds and to the presence or absence of any additional sounds or clicks.

The **1st sound** is caused by fluctuations of the mitral and tricuspid valves while they close, and also by fluctuations of the myocardium itself and of large vessels. Consequently, the 1st sound is made up of three elements:

- the valvular one, making the main contribution to its intensity;
- the mascular one, associated with the fluctuations of the cardiac muscle on isometric contractions of the ventricles;
- the vascular one, produced by the aortic walls and pulmonary artery fluctuations at the onset of the period of forcing blood out.

The 1st sound is examined at the heart apex, where in it is louder and longer than the 2nd one in a healthy individual. The 1st sound coincides with the apex beat and the carotid pulse, that is why it is advisable to compare it to the carotid pulsation when in doubt or while training in auscultation skills. The 1st sound is followed by a short pause (systole).

The factors determining the intensity of the 1st sound are:

- the position of the cusps at the beginning of the systole
- he hermeticity of the ventricle chamber in the period of isovolumetric contractions (how tight the cusps close)
- the speed of the valves' closing
- the mobility of the cusps
- the speed (but not the force!) of the ventricles contraction (the size of the ventricles' systolic volume, the metabolism intensity in the myocardium)

Hence, the greater the cusps movement amplitude is and the higher the valves closing speed is, the louder the 1st sound will be. So in tachycardia, when the ventricles filling is decreased and the valve cusps don't have enough time to "float up" by the start of the systole, the amplitude of their movement grows and as a result the 1st sound is loud. In contrast, in bradycardia the 1st sound is of low intensity because of the increased filling of the ventricles and the decreased fluctuation amplitude of the cardiac muscle.

As the fluctuation amplitude (the volume, loudness) of the 1st sound is mostly determined by the valvular and muscular components, weakening of the 1st sound may appear in a heart defect (the mitral valve incompetence, the aortic valve incompetence) or in cardiac muscle damage (myocarditis, cardiosclerosis).

Auscultating a heart a human ear can hear two sounds if they are divided by an interval of 0.03 sec Thus, during the auscultation one can not infrequently hear two elements of the 1st sound, the interval between them being 0.01 – 0.03 sec. This phenomenon is called splitting of the 1st sound. In this case the first element is produced by the mitral valve cusps vibration in the phase of isometric ventricle

tension, whereas the second element is caused by the tricuspid valve cusps vibration in the same phase.

When the interval between the vibrations of the mitral and tricuspid valves cusps is over 0.04 sec. they call it doubling of the 1st sound. It is often found in the right bundle brunch block due to the fact that the right ventricle starts contracting later and the tricuspid valve closed starts fluctuating later than normal. When there is the left bundle brunch block the 1st sound doubling can be much rarer heard as the late coming mitral valve fluctuations coincide with the late coming tricuspid valve fluctuations

The **2nd sound** is brought about by the aortic and pulmonary artery valves cusps fluctuations at the time of their closure and by the fluctuations of the walls of those aorta and pulmonary artery portions which are located over the valves. The quality of this sound is evaluated on the heart basis (where the 2nd sound is louder, shorter and higher than the 1st sound and is heard after a short pause). The 2nd sound is estimated by comparing its intensity on the aorta and pulmonary artery.

Normally, the 2nd sound is perceived as equal both on the aorta and on the pulmonary artery. If it is louder in the second intercostal space on the right, they call it *aortic accent* of the second sound, in case it is louder in the same place on the left it is called *pulmonary artery accent* of the second sound. The accent is most frequently brought about by the increased pressure in the systemic or pulmonary circulation. When the aortic or pulmonary artery valves cusps are united or deformed (in rheumatic heart defect, infectious endocarditis) there may occur weakening of the 2nd sound over the damaged valve.

There may be physiologic doubling (splitting) of the 2nd sound. It does not exceed 0.06 sec. and appears only on inspiration. This is due to the prolonged period of the right ventricle blood expulsion because of its increased filling on inspiration. It should be emphasized that the pulmonary element of the 2nd sound can often be found only within a limited region in the 2nd – 4th intercostal spaces along the left sternal edge, so it can be examined only in this area.

In the diseases accompanied by the significant increase of the blood pressure both in the systemic and pulmonary circulations (the mitral valve stenosis or incompetence, some congenital (inborn) heart defects) pathologic doubling of the 2nd sound arises; this one is well heard both on inspiration and on expiration. So, when a patient has an atrial septum defect and the tricuspid valve incompetence (Ebstein's abnormality) this phenomenon is well-marked and is called the fixed doubling of the 2nd sound.

Besides the principal heart sounds (the 1st and the 2nd ones) the physiological **3d sound** and the juvenile **4th sound** registered on the phonocardiogram can be heard. These are low-frequency sounds occuring with the ventricular walls (more often, of the left ventricle) fluctuations, as a result of their passive filling (the 3d sound) or active one (the 4th sound). Physiological muscular sounds may be found in children (until the age of 6 – the 4th sound), teenagers, young people under the age of 25 (the 3d sound), mainly in the thin ones . The 3d sound appears with the active dilatation of the left ventricle and its quick filling at the start of the systole. It is heard at the heart apex and at the fifth point.

In patients with the heart muscle damage the pathologic 3d and 4th sounds heard are usually associated with the weakened 1st sound over the heart apex and tachycardia, that is why the rhythm formed is called "gallop rhythm". As the 3d sound is found at the start of the diastole it is spoken of as proto *diastolic gallop rhythm*. The pathologic 4th sound occuring at the end of the diastole, i.e. before the systole, is referred to as *presystolic gallop rhythm*.

Auscultating additional heart sounds one should keep it in mind that muscular sounds can be badly heard with the membrane, so it is advisable to apply the "bell" to auscultate them.

*Extrasounds***:** Apart from the muscular sounds an **additional sound** or click of the mitral valve opening – *mitral opening snap* - can be heard during the diastole. It immediately follows the 2nd sound in the mitral orifice stenosis. It can be better examined while the patient is on the left side breathing out, it is heard as a short abrupt sound, as loud as the 2nd sound. The association of the clapping 1st sound, the 2nd sound and the click of the mitral valve opening leads to the appearance of a specific three-element rhythm (the "*quail" rhythm*), which sounds as the Russian phrase "спать пора" ("spat pora"), with the emphasis on the first word (the clapping 1st sound).

Besides that, another quite loud sound, resembling the mitral click very much, may be heard following the 2nd sound during the diastole, this is so called "pericardium-sound". It is found in patients with constrictive pericarditis. In contrast to the mitral valve opening click, it is not associated with the clapping 1st sound.

Another additional sound, a *systolic click*, may also be found in the middle or at the end of the systole. It can be produced by recoiling (prolabing) of the mitral valve cusps (seldom those of the tricuspid valve) into the atrium or by the pericardial layers rub in adhesive pericarditis. The systolic click is a specific sound, it is short and high and resembles the sound of a recoiling can cap.

Heart Murmurs

Heart murmur is a sonic phenomenon occuring in the heart and its vessels at the change of the laminar blood flow to the turbulent one. It is due to various pathologies of the cardio-vascular system: narrowing of the outflow passages (*expulsion murmur*), changes of the speed or direction of the blood flow (*regurgitation murmur*). As to the phase of the cardiac activity murmur is divided into the systolic one, diastolic one and systolic-diastolic one.

Murmur can be functional ("innocent "ones), i.e. it is heard, but there is no damage of cardiac valves (e.g. in anemia, thyrotoxicosis, in the presence of false tendons); it may also be organic, when there is damage of the heart valves (in a heart defect).

Besides that, as to its origin, murmur can be endocardial (in disturbed inner cardiac hemodinamics) and exocardial (e.g. pericardial friction rub).

In order to define the cause of murmur it is necessary to reveal the condition of the heart sounds, the reference of the murmur to a phase of cardiac cycle, the

region of the best possible auscultation, the area of conduction, the timbre and intensity of the murmur, its duration, form and its relation to heart sounds, the change of the murmur character with the change of the body position or carrying out any trial.

To correspond the murmur to a phase of cardiac cycle properly one should palpate pulse on the carotid artery. *Systolic murmur* coincides with the pulse on the carotid. The presence of organic systolic murmur may be caused either by the narrowing of the aorta and pulmonary artery mouth (if the systolic murmur is heard on the heart basis) or by the mitral valve incompetence (if the systolic murmur is auscultated at the heart apex).

Diastolic murmur appears when blood passes from the atria to the ventricles, i.e. into the diastole of the heart. So diastolic murmur at the heart apex shows the presence of the mitral valve narrowing (stenosis) or of the back flow of blood (regurgetation) from the aorta to the left ventricle because of the aortic valve incompetence; diastolic murmur is auscultated on the heart basis.

In a heart defect the murmur epicenter coincides with the point of auscultation of the affected valve. In this case the murmur timbre also plays its part. Thus, coarse sawing or scraping systolic murmur is most often found in the aortic valve stenosis. High blowing sound reminding the sound of Russian “x’ (“kh”) arises in the aortic valve incompetence. Systolic murmur of the mitral valve incompetence, reminding Russian “ш” or “с” (“sh”,”s”), is always conducted to the axillary area (into the armpit). Rolling diastolic murmur, reminding Russian “р”(“r”) is typical for the mitral valve stenosis.

Features	Functional	Organic
Heart sounds	preserved	increased or weakened
Reference of the murmur to a heart cycle phase	usually systolic	systolic and diastolic
Epicenter of the auscultation	more often the apex or pulmonary artery	different points on the heart valve damaged
As to conduction	is not conducted	is conducted to cervical vessels or axilla
Timbre and intensity	soft blowing (labial) reminding ”ф”	usually coarse rolling, of different intensity
Duration	short, taking a part of systole	long,takes all the systole or most of diastole
As to the patient’s body position	best heard in the recumbent position	well heard in any position
Reference to respiration phases	best on inspiration	best on expiration

Trial on physical exertion (10 squattings)	weakens or disapears	increases

According to its form murmur can be decreasing, growing (increasing), rhomboid, sadle-like, spindle-like, tape-like.

Measuring Arterial Blood Pressure

Arterial blood pressure (BP) is assessed mainly by two parameters (measurements): by the size of the systolic output and by the measure of the periphery vessels resistance. Besides, the height of the arterial blood pressure depends on the cardiac activity phases, it increases during the systole (the systolic pressure) and decreases during the diastole (the diastolic pressure).

To measure the arterial blood pressure they use the indirect method suggested by N.S. Korotkov in 1905. While the upper arm tissue is compressed by an elastic rubber cuff, the brachial artery is auscultated for the heart sounds arising at decompression. The moment the heart sounds appear and the moment they disappear are fixed at the manometer (pressure gauge). A patient's blood pressure is measured in the patient's sitting position (if his state allows that). The measurement is repeated not less than 3 times, with the resulting figure being the mean of the three.

Usually, the normal range of the systolic pressure in adults is 100 – 139 mm Hg, and the one of the diastolic pressure is 60 – 89 mm Hg. The arterial blood pressure lower than 100\60 mm Hg means hypotension, an increase of the blood pressure within the limits of 140\90 – 159 – 94 mm Hg is considered the borderline arterial hypertension, the arterial blood pressure of 160\95 mm Hg and over is called arterial hypertension.

According to the modern notion, even a moderate rise of the arterial blood pressure significantly increases the risk of developing ischemic heart disease, brain stroke and other vascular affections with time. Taking the above into account anew approach to the assessment of the blood pressure level (category) has lately been suggested (it was recommended by the World Health Organization in 1999), This present day approach is shown in.

Classification of the Arterial Blood Pressure Level (BP)

Category	Systolic BP	Diastolic BP
Optimal	< 120	< 80
Normal	< 130	<85
High normal	130 – 139	85 – 89
Degree 1	140 – 159	90 – 99
Degree 2	160 – 179	100 – 109

Degree 3	>180	>110

EXAMINATION OF RESPIRATORY ORGANS

Questioning

In any pathology of bronchi or lungs the commonest complains are: cough, expectoration of sputum (phlegm), expectoration of bloody sputum (hemoptisis), breathlessness (dyspnea), pain in the chest, temperature rise and other symptoms of intoxication.

Cough (tussis) is a reflex response to an irritation of the larynx, vocal cord or bifurcation of the trachea and larger bronchi, that is why cough often accompanies any inflammatory process in these areas. There are no cough reflex receptors in the smaller bronchi, so an isolated damage in them may develop without any associated cough.

The time of the cough appearance, its timbre (quality), absence or presence of the phlegm (sputum) are of great diagnostic importance. Thus, a classic symptom of chronic bronchitis is the morning cough, whereas the cough occurring proportionally during the day is characteristic of acute pneumonia and dry pleuritis. Patients with pulmonary tuberculosis have low small hacking cough, those having larger bronchi and upper respiratory affection cough loudly, which is sometimes called “barking” cough.

Cough is also distinguished by the presence or absence of expectoration. There is dry (unproductive) and productive cough accompanied with expectoration of sputum. Dry cough is associated with dry pleuritis, bronchitis; productive cough occurs in pneumonia, bronchitis and when there are cavities in the lungs.

Expectoration of **sputum** is always a sign of pathology. Its amount, quality, colour and smell are of certain diagnostic value.

Sputum is divided into mucous, serous, purulent, mucopurulent and bloody in character. It is important to differentiate between the bloody sputum, the one with streaks of blood, and the rusty (prune juice one that is characteristic of pneumococcal (croupous) pneumonia. Appearance of scarlet blood in the sputum is called hemoptisis.

Pulmonary **dyspnea** is a compensating phenomenon striving to maintain normal gas composition of the blood. There is expiratiry dyspnea (the one with difficulty on breathing out), inspiratory dyspnea (the one with difficulty on breathing in) and mixed dyspnea (the one with the difficulty on both breathing in and out).

When there is an inflammatory process (chronic bronchitis), dyspnea progresses gradually as the lung tissue gradually loses its ability to breathe. Dyspnea is the main sign of pulmonary insufficiency.

Pains associated with the respiratory organs disorders occur because of the involvement of the pleura. They are found in pneumococcal (croupous)

pneumonia, dry pleuritis, pleura carcinomatosis. Such pains are usually rather intense, they increase on deep inspiration, cough and with leaning the body to the healthy side.

Temperature rise, weakness, profuse sweating are distinctive of many diseases, bronchopulmonary system diseases included. These complaints are usually referred to as "common" because they demonstrate common (typical) body reactions to various pathologies.

Inspection

Inspecting the patient one should pay attention to the shape of the chest, the type of breathing, the rate and rhythm of breathing, the simmetricity of the respiratory movements of the left and right side of lungs, participation of subsidiary muscles in breathing. One should also note the skin colour (the presence or absence of cyanosis) and the patient's position.

For instance, during an attack of bronchial asthma the patient is sitting, leaning on his or her arms (orthopnea), while having dry pleuritis the patient stays lying on the ill side as it decreases feeling of pain.

Inspecting the patient's skin the examiner can get an idea of the patient's condition (whether it is severe or not) and of the respiratory insufficiency (how marked it is). A patient with pneumococcal (croupous) pneumonia can have feverish flush on the cheeks, herpetic rash on the lips. In the presence of severe respiratory insufficiency the examiner will find cyanosis, sometimes quite well-marked.

Normally, they differentiate *three types of chest shape*: the normosthenic one, the asthenic one and the hypersthenic one. In a person having the normosthenic chest shape the anterior-posterior measure is smaller than the lateral one and the epigastric angle is close to the rightangle. In a person with the asthenic chest shape the epigastric angle is sharp, the chest is narrow, flat, the ribs are directed obliquely down, the intercostal spaces are narrow. In a person with the hypersthenic chest shape, the chest is cylindrical, with the ribs being situated horizontally and the epigastric angle being obtuse.

There are the following *pathologic types of the chest shape*: a barrel (emphysematous) one, a paralitic one, a rachitic one, a funnel (cobbler's) one, a keeled one, a vessel one. All of them develop both as a result of a chronic disease of the bronchopulmonary system (the emphysematous or the paralytic chest) and due to a chronic disease of the musculoskeletal system (the rachitic chest) or of the nervous system (the vessel chest in syrengomyelia or owing to an injury).

The *types of breathing* are: the thoracic one (in females), the abdominal one (in males) and the mixed one. In a healthy person the respiration rate is 16 – 18 per minute and its proportion to the pulse rate is 1 to 4. In a disorder of a respiratory organ the respiration rate increases whereas the pulse rate remains the same. This is called tachipnosis.

Besides acceleration of the respiration rate the respiration rhythm can also change. For example, in the comatous state the patient has rare and noisy breathing

called Kussmaul's breathing. If the respiration center is affected pathologic respiration of the type called Chayne- Stocks or Biot may develop.

To evaluate the *simmetricity of the chest participation in respiration* the patient is asked to breathe in deeply and breathe out completely and is watched to find out if both parts of the chest act equally (the simmetricity of respiration is estimated by the examiner standing behind the patient, by observing the simmetricity of the scapula angles movement). Lagging behind is noticed in pneumococcal (croupous) pneumonia, exudative pleuritis. It is also important to pay attention to the participation of the subsidiary muscles in the respiration act (the nose wings movements, those of the sternoclavicularmastoid muscle, those of the shoulder girdle and those of the intercostal muscles.

Palpation

Palpation of the chest is begun with one hand examining the skin, subcutaneous tissue, muscles and ribs.

Then both hands are used to palpate the rigidity of the chest, the vocal tremor and to find out any pathologic muscular symptoms. During the palpation the patient is sitting or standing. To determine the chest resistance (elasticity)it is pressed with both hands into different directions: anterior-posterior, lateral ones and sidelong. The degree of elasticity is judged by the amount of the resistance to the compression which is performed by jerks. Normally chest is elastic (with good resistance) and palpation is painless.

Tenderness on palpating intercostal spaces may result from a damage of intercostal muscles, pleura or intercostal nerves. Local tenderness of ribs associated with the sound of crunching (crepitation) often occurs when there is fracture (break) of the ribs.

Sometimes when there is some pathology of the bronchopulmonary system one reveals tenderness of the trapezoid muscles (Sternberg symptom) or their rigidity (Potenger' symptom) usually characteristic of persons ill with pulmonary tuberculosis.

When a person pronounces words vocal cords fluctuations are transmitted down the air shaft of the bronchial tree to the alveoli and farther to the chest. These fluctuations can be felt by the palms applied to the chest. This is the physical basis of the technique of palpation of **vocal fremitus.** Low-pitched vocal fluctuations (natural to males) are conducted better than high-pitched ones (natural to children and women). Determining the vocal tremor you should follow certain rules: a) the person examined repeats the same words with vowels and the sound "r", e.g. the Russian words "raz, dwa, tree, tridzat tree" in a loud voice; b) the palms of the examiner are placed to strictly symmetrical regions of the patient's chest in succession (in the front and on the back).

Increased vocal fremitus is found over the area of consolidated lung tissue and over a cavity formation, that is in the same conditions when bronchial breathing may be heard (auscultated).

Vocal fremitus is absent in atelectasis, exudative pleuritis, pneumothorax.

Percussion

There are topographic and comparative percussion of lungs.

Topographic Percussion of Lungs

The topographic percussion of lungs includes the topography of lungs' apexes, the topography of the lower edge of the lungs, determining the lower edge mobility and the topography of lungs' lobes.

To define the **height of the lungs apexes location** one uses the technique of "quiet" percussion. In the front one should percuss from the middle of the supraclavicular pit up and medially towards the mastoid pricessus. Normally the lung apex is 3 – 5 cm higher than the clavicle is. **At the back one** looks for the lung border from the middle of spina scapulae towards the 7th cervical vertebra at the level of which it is normally located.

The table shows the normal limits of the **lower lung borders**.

Normal lower lung borders

Topographic lines	*On the right*	*On the left*
Midclavicular line	6th rib	Not determined
Anterior axillary line	7th rib	7th rib
Medium axillary line	8th rib	8-9th rib
Posterior axillary line	9th rib	9th rib
Scapular line	10th rib	10th rib
Paravertebral line	11th rib (or XI vertebra spinous process)	

In marked hypersthenics the lower lung border may be located one rib above and in asthenics – one rib below the one mentioned in Table 4.

For determining the **lung margin mobility** percussion is performed along all topographic lines whereas the patient must be breathing in and out. First, the lower lung border is determined with the patient breathing quietly, without any forced respiration. Then the patient is asked to breathe in deeply and hold his breath, this is the moment to percuss until the dullness is reached. As the next step, the patient is suggested to breathe out actively and percussion is carried out downwards till dullness is achieved. The distance between the dullness revealed in breathing in

and out coincides with the lung margin mobility. Normally it makes 6-8 cm along axillary lines. When estimating lower lung margins mobility it is important to pay one's attention not only to their size, but also to their symmetry. Asymmetry is generally observed in case of one-sided inflammatory process (pneumonia, pleuritis, in the presence of commisures), and bilateral lung margin lowering is typical for pulmonary emphysema.

Identifying lung apexes width or **Krenig's fields** also has some diagnostic value. Krenig's fields should be determined on both sides because it is important to estimate their symmetriciy. Percussion is performed along the upper edge of the trapezoid muscle, from its middle, medially and laterally. Normally Krenig's field is 4 to 8 cm. In case of lung apex damaged by tuberculosis with developed fibrosis its size is decreased on the damaged side..

Comparative lung percussion

Comparative lung percussion is carried out successively over anterior, lateral and posterior lung surfaces. When performing comparative lung percussion the following rules should be followed:

- One should carry out percussion in exactly symmetrical regions
- It is necessary6 to sustain percussion conditions identity, i.e. the finger-plexor position, the pressing power on the chest, the percussion intensity. Generally percussion of an average intensity is used, but in case a focus in the depth of a lung is revealed, high intensity percussion should be applied.

At the front of the chest one should percuss beginning with supraclavicular foveae, placing the finger-plexor parallel to the clavicle. Then the clavicle itself and the1st and 2nd intercostal spaces are percussed along the midclavicular lines, with the finger-plexor placed along the course of intercostal spaces.

On the lateral chest surface comparative lung percussion is carried out along anterior, middle and posterior axillar lines, with the patient's arms raised. When the posterior lung surface is percussed the patient is offered to cross his arms on the chest. Then scapules go apart and the interscapular space widens. First, the suprascapular area is percussed (the finger-plexor is placed parallel to scapular spina). Then the interscapular space is percussed successively (the finger-plexor is parallel to the spine). In the infrascapular area one should percuss paravertebrally first and then along scapular lines placing the finger-plexor parallel to the ribs.

Normally in comparative lung percussion **clear pulmonary sound** is heard. It is principally equal in symmetrical chest regions, though it should be remembered that on the right side percussing sound is found to be duller than on the left because the right lung apex is located lower than the left one, the right upper extremity muscle girdle is more developed than on the left in most people, and this partly muffles percussion sound.

Dull or duller pulmonary sound may be revealed in case of decreased lung airiness (pulmonary tissue infiltration), in fluid accumulation in the pleural cavity, in lung collapse (atelectasis), in the presence of a cavity with liquid contents in a lung.

Tympanic percussion sound is determined in case of increased pulmonary tissue airiness (acute or chronic emphysema) which is observed with a number of hollow neoformations: cavity, abscess or air accumulation in the pleural cavity (pneumothorax).

Duller-tympanic sound appears when pulmonary tissue elasticity is decreased and its airiness is increased. Such condition developes in case of pneumococcus (croupous) pneumonia (at the stage of congestion and resolution) in the area of Shkoda's stripe in exudative pleuritis, obturative atelectasis.

Auscultation

Auscultation is carried out in the same succession as comparative lung percussion, it means along the same lines, for auscultating exactly symmetrical chest regions. But in contrast to percussion auscultation should be performed above the shoulder-blades region. The patient is sitting or standing, breathing freely and quietly through his nose, and sometimes at doctor.s request, through his mouth. Respiratory sounds heard at lung auscultation are divided into basic and additional. The basic ones include vesicular and laryngotracheal breathing determined normally and bronchial and harsh breathing observed in pathology. Additional respiratory sounds such as rales, crepitation and pleura friction (rubbing) sound are revealed only in case of pathology. Thus, basic respiratory sounds make background against which additional sounds are heard.

The Main Kinds of Respiratory Sounds

Vesicular breathing results from the tension and fluctuations of the lung alveoli when they are being filled with air in inspiration. This breathing is also sometimes called alveolar one. This type of breathing is characteristic of a healthy person; its sound reminds the sound "f". While auscultating lungs you can hear the breathing during the whole inspiration and only at the start of expiration. Normally vesicular breathing is clearer on the left than on the right. However, on the right inspiration is more marked as the main bronchus is shorter and wider.

Vesicular breathing may *increase or decrease*. An example of the increased vesicular breathing is **puerile** respiration that is found in children under 12, which may be explained both by the fragility and elasticity of the chest and by the narrowness of the bronchi.

Diminished vesicular breathing may be physiologic one (in obese patients) as well as pathologic one (when fluid or air has accumulated in the pleural cavity).

Laringotracheal breathing results when an air stream passes through the vocal slit, which causes vibration of trachea walls and large bronchi. In a healthy person it can be auscultated above the larynx, trachea and in the region of the

trachea bifurcation, i.e. in the area of manubrium sternum (breastbone) and in the interscapular space up to the IVth thoracic vertebra. Laringotracheal breathing can be heard both on inspiration and expiration, with the accent being on expiration. This type of respiration resembles the sound "kh."

Laringotracheal breathing is a high frequency sound (600 - 800 Hz). It is conducted from the point of its origin to small bronchi, here it is drowned by the fluctuations of low frequency (about 120 Hz) characteristic of vesicular breathing. That is why normally only the vesicular breathing can be auscultated over the lungs.

The laringotracheal breathing can be heard over lungs (where normally only vesicular breathing is found) due to two reasons. First, conduction of the physiologic laringotracheal breathing may be increased which shows the presence of consolidated lung tissue; secondly, there may be an increase of the laringotracheal breathing which shows cavities development in the lung (thanks to the resonance phenomenon). In this case laringotracheal breathing is called **bronchial**. Therefore, bronchial breathing results from the conduction of the laringotracheal breathing to the periphery, it may occur in pneumococcus (croupous) pneumonia at its peak (hepatization), in pneumophibrosis, in an inflammatory process, tuberculosis with cavity formations in the lung included.

Amphoric breathing is a kind of bronchial breathing. It can be revealed only in the presence of a big cavity in a lung (not less than 5 cm in its diameter).with smooth, even walls. Amphoric respiration develops when additional high pitched tone, resulting from reflection of the cavity wall fluctuation, is added to the bronchial breathing. The specific respiration murmur developing under these conditions resembles the sound of air being blown into an empty vessel. The amphoric breathing is heard when there is a big abscess or cavity in the lung.

Harsh breathing may be found only in a pathology: a focal consolidation in a lung or narrowing of the vessel lumen.

There is no agreement on the origin of harsh breathing yet. A number of authors consider it to be a kind of vesicular respiration. It is so- called "local theory" which says that when small bronchi get narrow due to the swollen mucous membrane, on inspiration air friction increases because of the increased resistance to the air stream, and the sound of harsh breathing results. Another theory called "conduction theory" says that when there is a peribronchial consolidation or focal pneumonia laringotracheal breathing is conducted to the periphery, but normal lung tissue surrounding the focus modifies the sound to harsh breathing.

Additional Respiratory Murmur

Apart from defining the main breath sounds it may be necessary to estimate additional murmurs which are: rales, crepitation and pleural friction rib. They distinguish moist and dry rales depending on the quality of exudate in the bronchi.

Dry rales (Wheeze and Rhonchi) are revealed in cases of acute and chronic inflammation of the tracheobronchial tree and during an attack of bronchial asthma. The mode of dry rales is determined by the diameter of the bronchi. So,

whistling or descant (treble) rales result from the turbulent stream of air through small bronchi constricted due to an inflammatory process. Bronchi of average diameter produce *buzzing* rales, large bronchi give *droning bass rales*. Both buzzing and droning rales originate thanks to fluctuations of threads of thick (adherent) secreted discharge going between the opposite sides of bronchial walls in the air stream. The amount of dry rales may vary from single ones to multiple rales disseminated over the whole lung surface.

Dry rales are characterized by inconstancy and changeability, they may disappear and reappear in the same place during a short while. The buzzing and droning rales are better heard on inspiration, whereas the whistling rales are better auscultated on expiration.

Moist rales (Crackles) are produced when air passes through liquid exudate. According to the bronchi diameter they are divided into fine bubbling, average bubbling and coarse bubbling rales. *Fine bubbling* rales are formed in small bronchi and they are typically auscultated in pneumonia. *Average bubbling* rales develop in average bronchi, they are heard in acute bronchitis and exacerbations of chronic bronchitis. *Coarse bubbling* rales are produced in large bronchi. They are discovered in pulmonary edema (swelling), above a cavity, an abscess and bronchoectasis. Quite often one can find various moist rales of every size over lung cavities at the same time.

Moist rales can be heard in both phases of respiration; however, they are best heard on inspiration. The moist rales heard above a lung tissue consolidation or over a cavity are especially sonorous, they seem to be heard at the very ear of yours. They are called sonorous rales. Non-sonorous rales are auscultated in bronchitis, blood congestion in the lungs when the surrounding tissue is not changed.

Crepitation is a special kind of moist rales. Crepitation is an additional murmur arising when alveoli come unstucked at the end of the inspiration phase. That is why in contrast to moist bubbling rales crepitation is heard only during inspiration. The sound resembling crepitation is well imitated by rubbing a strand of hair near your ear. This phenomenon occurs in croupous pneumonia, incomplete atelectasis, at an early stage of pulmonary edema.

Pleural friction rub is a specific sound symptom arising over the chest surface when changed visceral and parietal layers rub each other. This sound is most often heard in the presence of an inflammatory process, when fibrin is deposited on the pleural layers forming irregular thickening on their surface.

Pleural friction rub has some specific features:

1. it is felt as a superficial sound heard at the very ear;
2. it is heard in both phases of the respiratory cycle;
3. in contrast to rales it is heard in a limited area, i.e. only in the region of pathologically changed pleura;
4. it is more often found in the lower lateral portions of the chest where respiratory excursion of the lungs is maximal;
5. it is usually associated with painful sensations;
6. it increases when a stethoscope is pressed into the chest.

Bronchophony is an acoustic (phonic) equivalent of vocal fremitus. It is also due to the conduction of voice from the larynx along the bronchial tree onto the chest surface. To discover the bronchophony phenomenon the person examined is offered to pronounce words containing the sounds “sh.”, “ch” etc like Russian words “чашка чая”, “шестьдесят шесть” in whisper, while the examiner auscultates the symmetric regions of lungs with a stethoscope.

In a healthy person the words pronounced are not differentiated, only indistinct droning is heard. If there is any consolidated lung tissue or a cavity the words pronounced are heard very distinctly (increased bronchophony). The bronchophony technique is more sensitive than the technique of vocal fremitus as it allows to reveal small-sized foci of consolidated lung tissue at the early stage of their formation.

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