

DIAGNOSTIC METHODS IN CASE OF INTERNAL DISEASES

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**ДОПОЛНИТЕЛЬНЫЕ МЕТОДЫ ИССЛЕДОВАНИЯ
ПРИ ЗАБОЛЕВАНИЯХ ВНУТРЕННИХ ОРГАНОВ**
DIAGNOSTIC METHODS IN CASE OF INTERNAL DISEASES

Практикум



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PART 1. LABORATORY DIAGNOSTICS

In the diagnosis of diseases and in the process of treatment, patients undergo a variety of diagnostic examinations, among which an important place is occupied by clinical laboratory tests.

Laboratory tests are performed using biological material that is taken from the patient. The doctor prescribes the necessary laboratory tests and interprets their results. The nurse ensures the interaction between the laboratory, the patient and the doctor: she is responsible for the proper preparation for the test, the reception and collection of biological material, and the correct and timely delivery of it to the laboratory.

The most popular tests doctors use in therapeutic practice are as follows:

- complete blood count (CBC);
- urinalysis;
- biochemical blood analysis;
- sputum tests;
- examination of pleural fluid and other biological fluids;
- stool tests.

It should be noted that the “normal values” of laboratory parameters are the values found in a carefully examined group of people without objective signs of pathology. Since the term “normal values” is difficult to interpret, it was proposed to replace it with the concept of “reference values”, that is, the values given for comparison

The reference interval usually includes the central 95 % of the values, i.e., 2.5 % of the minimum and maximum values are discarded. Currently, due to the significant diversification of laboratory research methods, it is impossible for all indicators to provide unified reference values. In each laboratory, the reference

interval may differ slightly (and sometimes significantly). Therefore, when interpreting the results of laboratory studies, it is necessary to rely not on abstract “normal” values, but on the reference values of the particular laboratory that performed the analysis.

When interpreting the results of laboratory and instrumental studies, it should be remembered that there are no absolute methods. This means that even with the error-free execution of the preanalytical and analytical steps, there are a small number of patients in whom this method does not confirm the existing disease (or indicates the disease in its absence). For example, in case of a bacterial infection, an increased level of leukocytes (leukocytosis) in the peripheral blood occurs in 90 % of patients; however, some patients have a decrease in the number of leukocytes (leukopenia) or their normal level. These patients will have false negative test results in relation to the underlying disease, which may lead to the false conclusion that there is no bacterial infection.

On the other hand, leukocytosis can occur in patients with leukemia, and our conclusion about the presence of a bacterial infection in this patient will be false in relation to the patient's disease (false positive result).

Therefore, when we interpret the results of laboratory and instrumental examinations, especially if these are new or rarely used methods, we must know the characteristics of the method: sensitivity and specificity.

Sensitivity measures the proportion of truly positive results that correctly indicate an underlying disease (the proportion of those who do have a disease who are correctly identified by the method as suffering from that disease).

Specificity measures the proportion of truly negative outcomes (the proportion of those who do not have the disease who are correctly identified as not having the disease).

Thus, if the sensitivity of the test is 98 % and its specificity is 92 %, the false-negative rate is 2 %, and the false-positive rate is 8 %.

Complete Blood Count (CBC)

An important condition for ensuring the quality of laboratory blood tests is taking the material on an empty stomach in the morning. 12 hours before examination the patient should exclude alcohol, smoking, eating, and should limit physical activity. After dinner, it's necessary not to eat, go to bed the night before at the usual time for the patient and get up no later than 1 hour before the blood sampling. CBC should be taken before radiological, endoscopic examinations or physiotherapy (if they are performed on one day). Patients should exclude medication intake in the morning before blood sampling (if it's impossible to stop taking the medication, it's necessary to make a note about it for the laboratory). Right before taking blood tests, the patient should reduce physical activity and emotional stress and have a rest 10–15 minutes before the procedure and calm down.

CBC is a basic and one of the first tests for determining the hematological status and diagnosis of various hematological and non-hematological pathologies. The purpose of this blood test is a quantitative and qualitative analysis of blood cells (erythrocytes, leukocytes, platelets), determination of hemoglobin and erythrocyte sedimentation rate (ESR). Currently, most indicators are performed on automatic hematology analyzers, which are able to simultaneously determine from 5 to 24 parameters of blood.

The main ones are the number of leukocytes, erythrocytes, hemoglobin concentration, hematocrit, mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), mean corpuscular volume (MCV), platelets, mean platelet volume (MPV), etc.

Erythrocyte sedimentation rate (ESR) is measured in mm per hour. Two methods are used: Panchenkov's and Westergren's. The Westergren's method is an international method, it is more sensitive to increased ESR, and has more accurate results in the zone of elevated ESR values.

ESR increases when the ratio of blood protein fractions is disturbed (albumins slow down erythrocyte sedimentation, globulins and fibrinogen accelerate it). An increase in ESR is observed in various inflammatory processes, infectious diseases, rheumatic and oncological diseases, tuberculosis, myocardial infarction. ESR decreases in case of blood clotting (polycythemia, cholera, food toxicoinfections).

Hemoglobin is the red blood cell pigment. It's a carrier of oxygen from the lungs to the tissues and carbon dioxide from the tissues to the lungs. Currently, hemoglobin is determined automatically using the photometric method. The amount of hemoglobin is significantly reduced with anemia, other blood diseases, and malignant tumors.

Erythrocytes (red blood cells, RBC) are the most numerous blood cells that don't contain nuclei. The main function of RBC is oxygen transport from the lungs to the tissues and carbon dioxide from the tissues to the lungs with the help of hemoglobin. The red blood cells shape (a biconcave disc) gives the optimum ratio of volume to surface for the gases exchange, and provides RBC with the ability to deform during microcirculation. The red blood cells count underlies the assessment of erythropoiesis. The red blood cells count is used to calculate the hemoglobin concentration and hematocrit. Mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), mean corpuscular volume (MCV) characterize RBC quality. A low level of red blood cells below normal indicates the presence of anemia. A decrease in

their number to $1 \cdot 10^{12}$ cells/l is a life-threatening condition. In patients with erythremia, the number of red blood cells increases to $8\text{--}12 \cdot 10^{12}$ cells/l.

Platelets (thrombocytes) are round or oval in shape and take part in a blood clot formation. The number of platelets increases in case of bleeding, surgery, cancer. Thrombocytopenia occurs with Verlgof's disease, leukemia, and infectious diseases.

Leukocytes (white blood cells, WBC) are divided into several groups: depending on their affinity for staining in blood smears, three types of granulocytes are identified: neutrophils, eosinophils, and basophils. Lymphocytes and monocytes don't contain specific cytoplasmic granules, and have a non-segmented nucleus. In healthy individuals, the number of leukocytes ranges from $4\text{--}9 \cdot 10^9$ /l. When the number of leukocytes exceeds $9 \cdot 10^9$ /l, we are talking about leukocytosis; the number of white blood cells below $4 \cdot 10^9$ /l is called leukopenia. Leukocytosis is observed in many diseases of the blood system (leukemia, Hodgkin's disease), in purulent inflammation (abscess, appendicitis, cholangitis), pneumonia and myocardial infarction. Leukopenia can occur in case of blood diseases, liver cirrhosis, poisoning, radiation sickness, as well as with some infectious diseases (viral hepatitis, brucellosis, influenza, typhoid fever). The leukocyte count is the ratio between the various forms of white blood cells.

To determine the leukocyte count, the coloring according to Romanovsky–Giemsa is used. The colorant is a mixture of acid and alkaline paints. Acidic substances in a blood smear are stained in blue color, alkaline substances are red color, while neutral get both colors and turn in purple color.

Neutrophils amount to 50–70 % of leukocytes. Their cytoplasm is stained in light pink, granules are purple. Neutrophils are divided into band and segmented. Eosinophils have

a characteristic bright red grain and a segmented core. Basophils are the smallest granulocytes, the nucleus of basophils has an irregular shape and occupies almost the entire cell.

Lymphocytes have a central, round or bean-shaped core, stained in blue-violet color.

Monocytes are the largest blood cells. Their horseshoe-shaped or irregular shaped core are stained purple-red. Cytoplasm has a purple-blue color with a delicate reddish texture.

Neutrophils perform a protective function in the body. They fight against microbes and toxins. During infections, intoxication, their number increases significantly. At the same time, immature forms appear: the number of band neutrophils increases, young neutrophils, promyelocytes, and myelocytes appear. An increase in young forms of neutrophils is called a shift of the leukocyte count to the left. Toxic granulation of neutrophils — the appearance of large dark purple granules in the cytoplasm of neutrophils — indicates a severe bacterial infection, sepsis, or marked intoxication.

The number of eosinophils increases in case of allergic diseases, connective tissue diseases, and diseases of the blood system. Eosinophilia is characteristic of parasitic diseases, scarlet fever, and Hodgkin's disease. In some diseases (tuberculosis, typhoid fever), their number, on the contrary, decreases. Basophils take part in the immune response. Basophilia can occur in acute infectious diseases, leukemia, and allergic reactions. The main function of lymphocytes is to provide humoral immunity. An increase in the number of lymphocytes (lymphocytosis) is observed in tuberculosis, thyrotoxicosis, and especially in lymphocytic leukemia. Lymphopenia occurs in case of Hodgkin's disease, viral infections, autoimmune diseases. Monocytes are cells of the innate immune response, after entering the blood they are in the bloodstream for 1–2 days, then they settle down in

the tissues. Monocytosis is observed in malaria, tuberculosis, monocytopenia occurs in case of severe sepsis, typhoid fever.

Biochemical Blood Analysis

A biochemical blood analysis includes a long list of indicators. The number of these indicators depends on the capacity of the clinical laboratory. In the practice of the hospital, there is an order that defines the minimum number of biochemical tests. This minimum volume usually includes:

1. Renal function parameters (urea and creatinine). In addition, based on creatinine, the doctor needs to calculate the glomerular filtration rate (GFR). This is a very important indicator that allows you to individualize the functional state of the kidneys. Several formulas can be used: Cockcroft-Gault formula, MDRD formula, CKD-EPI formula, and others. To calculate GFR, in addition to the creatinine level, it is necessary to know the patient's gender, age, height and weight. In some laboratories, GFR is calculated automatically, but usually the doctor does it on his own using a special calculator program.

2. Liver function parameters: total bilirubin, direct and indirect bilirubin, alanine transaminase (ALT), aspartate transaminase (AST), lactate dehydrogenase (LDH), total protein, albumin. The activity of gamma-glutamyltransferase (GGTP), alkaline phosphatase (ALP) is also evaluated. The level of bilirubin increases in case of jaundice (hemolytic jaundice is characterized mainly by an increase in the level of indirect bilirubin, hepatocellular and obstructive jaundice — mainly by an increase in direct bilirubin). AST and ALT are key markers of hepatocyte damage. GGTP and ALP are indicators of cholestasis. LDH increases in case of liver damage, myocardial infarction, hemolysis, lung damage or tumors of various localizations.

3. Peripheral blood glucose level.

4. Electrolytes: sodium, potassium, chlorides, calcium, iron. Sodium is necessary for muscle contraction, heart function, and transmission of nerve signals. Hyponatremia occurs due to renal failure, heart failure, liver cirrhosis, and diuretic use. Hypernatremia is most often a consequence of dehydration.

Potassium is mainly intracellular, its concentration in blood plasma is small, however, it is a critically important electrolyte, maintaining membrane potential, water and acid-base balance. Hyperkalemia develops due to insufficient excretion of potassium from the body (renal failure) or massive cell destruction and leads to marked bradycardia, up to complete cardiac arrest. Hypokalemia is most often caused by diuretic use and is dangerous due to the development of tachyarrhythmia.

Hyperchloremia occurs in case of dehydration, impaired renal excretory function, diabetes insipidus, respiratory alkalosis, adrenal insufficiency. Hypochloremia occurs after repeated vomiting, profuse diarrhea, uncontrolled use of diuretics, renal failure and metabolic alkalosis.

Serum iron decreases in case of chronic blood loss, insufficient intake from food, malabsorption and increased demand (pregnancy, childhood and adolescence). An increase in blood iron levels may be associated with the intake of iron-containing medications, previous blood transfusion, or hereditary causes (hemochromatosis).

5. C-reactive protein (CRP) level is used to assess inflammatory changes.

6. The state of the cardiovascular system is estimated by different groups of parameters as follows:

6.1. Lipid metabolism parameters: total cholesterol, high density lipoprotein cholesterol (HDL-C), low-density lipoprotein

cholesterol (LDL-C), triglycerides. The lipid profile is used to assess the risk of developing atherosclerosis and its complications. HDL-C transports lipids from the vascular wall; its high level reduces the risk of cardiovascular disease. LDL-C transports fats to tissues; its high level contributes to the formation of atherosclerotic plaques. The atherogenic coefficient ($AC = (\text{Total cholesterol} - \text{HDL-C}) / \text{HDL-C}$) is also calculated. AC values above 4.0 indicate a high risk of cardiovascular disease.

6.2. Myocardial damage parameters: troponin, myoglobin, creatine kinase (CK) and its MB fraction (CK-MB).

Depending on the diagnostic hypothesis, we have a fairly wide range of possibilities: for example, the state of the pancreas can be judged by the activity of amylase; in case of anemia, it is useful to determine serum iron, its carrier transferrin, its tissue stores ferritin, etc.

Urinalysis

Urinalysis is an important diagnostic test not only for kidney and cardiovascular diseases, but also for diseases of other organs and systems. Various pathological processes affect the properties of urine. The results of urine tests allow us to assess the disease course and effectiveness of treatment.

For urinalysis, it's necessary to collect strictly morning urine collected immediately after awakening. The patient shouldn't take diuretics, alcohol, spicy and salty food, products that change the color of urine (beets, carrots) on the day before urine collection. Before urine collection, the patient should perform genital hygiene without using antiseptics. Women are not recommended to take a urine test during menstruation. In case of urgency, urine is taken with a catheter. Urine is collected in a sterile disposable container. The container after collection is tightly closed with a lid, placed in a clean disposable bag and delivered to the laboratory.

For urinalysis, the middle portion of morning urine is collected (at least 50 ml). Urinalysis includes determination of physical properties, chemical analysis and microscopic examination of the sediment.

Physical properties of urine. The color of urine normally depends on its concentration and ranges from amber-yellow to straw-yellow. Colorless urine is observed in case of increased diuresis (after taking diuretics, in case of diabetes mellitus). Dark-yellow urine color, like beer color, occurs in case of jaundice due to the presence of bile pigments. The urine of the color of meat slop is observed in case of hematuria, for example, in glomerulonephritis. Normal urine is clear. Turbidity of the urine can be caused by the presence of salts, cellular elements, mucus, fat, bacteria. Smell: fresh urine of a healthy person has no smell. If the urine was in a warm room for a long time, it acquires a characteristic ammonia smell. In case of diabetes mellitus, in some cases acetone may appear in the urine, and then the urine acquires a "fruity" odor.

Reaction of urine (pH): in case of a mixed diet, urine has an acidic or neutral reaction; in case of acidosis, it becomes more acidic; in case of alkalosis, it becomes more alkaline. In case of diseases accompanied by the appearance of acidic metabolic products in the blood (uremia, diabetes mellitus, heart failure), urine becomes sharply acidic. The pH of urine is determined by titration, using a pH meter and litmus paper. The density of urine ranges from 1001 to 1040. The density of the primary urine is 1010–1012, i.e., it is equal to the plasma density. The excretion of urine with a constant density of 1010–1012 is called isostenuria, the excretion of urine with a lower density is called hyposthenuria. Prolonged hyposthenuria is a poor prognostic sign. The amount of urine depends on the amount of fluid intake, ambient temperature

and physical activity. A healthy person produces 1000–2000 ml of urine per 24 hours.

Normally, most urine is excreted during the day. Excretion of urine mainly at night (nocturia) is observed in chronic kidney failure and in chronic heart failure.

Chemical examination of urine. The presence of protein, urobilin, glucose, acetone, salts is determined in the urine. By a special test, the concentration of certain enzymes, hormones, drug metabolites, alcohol, etc. can be determined. Protein: urine of a healthy person contains a minimal amount of protein (0.03 g/l). Urinary protein excretion is called proteinuria. Proteinuria can be renal and extrarenal. In renal proteinuria, protein enters the urine from the blood plasma due to damage to the glomerulus (glomerulonephritis, nephrotic syndrome) or increased permeability of the nephron under the influence of an external stimulus (cold, physical activity). Extrarenal proteinuria can be prerenal (associated with an excessive concentration of protein in the blood plasma, for example, in multiple myeloma) and postrenal (associated with diseases of the urinary tract).

Glucose: urine of a healthy person does not contain glucose. In case of diabetes mellitus, diseases of the pituitary gland, adrenal glands, and taking certain medications, glucosuria occurs. Ketone bodies include acetone, acetoacetic acid and beta-oxybutyric acid. They appear in the urine in case of a complication of diabetes mellitus (diabetic ketoacidotic coma), as well as in acute liver and kidney damage, during intoxication, and starvation.

Microscopic examination of the urinary sediment is done to evaluate cellular elements in the urine — erythrocytes, leukocytes, casts, epithelial cells. The presence of red blood cells in the urine is called hematuria. There is macrohematuria, when the amount of blood in the urine is so great that the urine becomes red, and

microhematuria, in which red blood cells are detected only under a microscope. Unchanged erythrocytes are found when blood enters the urine through a damaged vessel (in case of kidney infarction, kidney stones, cancer, kidney tuberculosis, injuries, as well as in cystitis and urethritis). Changed erythrocytes are found when erythrocytes enter the urine directly through the nephron (in case of glomerulonephritis). Leukocytes in the urine of healthy people are found in small numbers (3–5 per high-powered field). If leukocytes cover the entire field of view, it is called pyuria; this occurs in case of kidney damage (pyelonephritis), bladder damage (cystitis) and urinary tract damage.

Casts are cylindrical structures formed from protein in the kidney's renal tubules. The appearance of casts in the urine (cylindruria) indicates the damage to the epithelium of the renal tubules.

Epithelial cells can be represented by squamous, transitional and renal epithelial cells. Squamous epithelial cells have a round or polygonal shape with a small nucleus. They enter the urine from the external genitalia or urethra. Transitional epithelial cells line the mucous membrane of the urinary tract. The presence of a large number of these cells in the urine indicates an inflammatory process in the bladder. Renal epithelial cells have an irregular round, polygonal shape. Their appearance is a characteristic sign of damage to the kidney parenchyma.

Nechiporenko's urine test is usually prescribed after a urinalysis and collected separately from it (on another day). The purpose of the test: to evaluate the number of cells (leukocytes, erythrocytes) and casts per unit volume of urine. According to the results of Nechiporenko's urine test in healthy people, the number of leukocytes in urine is $0-4 \cdot 10^6/l$, erythrocytes — $0-2 \cdot 10^6/l$, casts —

$0-0.25 \cdot 10^6/l$. The method of collecting urine for Nechiporenko's urine test is the same as for urinalysis.

The purpose of Zimnitsky's urine test is to evaluate the concentration function of the kidneys, daytime, nighttime and total diuresis. For this test, 8 containers for urine collection are needed. The patient collects urine during the day every three hours, including at night, in separate containers. Labels are stuck on the containers with the indication of the number and time when this portion was received. Urine collection begins after 6.00 in the morning, is carried out every three hours, the last portion at 6.00 the next day. Containers with urine must be stored in a cool place, for example, in a refrigerator on the lower shelf at $t = +4\text{ }^{\circ}\text{C}$, without allowing freezing. Each container must be tightly closed with a lid, placed in clean disposable bags and delivered to the laboratory.

Note!

The reference values of laboratory parameters given in workbook are not universal and may vary depending on the laboratory and the reagents used.

Sputum Examination

Sputum should be collected in the morning before breakfast and medication. To prevent saliva from entering, the mouth should be rinsed with water. The patient needs to take two deep breaths, holding the breath for a few seconds after each inhalation and exhaling slowly. After the third breath, he should cough up well, collect the secreted sputum in a container and immediately close the lid.

During macroscopic examination of sputum, the amount, smell, consistency, character, color, and the presence of

pathological impurities are determined. In bronchitis, bronchial asthma, lobar pneumonia, patients produce sputum in single portions. In the presence of bronchiectasis, the amount of sputum can be 0.5 liters or more per day. By consistency, sputum can be liquid, viscous and thick. In bronchitis and bronchopneumonia, sputum is liquid or moderately viscous, while in lobar pneumonia it is thick and difficult to separate. The character of sputum is mucous, mucopurulent in bronchitis and bronchial asthma, serous in pulmonary edema, purulent in bronchiectasis and lung abscess. Bloody sputum contains blood in various quantities. In some cases, it consists almost entirely of blood (in case of pulmonary hemorrhage), in others, it contains blood in separate portions (tuberculosis, abscess, lung cancer). The color of sputum depends on the nature of the disease: for lung cancer, sputum of a crimson color is characteristic; for lobar pneumonia, it is rusty. Purulent sputum usually has a yellow or green color; in bronchial asthma, transparent "vitreous" sputum is produced. The smell of sputum is often absent. A foul odor arises from the purulent decay of lung tissue (lung gangrene, lung cancer), as well as from the decomposition of protein when sputum is retained in cavities (bronchiectasis, lung abscess). Impurities in sputum include the presence of fibrin from the bronchi in lobar pneumonia, Kurschmann spirals and Charcot-Leyden crystals in bronchial asthma.

Microscopic examination of sputum is carried out in both native (unstained) and stained preparations. In the first case, a portion of sputum is applied to a glass slide, covered with a cover glass and then examined under a microscope under different magnifications. In the native preparation, epithelial cells, leukocytes, erythrocytes, actinomycetes, hematin crystals and fatty acids are examined.

Squamous epithelial cells are found in the oral cavity and should be absent or found in sputum in minimal amounts. If more than 10 squamous epithelial cells per field of view are detected in the sputum sample, further analysis is not performed, as the rules for sputum collection were violated and the fluid being studied has a large admixture of saliva. Ciliated columnar epithelial cells are cells of the mucous membrane of the larynx, trachea and bronchi; they are found in bronchitis, tracheitis, bronchial asthma, and malignant neoplasms. Alveolar macrophages are found in chronic processes and at the stage of resolution of acute processes in lung tissue.

Eosinophils in sputum are found in allergic diseases (bronchial asthma). Charcot–Leyden crystals appear as shiny transparent crystals; they are formed when eosinophils are destroyed. Kurschmann spirals are twisted cylinders of transparent mucus, peculiar casts of small bronchi, occurring in bronchial asthma. Elastic fibers are double-contoured shiny formations; they are formed during the breakdown of lung tissue and are found in tuberculosis, cancer and lung abscess. Hematoidin crystals have the shape of rhombuses or starlets of a golden color and are found in hemorrhages in lung tissue. Cells of malignant tumors enter the sputum when they disintegrate. These cells are large, have different shapes, a large nucleus, and sometimes several nuclei. Actinomycetes consist of a central part, which is a plexus of mycelium, and radiantly located flask-shaped formations surrounding it. Acid-fast bacteria (AFB) are a type of bacteria that cause tuberculosis.

Pleural Fluid Examination

Fluid that accumulates in cavities is obtained by puncture of serous cavities (pleural, abdominal, pericardial). Depending on the properties of the accumulated fluid, as well as the nature of the pathological process in the pleural cavity, there are:

- hydrothorax — accumulation of transudate in the pleural cavity, the so-called non-inflammatory fluid;

- exudative pleurisy — an inflammatory process accompanied by the accumulation of exudate in the pleural cavity (an inflammatory fluid);

- empyema (pyothorax) — purulent inflammation of the pleura, accompanied by the accumulation of pus in the pleural cavity;

- hemothorax — accumulation of blood in the pleural cavity; most common in case of chest injury;

- chylothorax — accumulation of lymph in the pleural cavity, most often found in case of injury to the thoracic lymphatic duct or mediastinal tumors.

Rivalta's test is a qualitative test for differentiating transudate and exudate: a drop of pleural fluid is dropped into a weak solution of acetic acid (100 ml of water + 2–3 drops of glacial acetic acid). The appearance of a “white cloud” slowly settling down indicates a high protein content (seromucin) and is regarded as a positive result characteristic of exudate; transudate gives a negative reaction — the drop dissolves without a trace.

It should be noted that normally the amount of pleural fluid is very small and amounts to 10–20 ml, distributed over the entire fairly large area of the pleura. It is very difficult to extract pleural fluid for analysis when its amount is normal. Pleural puncture is possible, although difficult, when the accumulated fluid volume exceeds 100 ml, and in almost all cases it is possible when the accumulated fluid volume exceeds 400 ml.

When interpreting the obtained pleural fluid, it is first necessary to differentiate the effusion as *transudate* (edematous fluid of a non-inflammatory nature, accumulating with increased hydrostatic or decreased oncotic pressure) and *exudate* (fluid of an inflammatory nature, accumulating in infections, injuries or tumors).

Differential diagnosis of the exudates and transudates

Characteristics	Transsudat	Exudate
Color	pale yellow	dark yellow, orange, green
Transparency	transparent	transparent or cloudy
Density	less than 1.015	more than 1.015
Protein concentration	less than 20 g/l	more than 30 g/l
The ratio of protein content effusion/serum*	less than 0.5	0.5 and more
LDH activity*	less than 200 u/l (less than $\frac{2}{3}$ upper reference limit for blood)	more than 200 u/l (more than $\frac{2}{3}$ upper reference limit for blood)
The ratio of the activity of LDH effusion / serum*	below 0.6	over 0.6
Rivalt test	negative	positive
Glucose concentration	more than 3.33 mmol/l	less than 3.33 mmol/l
Cells	little amount	high cell count
Causes	heart failure (cardiogenic hydrothorax), liver cirrhosis, nephrotic syndrome, severe hypothyroidism	pneumonia (para- and metapneumonic pleurisy), infectious destruction of the lungs, tuberculosis (tuberculous pleurisy), metastatic damage to the pleura, pleural mesothelioma, systemic vasculitis, sarcoidosis, pneumoconiosis

Parameters marked with * are called “Light’s criteria” (R. W. Light) and allow to differentiate exudate with a sensitivity of 100 % and a specificity of 80 %.

COMPLETE BLOOD COUNT (CBC)

Note!

The reference values given in the workbook are not universal and may vary at different laboratories and using reagents.

1. CBC				
Parameter	Reference value		Unit	Note
	male	female		
RBC	3.8–5.7	3.5–5.1	10^{12} /l	
Hemoglobin	130–160	120–150	g/l	
Hematocrit	40–52	36–42	%	
MCV	80–95		fl.	
MCH	27–33.3		pg	
MCHC	300–370		g/l	
Reticulocytes	0.5–1.5		%	
WBC	4–9		10^9 /l	
Platelets	150–450		10^9 /l	
ESR Panchenkov’s method	2–10		mm/h	male
	2–15		mm/h	female
ESR Westergren’s method	1–15		mm/h	before 50 y.o.
	1–20		mm/h	after 50 y.o.
Leukocyte count				
Parameter	%		10^9 /l	Note
Basophils	0.5–1		0.01–0.065	
Eosinophils	1–5		0.02–0.5	from 5 y.o.
Neutrophils: band	1–6		0.04–0.57	from 14 y.o.
segmented	47–72		1.8–6.5	from 5 y.o.
Lymphocytes	19–39		1.5–4	from 5 y.o.
Monocytes	2–11		0.05–0.8	from 14 y.o.
Conclusion:				

2. CBC		
PATIENT'S NAME: IVANOV II		
AGE: 67 y.o.	Sex: male	
Parameter	Result	Note
RBC	$3.5 \cdot 10^{12} /l$	
Hemoglobin	103 g/l	
Hematocrit	44 %	
MCV	82 fl.	
MCH	28 pg	
MCHC	310 g/l	
Reticulocytes	1 %	
WBC	$5.4 \cdot 10^9 /l$	
Platelets	$322 \cdot 10^9 /l$	
ESR	12 mm/h	
Leukocyte count		
Basophils	1 %	
Eosinophils	2 %	
Neutrophils: band	3 %	
segmented	52 %	
Lymphocytes	37 %	
Monocytes	5 %	
Conclusion:		

3. CBC		
PATIENT'S NAME: IVANOVA II		
AGE: 62 y.o.	Sex: female	
Parameter	Result	Note
RBC	$2.8 \cdot 10^{12} /l$	
Hemoglobin	74 g/l	
Hematocrit	38 %	
MCV	66 fl.	
MCH	25 pg.	
MCHC	260 g/l	
Reticulocytes	0.4 %	
WBC	$6.6 \cdot 10^9 /l$	
Platelets	$360 \cdot 10^9 /l$	
ESR	50 mm/h	
Leukocyte count		
Basophils	1 %	
Eosinophils	2 %	
Neutrophils: band	5 %	
segmented	49 %	
Lymphocytes	37 %	
Monocytes	6 %	
Morphology	Poikilocytosis Anisocytosis (microcytes)	
Conclusion:		

4. CBC		
PATIENT'S NAME: IVANOVA II		
AGE: 62 y.o.	Sex: female	
Parameter	Result	Note
RBC	$3.1 \cdot 10^{12} /l$	
Hemoglobin	52 g/l	
Hematocrit	20 %	
MCV	64 fl.	
MCH	15 pg.	
MCHC	230 g/l	
Reticulocytes	0.9 %	
WBC	$5.2 \cdot 10^9 /l$	
Platelets	$270 \cdot 10^9 /l$	
ESR Westergren's method	32 mm/h	
Leukocyte count		
Basophils	0.5 %	
Eosinophils	1 %	
Neutrophils: band	5 %	
segmented	60 %	
Lymphocytes	23 %	
Monocytes	10 %	
Morphology	Anisocytosis (microcytes), poikilocytosis	
Conclusion:		

5. CBC		
PATIENT'S NAME: IVANOV II		
AGE: 37 y.o.	Sex: male	
Parameter	Result	Note
RBC	$1.5 \cdot 10^{12} /l$	
Hemoglobin	66 g/l	
Hematocrit	25 %	
MCV	110 fl.	
MCH	38 pg.	
MCHC	390 g/l	
Reticulocytes	0.1 %	
WBC	$3.5 \cdot 10^9 /l$	
Platelets	$259 \cdot 10^9 /l$	
ESR	45 mm/h	
Leukocyte count		
Basophils	0 %	
Eosinophils	0 %	
Neutrophils: band	6 %	
segmented	46 %	
Lymphocytes	42 %	
Monocytes	6 %	
Morphology	Microanysocytosis ++	
Conclusion:		

6. CBC		
PATIENT'S NAME: IVANOVA II		
AGE: 69 y.o.	Sex: female	
Parameter	Result	Note
RBC	$2.9 \cdot 10^{12} /l$	
Hemoglobin	70 g/l	
Hematocrit	23.6 %	
MCV	93 fl.	
MCH	32 pg	
MCHC	360 g/l	
Reticulocytes	10 %	
WBC	$15.0 \cdot 10^9 /l$	
Platelets	$480 \cdot 10^9 /l$	
ESR	17 mm/h	
Leukocyte count		
Basophils	0 %	
Eosinophils	2 %	
Neutrophils:		
myelocytes	0 %	
metamyelocytes	6 %	
band	12 %	
segmented	60 %	
Lymphocytes	15 %	
Monocytes	6 %	
Note	Normoblasts, polychromatophiles	
Conclusion:		

7. CBC		
PATIENT'S NAME: IVANOV II		
AGE: 35 y.o.	Sex: male	
Parameter	Result	Note
RBC	$6.0 \cdot 10^{12} /l$	
Hemoglobin	190 g/l	
Hematocrit	59 %	
MCV	90.6 fl.	
MCH	30.5 pg	
MCHC	336 g/l	
Reticulocytes	2.0 %	
WBC	$4.8 \cdot 10^9 /l$	
Platelets	$300 \cdot 10^9 /l$	
ESR Westergren's method	3 mm/h	
Leukocyte count		
Basophils	0 %	
Eosinophils	2 %	
Neutrophils:		
band	1 %	
segmented	68 %	
Lymphocytes	28 %	
Monocytes	1 %	
Conclusion:		

8. CBC		
PATIENT'S NAME: IVANOV II		
AGE: 25 y.o.	Sex: male	
Parameter	Result	Note
RBC	$5.0 \cdot 10^{12} /l$	
Hemoglobin	140 g/l	
Color index	0.9	
Hematocrit	44 %	
MCV	86 fl.	
MCH	28 pg	
MCHC	300 g/l	
Reticulocytes	0.6 %	
WBC	$8.8 \cdot 10^9 /l$	
Platelets	$322 \cdot 10^9 /l$	
ESR	27 mm/h	
Leukocyte count		
Basophils	0 %	
Eosinophils	14 %	
Neutrophils: band	4 %	
segmented	49 %	
Lymphocytes	30 %	
Monocytes	3 %	
Conclusion:		

9. CBC		
PATIENT'S NAME: IVANOV II		
AGE: 36 y.o.	Sex: male	
Parameter	Result	Note
RBC	$4.6 \cdot 10^{12} /l$	
Hemoglobin	145 g/l	
Color index	0.9	
Hematocrit	37 %	
MCV	85 fl.	
MCH	28 pg	
MCHC	300 g/l	
Reticulocytes	0.8 %	
WBC	$17.2 \cdot 10^9 /l$	
Platelets	$200 \cdot 10^9 /l$	
ESR	40 mm/h	
Leukocyte count		
Basophils	1 %	
Eosinophils	2 %	
Neutrophils: band	11 %	
segmented	65 %	
Lymphocytes	20 %	
Monocytes	1 %	
Conclusion:		

10. CBC		
PATIENT'S NAME: IVANOVA II		
AGE: 50 y.o.	Sex: female	
Parameter	Result	Note
RBC	$5.0 \cdot 10^{12} /l$	
Hemoglobin	130 g/l	
Hematocrit	41 %	
MCV	87 fl.	
MCH	30 pg	
MCHC	320 g/l	
Reticulocytes	0.9 %	
WBC	$2.5 \cdot 10^9 /l$	
Platelets	$313 \cdot 10^9 /l$	
ESR Westergren's method	22 mm/h	
Leukocyte count		
Basophils	1 %	
Eosinophils	1 %	
Neutrophils: band	3 %	
segmented	80 %	
Lymphocytes	9 %	
Monocytes	6 %	
Conclusion:		

11. CBC		
PATIENT'S NAME: IVANOVA II		
AGE: 28 y.o.	Sex: female	
Parameter	Result	Note
RBC	$3.4 \cdot 10^{12} /l$	
Hemoglobin	111 g/l	
Hematocrit	35 %	
MCV	89 fl.	
MCH	31 pg	
MCHC	330 g/l	
Reticulocytes	0.6 %	
WBC	$12.5 \cdot 10^9 /l$	
Platelets	$298 \cdot 10^9 /l$	
ESR Westergren's method	37 mm/h	
Leukocyte count		
Basophils	1 %	
Eosinophils	2 %	
Neutrophils: band	14 %	
segmented	43 %	
Lymphocytes	32 %	
Monocytes	8 %	
Morphology	Toxic granularity of neutrophils ++	
Conclusion:		

12. CBC		
PATIENT'S NAME: IVANOV II		
AGE: 65 y.o.	Sex: male	
Parameter	Result	Note
RBC	$4.5 \cdot 10^{12} /l$	
Hemoglobin	146 g/l	
Hematocrit	42 %	
MCV	88 fl.	
MCH	30 pg	
MCHC	320 g/l	
Reticulocytes	0.7 %	
WBC	$6.8 \cdot 10^9 /l$	
Platelets	$355 \cdot 10^9 /l$	
ESR Westergren's method	10 mm/h	
Leukocyte count		
Basophils	1 %	
Eosinophils	12 %	
Neutrophils: band	4 %	
segmented	35 %	
Lymphocytes	30 %	
Monocytes	8 %	
Conclusion:		

13. CBC		
PATIENT'S NAME: IVANOVA II		
AGE: 72 y.o.	Sex: female	
Parameter	Result	Note
RBC	$1.1 \cdot 10^{12} /l$	
Hemoglobin	30 g/l	
Hematocrit	16 %	
MCV	71 fl.	
MCH	22 pg	
MCHC	280 g/l	
Reticulocytes	0 %	
WBC	$1.0 \cdot 10^9 /l$	
Platelets	$34 \cdot 10^9 /l$	
ESR	72 mm/h	
Leukocyte count		
Basophils	0 %	
Eosinophils	1 %	
Neutrophils: band	7 %	
segmented	56 %	
Lymphocytes	32 %	
Monocytes	4 %	
Conclusion:		

14. CBC		
PATIENT'S NAME: IVANOV II		
AGE: 58 y.o.	Sex: male	
Parameter	Result	Note
RBC	$5.0 \cdot 10^{12} /l$	
Hemoglobin	125 g/l	
Hematocrit	40 %	
MCV	85 fl.	
MCH	29 pg	
MCHC	310 g/l	
Reticulocytes	0.7 %	
WBC	$4.2 \cdot 10^9 /l$	
Platelets	$55 \cdot 10^9 /l$	
ESR	14 mm/h	
Leukocyte count		
Basophils	1 %	
Eosinophils	1 %	
Neutrophils: band	3 %	
segmented	43 %	
Lymphocytes	48 %	
Monocytes	5 %	
Conclusion:		

15. CBC		
PATIENT'S NAME: IVANOVA II		
AGE: 38 y.o.	Sex: female	
Parameter	Result	Note
RBC	$3.35 \cdot 10^{12} /l$	
Hemoglobin	105 g/l	
Hematocrit	33 %	
MCV	78 fl.	
MCH	25.7 pg	
MCHC	289 g/l	
WBC	$72 \cdot 10^9 /l$	
Reticulocytes	0.5 %	
Platelets	$256 \cdot 10^9 /l$	
ESR Westergren's method	48 mm/h	
Leukocyte count		
Basophils	0 %	
Eosinophils	1 %	
Neutrophils: band	3 %	
segmented	5 %	
Lymphocytes	93	
Monocytes	0 %	
Morphology		
Shadow cells of Botkin–Gumprecht	2–3 per high-powered field	
Conclusion:		

16. CBC		
PATIENT'S NAME: IVANOV II		
AGE: 24 y.o.	Sex: male	
Parameter	Result	Note
RBC	$3.2 \cdot 10^{12} /l$	
Hemoglobin	99 g/l	
Color index	0.7	
Hematocrit	33 %	
MCV	78 fl.	
MCH	25.7 pg	
MCHC	289 g/l	
Reticulocytes	0.5 %	
WBC	$132 \cdot 10^9 /l$	
Platelets	$140 \cdot 10^9 /l$	
ESR	52 mm/h	
Leukocyte count		
Basophils	6 %	
Eosinophils	10 %	
Promyelocytes	3 %	
Myelocytes	4 %	
Young	13 %	
Neutrophils: band	15 %	
segmented	39 %	
Lymphocytes	3 %	
Monocytes	1 %	
Conclusion:		

17. CBC		
PATIENT'S NAME: IVANOV II		
AGE: 66 y.o.	Sex: male	
Parameter	Result	Note
RBC	$2.0 \cdot 10^{12} /l$	
Hemoglobin	62 g/l	
Color index	0.5	
Hematocrit	32 %	
MCV	80 fl.	
MCH	25 pg	
MCHC	290 g/l	
Reticulocytes	0.3 %	
WBC	$2.8 \cdot 10^9 /l$	
Platelets	$80 \cdot 10^9 /l$	
ESR	45 mm/h	
Leukocyte count		
Basophils	0 %	
Eosinophils	0 %	
Blasts	10 %	
Neutrophils: band	2 %	
segmented	16 %	
Lymphocytes	70 %	
Monocytes	2 %	
Morphology	Anisocytosis, poikilocytosis	
Conclusion:		

FOR NOTES

Note!

The reference values given in the workbook are not universal and may vary at different laboratories.

URINALYSIS

18. URINALYSIS	
PATIENT'S NAME: I. II	
AGE: 50 y.o.	Sex:
Parameter	Straw-yellow
Physical properties	
Amount	100 ml
Color	pale yellow to deep amber
Transparency	Transparent
Urine reaction	Slightly alkaline to acidic
Urine Ph	5–8
Relative density	1012–1025
Chemical properties	
Protein	less 0.033 g/l
Glucose	Absent
Ketone bodies	Absent
Bilirubin	Absent
Urobilin	Absent
Microscopic examination	
Epithelium:	
squamous	0–5 per high-powered field
transitional	Absent
renal	Absent
RBC	0–5 per high-powered field — female 0–2 per high-powered field — male
WBC	0–6 per high-powered field — female 0–3 per high-powered field — male
Casts (hyaline)	0–1 per high-powered field
Casts (other types)	Absent
Salts	Absent
Bacteria	Absent
Mucus	Absent

19. URINALYSIS		
PATIENT'S NAME: IVANOV II		
AGE: 32 y.o.	Sex: male	
Parameter	Result	Note
Physical properties		
Amount	200.0	
Color	Straw-yellow	
Transparency	Transparent	
Urine reaction	Alkaline	
Urine Ph	8	
Relative density	1022	
Chemical properties		
Protein	0.08 g/l	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	Absent	
Urobilin	Absent	
Microscopic examination		
Epithelium:		
squamous	2–3 per high-powered field	
transitional	5–6 per high-powered field	
renal	Absent	
RBC	6–7 per high-powered field	
WBC	20–30 per high-powered field	
Casts	Absent	
Salts	Absent	
Bacteria	Absent	
Mucus	Absent	
Conclusion:		

20. URINALYSIS		
PATIENT'S NAME: IVANOV II		
AGE: 43 y.o.	Sex: male	
Parameter	Result	Note
Physical properties		
Amount	120.0	
Color	Straw-yellow	
Transparency	Cloudy	
Urine reaction	Acidic	
Urine Ph	4.5	
Relative density	1036	
Chemical properties		
Protein	Absent	
Glucose	++	
Ketone bodies	++	
Bilirubin	Absent	
Urobilin	Absent	
Microscopic examination		
Epithelium:		
squamous	1–2 per high-powered field	
transitional	Absent	
renal	Absent	
RBC	0–1 per high-powered field	
WBC	0–2 per high-powered field	
Casts	Absent	
Salts	Absent	
Bacteria	Absent	
Mucus	Absent	
Conclusion:		

21. URINALYSIS		
PATIENT'S NAME: IVANOVA II		
AGE: 68 y.o.	Sex: female	
Parameter	Result	Note
Physical properties		
Amount	100.0	
Color	Straw-yellow	
Transparency	Absent	
Urine reaction	Acidic	
Urine Ph	5.2	
Relative density	1028	
Chemical properties		
Protein	Absent	
Glucose	Absent	
Ketone bodies	+++	
Bilirubin	Absent	
Urobilin	Absent	
Microscopic examination		
Epithelium:		
squamous	8–10 per high-powered field	
transitional	Absent	
renal	Absent	
RBC	0–3 per high-powered field	
WBC	2–4 per high-powered field	
Casts	Absent	
Bacteria	Absent	
Mucus	Absent	
Conclusion:		

22. URINALYSIS		
PATIENT'S NAME: IVANOVA II		
AGE: 54 y.o.	Sex: male	
Parameter	Result	Note
Physical properties		
Amount	70.0	
Color	Straw-yellow	
Transparency	cloudy	
Urine reaction	Alkaline	
Urine Ph	7.8	
Relative density	1018	
Chemical properties		
Protein	0.1 g/l	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	Absent	
Urobilin	Absent	
Microscopic examination		
Epithelium:		
squamous	2–3 per high-powered field	
transitional	Absent	
renal	Absent	
RBC	1–3 per high-powered field	
WBC	20–30 per high-powered field	
Casts	Absent	
Bacteria	+++	
Mucus	Absent	
Conclusion:		

23. URINALYSIS		
PATIENT'S NAME: IVANOVA II		
AGE: 60 y.o.	Sex: female	
Parameter	Result	Note
Physical properties		
Amount	200.0	
Color	yellow	
Transparency	Cloudy	
Urine reaction	Alkaline	
Urine Ph	8.1	
Relative density	1018	
Chemical properties		
Protein	0.099 g/l	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	Absent	
Urobilin	Absent	
Microscopic examination		
Epithelium:		
squamous	3–4 per high-powered field	
transitional	Absent	
renal	3–4 per high-powered field	
RBC	0–3 per high-powered field	
WBC	30–40 per high-powered field	
Casts	Hyaline 0–2 per high-powered field	
Bacteria	+++	
Mucus	Big amount	
Conclusion:		

24. URINALYSIS		
PATIENT'S NAME: IVANOV II		
AGE: 55 y.o.	Sex: male	
Parameter	Result	Note
Physical properties		
Amount	190.0	
Color	Straw-yellow	
Transparency	Cloudy	
Urine reaction	Acidic	
Urine Ph	6.2	
Relative density	1006	
Chemical properties		
Protein	2.3 g/l	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	Absent	
Urobilin	Absent	
Microscopic examination		
Epithelium:		
squamous	2–3 per high-powered field	
transitional	Absent	
renal	Absent	
RBC	Changed 8–10 per high-powered field	
WBC	2–3 per high-powered field	
Casts	Granular: 2–3 per high-powered field	
Conclusion:		

25. URINALYSIS		
PATIENT'S NAME: IVANOVA II		
AGE: 35 y.o.	Sex: female	
Parameter	Result	Note
Physical properties		
Amount	120.0	
Color	Yellow	
Transparency	Transparent	
Urine reaction	Neutral	
Urine Ph	7.0	
Relative density	1024	
Chemical properties		
Protein	Absent	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	Absent	
Urobilin	+++	
Microscopic examination		
Epithelium:		
squamous	1–2 per high-powered field	
transitional	Absent	
renal	Absent	
RBC	0–1 per high-powered field	
WBC	1–2 per high-powered field	
Casts	Absent	
Salts	Absent	
Bacteria	Absent	
Mucus	Absent	
Conclusion:		

26. URINALYSIS		
PATIENT'S NAME: IVANOV II		
AGE: 54 y.o.	Sex: male	
Parameter	Result	Note
Physical properties		
Amount	60.0	
Color	Bloody	
Transparency	Cloudy	
Urine reaction	Acidic	
Urine Ph	6.8	
Relative density	1022	
Chemical properties		
Protein	0.5 g/l	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	Absent	
Urobilin	Absent	
Microscopic examination		
Epithelium:		
squamous	10–15 per high-powered field	
transitional	Absent	
renal	Absent	
RBC	Cover all field, fresh	
WBC	5–8 per high-powered field	
Casts	Absent	
Salts	Oxalates, +++	
Bacteria	Absent	
Mucus	Absent	
Conclusion:		

27. URINALYSIS		
PATIENT'S NAME: IVANOV II		
AGE: 49 y.o.	Sex: male	
Parameter	Result	Note
Physical properties		
Amount	200.0	
Color	Dark-brown	
Transparency	Transparent	
Urine reaction	Acidic	
Urine Ph	6.4	
Relative density	1017	
Chemical properties		
Protein	Absent	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	+++	
Urobilin	+++	
Microscopic examination		
Epithelium:		
squamous	1–2 per high-powered field	
transitional	Absent	
renal	Absent	
RBC	0–1 per high-powered field	
WBC	1–2 per high-powered field	
Casts	Absent	
Salts	Absent	
Bacteria	Absent	
Mucus	Absent	
Conclusion:		

28. URINALYSIS		
PATIENT'S NAME: IVANOV II		
AGE: 40 y.o.	Sex: male	
Parameter	Result	Note
Physical properties		
Amount	190.0	
Color	Brown	
Transparency	Transparent	
Urine reaction	Low acidic	
Urine Ph	6.9	
Relative density	1022	
Chemical properties		
Protein	Absent	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	+++	
Urobilin	Absent	
Microscopic examination		
Epithelium:		
squamous	1–2 per high-powered field	
transitional	Absent	
renal	Absent	
RBC	0–1 per high-powered field	
WBC	1–2 per high-powered field	
Casts	Absent	
Salts	Absent	
Bacteria	Absent	
Conclusion:		

NECHIPORENKO'S URINE TEST

29. NECHIPORENKO'S URINE TEST		
PATIENT'S NAME: I. II		
AGE: 63 y.o.	Sex:	
Parameter	Reference value	
RBC	Less $2 \cdot 10^6 / l$	
WBC	Less $4 \cdot 10^6 / l$	
Casts	Less $0.25 \cdot 10^6 / l$	
Conclusion:		

30. NECHIPORENKO'S URINE TEST		
PATIENT'S NAME: IVANOV II		
AGE: 45 y.o.	Sex: male	
Parameter	Result	Notes
RBC	$12 \cdot 10^6 / l$	
WBC	$2.5 \cdot 10^6 / l$	
Casts	$0.2 \cdot 10^6 / l$	
Conclusion:		

31. NECHIPORENKO'S URINE TEST		
PATIENT'S NAME: IVANOVA II		
AGE: 38 y.o.	Sex: female	
Parameter	Result	Notes
RBC	$1 \cdot 10^6 / l$	
WBC	$25.2 \cdot 10^6 / l$	
Casts	$0.8 \cdot 10^6 / l$	
Conclusion:		

32. NECHIPORENKO'S URINE TEST		
PATIENT'S NAME: IVANOV II		
AGE: 68 y.o.	Sex: male	
Parameter	Result	Notes
RBC	$21 \cdot 10^6 / l$	
WBC	$7.6 \cdot 10^6 / l$	
Casts	$0.4 \cdot 10^6 / l$	
Conclusion:		

**ZIMNITSKY'S URINE TEST
(24-HOUR URINE TEST)**

33. ZIMNITSKY'S URINE TEST (24-HOUR URINE TEST)			
PATIENT'S NAME IVANOV II SEX: male AGE: 42 y.o.			
DEPARTMENT NEPHROLOGICAL			
Amount of fluid intake: 2100 ml			
№ of portion	Hours	Relative density	Amount of urine
1	9.00	1018	200.0
2	12.00	1010	300.0
3	15.00	1020	300.0
4	18.00	1029	200.0
5	21.00	1017	100.0
6	24.00	1018	200.0
7	3.00	1018	100.0
8	6.00	1020	100.0
Day diuresis 1000 ml Night diuresis 660 ml Total diuresis 1660 ml			
Conclusion:			

34. ZIMNITSKY'S URINE TEST (24-HOUR URINE TEST)			
PATIENT'S NAME IVANOV II SEX: male AGE: 65 y.o.			
DEPARTMENT UROLOGICAL			
Amount of fluid intake: 1000 ml			
№ of portion	Hours	Relative density	Amount of urine
1	9.00	1014	40
2	12.00	1012	50
3	15.00	1016	30
4	18.00	1013	50
5	21.00	1010	100
6	24.00	1015	90
7	3.00	1013	70
8	6.00	1013	30
Day diuresis 190 ml Night diuresis 290 ml Total diuresis 480 ml			
Conclusion:			

35. ZIMNITSKY'S URINE TEST (24-HOUR URINE TEST)			
PATIENT'S NAME IVANOV II SEX: male AGE: 60 y.o.			
DEPARTMENT NEPHROLOGICAL			
Amount of fluid intake: 900 ml			
№ of portion	Hours	Relative density	Amount of urine
1	9.00	1010	20
2	12.00	1007	-
3	15.00	1009	30
4	18.00	1008	-
5	21.00	1007	-
6	24.00	1008	50
7	3.00	1007	-
8	6.00	1005	10
Day diuresis 50 ml Night diuresis 60 ml Total diuresis 90 ml			
Conclusion:			

36. ZIMNITSKY'S URINE TEST (24-HOUR URINE TEST)			
PATIENT'S NAME IVANOV II SEX: male AGE: 35 y.o.			
DEPARTMENT UROLOGICAL			
Amount of fluid intake: 650 ml			
№ of portion	Hours	Relative density	Amount of urine
1	9.00	1.006	230
2	12.00	1007	210
3	15.00	1009	250
4	18.00	1008	230
5	21.00	1007	490
6	24.00	1008	380
7	3.00	1007	350
8	6.00	1005	400
Day diuresis 920 ml Night diuresis 1620 ml Total diuresis 2540 ml			
Conclusion:			

Please note!

***Sputum and pleural fluid are pathological fluids;
the concept of a reference interval does not apply to them!***

SPUTUM TEST

37. SPUTUM TEST	
PATIENT'S NAME: IVANOVA II	
Sex: female	Age: 36 y.o.
DEPARTMENT pulmonology	
Macroscopic examination	
Amount: 30 ml	Consistence: fluid
Odor: odorless	Color: grayish-yellow
Character: mucous	Admixture: absent
Microscopic examination	
<i>Native preparation</i>	
WBC	18–20 per high-powered field
RBC	absent
Epithelium squamous	0–1 per high-powered field
Epithelium cylindrical	1–2 per high-powered field
Alveolar macrophage	absent
Elastic fibers	absent
Spirals of Kurshman	absent
Crystals of Charcot–Leyden	absent
<i>Special stain</i>	
Neutrophils	90 %
Lymphocytes	10 %
Eosinophils	absent
Alveolar macrophage	absent
Fungi	absent
Acid Resistant Bacteria	absent
Conclusion:	

38. SPUTUM TEST	
PATIENT'S NAME: IVANOVA II	
Sex: female	Age: 80 y.o.
DEPARTMENT pulmonology	
Macroscopic examination	
Amount: 20 ml	Consistence: viscous
Odor: odorless	Color: grayish
Character: mucous	Admixture: absent
Microscopic examination	
<i>Native preparation</i>	
WBC	25–30 per high-powered field
RBC	absent
Epithelium squamous	2–3 per high-powered field
Epithelium cylindrical	3–4 per high-powered field
Alveolar macrophage	absent
Elastic fibers	absent
Spirals of Kurshman	absent
Crystals of Charcot–Leyden	absent
<i>Special stain</i>	
Neutrophils	12 %
Lymphocytes	88 %
Eosinophils	0–1 per high-powered field
Alveolar macrophage	absent
Fungi	absent
Acid Resistant Bacteria	absent
Conclusion:	

39. SPUTUM TEST	
PATIENT'S NAME: IVANOVA II	
Sex: female	Age: 60 y.o.
DEPARTMENT pulmonology	
Macroscopic examination	
Amount: 15 ml	Consistence: viscous
Odor: odorless	Color: brownish
Character: hemorrhagic	Admixture: absent
Microscopic examination	
<i>Native preparation</i>	
WBC	10–15 per high-powered field
RBC	20–30 per high-powered field
Epithelium squamous	0–1 per high-powered field
Epithelium cylindrical	0–1 per high-powered field
Alveolar macrophage	7–8 per high-powered field
Fibrous tissues	1–2 per high-powered field
<i>Special stain</i>	
Neutrophils	40 %
Lymphocytes	20 %
Eosinophils	single
Alveolar macrophage	8–10 per high-powered field
Fungi	absent
Acid Resistant Bacteria	absent
Bacteria	Coccus
Conclusion:	

40. SPUTUM TEST	
PATIENT'S NAME: IVANOV II	
Sex: male	Age: 50 y.o.
DEPARTMENT pulmonology	
Macroscopic examination	
Amount: 280 ml	Consistence: viscous
Odor: stinking	Color: grayish-yellow-green
Character: serous-purulent	Admixture: 3 layers
Microscopic examination	
<i>Native preparation</i>	
WBC	cover all sight
RBC	absent
Epithelium squamous	0–1 per high-powered field
Epithelium cylindrical	8–10 per high-powered field
Alveolar macrophage	absent
Elastic fibers	absent
Spirals of Kurshman	absent
Crystals of Charcot–Leyden	absent
<i>Special stain</i>	
Neutrophils	98 %
Lymphocytes	2 %
Eosinophils	absent
Alveolar macrophage	absent
Fungi	absent
Acid Resistant Bacteria	absent
Staphylococci	present
Conclusion:	

41. SPUTUM TEST	
PATIENT'S NAME: IVANOVA II	
Sex: male	Age: 75 y.o.
DEPARTMENT pulmonology	
Macroscopic examination	
Amount: 10 ml	Consistence: fluid
Odor: odorless	Color: pink
Character: frothy	Admixture: absent
Microscopic examination	
WBC	1–2 per high-powered field
RBC	8–12 per high-powered field
Epithelium squamous	1–2 per high-powered field
Epithelium cylindrical	absent
Alveolar macrophage	absent
Elastic fibers	absent
Spirals of Kurshman	absent
Crystals of Charcot–Leyden	absent
<i>Special stain</i>	
Neutrophils	single
Lymphocytes	single
Eosinophils	absent
RBC	considerable amount
Alveolar macrophage	absent
Fungi	absent
Acid Resistant Bacteria	absent
Conclusion:	

42. SPUTUM TEST	
PATIENT'S NAME: IVANOV II	
Sex: male	Age: 34 y.o.
DEPARTMENT pulmonology	
Macroscopic examination	
Amount: 200 ml	Consistence: viscous
Odor: odorless	Color: grayish-yellow
Character: bloody	Admixture: absent
Microscopic examination	
WBC	5–6 per high-powered field
RBC	1–2 per high-powered field
Epithelium squamous	2–4 per high-powered field
Epithelium cylindrical	absent
Alveolar macrophage	absent
Elastic fibers	1–2 per high-powered field
Spirals of Kurshman	absent
Crystals of Charcot–Leyden	absent
<i>Special stain</i>	
Neutrophils	20 %
Lymphocytes	80 %
Eosinophils	absent
Alveolar macrophage	absent
Fungi	absent
Acid Resistant Bacteria	3–4 in 100 sights
Conclusion:	

43. SPUTUM TEST	
PATIENT'S NAME: IVANOV II	
Sex: male	Age: 74 y.o.
DEPARTMENT pulmonology	
Macroscopic examination	
Amount: 20 ml	Consistence: fluid
Odor: odorless	Color: reddish-yellow
Character: mucous	Admixture: absent
Microscopic examination	
WBC	5–12 per high-powered field
RBC	absent
Epithelium squamous	0–1 per high-powered field
Epithelium cylindrical	0–1 per high-powered field
Alveolar macrophage	absent
Elastic fibers	absent
Spirals of Kurshman	absent
Crystals of Charcot–Leyden	0–1 per high-powered field
Crystals of hematoidin	2–3 per high-powered field
<i>Special stain</i>	
Neutrophils	absent
Lymphocytes	absent
Eosinophils	5–12 per high-powered field
Alveolar macrophage	absent
Fungi	absent
Acid Resistant Bacteria	absent
Conclusion:	

FOR NOTES

EXAMINATION OF PLEURAL FLUID

44. EXAMINATION OF PLEURAL FLUID	
PATIENT'S NAME: IVANOVA II	
Sex: female	Age: 60 y.o.
DEPARTMENT pulmonology	
Amount	300.0
Transparency	cloudy
Color	yellow-green
Rivalta's test	positive
Protein	44 g/l
LDH	760 u/l
<i>Microscopy</i>	
WBC	40–55 per high-powered field
RBC	7–8 per high-powered field
<i>Cellular count</i>	
Neutrophils	93 %
Lymphocytes	2 %
Macrophage	1 %
Eosinophils	absent
Erythrocytes	4 %
Conclusion:	

45. EXAMINATION OF PLEURAL FLUID	
PATIENT'S NAME: IVANOVA II	
Sex: female	Age: 52 y.o.
DEPARTMENT pulmonology	
Amount	400.0
Transparency	cloudy
Color	pink
Rivalta's test	positive
Protein	35 g/l
LDH	618 u/l
<i>Microscopy</i>	
WBC	1–2 per high-powered field
RBC	50–60 per high-powered field
<i>Cellular count</i>	
RBC	99 %
Neutrophils	solitary
Lymphocytes	solitary
Macrophage	absent
Eosinophils	absent
Conclusion:	

46. EXAMINATION OF PLEURAL FLUID	
PATIENT'S NAME IVANOV II	
Sex: male	Age: 51 y.o.
DEPARTMENT pulmonology	
Amount	280.0
Transparency	cloudy
Color	milky
Odor	absent
Rivalta's test	positive
Protein	44 g/l
Fat drops	+++
<i>Microscopy</i>	
WBC	10–20 per high-powered field
RBC	20–30 per high-powered field
<i>Cellular count</i>	
Neutrophils	9 %
Lymphocytes	65 %
Macrophage	15 %
Eosinophils	absent
Erythrocytes	10 %
Conclusion:	

47. EXAMINATION OF PLEURAL FLUID	
PATIENT'S NAME: IVANOV II	
Sex: male	Age: 38 y.o.
DEPARTMENT pulmonology	
Amount	350.0
Transparency	cloudy
Color	golden-yellow
Rivalta's test	positive
Protein	48 g/l
<i>Microscopy</i>	
WBC	30–40 per high-powered field
RBC	4–5 per high-powered field
Fat drops	+++
<i>Cellular count</i>	
Erythrocytes	single
Neutrophils	88 %
Lymphocytes	7 %
Macrophage	5 %
Eosinophils	absent
Conclusion:	

48. EXAMINATION OF PLEURAL FLUID	
PATIENT'S NAME IVANOV II	
Sex: male	Age: 51 y.o.
DEPARTMENT pulmonology	
Amount	280.0
Transparency	cloudy
Color	brown
Odor	stinking
Rivalta's test	positive
Protein	38 g/l
LDH	680 u/l
<i>Microscopy</i>	
WBC	30–40 per high-powered field
RBC	20–30 per high-powered field
<i>Cellular count</i>	
Neutrophils	78 %
Lymphocytes	7 %
Macrophage	8 %
Eosinophils	absent
Erythrocytes	7 %
Conclusion:	

49. EXAMINATION OF PLEURAL FLUID	
PATIENT'S NAME IVANOV II	
Sex: male	Age: 30 y.o.
DEPARTMENT pulmonology	
Amount	680.0
Transparency	transparent
Color	slight-yellow
Rivalta's test	negative
Protein	10 g/l
LDH	152 u/l
<i>Microscopy</i>	
WBC	5–6 per high-powered field
RBC	2–3 per high-powered field
<i>Cellular count</i>	
Neutrophils	6 %
Lymphocytes	94 %
Macrophage	absent
Eosinophils	absent
Conclusion:	

BIOCHEMICAL BLOOD ANALYSIS

50. BIOCHEMICAL BLOOD ANALYSIS		
Parameter	Reference value	Units
Urea	2.5–8.3	mmol/l
Creatinine	0.044–0.12	mmol/l
Total protein	60–87 (after 65 y.o.) 65–87 (3–65 y.o.)	g/l
Albumen	35–55	g/l
Glucose	3.9–6.4	mmol/l
Bilirubin total	5–21	mcmol/l
Bilirubin direct	0.53–5.1	mcmol/l
Bilirubin indirect	6.45–15.42	mcmol/l
ALT	5–45	u/l
AST	Less 45	u/l
GGTP	Female: 4–38 Male: 2–55	u/l
LDH	Less 248	u/l
Alkaline phosphatase	Female: less 240 Male: less 270	u/l
Amylase	22–120	u/l
CRP	0–6	mg/l
Rheumatoid factor	Less 15	IU/ml
ASL-O	Less 200	IU/ml
Uric acid	Female: 0.24–0.36 Male: 0.3–0.42	mmol/l
Creatine kinase	20–174	u/l
Creatine kinase-MB	Less 24	u/l
Troponin	Less 0.05	ng/ml

Parameter	Reference value	Units
Total cholesterol	2.82–5.2	mmol/l
LDL (low-density lipoprotein) cholesterol	Less 3.36	mmol/l
HDL (high-density lipoprotein) cholesterol	0.78–1.63	mmol/l
Triglycerides	0.42–1.67	mmol/l
Atherogenic index	2–3	
Potassium	3–5.4	mmol/l
Calcium	2–2.75	mmol/l
Sodium	130–150	mmol/l
Chloride	95–110	mmol/l
Iron	9–30.4	mcmol/l

51. BIOCHEMICAL BLOOD ANALYSIS			
PATIENT'S NAME: IVANOVA II			
Sex: female	Age: 30 y.o.		
Height 168 sm	Weight 70 kg		
Parameter	Result	Units	Note
Urea	17.2	mmol/l	
Creatinine	0.19	mmol/l	
Total protein	56	g/l	
Albumen	23	g/l	
Glucose	5.6	mmol/l	
Bilirubin total	10	mcmol/l	
ALT	13	u/l	
AST	16	u/l	
CRP	6	mg/l	
Potassium	5.8	mmol/l	
Calcium	2.25	mmol/l	
Sodium	131	mmol/l	
Chloride	100	mmol/l	
Calculation of glomerular filtration rate (GFR)			
Conclusion:			

52. BIOCHEMICAL BLOOD ANALYSIS			
PATIENT'S NAME: IVANOV II			
Sex: male	Age: 48 y.o.		
Height 182 sm	Weight 91 kg		
Parameter	Result	Units	Note
Urea	5.6	mmol/l	
Creatinine	0.091	mmol/l	
Total protein	69	g/l	
Albumen	39	g/l	
Glucose	4.5	mmol/l	
Bilirubin total	25.5	mcmol/l	
Bilirubin direct	10.5	mcmol/l	
Bilirubin indirect	15	mcmol/l	
ALT	285	u/l	
AST	174	u/l	
LDH	488	u/	
GGTP	355	u/l	
Potassium	4.7	mmol/l	
Calcium	2.23	mmol/l	
Ferrum	1.9	mcmol/l	
Calculation of glomerular filtration rate (GFR)			
Conclusion:			

53. BIOCHEMICAL BLOOD ANALYSIS			
PATIENT'S NAME: IVANOVA II			
Sex: female	Age: 51 y.o.		
Height 177 sm	Weight 85 kg		
Parameter	Result	Units	Note
Urea	5.6	mmol/l	
Creatinine	0.088	mmol/l	
Total protein	68	g/l	
Albumen	38	g/l	
Glucose	4.4	mmol/l	
Bilirubin total	52.8	mcmol/l	
Bilirubin direct	31.5	mcmol/l	
Bilirubin indirect	21.3	mcmol/l	
ALT	40	u/l	
AST	42	u/l	
GGTP	480	u/l	
Alkaline phosphatase	579	u/l	
Potassium	4.4	mmol/l	
Calcium	2.2	mmol/l	
Sodium	134	mmol/l	
Chloride	107	mmol/l	
Total cholesterol	8.9	mmol/l	
Calculation of glomerular filtration rate (GFR)			
Conclusion:			

54. BIOCHEMICAL BLOOD ANALYSIS			
PATIENT'S NAME: IVANOV II			
Sex: male	Age: 66 y.o.		
Height 170 sm	Weight 82 kg		
Parameter	Result	Units	Note
Urea	4.5	mmol/l	
Creatinine	0.1	mmol/l	
Total protein	55	g/l	
Albumen	25	g/l	
Uric acid	0.655	mmol/l	
Glucose	5.6	mmol/l	
Bilirubin total	28.6	mcmol/l	
Bilirubin direct	24	mcmol/l	
Bilirubin indirect	4.6	mcmol/l	
ALT	75	u/l	
AST	66	u/l	
GGTP	330	u/l	
Alkaline phosphatase	266	u/l	
Potassium	4.4	mmol/l	
Calcium	2.26	mmol/l	
Sodium	130	mmol/l	
Chloride	103	mmol/l	
Total cholesterol	2.3	mmol/l	
Calculation of glomerular filtration rate (GFR)			
Conclusion:			

55. BIOCHEMICAL BLOOD ANALYSIS			
PATIENT'S NAME: IVANOVA II			
Sex: male	Age: 70 y.o.		
Height 160 sm	Weight 73 kg		
Parameter	Result	Units	Note
Urea	6.5	mmol/l	
Creatinine	0.072	mmol/l	
Total protein	65	g/l	
Uric acid	0.66	mmol/l	
Glucose	7.8	mmol/l	
Bilirubin total	14.3	mcmol/l	
Bilirubin direct	3.3	mcmol/l	
Bilirubin indirect	11.0	mcmol/l	
ALT	22	u/l	
AST	21	u/l	
GGTP	48	u/l	
Alkaline phosphatase	148	u/l	
Potassium	4.2	mmol/l	
Calcium	2.2	mmol/l	
Sodium	140	mmol/l	
Chloride	102	mmol/l	
Total cholesterol	8.0	mmol/l	
LDL	6.3	mmol/l	
HDL	0.7	mmol/l	
Triglycerides	10.1	mmol/l	
Calculation of glomerular filtration rate (GFR)			
Conclusion:			

56. BIOCHEMICAL BLOOD ANALYSIS			
PATIENT'S NAME: IVANOV II			
Sex: female	Age: 60 y.o.		
Height 174 sm	Weight 122 kg		
Parameter	Result	Units	Note
Urea	5.4	mmol/l	
Creatinine	0.1	mmol/l	
Total protein	66	g/l	
Uric acid	0.59	mmol/l	
Glucose	6.8	mmol/l	
Bilirubin total	20.0	mcmol/l	
ALT	82	mg/l	
AST	112	IU/ml	
LDG	448	IU/ml	
ALT	18	u/l	
AST	22	u/l	
Potassium	4.8	mmol/l	
Calcium	2.15	mmol/l	
Sodium	142	mmol/l	
Chloride	104	mmol/l	
Troponin	2.25	mmol/l	
Creatine phosphokinase	960	u/l	
Creatine Kinase-MB	556	u/l	
Total cholesterol	8.0	mmol/l	
LDL	3.4	mmol/l	
HDL	1.1	mmol/l	
Triglycerides	2.5	mmol/l	
Calculation of glomerular filtration rate (GFR)			
Conclusion:			

57. BIOCHEMICAL BLOOD ANALYSIS			
PATIENT'S NAME: IVANOVA II			
Sex: male	Age: 70 y.o.		
Height 160 sm	Weight 73 kg		
Parameter	Result	Units	Note
Urea	6.6	mmol/l	
Creatinine	0.07	mmol/l	
Total protein	55	g/l	
Uric acid	0.34	mmol/l	
Glucose	5.6	mmol/l	
Bilirubin total	18.5	mcmol/l	
Bilirubin direct	22.4	mcmol/l	
Bilirubin indirect	11.0	mcmol/l	
CRB	22.4	mg/l	
Rheumatoid factor	58	u/l	
ASL-O	360	u/l	
ALT	18	u/l	
AST	22	u/l	
GGTP	50	mmol/l	
Calcium	4.0	mmol/l	
Sodium	142	mmol/l	
Chloride	103	mmol/l	
Iron	3.5	mcmol/l	
Total cholesterol	8.0	mmol/l	
Triglycerides	10.1	mmol/l	
Calculation of glomerular filtration rate (GFR)			
Conclusion:			

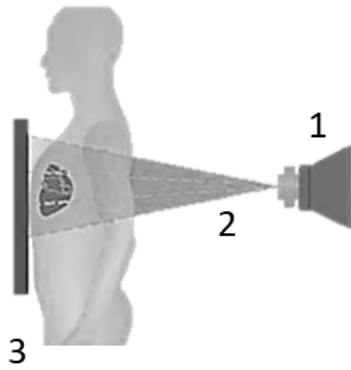
58. BIOCHEMICAL BLOOD ANALYSIS			
PATIENT'S NAME: IVANOV II			
Sex: male	Age: 58 y.o.		
Height 180 sm	Weight 144 kg		
Parameter	Result	Units	Note
Urea	18.2	mmol/l	
Creatinine	0.38	mmol/l	
Total protein	50	g/l	
Uric acid	0.59	mmol/l	
Glucose	15.2	mmol/l	
Bilirubin total	22.0	mcmol/l	
ALT	22.4	mg/l	
Rheumatoid factor	48	IU/ml	
ASL-O	350	IU/ml	
ALT	18	u/l	
AST	22	u/l	
GGTP	50	u/l	
Potassium	5.8	mmol/l	
Calcium	2.1	mmol/l	
Sodium	101	mmol/l	
Chloride	101	mmol/l	
Creatine phosphokinase	172	u/l	
Creatine Kinase-MB	12	u/l	
Total cholesterol	7.2	mmol/l	
Triglycerides	4.6	mmol/l	
Calculation of glomerular filtration rate (GFR)			
Conclusion:			

CHAPTER 2. CHEST X-RAY

X-RAY INTERPRETATION

X-ray imaging		Plain, tomography
Image quality (contrast, penetration)		Good, low quality
Examination area		Chest
X-ray projection		Direct (standart posteroanterior, frontal), lateral
Assessment of the chest shape, walls, diaphragm	Norm	Pathology
Chest shape	Normosthenic (mesomorph), asthenic (ectomorph), hypersthenic (endomorph)	Barrel chest, deformed (indicate the deformation character and localization)
Mediastinum position	Normal	Shifted to the left/right
Position of the hemidiaphragm	Normal (the right is 1.5–2 cm higher than the left one)	Diaphragm elevation (right, left) Flat diaphragm
Costophrenic angles	Sharp	Costophrenic angle blunting
Lung fields and lung roots (hila) assessment	Norm	Pathology (indicate localization)
Sizes of lung fields	Normal	Increased/decreased
Density of lung fields	Normal	Increased/decreased
Condition of lung roots (hila)	Structural, not enlarged	Unstructured, enlarged
Shadow characteristics	Physiological — pectoralis major muscle, mammary gland	Amount, localization, shape, size, intensity of pathological structures
Heart size and contours	Norm	Pathology
	Size	CTR is less than 50 %
	Contours (silhouette)	Normal
		Cardio-Thoracic Ratio (CTR) Cardiac width/Thoracic width Mitral, Aortic, Trapezoidal
Clinical syndrome at presented X-ray image		Bronchial obstruction, consolidation of the lung tissue, atelectasis, cavity in the lung, fluid accumulation in pleural cavity, air accumulation in pleural cavity
Conclusion:		

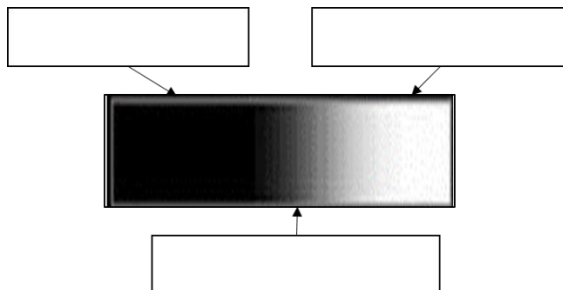
Label the objects marked with numbers:



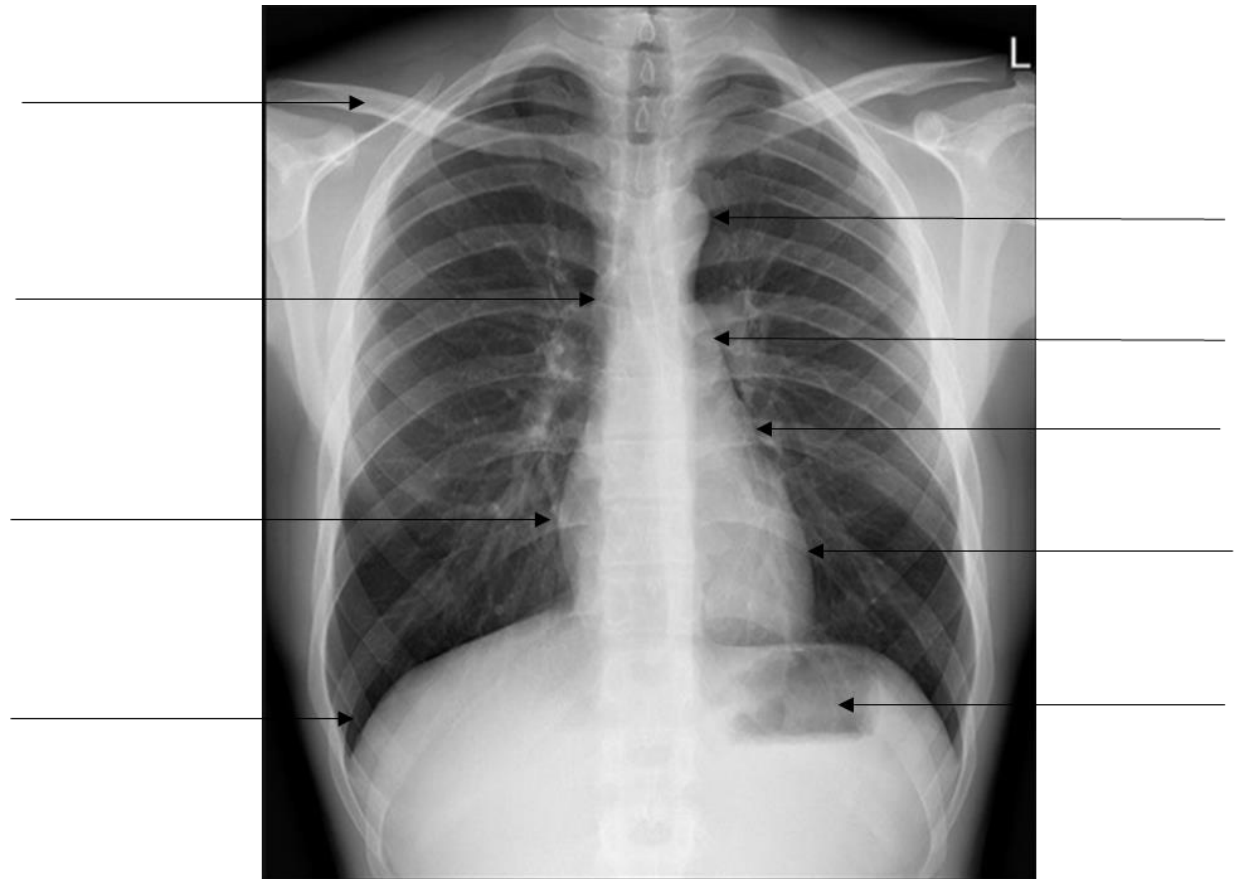
1. _____
2. _____
3. _____

TISSUE PERMEABILITY FOR X-RAYS

Name the tissues:



Write the most common X-ray imaging:



FEATURES OF THE X-RAY IMAGE

Evaluate the type of X-ray image:

Positive X-ray _____

Negative X-ray _____



1

2

What tissue colors are in case of different X-ray images?

Tissue (structure)	Positive	Negative
Mediastinum		
Ribs		
Lung fields		

X-ray image penetration assessment

With optimal penetration in the upper part of the thoracic spine, 3–4 intervertebral discs are visible, the shadows of the ribs do not overlap the pulmonary pattern.

Write the penetration of the imaging on the pictures (soft penetrated, optimum penetrated, well penetrated).



☛ Assess this X-ray image:

penetration is _____

Label the lung fields.

Lung fields are a radiographic term denoting the areas on a chest radiograph onto which the various lobes and segments of the lungs are projected.

For anatomical and topographic orientation, the lung fields are divided conventionally:

Horizontally — by lines drawn at the level of the anterior segments of the second and fourth ribs.

These lines divide the lung fields into three sections:

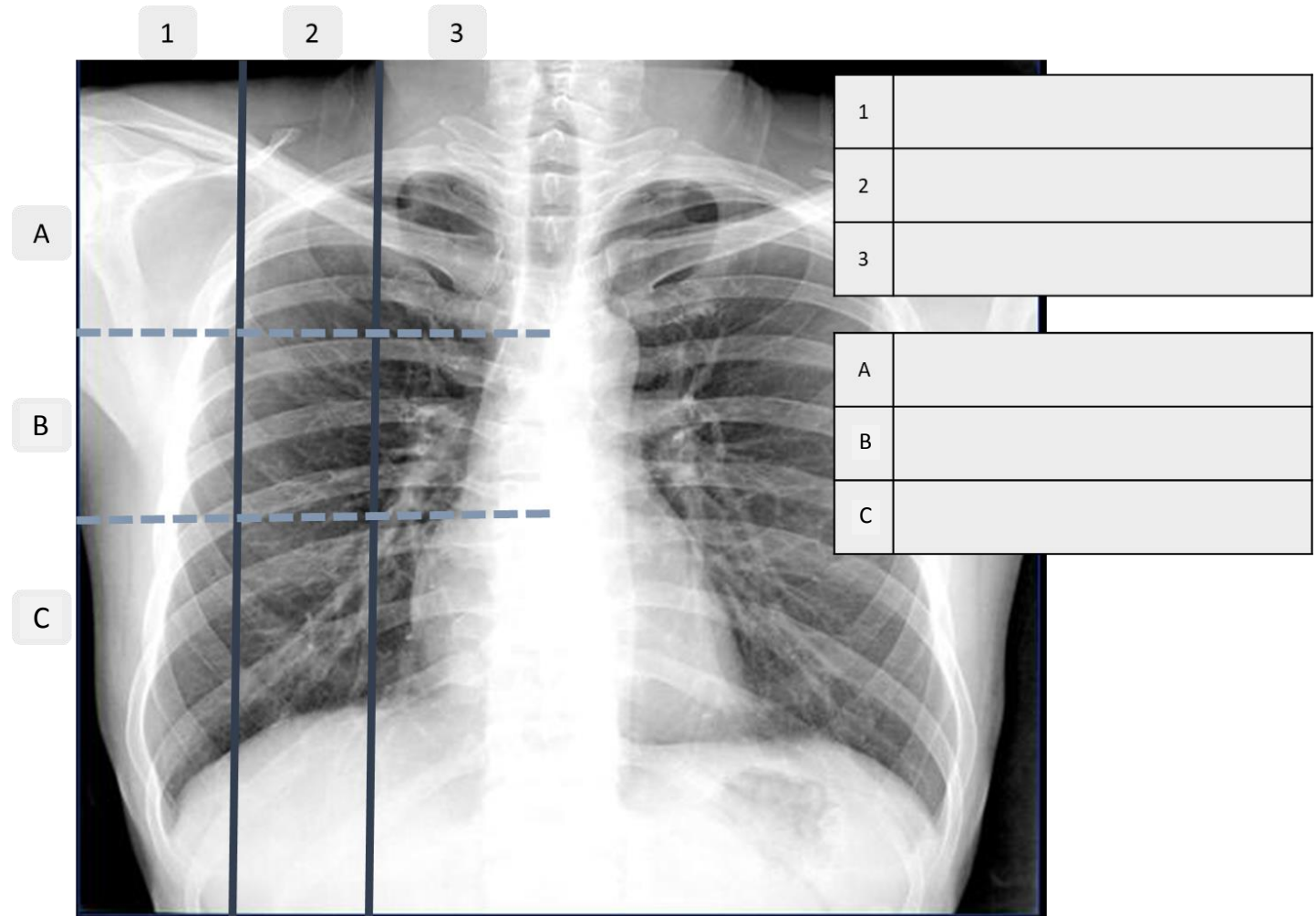
- superior (upper lung field);
- middle (middle lung field);
- inferior (lower lung field).

Vertically — by lines drawn:

- through the middle of the intrathoracic segment of the clavicle;
- through the intersection of the clavicle with the costal arch.

They designate three zones:

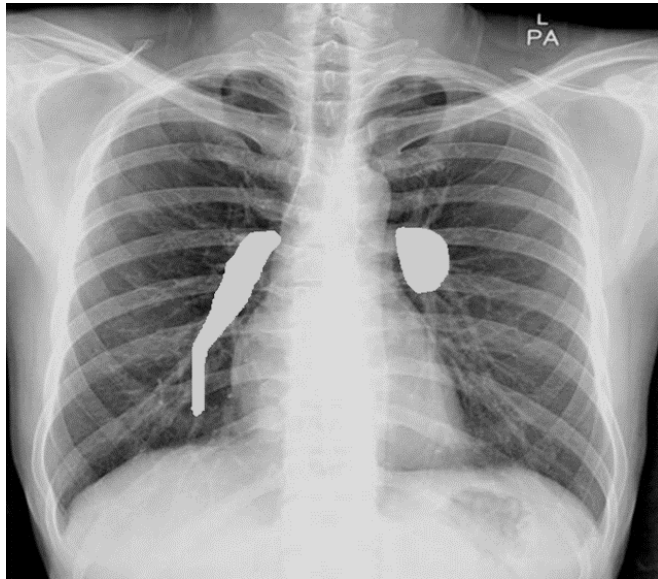
- inner (medial);
- middle, and outer (lateral or mantle).



LUNG ROOTS (HILA)

Anatomical substrate of the lung roots:

- 1 _____
- 2 _____
- 3 _____
- 4 _____



Assessment of the normal lung roots (hila)

Size: does not go beyond the medial third of the clavicle (width 1.5–2 cm)

Shape: left — oval, right — “comma”

Parts: left — head; right — head, body, tail

Contours: smooth

X-ray image of the lung roots is formed by _____



Assess the condition of the lung roots on the x-ray:

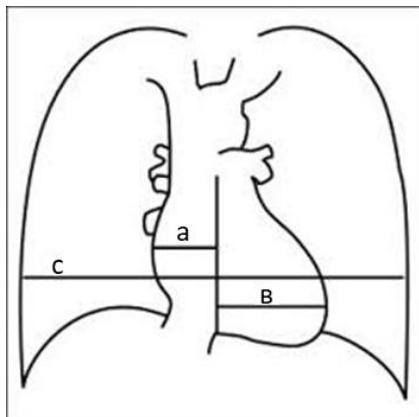
Size _____

Shape: left _____ right _____

Structure: left _____ right _____

Contours _____

CARDIOTHORACIC RATIO ASSESSMENT



$$\text{CTR} = (a + B) / c \cdot 100 \%$$

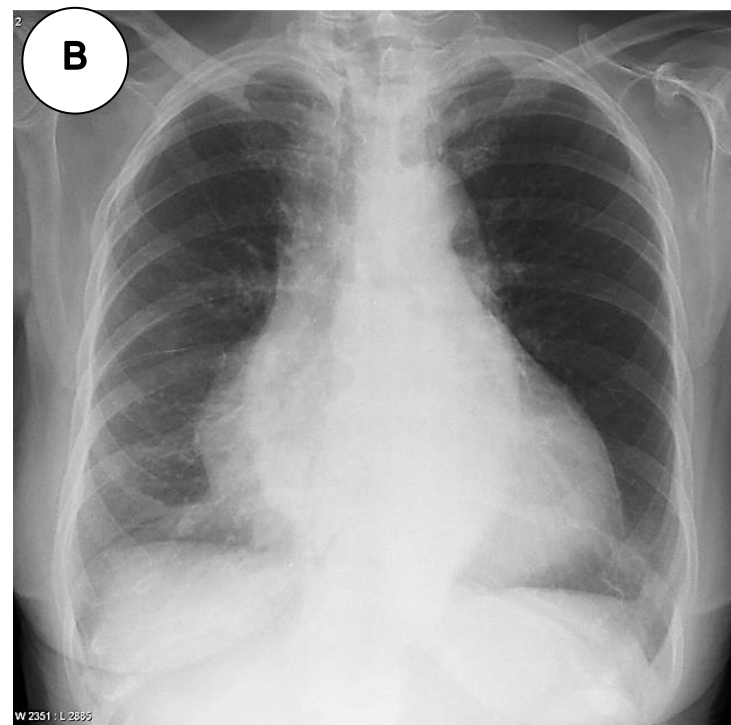
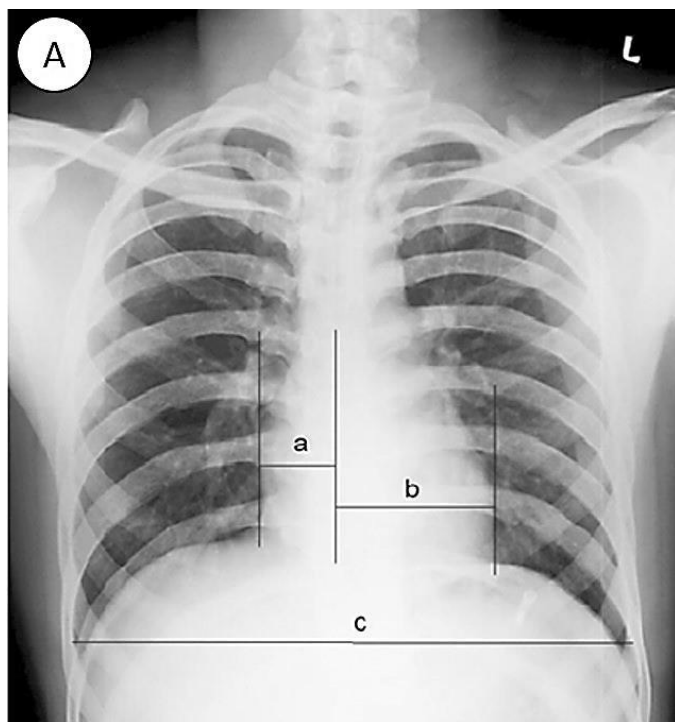
Normal CTR is less than
50 %

Assess the CTR on the X-ray:

A _____

B _____

Write the reasons for enlarged CTR:



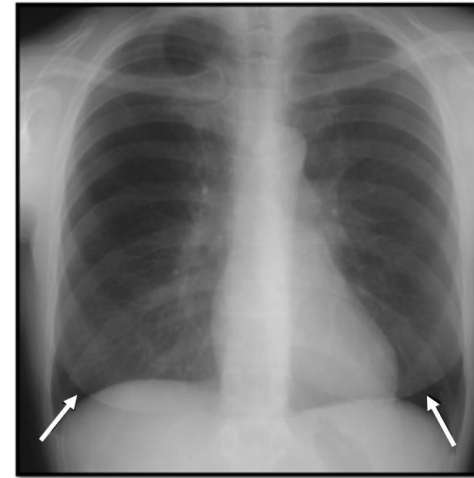
PHYSIOLOGICAL CHEST SHADOW

Write physiological shadows and artifacts, visible on these X-ray images, indicated by arrows.

1. _____



2. _____



3. _____



4. _____



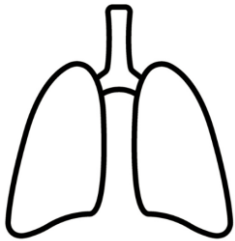
SHADOW SIZE

Write the characteristics:

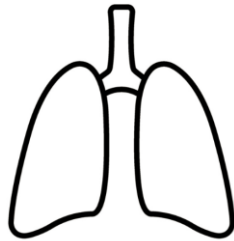
- Focal up to _____ cm
- Limited (focal) more than _____ cm

Draw the shadows:

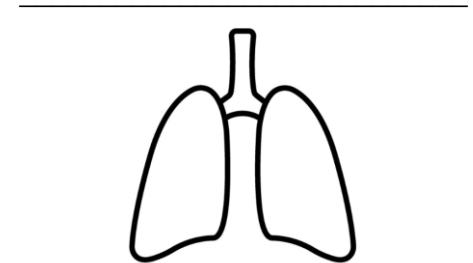
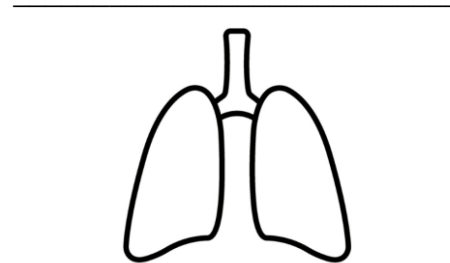
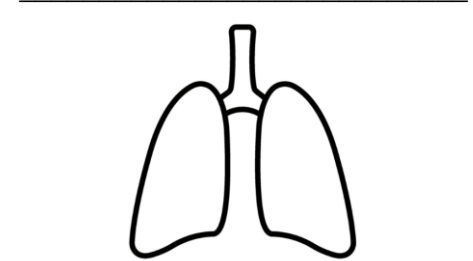
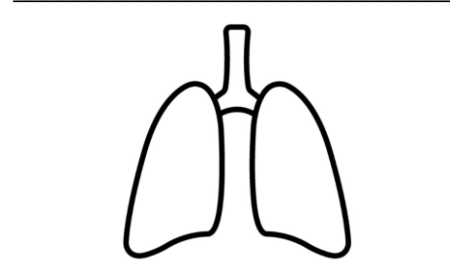
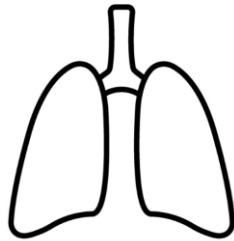
Focal



Total



Subtotal



SHADOW INTENSITY

Write the names and characteristics:

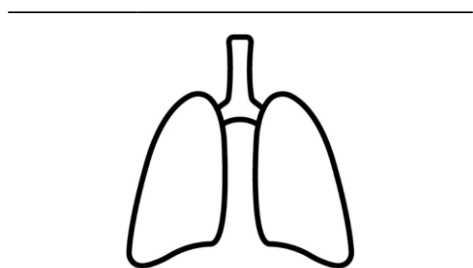
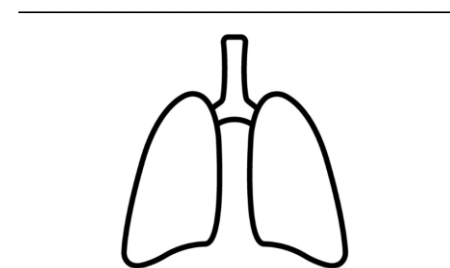
1. _____

2. _____

3. _____

SHADOW HOMOGENEOUS /INHOMOGENEOUS

Draw and sign the possible structure:



CHEST SHAPES ON THE X-RAY IMAGE

Asthenic (ectomorph)



Normosthenic (mesomorph)



Hypersthenic (endomorph)



Write the features of x-rays images in case of various types of chest shape:

Rib direction

Intercostal spaces

Mediastinum position

Rib direction

Intercostal spaces

Mediastinum position

Rib direction

Intercostal spaces

Mediastinum position

BASIC HEART SHAPE (SILHOUETTE) TYPES

1. Draw on the x-ray images the changes in the heart contours.
2. Write, what heart chambers are involved in the process?

Normal



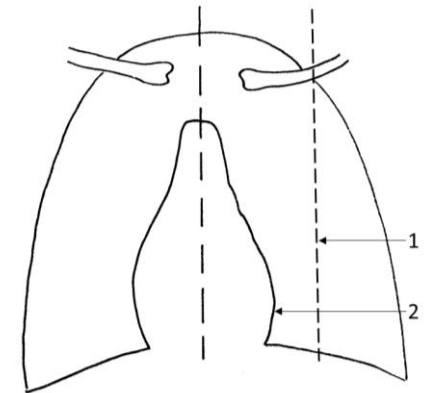
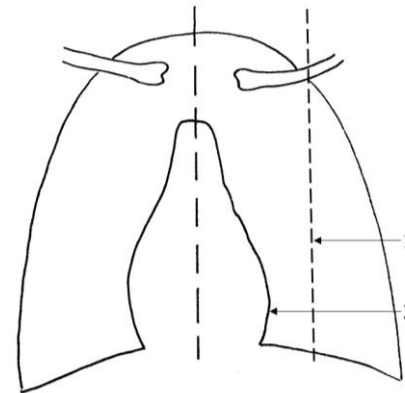
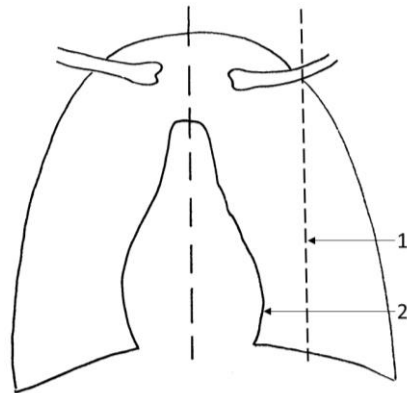
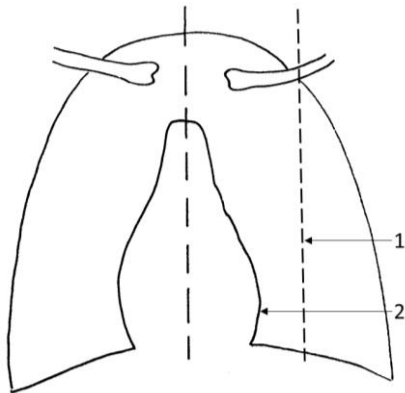
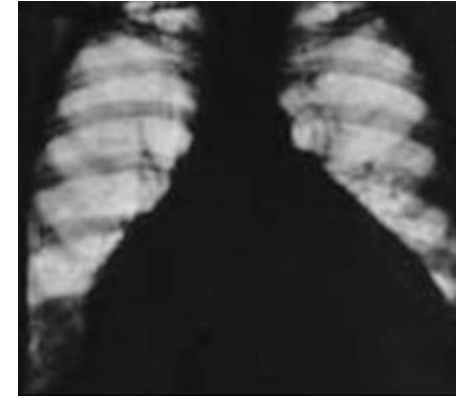
Mitral



Aortic



Trapezoidal



1 — Left midclavicular line, 2 — Left ventricle

1

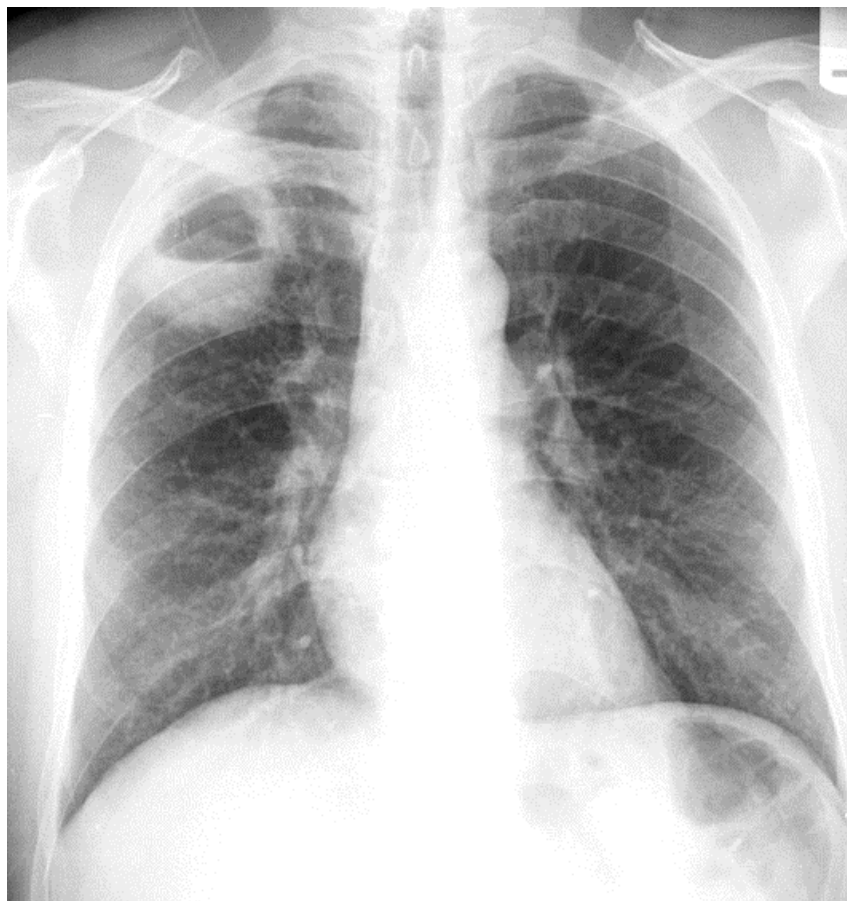


X-ray imaging	
Image quality	
Examination area	
X-ray projection	
Assessment of the chest shape, walls, diaphragm	
Chest shape	
Mediastinum position	
Position of the hemidiaphragm	
Costophrenic angles	
Lung fields and lung roots (hila) assessment	
Sizes of lung fields	
Density of lung fields	
Condition of lung roots (hila)	
Shadows characteristics	
Heart size and contours	

Clinical syndrome at presented X-ray image: _____

Conclusion: _____

2

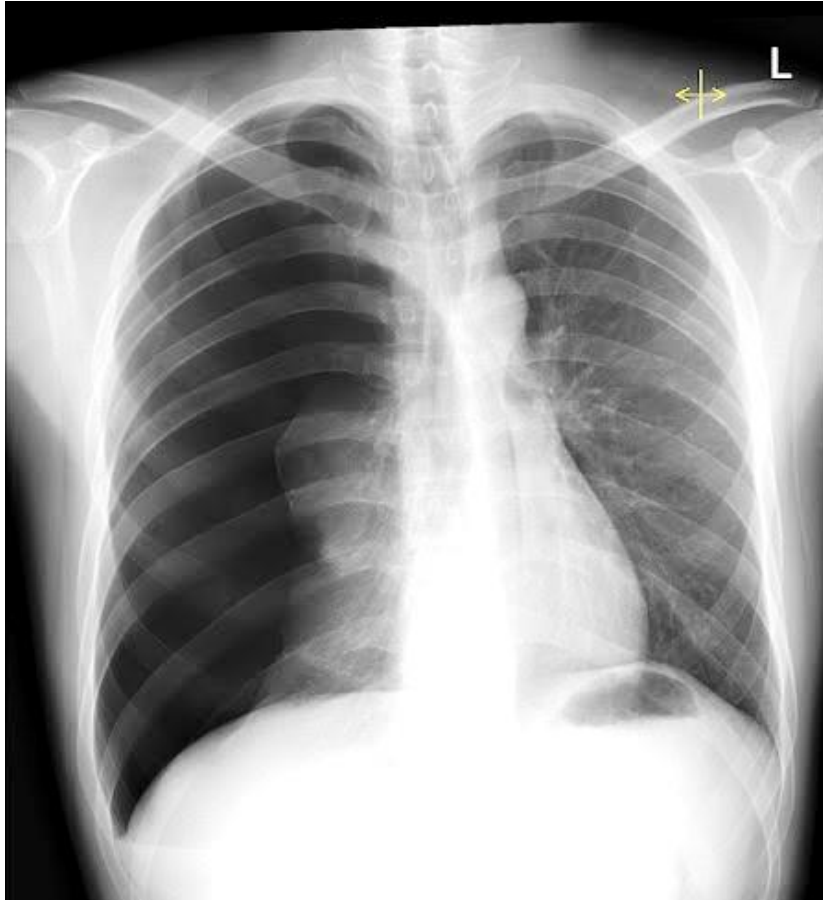


X-ray imaging	
Image quality	
Examination area	
X-ray projection	
Assessment of the chest shape, walls, diaphragm	
Chest shape	
Mediastinum position	
Position of the hemidiaphragm	
Costophrenic angles	
Lung fields and lung roots (hila) assessment	
Sizes of lung fields	
Density of lung fields	
Condition of lung roots (hila)	
Shadows characteristics	
Heart size and contours	

Clinical syndrome at presented X-ray image

Conclusion: _____

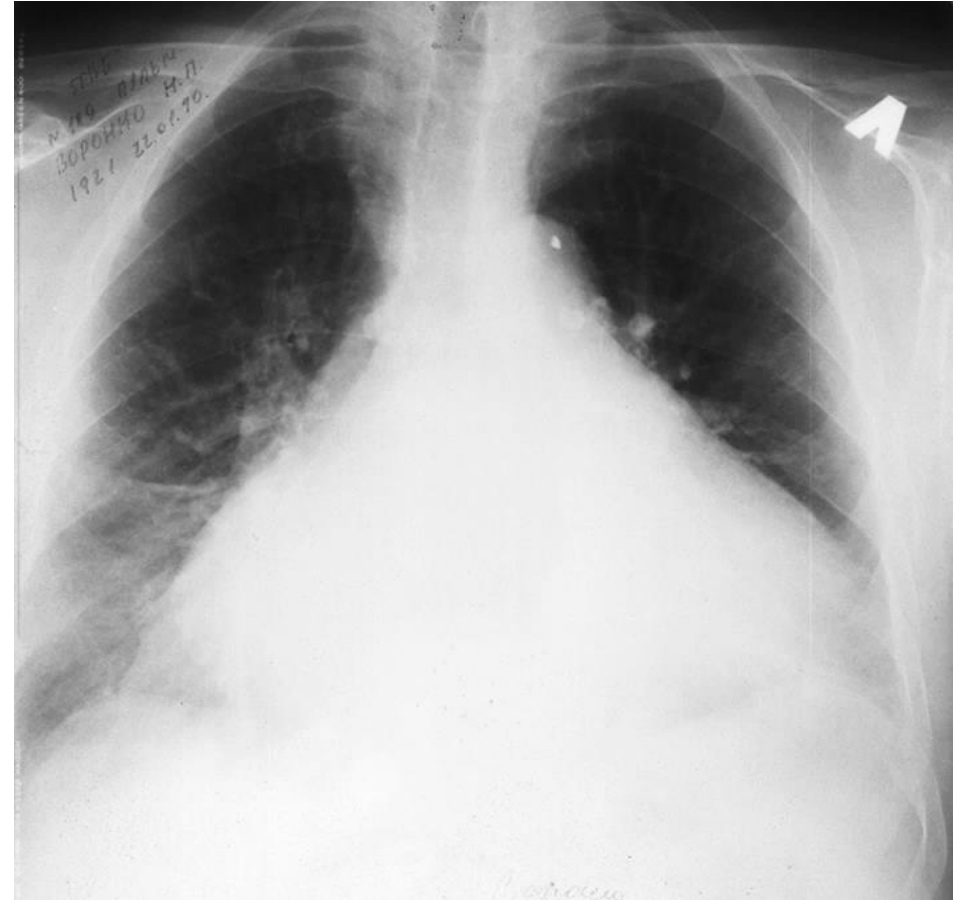
3



Clinical syndrome _____

Conclusion _____

4



Clinical syndrome _____

Conclusion _____

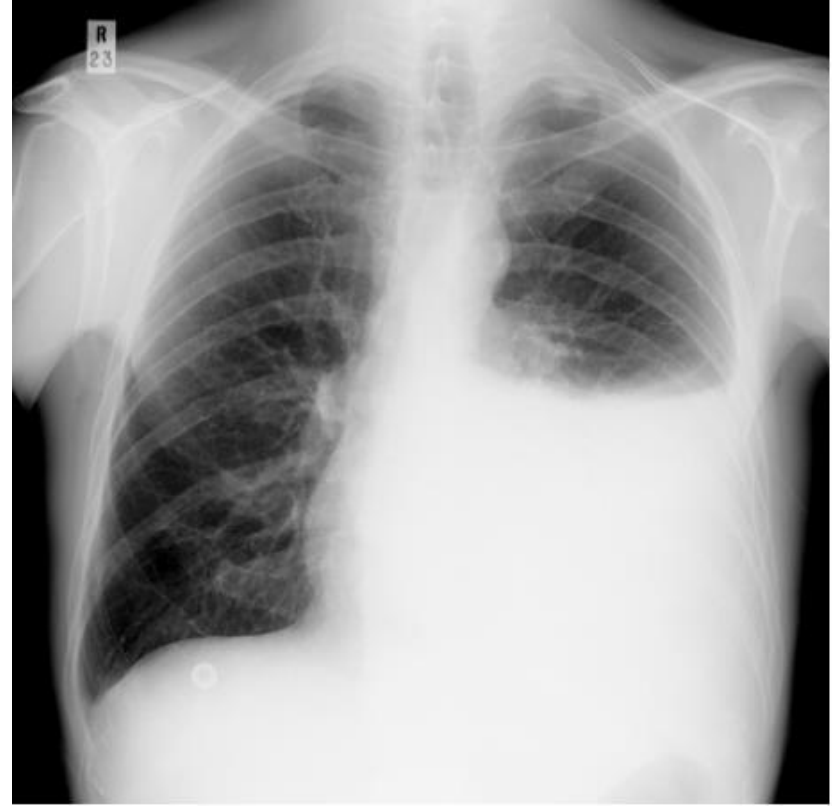
5



Clinical syndrome _____

Conclusion _____

6



Clinical syndrome _____

Conclusion _____

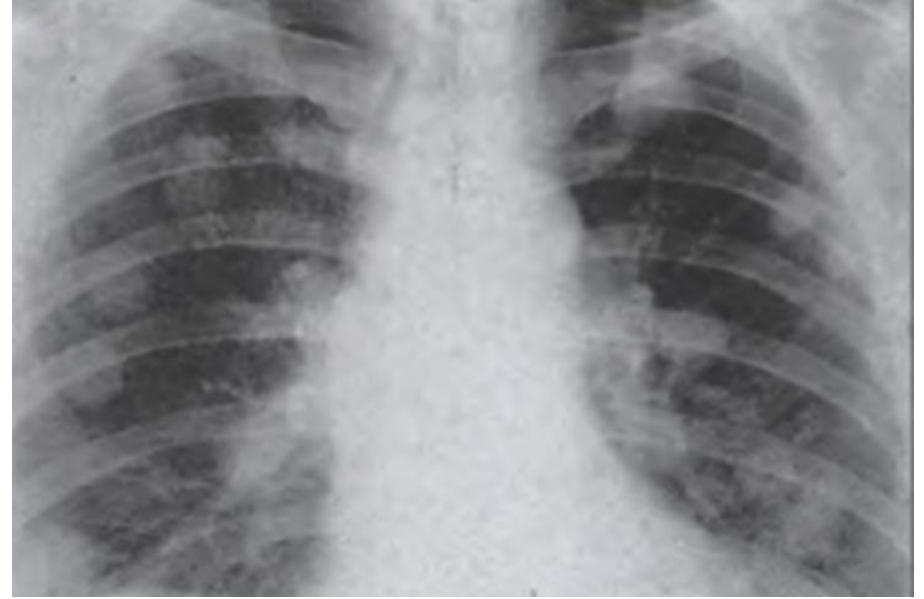
7



Clinical syndrome _____

Conclusion _____

8



Clinical syndrome _____

Conclusion _____

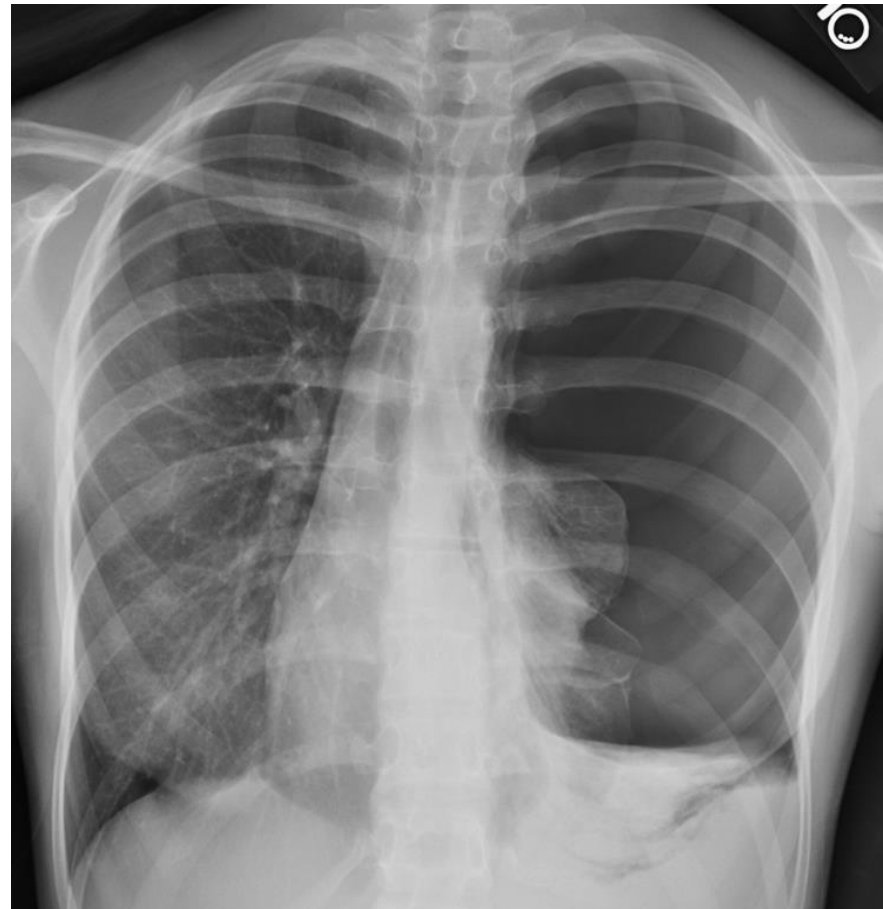
9



Clinical syndrome _____

Conclusion _____

10



Clinical syndrome _____

Conclusion _____

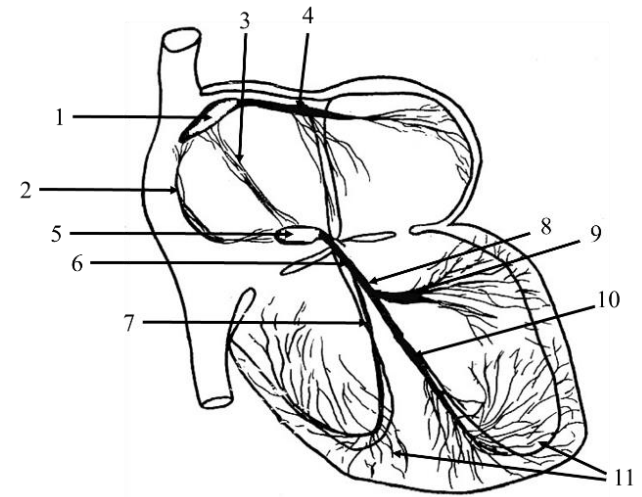
FOR NOTES

CHAPTER 3. ELECTROCARDIOGRAPHY

THE CARDIAC CONDUCTION SYSTEM

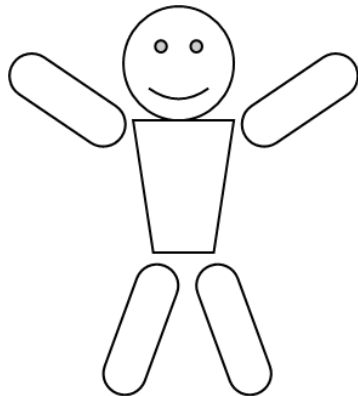
Write the elements of the cardiac conduction system:

- | | |
|-----|------|
| 1 — | 7 — |
| 2 — | 8 — |
| 3 — | 9 — |
| 4 — | 10 — |
| 5 — | 11 — |
| 6 — | |



ECG ELECTRODE PLACEMENT

1. Color the electrodes applied to the limbs.
2. Draw the standard leads by arrows.



Limb Leads (write)

I — between _____ and _____

II — between _____ and _____

III — between _____ and _____

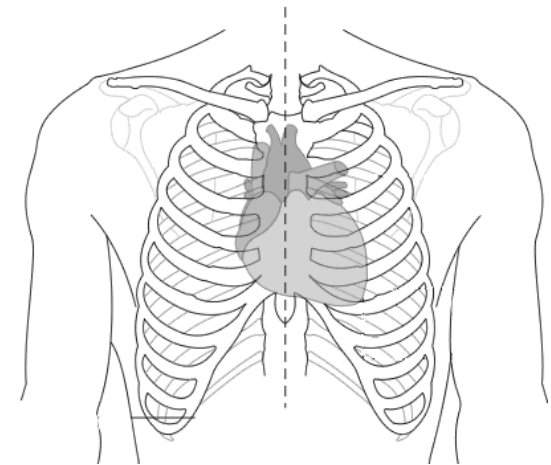
Augmented Limb Leads (write)

aVR — augmented lead from _____

aVL — augmented lead from _____

aVF — augmented lead from _____

Draw the location of the chest electrodes



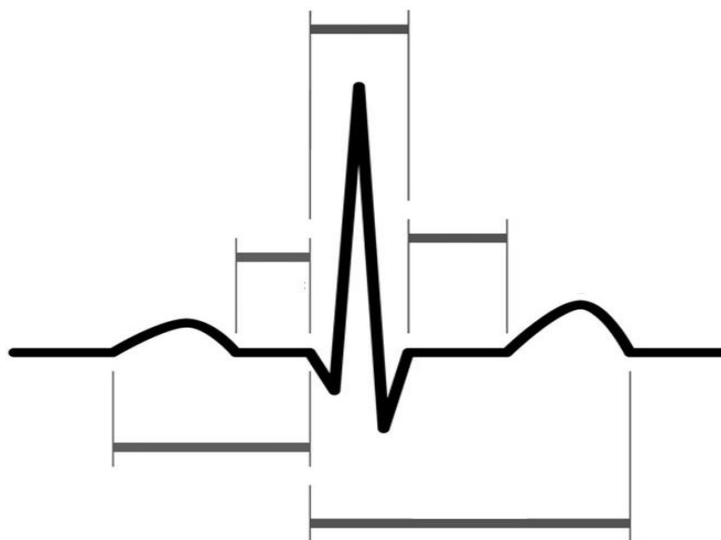
NORMAL ELECTROCARDIOGRAM

ECG elements		Duration, sec	Amplitude, mm
wave	P	0.08–0.1	0.05–2.5
wave	Q	0–0.03	$\frac{1}{4}$ R-wave at the same lead
wave	R	0.03–0.04	5–25
wave	S	0–0.03	0–6
wave	T	0.16–0.24	$\frac{1}{2}$ – $\frac{1}{3}$ R-wave at the same lead
interval	P-Q	0.12–0.2	
interval	Q-T	0.35–0.42	
interval	R-R	0.75–1.0	
segment	S-T		Elevation or depression less than 1 mm from isoline
complex	QRS	0.06–0.1	

Indicate the amplitude and speed of the ECG recording, indicate units

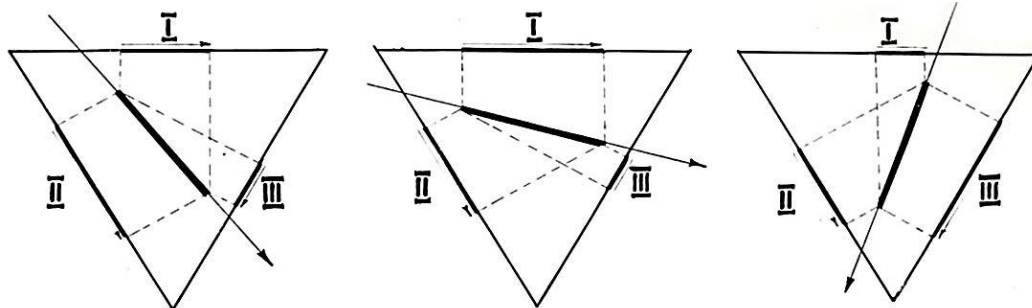


Indicate the elements of a normal ECG



ECG ANALYSIS ALGORITHM

1. Rhythm	Sinus rhythm	• wave P precedes every QRS complex, P is positive in standard lead II, the same in shape and direction in the same lead; • RR intervals are equal, regular If the difference between RR intervals is more than 10 %, arrhythmia presents
	Heart rate	Heart rate = 60 / RR (sec), 60–90 beats per minute — normocardia, less than 60 — bradycardia, more than 90 — tachycardia
2. Voltage	Amplitude of QRS I + QRS II + QRS III < 15 mm — low voltage	
3. Position of the electrical axis of the heart	RII > RI > RIII — normal position of the electrical heart axis RI > RII > RIII — left axis deviation RIII > RII > RI — right axis deviation	
4. Analysis of waves and intervals in standard lead II	Wave P: normal duration does not exceed 0.1 sec, amplitude — less than 2.5 mm. Interval PQ: 0.02 sec x ... mm = ... (0.12–0.20 sec). Wave Q — normally does not exceed 0.03 sec in duration, amplitude — $\frac{1}{4}$ R wave (in III — not more than $\frac{1}{2}$ R). Transition zone (R = S) in V3 (or between V3 and V4). The amplitude of the R and T waves is maximum in V4. Interval QRS: 0.02 sec x ... mm = ... (normally 0.06–0.1 sec); QRS > 0.1 sec, but less than < 0.12 sec — incomplete bundle branch block; QRS $\geq$ 0.12 sec — complete bundle branch block. Segment ST: the position in relation to the isoline (on the isoline, higher by ... mm, lower by ... mm). Normally, segment ST is on the isoline. Wave T: positive, negative, isoelectric — in what leads. Interval QT: 0.02 sec x ... mm = ... (less than 0.44 sec). Interval QT by Bazett formula = $K \times \sqrt{RR}$, with K (male) = 0.37 K (female) = 40	
Conclusion: <i>For example: Sinus rhythm, regular, with a heart rate of 66 per minute (normocardia), normal voltage, normal position of the electrical axis of the heart.</i>		



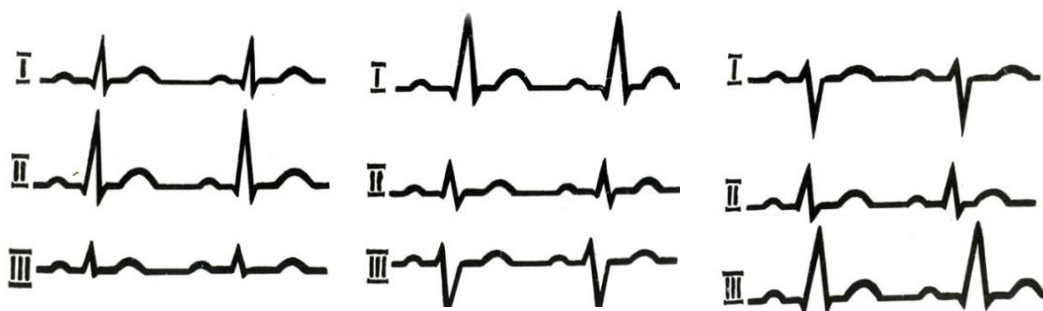
ECG SIGNS OF NORMAL SINUS RHYTHM

- The heart rate is between 60 and 90.
- Each QRS complex is preceded by a normal P wave.
- The RR intervals and PR intervals remain constant.
- The P waves are visible, positive at lead II and have the same shape and direction in the same lead.

Normal axis

Left axis deviation

Right axis deviation



Quick Heart Rate count:

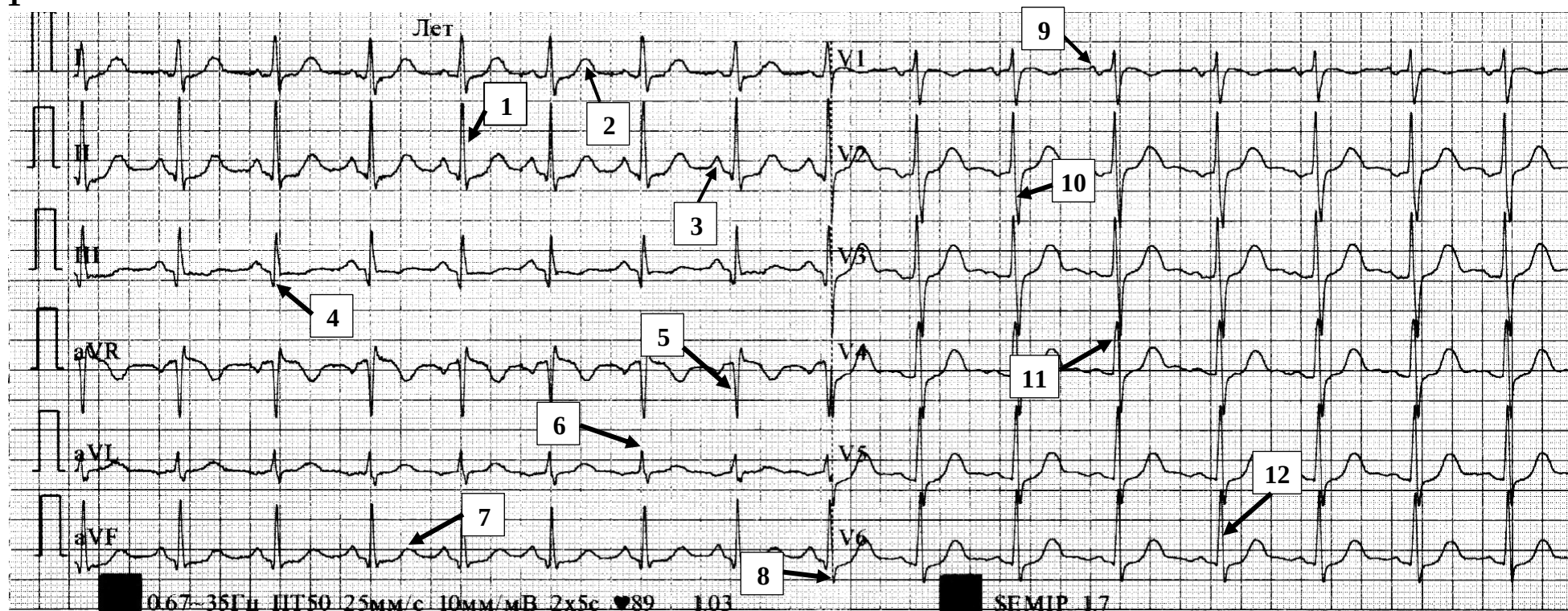
at a speed of 50 mm/s **Heart rate** = $\frac{600}{LB}$

at a speed of 25 mm/s **Heart rate** = $\frac{300}{LB}$

LB — the number of large boxes (5 mm each) in the RR interval

ECG signs of Sinus Tachycardia (write)	ECG signs of Sinus Bradycardia (write)
Heart rate _____ hits/min	Heart rate _____ hits/min
Rhythm _____	Rhythm _____

1

**Paper speed:**

50 mm/sec 1 mm = 0.02 sec

25 mm/sec 1 mm = 0.04 sec

Rhythm (sinus or not)**Heart rate: interval RR**

0.02 (or 0.04) sec × mm = sec

0.02 (or 0.04) sec × mm = sec

0.02 (or 0.04) sec × mm = sec

HR = 60 / RR interval (sec) =

Name the marked waves:

1 —

2 —

3 —

4 —

5 —

6 —

7 —

8 —

9 —

10 —

11 —

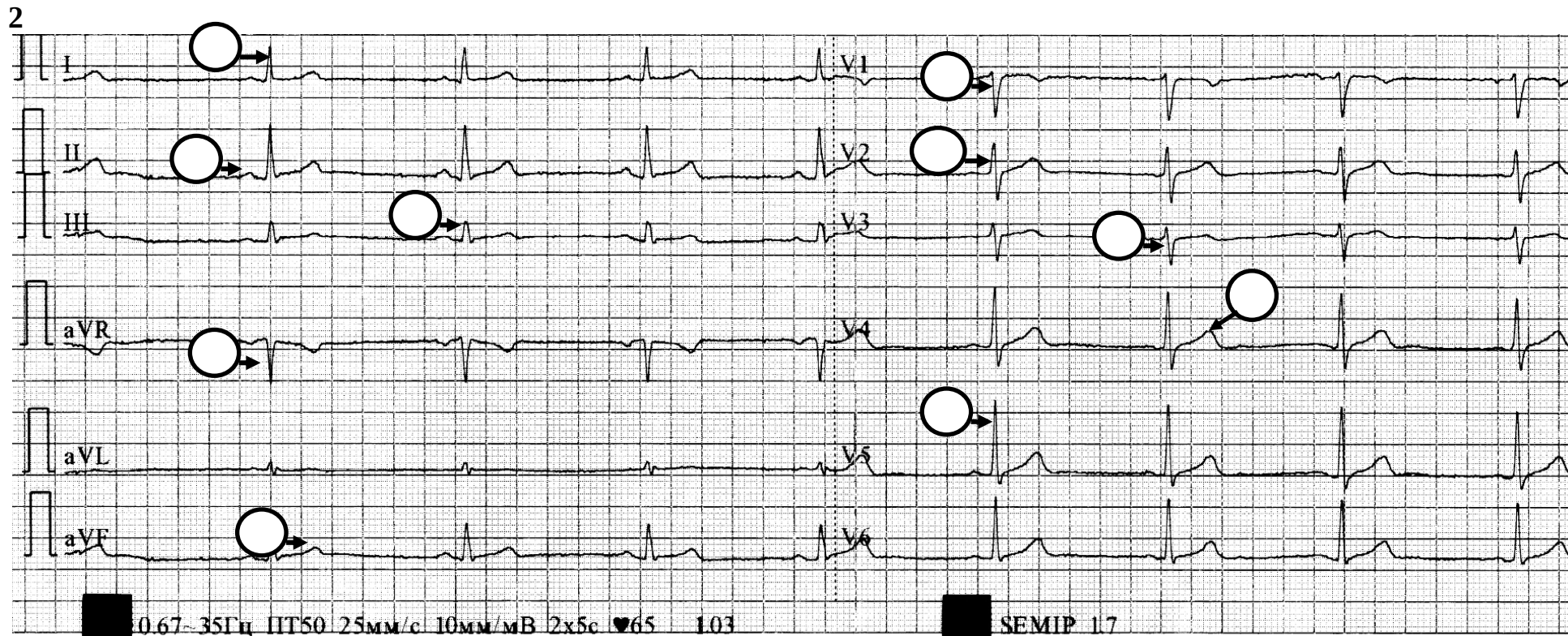
12 —

Position of the electrical axis of the heart (underline the correct answer)

normal position

left axis deviation

right axis deviation



Paper speed:

50 mm/sec 1 mm = 0.02 sec

25 mm/sec 1 mm = 0.04 sec

Rhythm (sinus or not)

Heart rate: interval RR

0.02 (or 0.04) sec × mm = sec

0.02 (or 0.04) sec × mm = sec

0.02 (or 0.04) sec × mm = sec

HR = 60 / RR interval (sec) =

Name the marked waves:

I —

II —

III —

aVR —

aVF —

V1 —

V2 —

V4 —

V5 —

V6 —

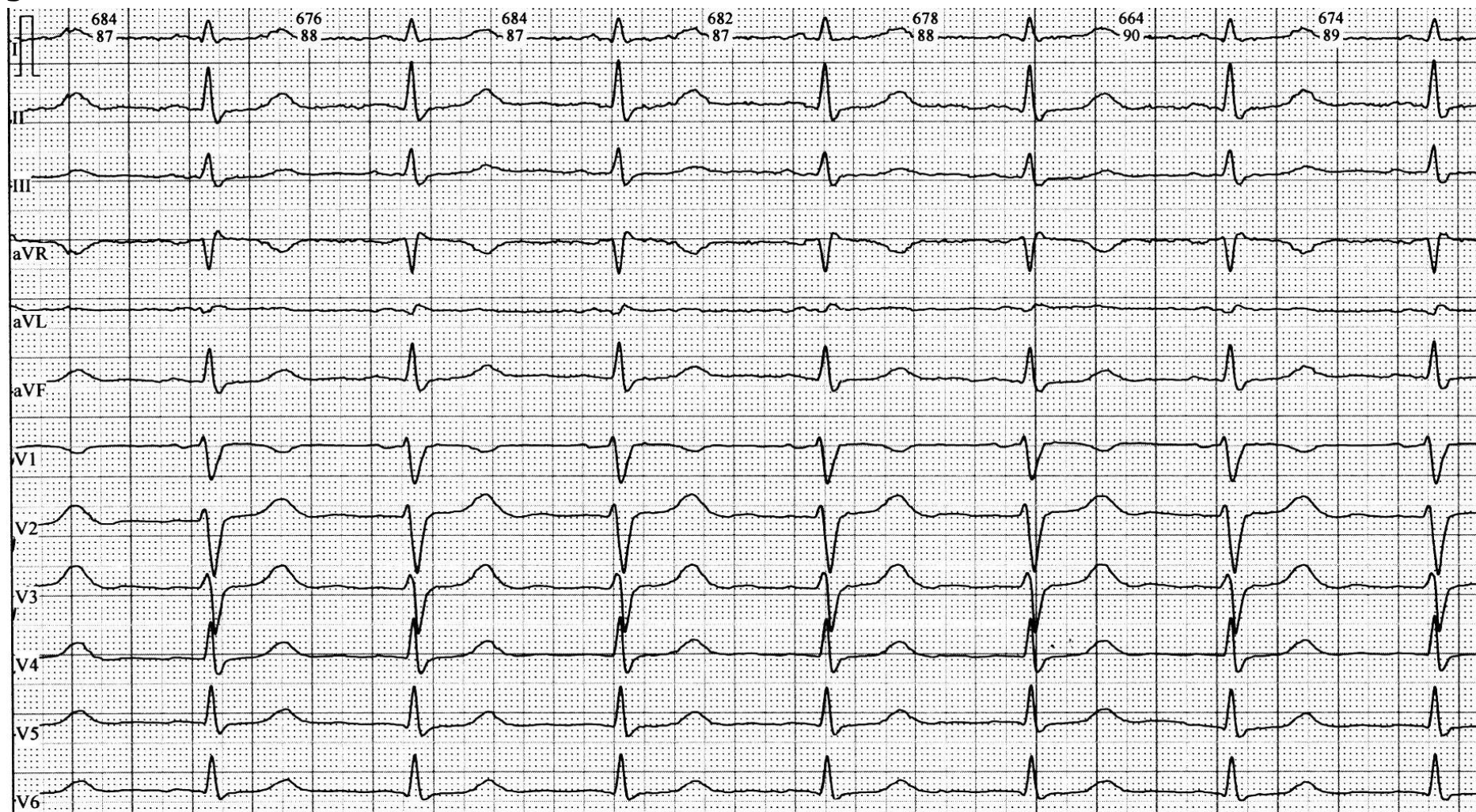
Position of the electrical axis of the heart (underline the correct answer)

normal position

left axis deviation

right axis deviation

3



50 mm/s

3

Paper speed: 50 mm/s 1 mm = 0.02 sec
25 mm/s 1 mm = 0.04 sec

I. Rhythm (sinus or not)

Normal sinus rhythm: normal heart rate is between 60 and 90.

Each QRS complex is preceded by a normal P wave.

The RR intervals and PR intervals remains constant, the P waves are visible, positive at II lead and have the same morphology in each lead.

RR (the same).

The difference between RR intervals is more than 0.16 sec — arrhythmia

0.02 (or 0.04) sec × mm = sec

0.02 (or 0.04) sec × mm = sec

0.02 (or 0.04) sec × mm = sec

Heart Rate = 60 / R-R interval (sec)

II. Voltage

Amplitude QRS I + II + III < 15 mm — low voltage

III. Axis

normal position

left axis deviation

right axis deviation

QT interval corresponds to _____ ventricles

What does Bazett formula calculate? _____

V. Conclusion

IV. Analysis of waves and intervals

P wave — duration < 0.1 sec amplitude < 2.5 mm

QRS — 0.02 (or 0.04) sec × mm = (less 0.1 sec)

0.11–0.12 sec — incomplete bundle branch block

> 0.12 sec — complete bundle branch block

PQ — 0.02 (or 0.04) sec × mm = (0.12–0.20 sec)

QT — 0.02 (or 0.04) sec × mm = (less 0.44 sec)

QT by Bazett formula $K \times \sqrt{RR/sec}$

Kmale = 0.37

Kfemale = 0.40

T wave — positive in leads _____

flat in leads _____

negative in leads _____

segment ST is characterized the position in relation to the isoline
(on the isoline, higher by ... mm, lower by ... mm)

I aVR V1 V4

II aVL V2 V5

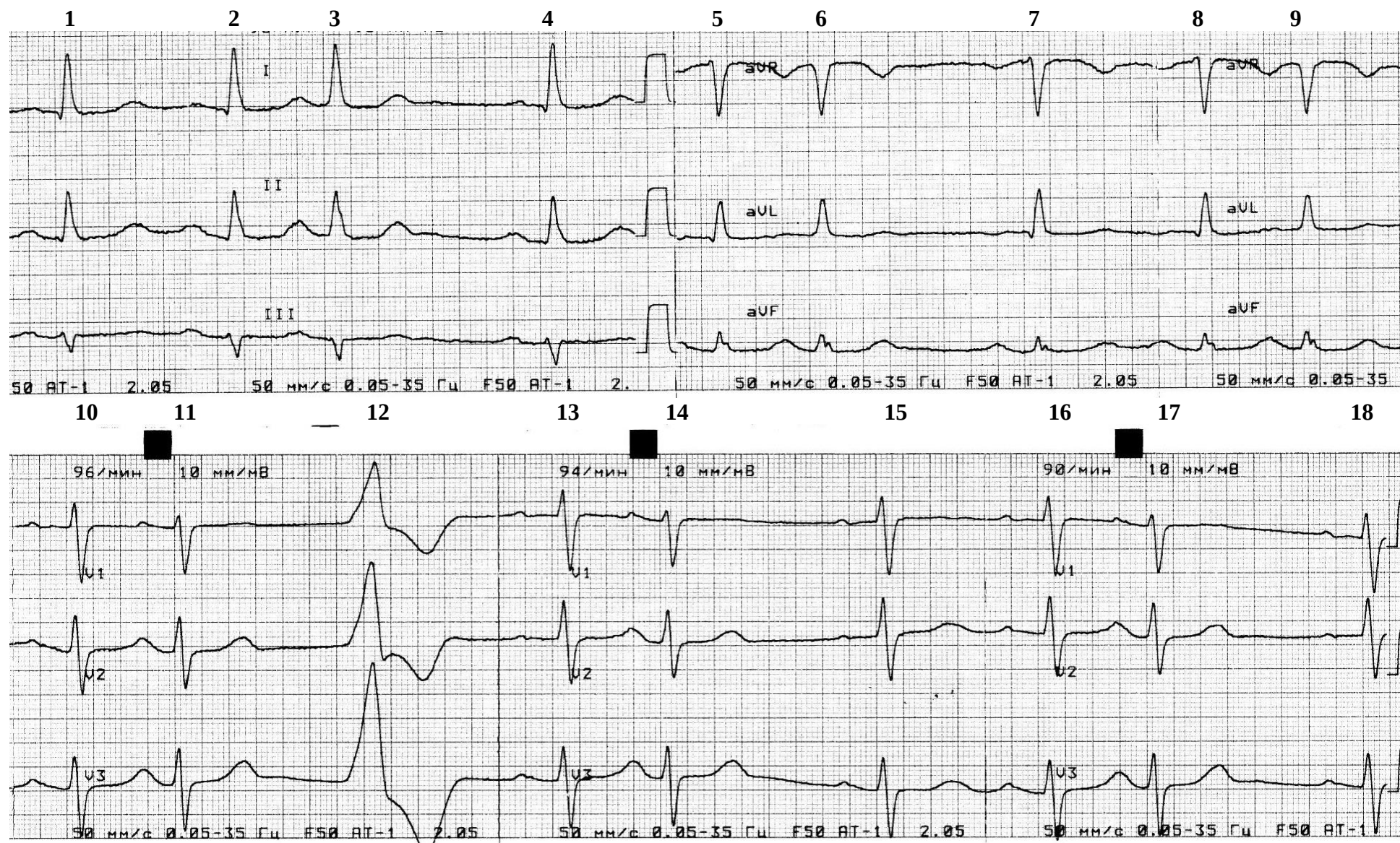
III aVF V3 V6

Q wave should be less than $\frac{1}{4}$ R wave in the same lead,
duration < 0.03 sec.

Transition zone (R = S) in V3 (or between V3 and V4)

R increases from V1 to V4, then decreases

4



4

Paper speed: 50 mm/s 1 mm = 0.02 sec
25 mm/s 1 mm = 0.04 sec

I. Rhythm (sinus or not)

Sinus rhythm: P wave before each QRS complex.

P wave is positive in standard lead II.

P wave is identical in shape in the same lead.

RR (minimum and maximum)

0.02 (or 0.04) sec × mm = sec

0.02 (or 0.04) sec × mm = sec

Heart Rate = 60/R-R interval (sec) (minimum and maximum)

II. Voltage

Amplitude QRS I + II + III < 15 mm — low voltage

IV. Conclusion.

III. Analysis of waves and intervals

QRS — 0.02 (or 0.04) sec × mm = (less 0.1 sec)

Name the impulse source for each QRS complex:

1 —

2 —

3 —

4 —

5 —

6 —

7 —

8 —

9 —

10 —

11 —

12 —

13 —

14 —

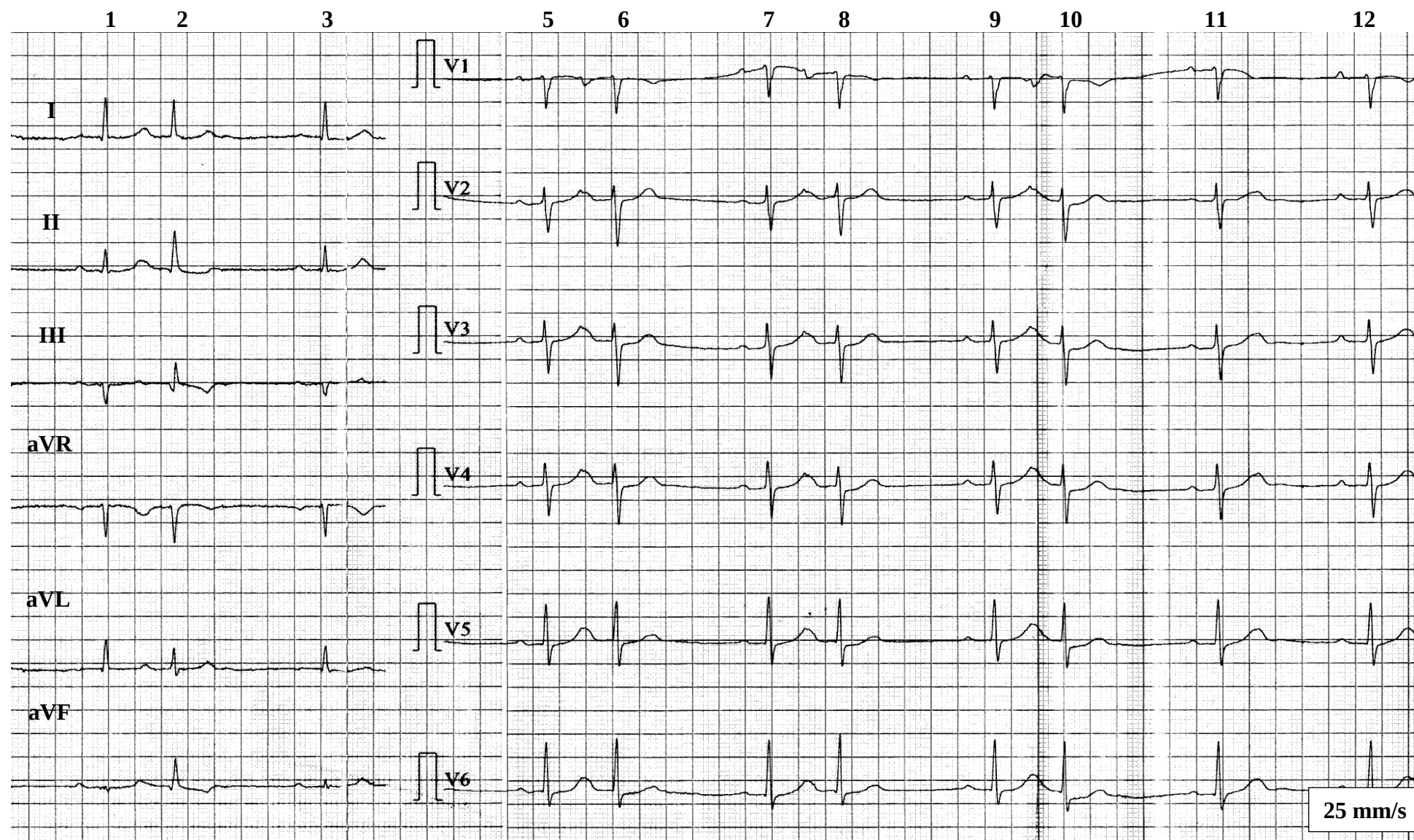
15 —

16 —

17 —

18 —

5



5

Paper speed: 50 mm/s 1 mm = 0.02 sec
25 mm/s 1 mm = 0.04 sec

I. Rhythm (sinus or not)

Sinus rhythm: P wave before each QRS complex.

P wave is positive in standard lead II.

P wave is identical in shape in the same lead.

RR (minimum and maximum)

0.02 (or 0.04) sec × mm = sec

0.02 (or 0.04) sec × mm = sec

Heart Rate = 60/R-R interval (sec) (minimum and maximum)

II. Voltage

Amplitude QRS I + II + III < 15 mm — low voltage

IV. Conclusion.

III. Analysis of waves and intervals

QRS — 0.02 (or 0.04) sec × mm = (less 0.1 sec)

Name the impulse source for each QRS complex:

1 —

2 —

3 —

4 —

5 —

6 —

7 —

8 —

9 —

10 —

11 —

12 —

13 —

14 —

15 —

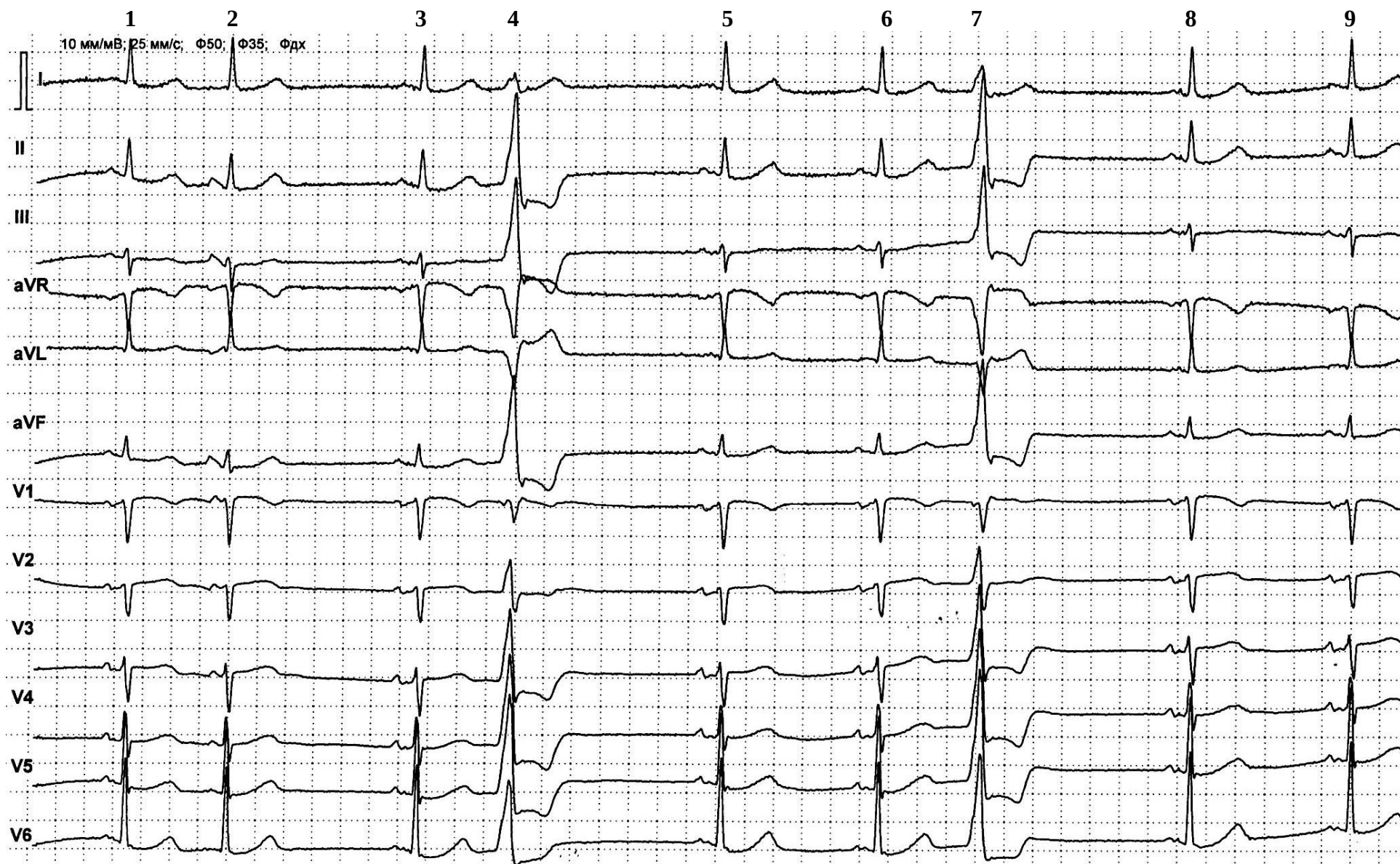
16 —

17 —

18 —

A condition in which each sinus contraction is followed by an extrasystole is called (insert name)

6



6

Paper speed: 50 mm/s 1 mm = 0.02 sec
25 mm/s 1 mm = 0.04 sec

I. Rhythm (sinus or not)

Sinus rhythm: P wave before each QRS complex.

P wave is positive in standard lead II.

P wave is identical in shape in the same lead.

RR (minimum and maximum)

0.02 (or 0.04) sec × mm = sec

0.02 (or 0.04) sec × mm = sec

Heart Rate = 60/R-R interval (sec) (minimum and maximum)

II. Voltage

Amplitude QRS I + II + III < 15 mm — low voltage

III. Axis

normal position

left axis deviation

right axis deviation

V. Conclusion

IV. Analysis of waves and intervals

P wave — duration < 0.1 sec, amplitude < 2.5 mm

QRS — 0.02 (or 0.04) sec × mm = (less 0.1 sec)

Measure all QRS complexes in lead II:

1) QRS — 0.02 (or 0.04) sec × mm = (less 0.1 sec)

2) QRS =

3) QRS =

4) QRS =

5) QRS =

6) QRS =

7) QRS =

8) QRS =

9) QRS =

Name the impulse source for each QRS complex:

1 —

2 —

3 —

4 —

5 —

6 —

7 —

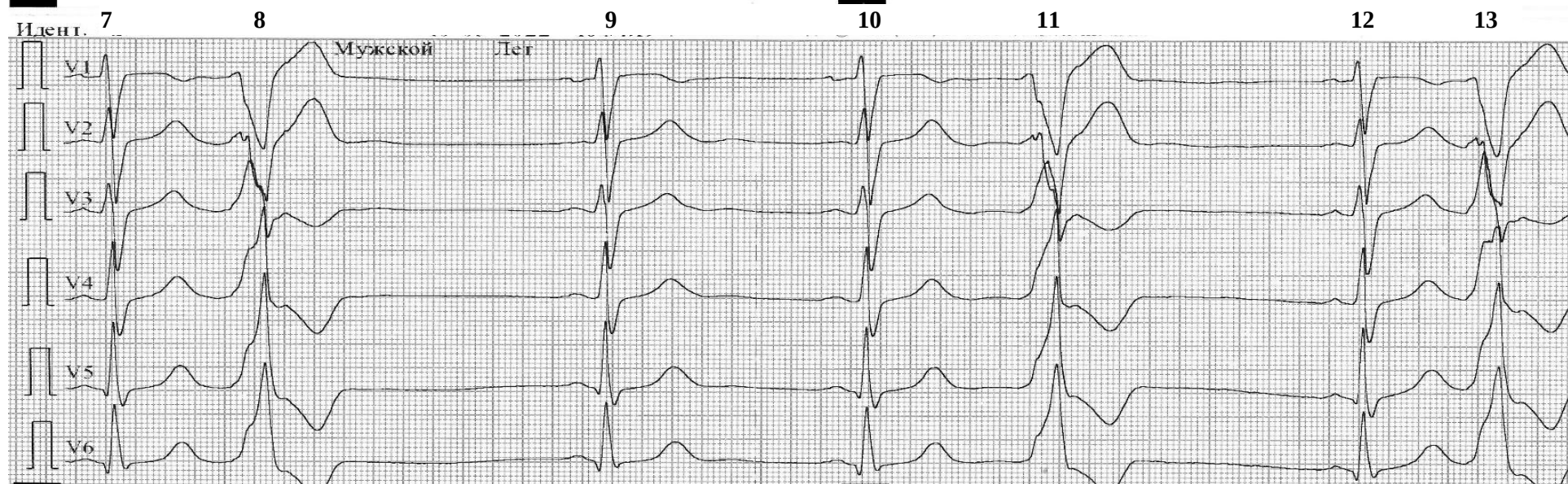
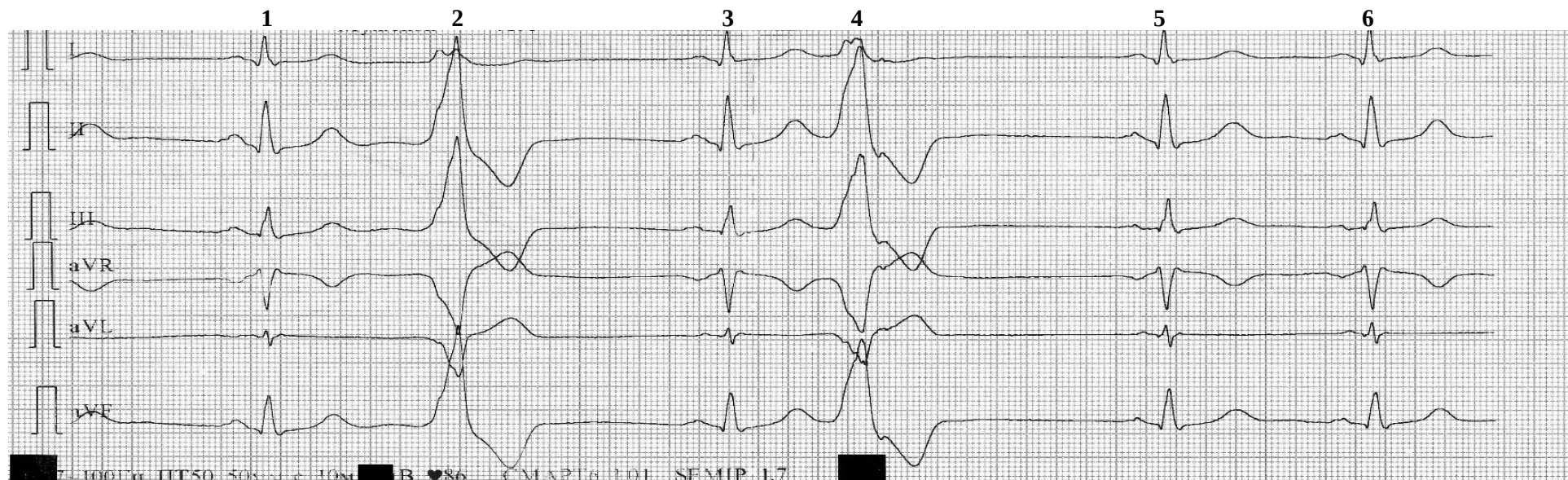
8 —

9 —

Sign all P waves in lead V2

Indicate a compensatory pause in lead III

7



7

Paper speed: 50 mm/s 1 mm = 0.02 sec
25 mm/s 1 mm = 0.04 sec

I. Rhythm (sinus or not)

Sinus rhythm: P wave before each QRS complex.

P wave is positive in standard lead II.

P wave is identical in shape in the same lead.

RR (minimum and maximum)

0.02 (or 0.04) sec × mm = sec

0.02 (or 0.04) sec × mm = sec

Heart Rate = 60/R-R interval (sec) (minimum and maximum)

II. Voltage

Amplitude QRS I + II + III < 15 mm — low voltage

III. Axis

normal position

left axis deviation

right axis deviation

V. Conclusion

IV. Analysis of waves and intervals

P wave — duration < 0.1 sec, amplitude < 2.5 mm

QRS — 0.02 (or 0.04) sec × mm = (less 0.1 sec)

Measure the duration of the QRS complexes in lead II

Write the impulse source for each QRS complex

1 —

2 —

3 —

4 —

5 —

6 —

7 —

8 —

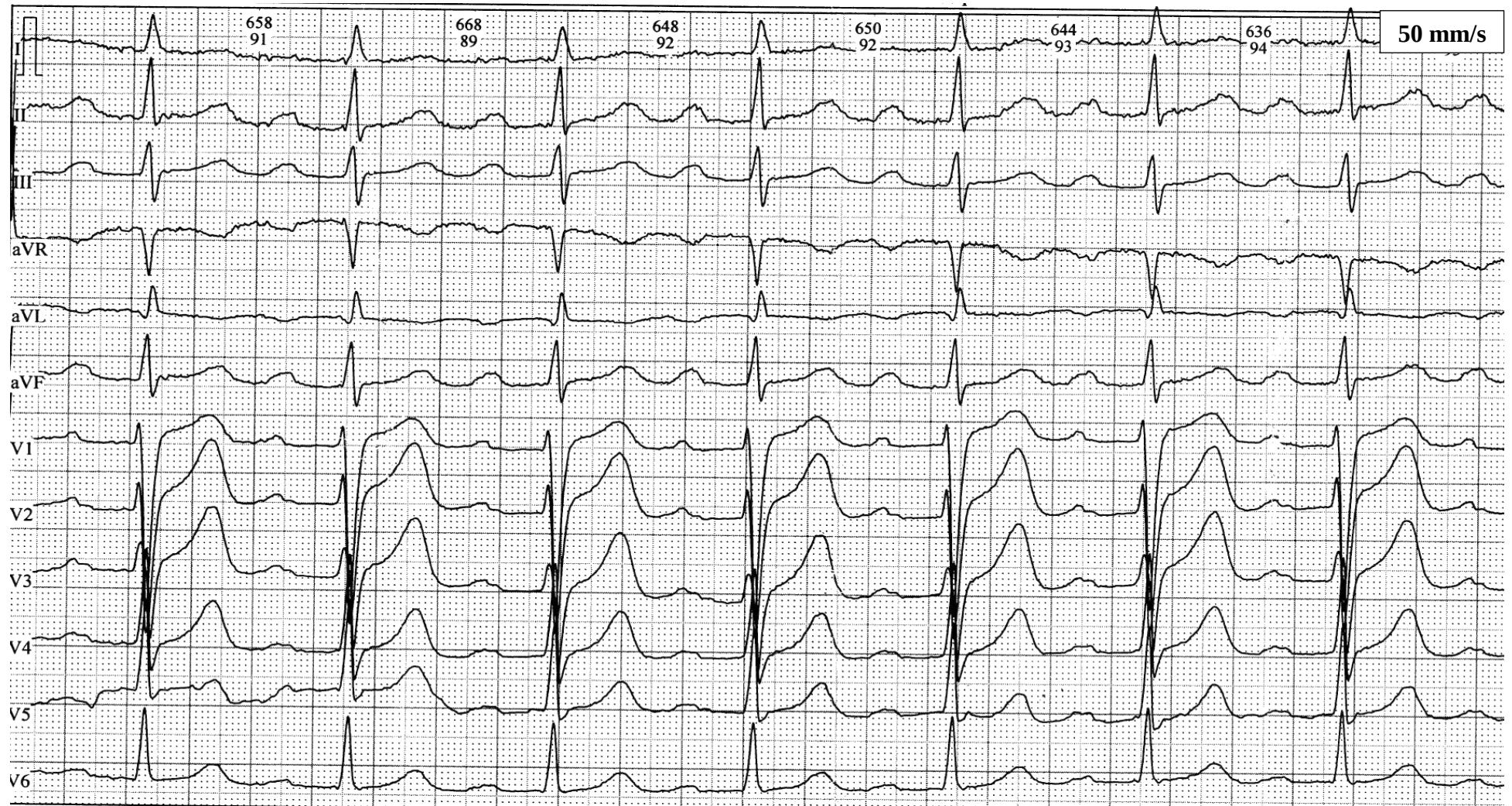
9 —

10 —

11 —

12 —

13 —



8

Paper speed: 50 mm/s 1 mm = 0.02 sec
25 mm/s 1 mm = 0.04 sec

I. Rhythm (sinus or not)

Normal sinus rhythm:

Each QRS complex is preceded by a normal P wave
P waves are visible, positive at II lead.
P is the same in shape in the same lead.

RR (minimum and maximum)

0.02 (or 0.04) sec × mm = sec

0.02 (or 0.04) sec × mm = sec

0.02 (or 0.04) sec × mm = sec

Heart Rate = 60/R-R interval (sec) (60–90 hits/minute)

II. Voltage (underline)

Sufficient or low

III. Axis

normal position

left axis deviation

right axis deviation

V. Conclusion

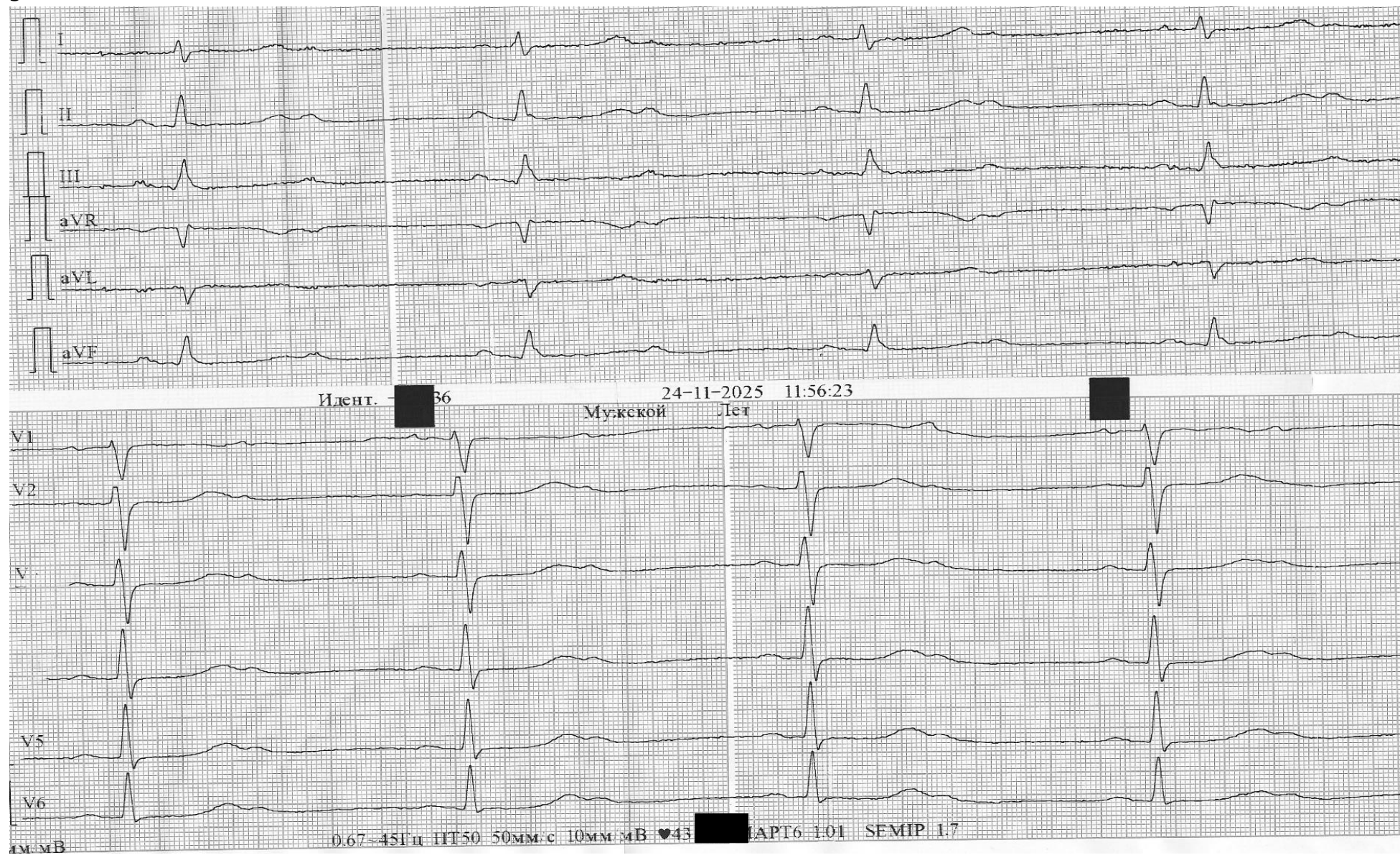
IV. Analysis of waves and intervals

P wave — duration < 0.1 sec, amplitude < 2.5 mm

QRS — 0.02 (or 0.04) sec × mm = (до 0.1 sec)

PQ — 0.02 (or 0.04) sec × mm = (0.12–0.20 sec)

- Mark all PQ segments in lead II.
- Mark all PQ intervals in lead aVF.
- Estimate PQ intervals (duration).



9

Paper speed: 50 mm/s 1 mm = 0.02 sec
25 mm/s 1 mm = 0.04 sec

I. Rhythm (sinus or not)

Normal sinus rhythm:

Each QRS complex is preceded by a normal P wave
P waves are visible, positive at II lead.
P is the same in shape in the same lead.

Heart rate = 60 / RR interval (sec.) =

II. Voltage (underline)

Sufficient or low

III. Axis

normal position
left axis deviation
right axis deviation

V. Conclusion

IV. Analysis of waves and intervals

P wave — duration < 0.1 sec, amplitude < 2.5 mm

QRS — 0.02 (or 0.04) sec × mm = (less 0.1 sec)

PQ — 0.02 (or 0.04) sec × mm = (0.12–0.20 sec)

- Mark each P wave in lead II.
- Determine the duration of the PQ interval.

What is the name for the disappearance of the QRS complex after the P wave?

(fulfill the name) _____

What is the normal rate of impulses coming from the sinus node?

(write) _____

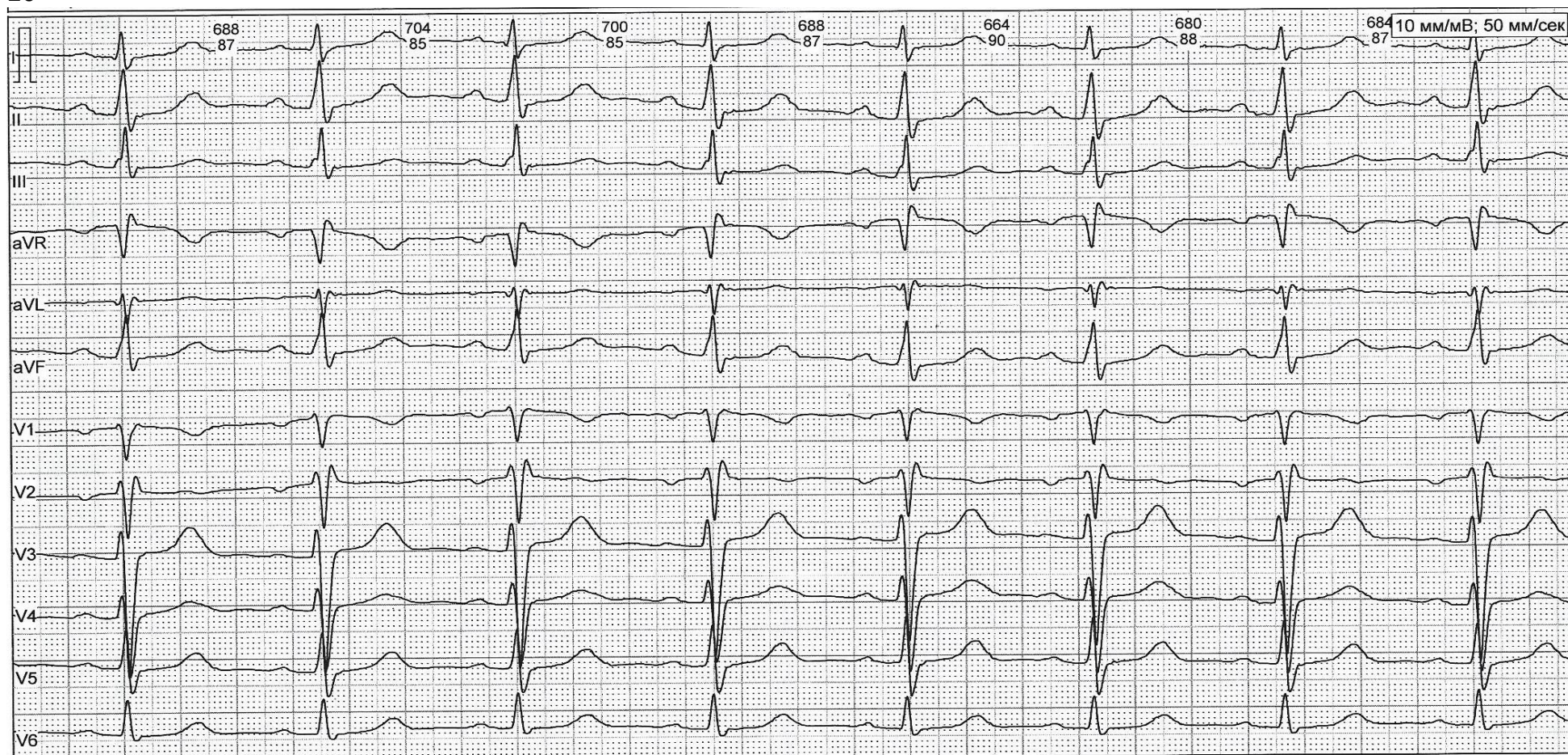
What is the normal rate of impulses coming from the atrio-ventricular node? (write) _____

What is the normal rate of impulses coming from the His bundle?

(write) _____

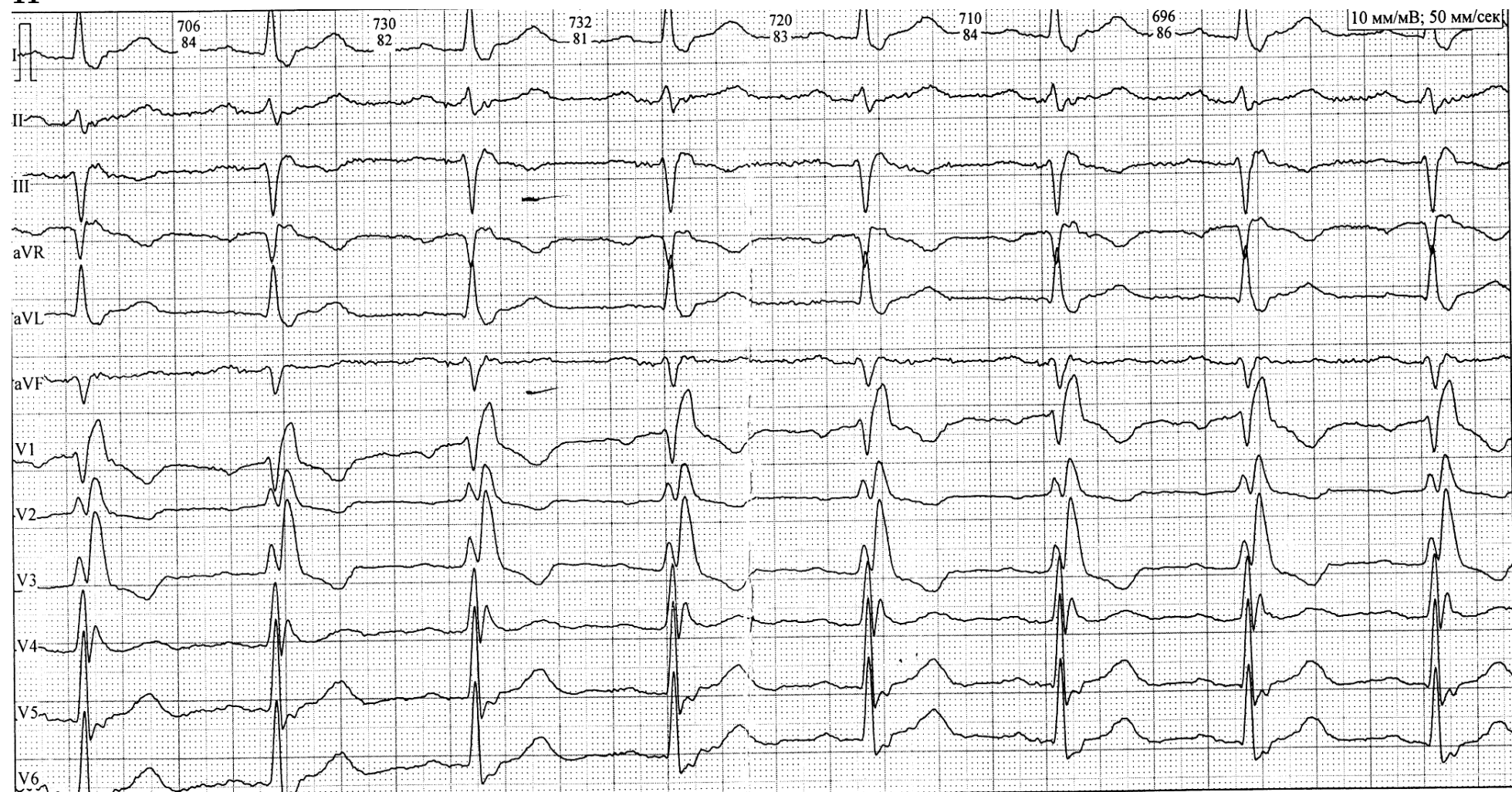
What is the normal rate of impulses coming from Purkinje fibers?

(write) _____



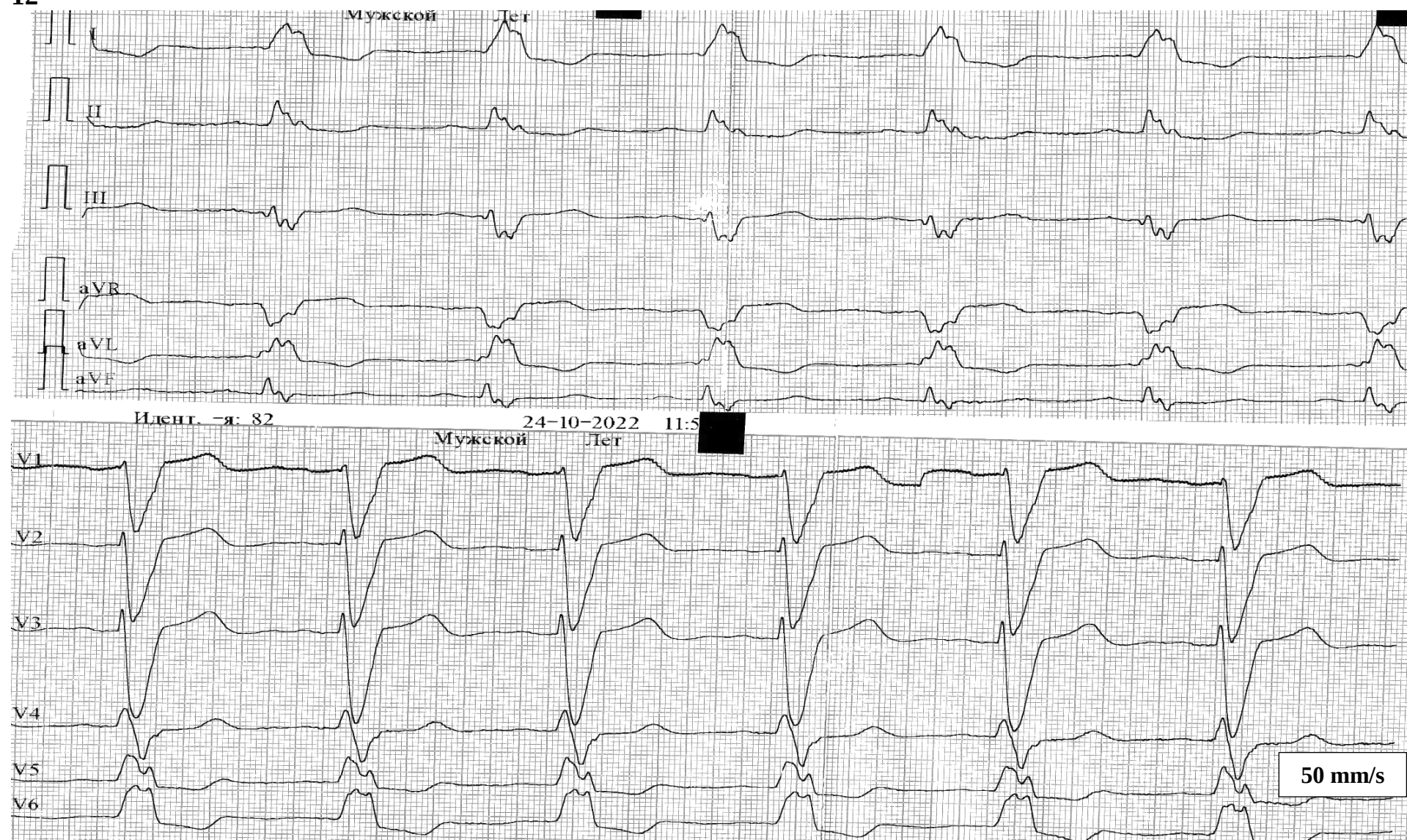
Conclusion:

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Conclusion:

12

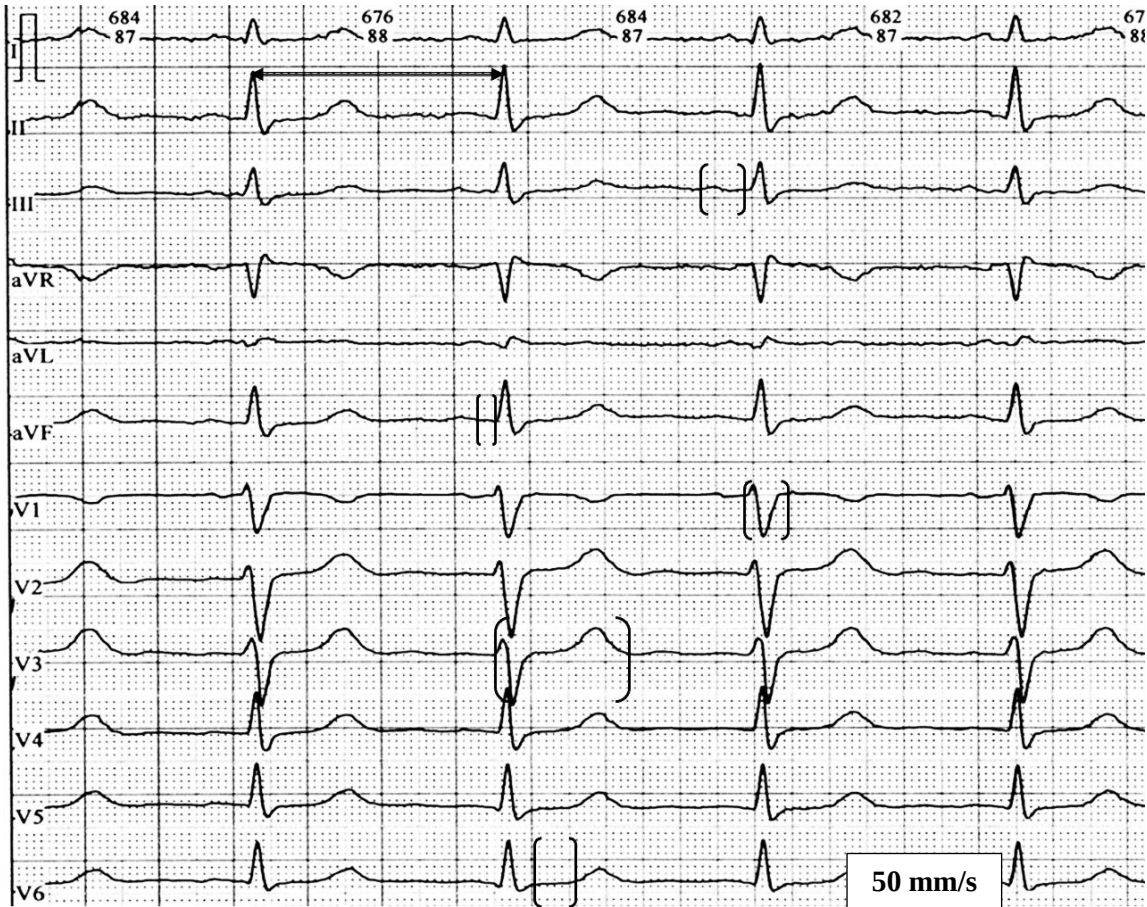


Conclusion:

Write the ECG elements and appropriate components of the electrical sequence of the heart

P		RR	
PQ	Segment Interval	QT	
QRS		ST	
T		TP	

Write the segments and intervals (in brackets) and compare their duration with normal values (writing speed 50 mm/s):



Lead	Segments or intervals	Duration, sec
II		
III		
aVF		
V1		
V3		
V6		

ECG SIGNS OF PREMATURE CONTRACTION (EXTRASYSTOLE)

Write the signs.

Give a definition Extrasystole is	Types of extrasystoles by origin: 1 — 2 — 3 —	General ECG signs of extrasystole: A — B — C —
Write ECG signs of extrasystole of various origins:		
1 — ECG signs of extrasystole	2 — ECG signs of extrasystole	3 — ECG signs of extrasystole

ECG SIGNS OF ATRIOVENTRICULAR BLOCK

Write the signs.

AV block I degree	AV block II degree			AV block III degree (complete AV block)
	Mobitz type I	Mobitz type II	Mobitz type III (High-grade AV block)	

ECG SIGNS OF BUNDLE BRANCH BLOCK

Write.

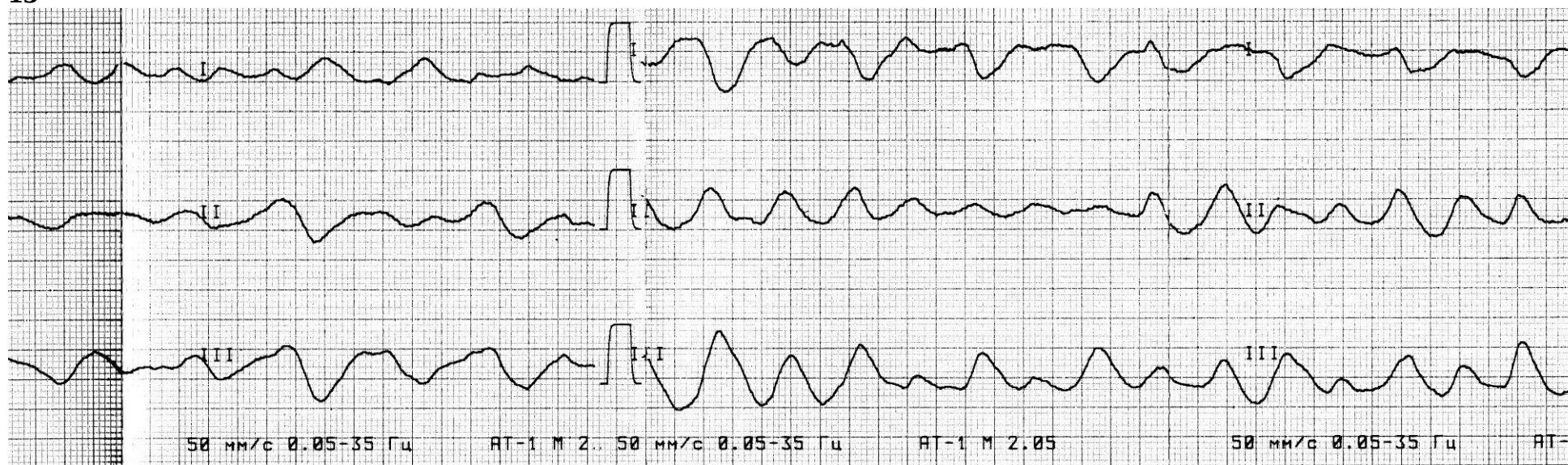
Right bundle branch block		Left bundle branch block
incomplete QRS =	complete QRS =	complete QRS =

ECG SIGNS OF ATRIAL FIBRILLATION AND FLATTER, VENTRICULAR FIBRILLATION

Write.

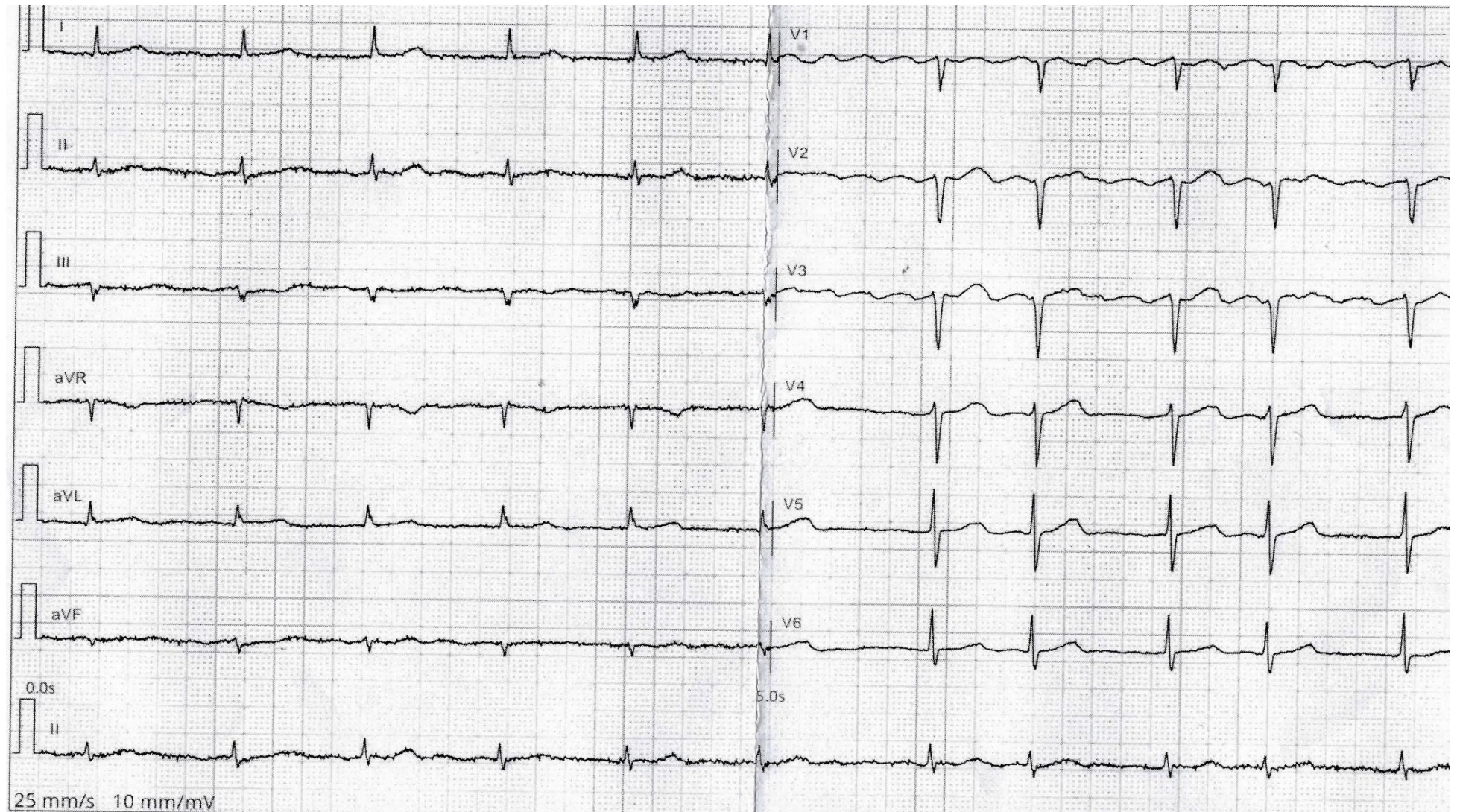
Atrial fibrillation	Atrial flutter	Ventricular fibrillation

13



Conclusion:

14



Conclusion:

14

Paper speed: 50 mm/s 1 mm = 0.02 sec
25 mm/s 1 mm = 0.04 sec

I. Rhythm (sinus or not)

Heart Rate = 60 / R-R interval (sec) (minimum and maximum)

II. Voltage (underline)

Sufficient or low

III. Axis

normal position

left axis deviation

right axis deviation

V. Conclusion

IV. Analysis of waves and intervals

QRS — 0.02 (or 0.04) sec × mm = (till 0.1 sec)

Mark the f or F waves in lead V2

Give a definition of the term “pulse deficit” —

Signs of atrial fibrillation (select):

1. Sinus rhythm of the atria
2. Absence of P waves
3. Prolongation of the QRS complex
4. Some impulses from the atria pass through the AV node and excite the ventricles
5. Absolutely irregular RR intervals
6. P duration less than 0.2 s
7. Appearance of f waves
8. Appearance of F waves
9. Prolongation of the QT interval

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15

Paper speed: 50 mm/s 1 mm = 0.02 sec
25 mm/s 1 mm = 0.04 sec

I. Rhythm (sinus or not)

Heart Rate = 60 / R-R interval (sec) (minimum and maximum)

II. Voltage (underline)

Sufficient or low

III. Axis

normal position

left axis deviation

right axis deviation

V. Conclusion

IV. Analysis of waves and intervals

QRS — 0.02 (or 0.04) sec × mm = (till 0.1 sec)

Mark the f or F waves in lead V2

Give a definition of the term “pulsus paradoxus” —

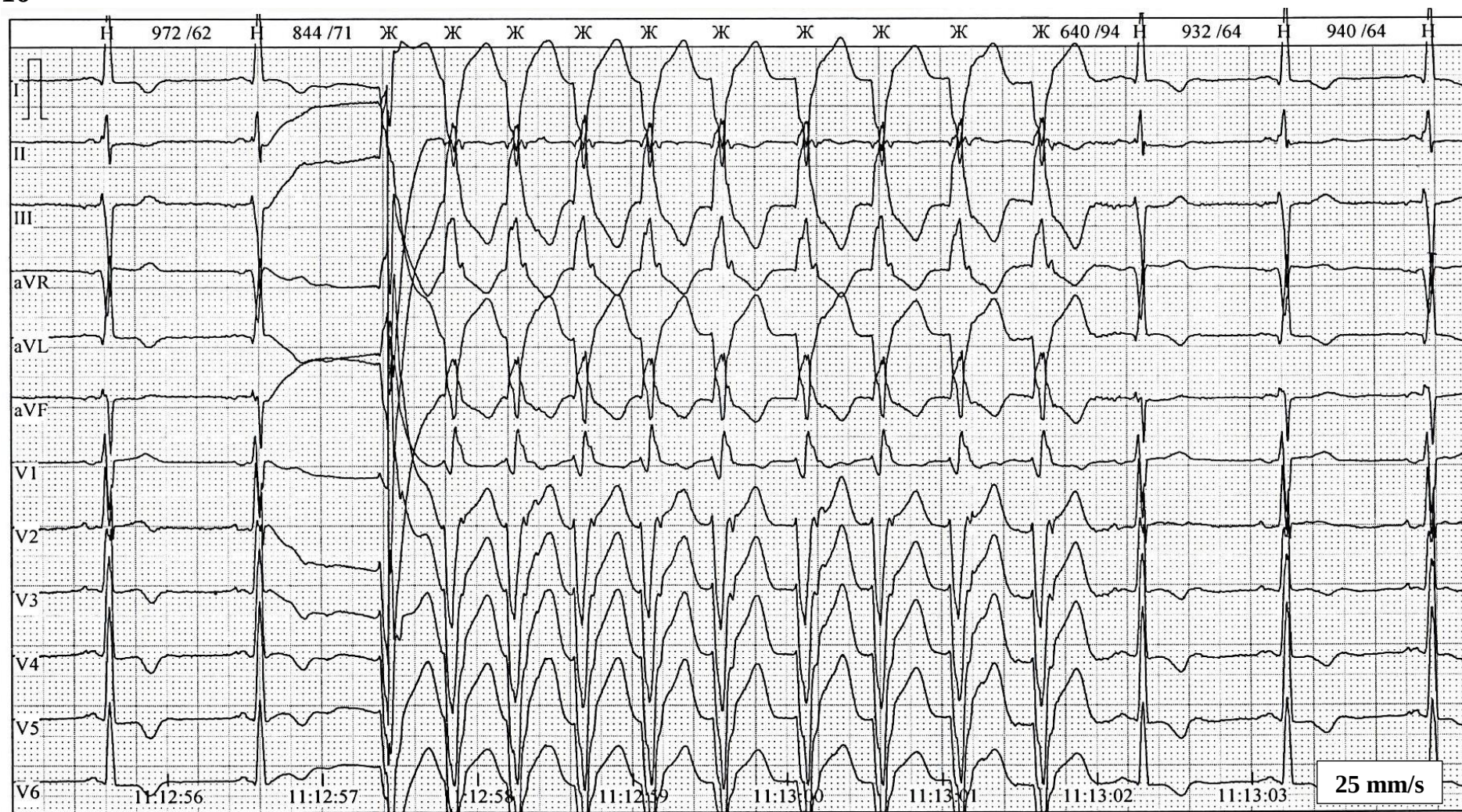
Signs of atrial flutter (select):

1. Sinus rhythm of the atria
2. Absence of P waves
3. Prolongation of the QRS complex
4. Some impulses from the atria pass through the AV node and excite the ventricles
5. Absolutely irregular PQ intervals
6. P duration less than 0.2 s
7. Appearance of f waves
8. Appearance of F waves
9. Shortening of the QT interval

Give a definition of the term “re-entry” —

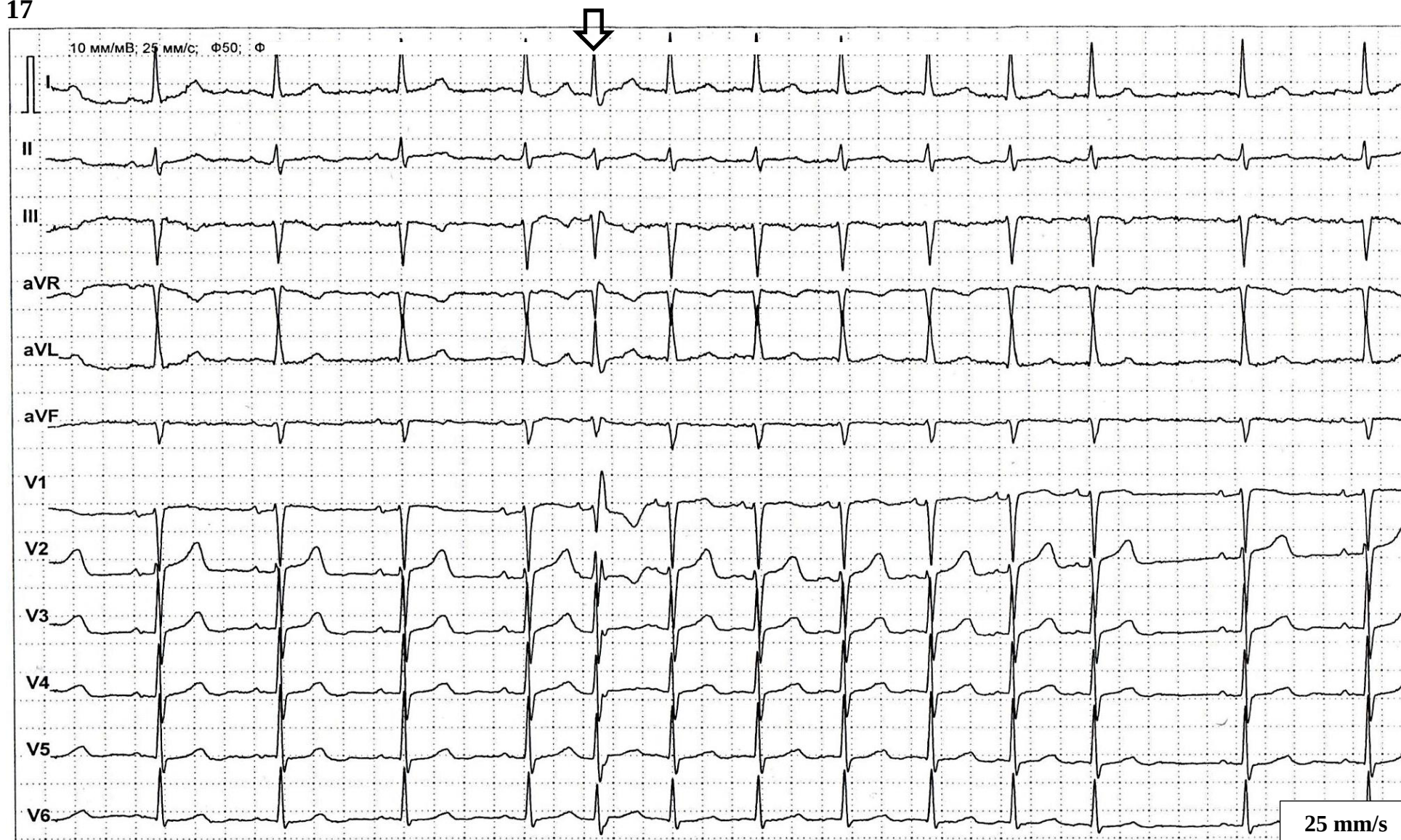
Conditions for the occurrence of rhythm disturbances by the re-entry mechanism

1. _____
2. _____



Conclusion:

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Conclusion:

ECG SIGNS OF PAROXYSMAL TACHYCARDIA

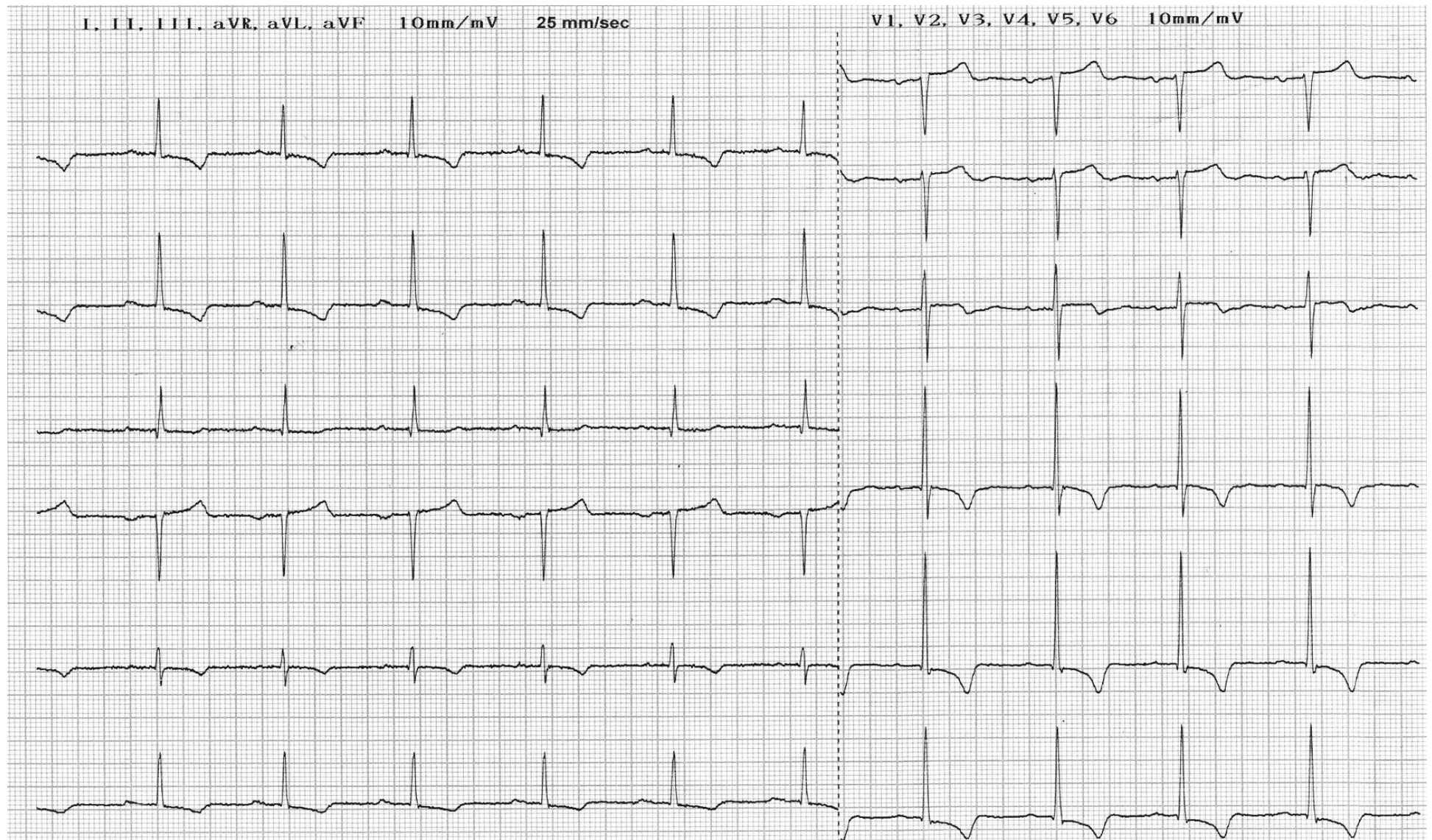
Write.

Paroxysmal atrial tachycardia	Paroxysmal tachycardia from the AV junction	Paroxysmal ventricular tachycardia

ECG SIGNS OF ATRIAL AND VENTRICULAR HYPERTROPHY

Write hypertrophy signs.

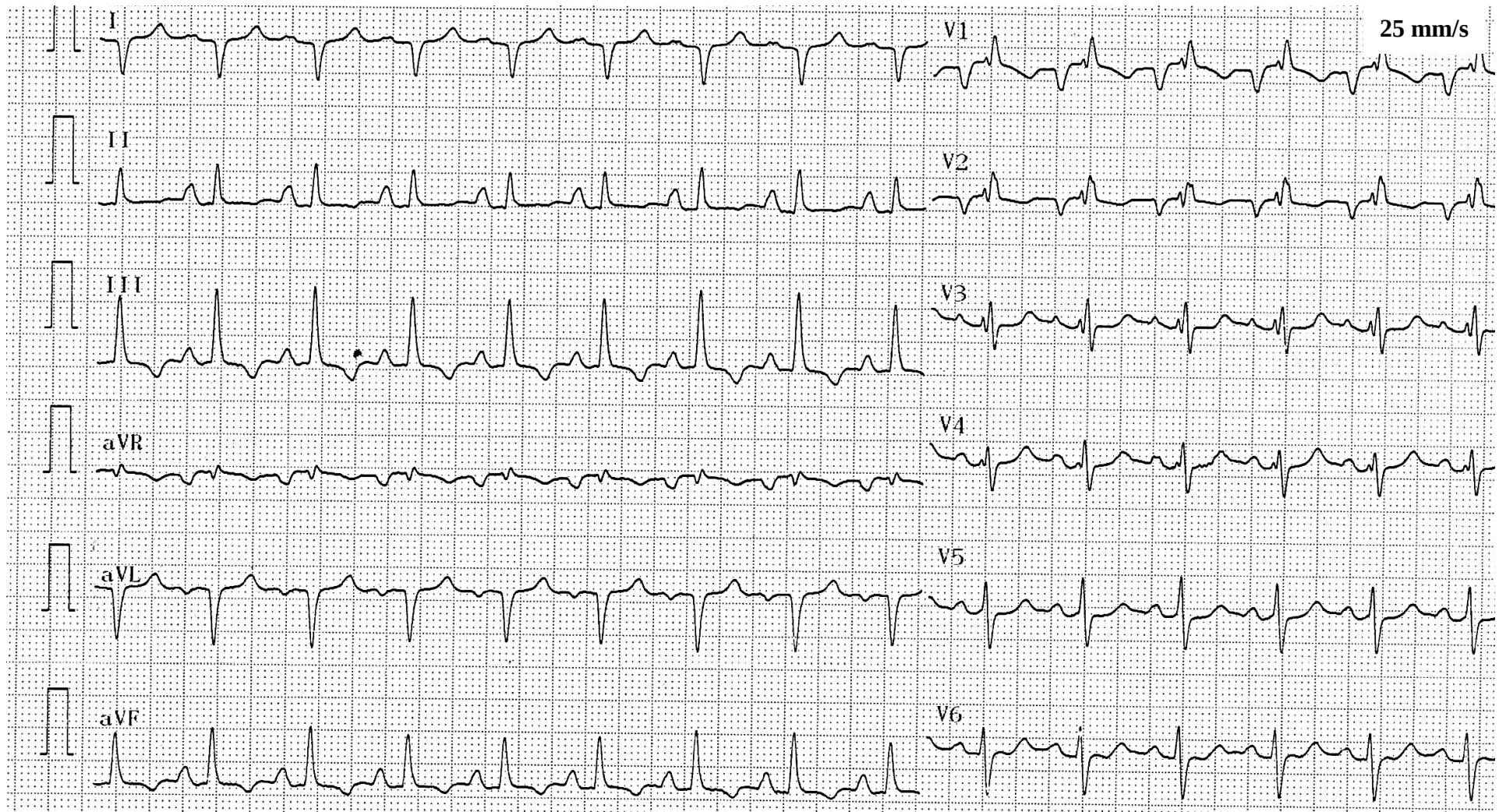
Right atrium	Right ventricle	Left atrium	Left ventricle



Conclusion:

The Sokolov-Lyon index is 		Draw: P-pulmonale P-mitrale	
Write down the causes of hypertrophy.		Write down the causes of hypertrophy.	
Right atrium	Left atrium	Right ventricle	Left ventricle

19



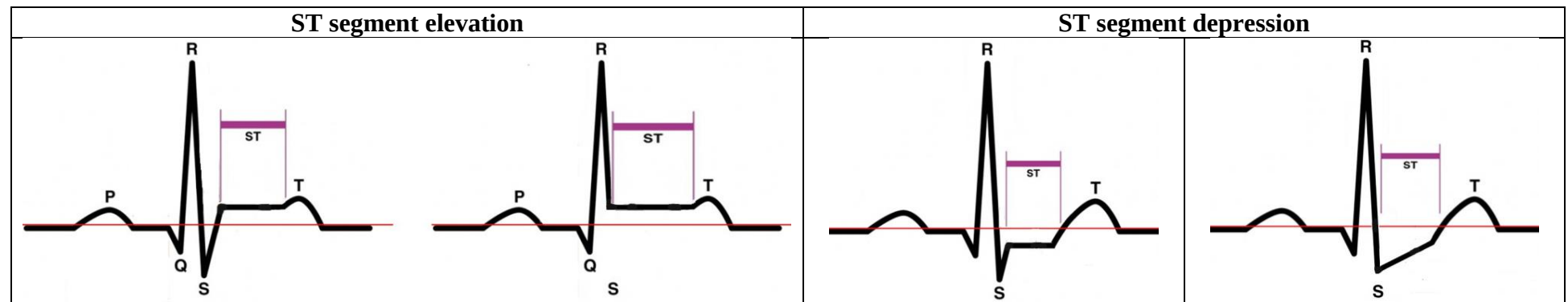
Conclusion:

ECG SIGNS OF MYOCARDIAL ISCHEMIA

Write the corresponding localization of processes in the myocardium.

Leads	Localization
I	
II	
III	
aVL	
aVF	
V ₁ , V ₂	
V ₃	
V ₄	
V ₅ , V ₆	

ST segment elevation and depression options



What deviation of the ST segment from the isoline is considered significant:

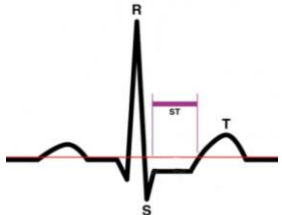
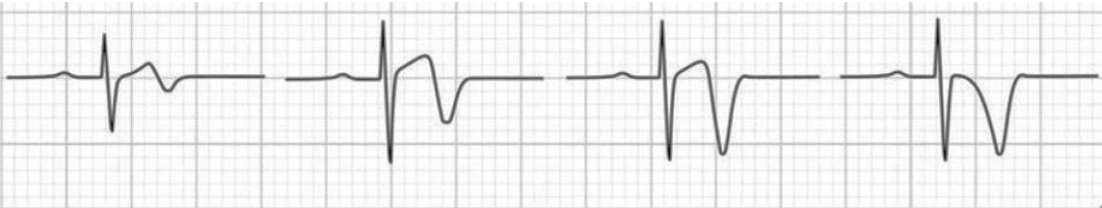
In the standart leads? _____

In the chest leads? _____

Signs of ST-elevation Acute Myocardial Infarction

		Signs	ECG
Normal ECG		Q wave is not pathological (less than $\frac{1}{4}$ R wave, duration < 0.03 sec). ST segment is at the isoline. T-wave is positive	
Evolution of STEMI	The most acute period	ST elevation (single monophasic deflection)	
	Acute period	Pathological Q wave. Segment ST gradually decreases, but remains above the isoline. Formation of a negative T wave	
	Subacute period	Pathological Q wave (QS). Segment ST on isoline. Wave T negative	
	Postinfarction cardiosclerosis (Infarct scar period)	Pathological Q wave (QS). Segment ST on isoline. Wave T positive, negative or flat	

Signs of non-Q-wave myocardial infarction

Clinical signs (write)	ECG-signs	ESG-scheme
	Depression of ST-segment	
	Negative T wave	

Biochemical signs of myocardial infarction

Sign	How long after the onset of MI does it increase	How long after the onset of myocardial infarction does it return to normal



20

Paper speed: 50 mm/s 1 mm = 0.02 sec
25 mm/s 1 mm = 0.04 sec

I. Rhythm (sinus or not)

Heart Rate = 60 / R-R interval (sec)

II. Voltage (underline)

Sufficient or low

III. Axis

normal position

left axis deviation

right axis deviation

V. Conclusion

IV. Analysis of waves and intervals

Draw an isoline in all leads

Wave T — positive in leads _____

flat in leads _____

negative in leads _____

Segment ST is on the isoline in leads _____

elevation by _____ mm in leads _____

depression by _____ mm in leads _____

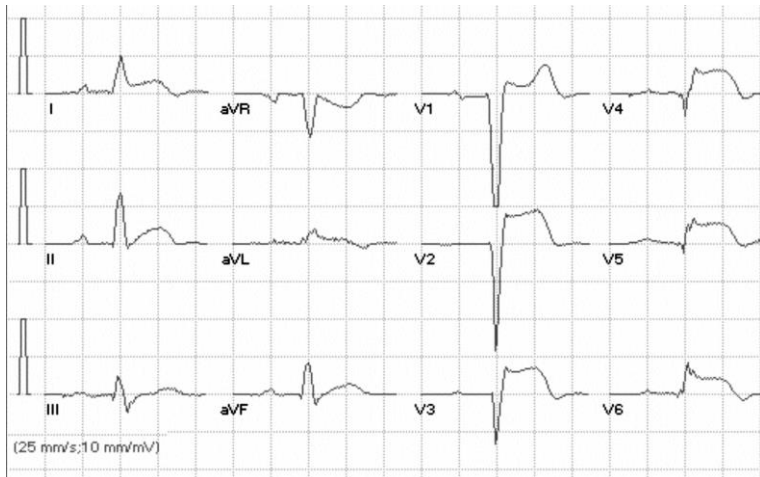
Wave Q in leads _____

Duration _____ sec

Amplitude (*what part*) _____ of R wave

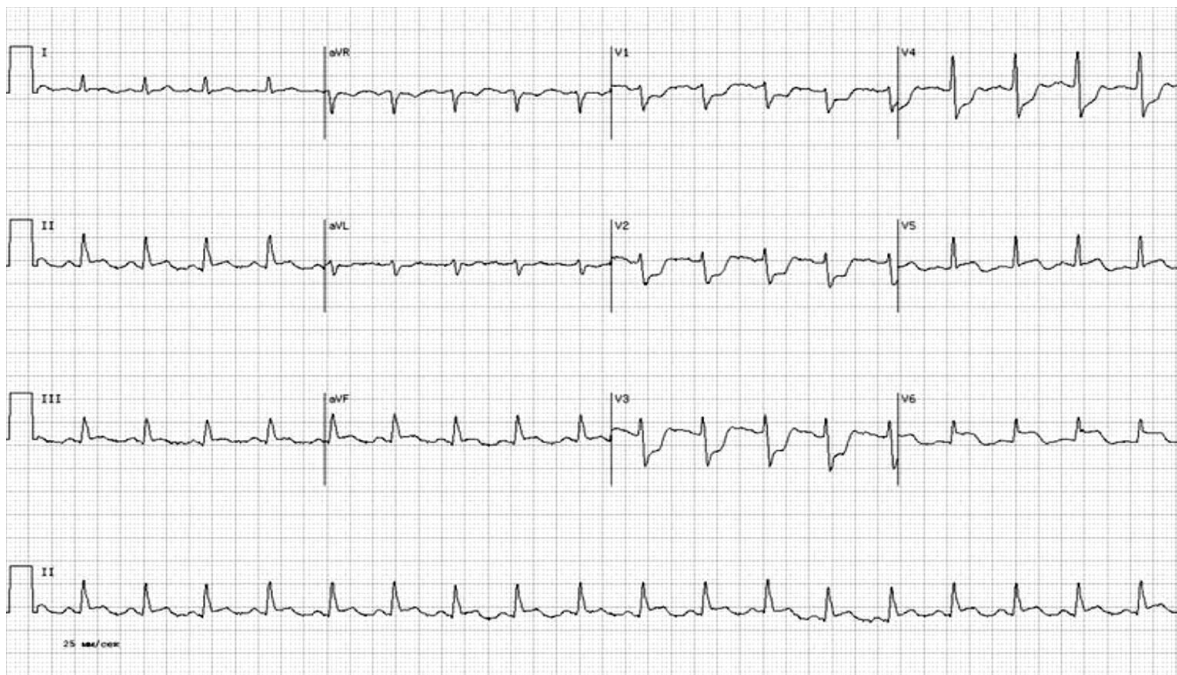
Localization of the ischemia _____

21



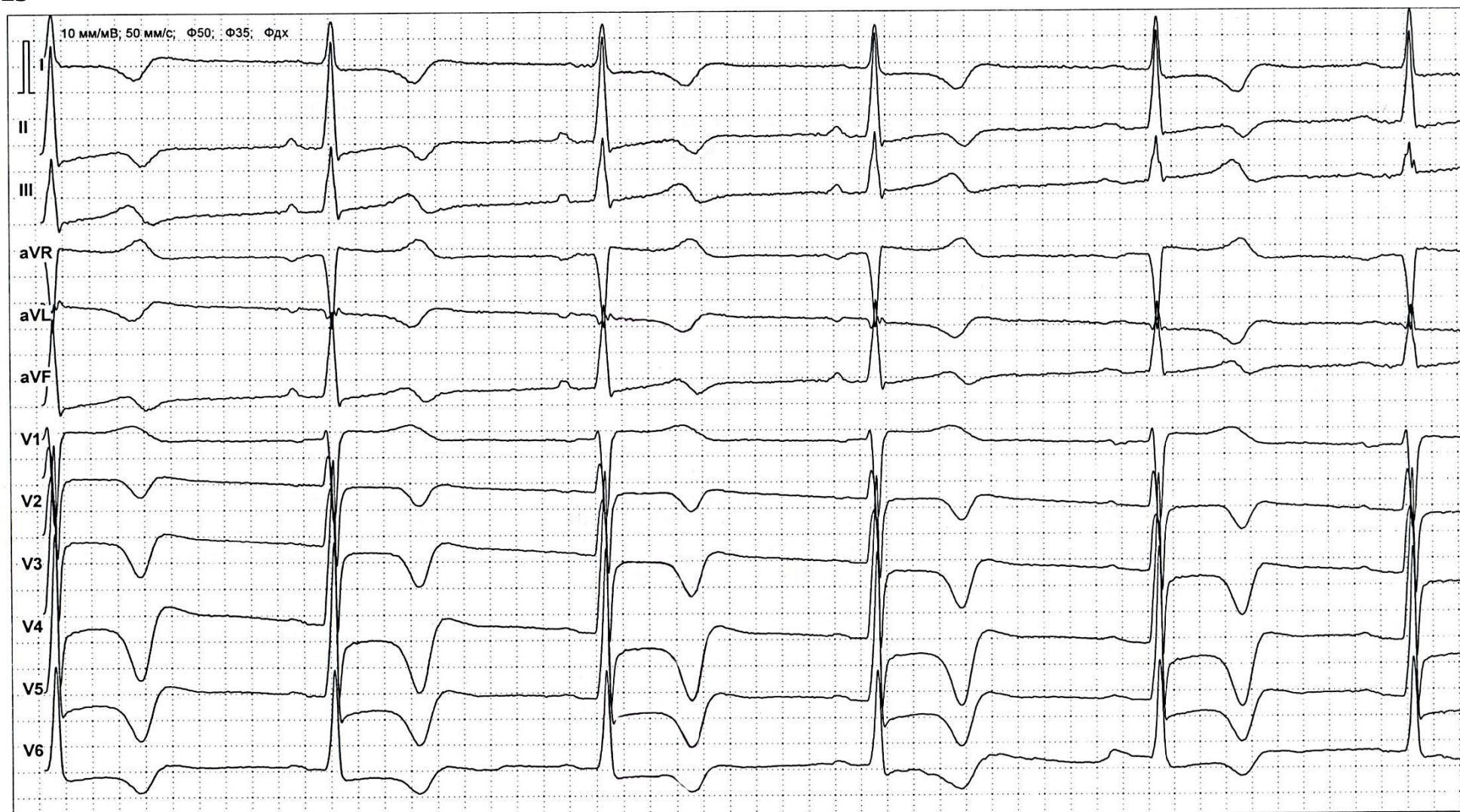
1. Mark all the waves on the provided ECG in leads I, II, and III.
2. Draw a baseline in the chest leads.
3. Measure the ST segment deviation from the baseline in the chest leads.
4. Conclusion:

22



1. Draw a baseline in leads I, II, III, and aVF.
 2. Draw a baseline in the chest leads.
 3. Measure the deviation of the ST segment from the baseline.
 4. List the leads with ST segment elevation.
-
5. List the leads with ST segment depression
-
6. Give the definition to a term reciprocal "ECG changes"

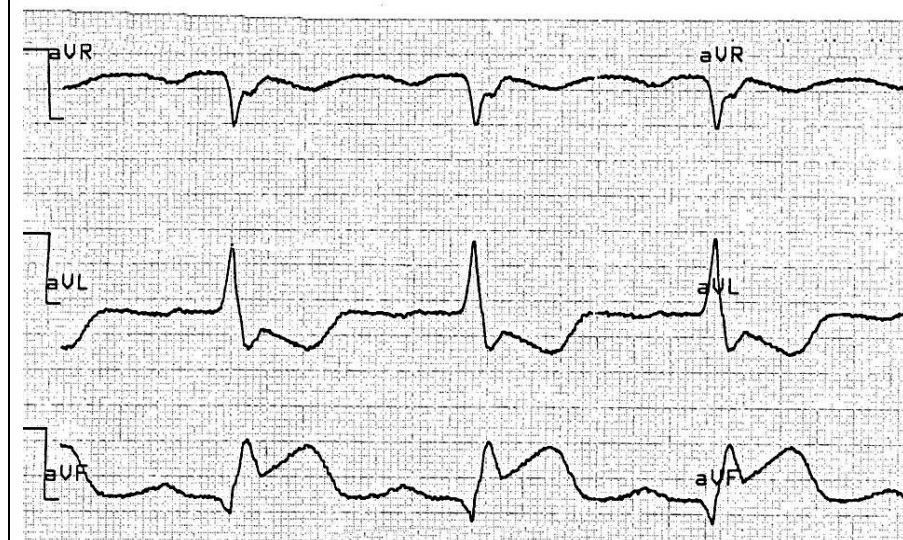
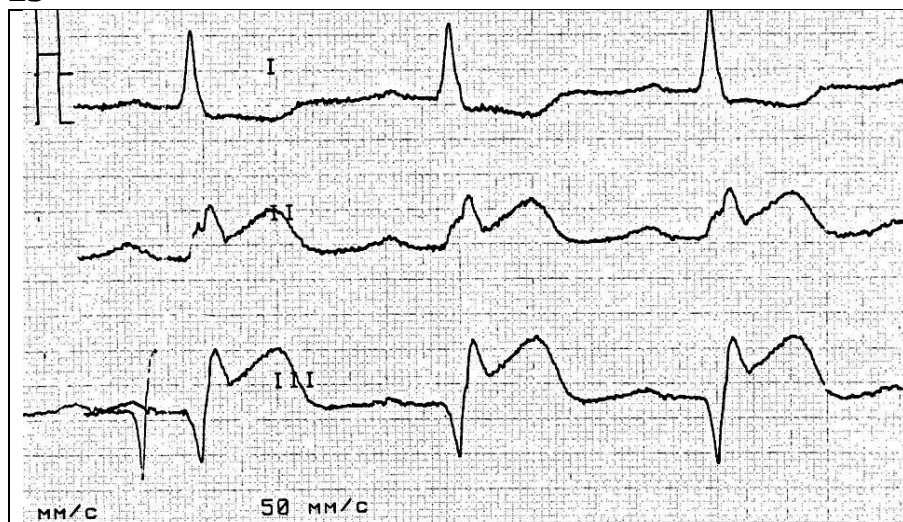
Conclusion:



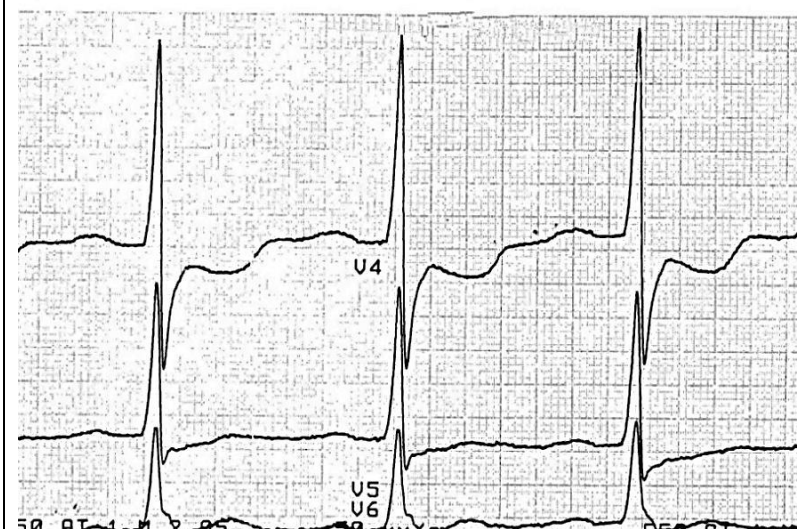
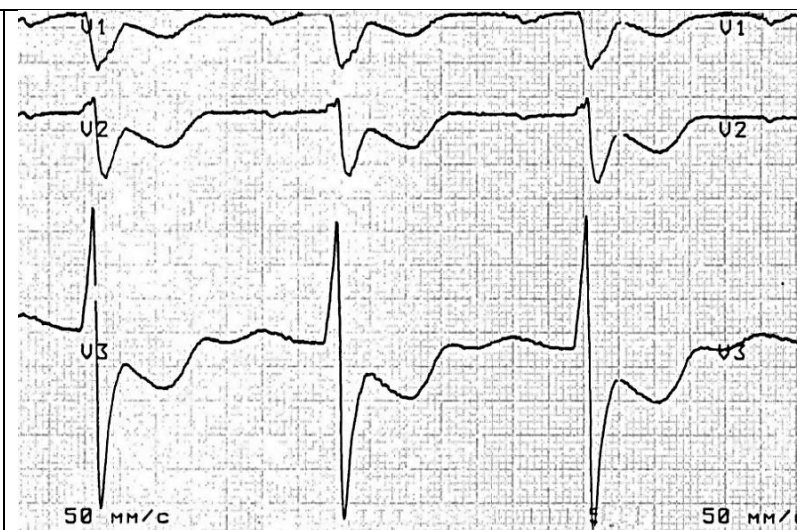
Conclusion:

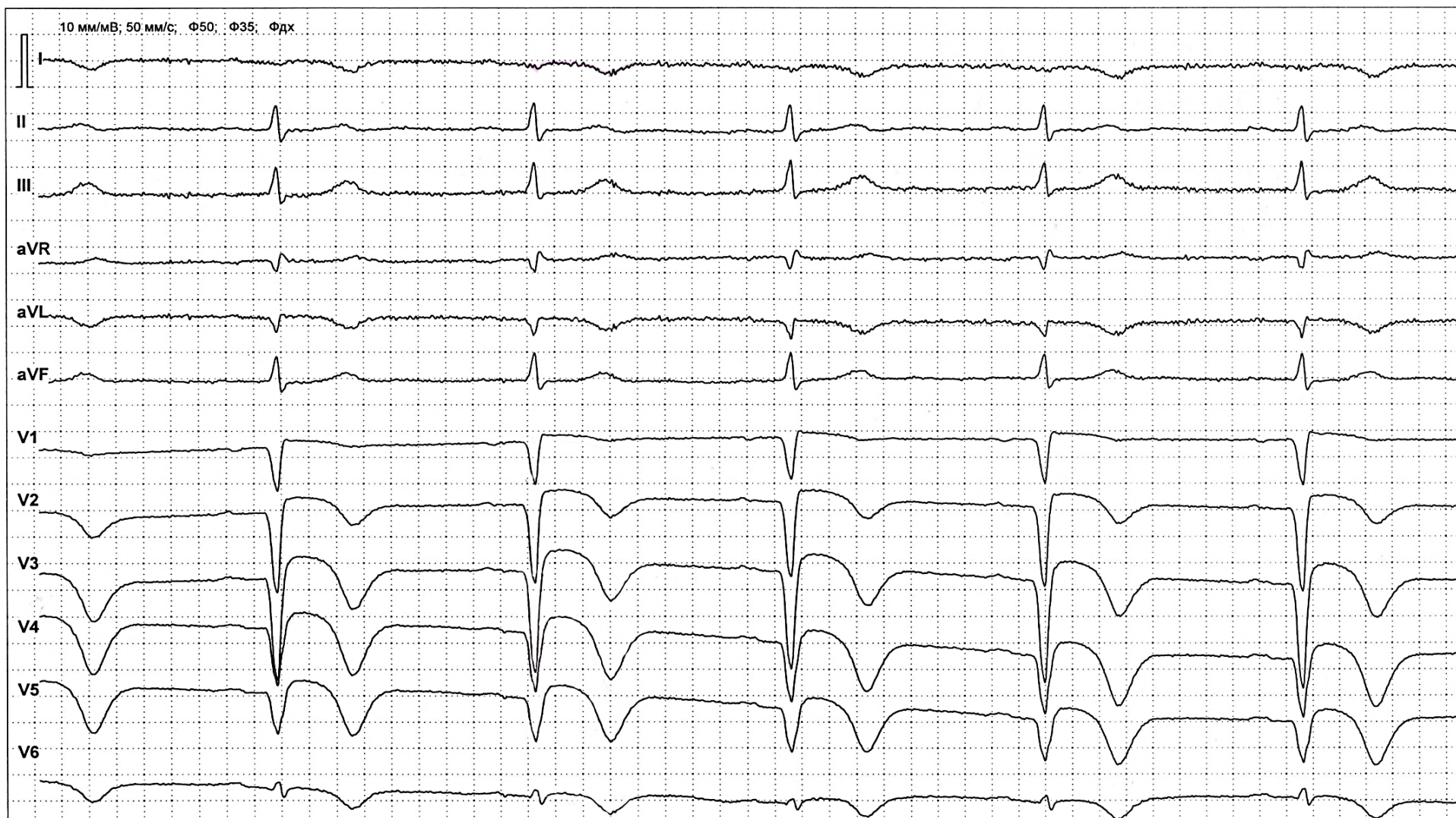


Conclusion:

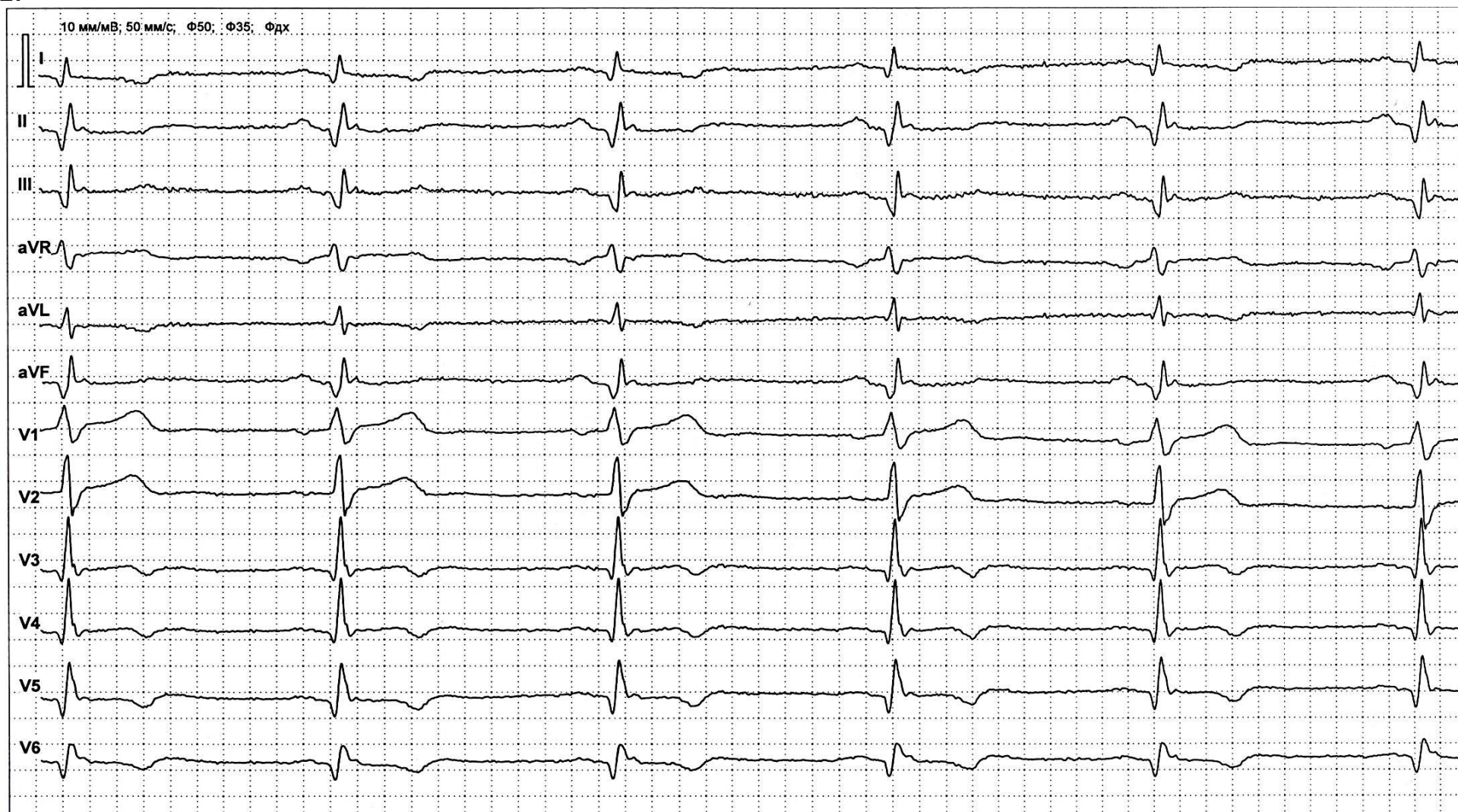


Conclusion:





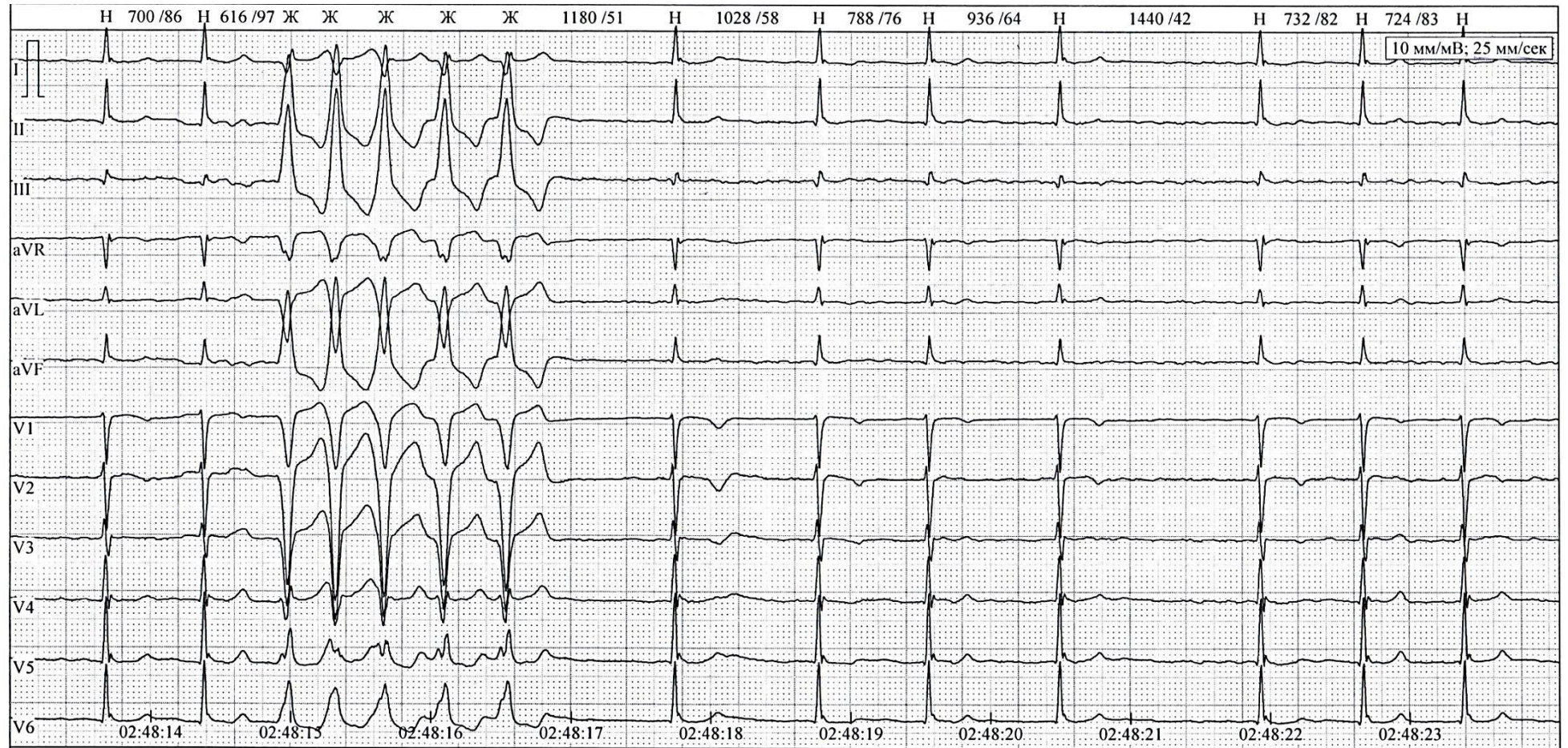
Conclusion:



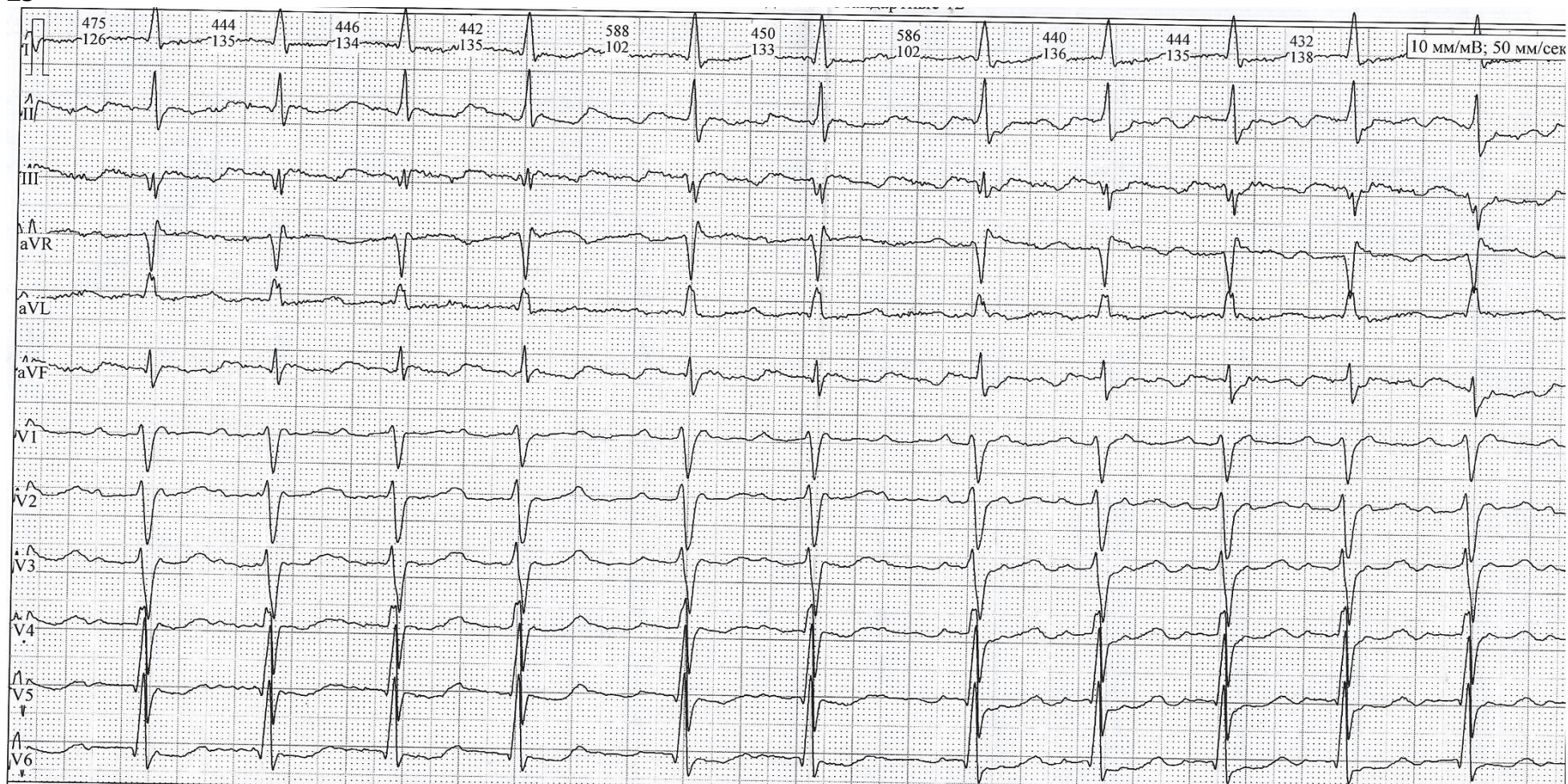
Conclusion:

ELECTROCARDIOGRAMS WITH COMPLEX DYSFUNCTIONS

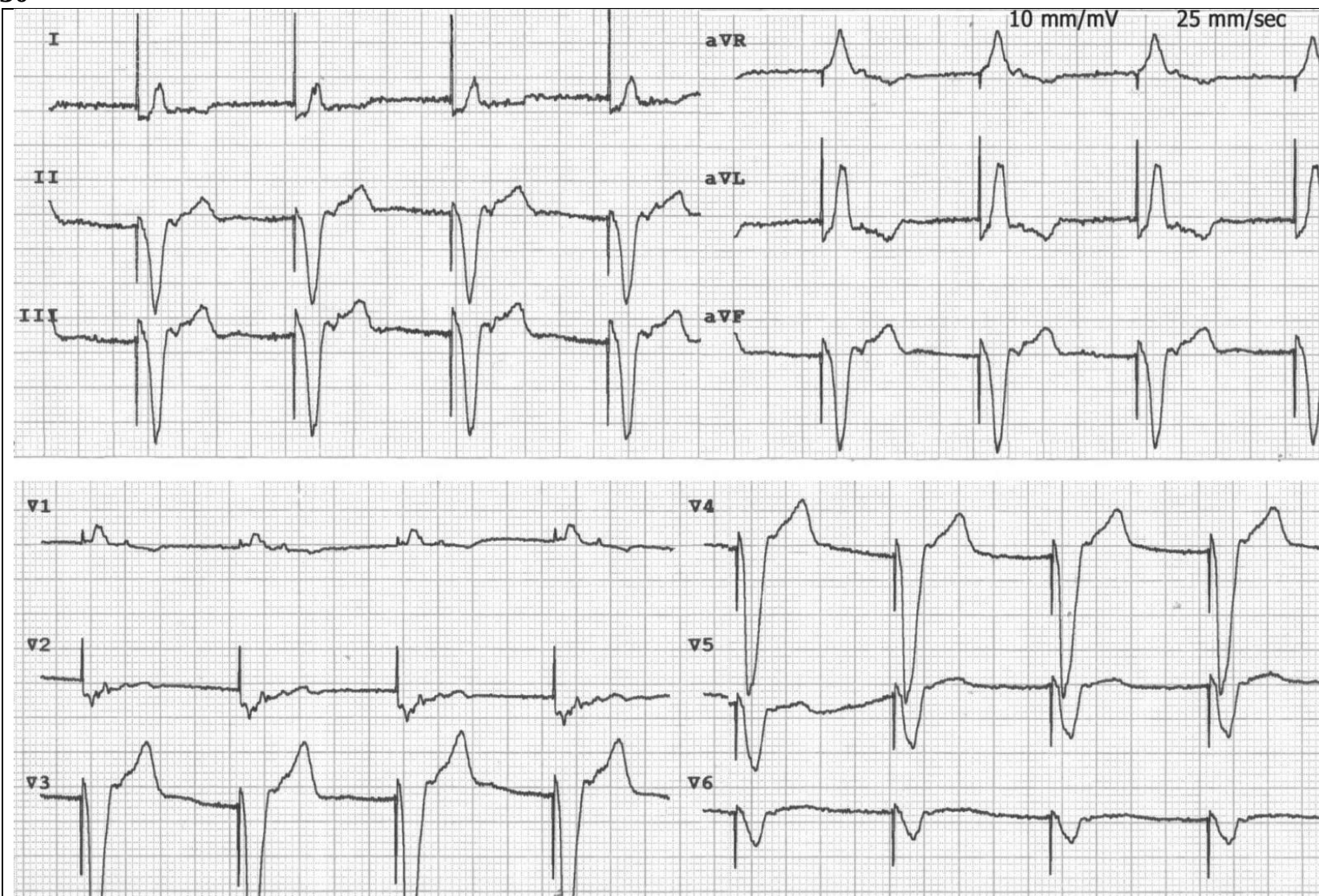
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Conclusion:



Conclusion:



Conclusion:

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