

**Ministry of Public Health of Ukraine  
National O.O. Bohomolets Medical University**

**METHODICAL GUIDE  
to practical classes for students**

<i>Educational discipline</i>	Propaedeutics of Pediatrics including nursing practice, basic medical skills in the pediatric department
<i>Training direction</i>	22 " Public Health ", II (master's) educational and qualification level
<i>Specialty</i>	222 «Medicine»
<i>Department</i>	Paediatrics # 2
<i>Thematic module 2</i>	Anatomical and physiological features of organs and systems in children, clinical examination methods. Semiotics of damage syndromes of each of the systems and the most common diseases.
<i>Topic:</i>	Additional methods of cardiovascular system's research. Semiotics of the main syndromes and diseases of the cardiovascular system in children.
<i>Course</i>	3

**Approved** on methodic meeting of department of pediatrics №2 from «28» august 2023., protocol №1

**Considered and approved:** CMC on pediatric disciplines from «28» august 2023., protocol №1



* Introductory,		Solving tasks according to the subject of the lesson.	
	Final	Analysis and assessment of student work results. Announcement of the topic of the next lesson, an indicative map for independent work with literature.	*
		<b>Together</b>	<b>2,5 academic hours</b>

\*\*reproducible, \*\*\* reconstructive, \*\*\*\* creative learning levels.

#### 4. Content of educational material

##### 4.1. A list of the main terms, parameters, and characteristics that the student should learn when preparing for the class:

<i>Term</i>	<i>Definition</i>
<b>Electrocardiography (ECG)</b>	this is a graphic method of recording the electrical activity of the heart per unit of time.
Automatism function	The ability of the heart to produce electrical impulses in the absence of any external stimuli
Conductance	The ability to conduct excitation that occurs in any part of the heart to another part of the myocardium.
Excitability	The ability of the heart to be excited under the influence of impulses.
Refractoriness	The impossibility of an activated heart cell to reactivate upon additional irritation, since all sodium ions are involved in the process and there is no substrate for additional irritation
Electric systole	Corresponds to the QT interval on the ECG
<b>Heart rate and conduction analysis</b>	The regularity of heart contractions is assessed by comparing the duration of R–R intervals between consecutively registered heart cycles. A regular, or correct, heart rhythm is diagnosed if the duration of the measured <b>R–R intervals is the same and the spread of the obtained values does not exceed <math>\pm 10\%</math></b> of the average duration of the R–R intervals. In the remaining cases, an incorrect (irregular) heart rhythm is diagnosed.
<b>Electrical axis of the heart</b>	– projection of the resulting QRS vector on the frontal plane. To determine the Electrical axis of the heart, the alpha angle is calculated. For this, it is necessary to calculate the algebraic sum of the amplitudes of the waves of the QRS complex in the I and III standard leads and substitute the obtained data in the table. The following variants of the position of the electrical axis of the heart are distinguished: <input type="checkbox"/> normal position, when the angle $\alpha$ is from $+30^\circ$ to $+69^\circ$ ; <input type="checkbox"/> vertical position — angle $\alpha$ from $+70^\circ$ to $+90^\circ$ ; <input type="checkbox"/> horizontal — angle $\alpha$ from $0^\circ$ to $+29^\circ$ ; <input type="checkbox"/> axis deviation to the right — angle $\alpha$ from $+91^\circ$ to $\pm 180^\circ$ ; <input type="checkbox"/> axis deviation to the left — angle $\alpha$ from $0^\circ$ to $-90^\circ$

<b>Interval PQ</b>	reflects the passage of excitation through the atria and atrioventricular conduction to the branching of Purkinje fibers. Depends on age, heart rate. It is 0.08-0.04 s in newborns, 0.08-0.16 s in infants, 0.1-0.8 in older children, and up to 0.2 s in adults.
<b>Q wave</b>	vector of depolarization of the interventricular septum; unstable, always negative; its depth should not exceed $\frac{1}{4}$ of the amplitude of the R wave (except for the avR lead).
<b>R wave</b>	always a positive wave of the ventricular complex reflects the process of further propagation of the excitation wave through the myocardium of the ventricles
<b>S wave</b>	- an inconstant, always negative wave of the ventricular complex, reflecting late coverage by excitation of the basal sections of the myocardium, subepicardial layers. The lead, where the amplitude of the R and S waves are equal, is called the transition zone
<b>The width of the QRS complex</b>	up to 0.09 s, in infants - up to 0.07 s.
<b>ST segment</b>	- indicates complete coverage of the excitation of the ventricles. The main characteristic is the location relative to the isoline. Normally, it is more often on the isoline, sometimes it shifts up or down, but not more than 1.0 mm.
<b>T wave</b>	- characterizes the rapid repolarization of the myocardium. A positive wave, in addition to a negative aVR lead, can also be negative in III standard lead (usually in children under 3 years old), V1-V3 (in V4 in newborns). The amplitude is equal to $\frac{1}{3}$ - $\frac{1}{4}$ of the amplitude of the R wave.
<b>U wave</b>	– non-constant wave, occurs 0.04 s after T.
<b>QT interval</b>	from the beginning of the Q wave to the end of the T electrical systole of the heart, reflecting the time during which the ventricles are in an electrically active state. The normal duration of the QT interval depends on age, sex, heart rate. On average, the duration is 0.26-0.34 s.
<b>Sinus tachycardia</b>	increase in heart rate by 10-15% of the age norm.
<b>Sinus bradycardia</b>	decrease in heart rate by 10-15% of the age norm.
<b>Sinus rhythm</b>	P waves are positive and precede each ventricular QRS complex; b) the shape of all P waves in one and the same lead is the same.

	
2. Atrial rhythms (from the lower departments):	<p>PII and P III waves are negative;  b) each P wave is followed by unchanged QRS complexes.</p>
Rhythms from AV connection:	<p>a) if the ectopic impulse simultaneously reaches the atria and ventricles, there are no P waves on the ECG, which merge with the usual unchanged QRS complexes;  b) if the ectopic impulse first reaches the ventricles and only then the atria, negative RII and RIII are recorded on the ECG, which are located after the usual unchanged QRS complexes.</p>
Ventricular (idioventricular) rhythm:	<p>a) all QRS complexes are expanded and deformed;  b) there is no regular connection of QRS complexes and P waves;  c) the number of heart contractions does not exceed 40–60 beats. /min.</p>
<b>Extrasystole</b>	– premature contraction of the heart or its parts.
atrial ES	<p>the presence of a P wave of different shape and direction before the QRS complex;  the QRS complex is unchanged, rarely aberrant;</p> <p style="text-align: center;"><b>Предсердная экстрасистолия</b></p> 
nodal ES	<p>absence of a P wave before the QRS complex;  unchanged or aberrant QRS complex;  incomplete or complete compensatory pause;</p>
right ventricular ES	<p>absence of P wave; aberrant QRS complex;  discordant T wave (sometimes with ST segment shift);  full compensatory pause; the main wave of the aberrant QRS complex is directed upwards in I, aVL, V5-V6;</p>
left ventricular ES	<p>absence of P wave; aberrant QRS complex;  discordant T wave (sometimes with ST segment shift);  full compensatory pause;  the main wave of the aberrant QRS complex is directed up in III, aVF, V5-V6;</p>
<b>Holter monitoring</b>	- a method of long-term electrocardiographic examination, in which information is recorded on a miniature tape recorder, and the data is analyzed retrospectively in an accelerated mode.

MRI of the heart	is a promising method of non-invasive diagnosis of myocarditis. The sensitivity and specificity of MRI for detecting this pathology in adults is 86 and 95%.
<b>Myocardial biopsy</b>	the gold standard for the diagnosis of myocarditis in European and American cardiology [37]. The classic histological criteria for the presence of myocarditis are the so-called Dallas criteria, according to which myocarditis is divided into active and borderline

<b>Heart failure</b>	Inability of the heart to supply tissues with blood and oxygen adequate to their metabolic needs at rest and during moderate physical exertion (decreased contractility of the myocardium and weakening of the tone of peripheral vessels).
Chronic renal failure	it arises gradually against the background of congenital or acquired sepsis, persists over a long period, decreases under the influence of adequate treatment, occurs after treatment is stopped.
Acute heart failure	occurs against the background of late seizures of the liver and other organs, it can disappear relatively quickly after treatment and elimination of the main cause. Acute and chronic heart failure, depending on the prevalence of the pathological process in a certain ventricle, is divided into right and left ventricular
Myocarditis	Damage to the heart muscle is mainly inflammatory in nature
Infectious endocarditis	Inflammatory disease of the endocardium of infectious etiology, which is caused by the invasion of the pathogen with its localization on valve structures, endocardium, endothelium in the area of main vessels
Pericarditis	Inflammation of the visceral and parietal leaves of the pericardium, manifested by fibrous changes and/or fluid accumulation in the pericardial cavity
Congenital heart defects	Various abnormalities in the development of the heart and large vessels that occur during embryogenesis
Aortic stenosis	— rough systolic expulsion murmur in the aortic space, well heard over the entire area of the heart, in the area of the jugular fossa, on the back.
Coarctation of the aorta	— a short systolic murmur over the left edge of the sternum and between the shoulder blades.
Aortic regurgitation	— high-intensity early diastolic flowing noise over the left edge of the sternum, best heard on exhalation.
Pulmonary regurgitation	— early diastolic murmur in the lung space.
Pulmonary artery stenosis	— systolic expulsion murmur in the pulmonary space following the systolic expulsion click
Left heart hypoplasia syndrome	— sometimes there is a systolic murmur over the left edge of the sternum.
Mitral insufficiency	— the systolic murmur is heard loudest at the top of the heart immediately after the weakened first sound. Can be heard throughout systole. The timbre is blowing, it is directed to the left axillary area, and maybe to the base of the heart.
mitral stenosis	— increased first sound at the top of the heart and diastolic or presystolic uneven rumbling noise. It is better heard in the position of the patient on the left side.
Tricuspid regurgitation	— pansystolic murmur in the area of the lower part of the sternum on the left edge.

Stenosis of the right atrioventricular foramen	— a cracking I sound over the lower third of the sternum and a rough short presystolic noise, which is heard better on the right side and increases during inspiration.
Small abnormalities of the heart	— such disorders, which are not malformations of the development of the heart and blood vessels, because they do not lead to changes in hemodynamics, the size of the heart and its contractility, which create additional turbulence of the blood and cause the appearance of murmur.

### **Theoretical questions that are considered in class.**

1. Describe the technique of ECG registration, give characteristics of standard, reinforced and chest leads.
2. Elements of a normal ECG: P, Q, S, T waves, PQ, QT intervals, ST segment.
3. The concept and method of determining the systolic index.
4. Methods of determination and variants of the position of the electrical axis of the heart.
5. Characteristics of sinus rhythm, inferior atrial rhythm, rhythm from the atrioventricular node, ventricular rhythm.
6. Determination of heart rate by ECG.
7. Concepts of sinus tachycardia and sinus bradycardia.
8. Concepts of sinus arrhythmia, respiratory arrhythmia.
9. Classification of extrasystole.
10. Characteristics of atrial extrasystole.
11. Characteristics of ventricular extrasystole.
12. Blockades: sinoatrial, atrioventricular.
15. Methodology of registration and interpretation of daily ECG monitoring. Indications for XM ECG.
16. What heart defects are distinguished.
17. Clinical manifestations of myocarditis in children.
18. Clinical manifestations of pericarditis in children.
19. Clinical manifestations of heart defects in children.
20. Clinical manifestations of heart failure in children.
21. What is acute rheumatic fever, its clinical manifestations in children.

### **Recommended literature.**

#### **Basic:**

Nelson textbook 21th Edition by Robert M. Kliegman, MD, Joseph St. Geme, Nathan J. Blum, Samair S. Shan, Robert C. Tasker, Karen M. Wilson, Richard E. Behrman Издавництво: Elsevier, 2020. P. 2340-2367.

#### **Additional:**

1. Illustrated Textbook of Pediatrics by Md Salim Shakur Видавництво: Jaypee Brothers Medical Publishers (P) Ltd, 2015 P.387-441
2. Suspected heart disease in infants and children: Criteria for referral by David A Kane, MD UpToDate- online recourse. 2022.  
<https://www.uptodate.com/contents/suspected-heart-disease-in-infants-and-children-criteria-for-referral>.

**The methodical recommendation was made by assistant. Karulina Y.V.**