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

METHODICAL GUIDE
to practical classes for students

Educational discipline	Propaedeutics of Pediatrics including nursing practice, basic medical skills in the pediatric department
Training direction	22 " Public Health "**,** II (master's) educational and qualification level
Specialty	222 «Medicine»
Department	Paediatrics # 2
Thematic module 2	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.
Topic:	Anatomical and physiological features of the cardiovascular system in children. Methods of physical examination of the cardiovascular system in children.
Course	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

1. Goal: the student acquires knowledge about:
• peculiarities of blood circulation in the fetal period;
• features of the newborn's blood circulation;
• anatomical and physiological features of the heart and blood vessels in children of different ages;
• features of history taking in children with pathology of the cardiovascular system;
• features of the general examination of children with pathology of the cardiovascular system;
• methods of palpation of the cardiovascular system's organs in children of different ages;
• rules for conducting percussion and auscultation of the heart in children;
• methods of heart percussion in children of different ages.
• peculiarities of the auscultatory picture of the heart in children of different ages.

the student's acquisition of skills regarding:
• collection of anamnesis from a patient with a pathology of the cardiovascular system;
• examination of the cardiovascular system by the method of general and special examination, by the palpation method, taking into account the age characteristics of children;
• determination of heart tones, rhythm of heart activity, characteristics of heart sounds;

2. Competencies:
• collection of complaints, medical history and life of a child (and/or his mother/caregiver) with diseases of the cardiovascular system;
• clinical examination of children with diseases of the cardiovascular system;
• interpretation of the received data of the clinical examination of children with diseases of the cardiovascular system;
• determination of clinical syndromes and symptoms in children with diseases of the cardiovascular system.

Equipment - textbook, computer, mannequin, phonendoscope.

3. **Plan and organizational structure of the lesson**

The name of the stage	**Description of the stage**	**Levels of assimilatio* ***
Preparatory stage	Organizational measures Setting educational goals, student motivation	*
The main stage	Test control on the subject of the lesson, checking and announcing the results. - theoretical survey;	** *, **, ***

* Introductory,		- demonstration of practical skills, clarification of the most important points regarding the clinical examination of children with pathology of the cardiovascular system (palpation of the pulse and determination of the main characteristics of the pulse in children, determination of the limits of relative cardiac dullness, auscultation of the heart in children - characteristics of tones, determination of noises); - students' work on acquiring the skills of clinical examination of children with pathology of the cardiovascular system; - acquisition by students of the ability to assess changes in the state of the cardiovascular system in various diseases in children. 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.	*
		Together 2,5 academic hours	

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:

Term	***Definition***
Heart rhythm, features	decrease in the duration of the heart rhythm (0.4-0.5 sec); at the age of 10, the cardiac cycle lasts 0.7 seconds, in adults - 0.77-0.8 seconds. Duration of hearts. cycle is reduced due to diastole.
Heart rate in children	Newborns - 140-160, 6 months - 130, 1 year - 120, 5 years - 100, 10 years - 80, when the body is raised by 1 C, the heart rate increases by 8-10 beats per minute
Blood pressure	Children of the first year - 76+2p (n-months), older than a year - 90 +2n (n-years)
Heart, features	In a newborn, it has a spherical shape, a transverse position and is projected at the level of T IV - T VIII. The dimensions and thickness of the walls (5 mm) of both ventricles are the same. In the future - more intensive growth of the left ventricle. At the end of the newborn period, the heart shifts in the frontal plane to the right due to a decrease in the size of the liver and an increase in the volume of the left lung. By the end of the

	first year, the transverse position changes to an oblique one, and by 2-3 years, the position of the heart stabilizes and the apex is directed forward, down and to the left.
Pulmonary artery, peculiarities	In children, it is wider than the aorta. In a newborn, its diameter is 1.2-2.0 cm. By the age of 10, the lumen of the pulmonary artery and aorta is equal. In adults, the aorta is wider than the pulmonary artery.
Arterioles of a small circle of blood circulation, features	the newborn has hypertrophy of the muscle layer and hyperplasia of the inner membrane. In the first months of life, the wall of these vessels thins and the lumen increases.
Examination Anamnesis	● Prenatal (IUI, medications, maternal illnesses) ● Postnatal (unsatisfactory weight gain, cyanosis, tachycardia, tachypnea, eyelid swelling, frequent respiratory infections, heart murmur, chest pain, palpitations, joint pain, neurological symptoms). ● Hereditary (hereditary syndromes, CHD in the family, rheumatic fever).
Inspection	Disturbance of consciousness, severity of the condition and position of the patient, skin color, edema, shape of the fingers (desaturation for more than 6 months leads to the formation of "drumsticks")
Apex beat	A limited area of chest pulsation in healthy children due to the beating of the apex of the heart on the chest wall during each systole. It is determined by palpation.
верхівкового поштовху Characteristics of the apical beat	1. Localization. In children under 2 years -4 intercostals from the outside from the mid-clavicular line, 2-7 years - 5 intercostals from the outside along the mid-clavicular line, after 7 years - 5 intercostals along the mid-clavicular line. 2. Width. Depends on the size of the area it occupies. In adults - 1.5-2 cm. In children - spilled. 3. The height is determined by the amplitude of the oscillation of the chest. There is moderate, high and low. 4. Strength (resistance) is the tension determined by the fingers. There is a moderate, high resistant and weakened apical impulse.
Heart beat	Rhythmic protrusion of the intercostals in the projection of the heart, as a result of the impact not only of the apex of the heart, but also of the enlarged ventricles. It is observed only in children with heart pathology (hypertrophy of the right ventricle).
Arterial pulse	periodic oscillations of the walls of peripheral vessels, synchronous with the systole of the heart. The pulse on the radial, carotid, temporal, femoral, popliteal, and posterior tibial arteries is determined by palpation. Calculated in 1 minute. Allowable deviation of 10-15%. If the deceleration is greater, then this is bradycardia, and acceleration is tachycardia.
Precapillary pulse	Lightly press on the tip of the nail so that a white spot remains. With each heartbeat, the spot expands, then narrows.
Pulse characteristics Rhythm	Rhythm can be right or wrong. Normally, children's pulse is very labile.
Tension	The sensation that occurs when the pulse wave is compressed. Normally, it is moderate, there is also a tense hard and relaxed soft pulse. The tone of the arterial wall and blood pressure are assessed according to the degree of tension.
Filling	the sensation that occurs when the compressed radial artery is released. Normally, it is moderate, there is also a full and empty pulse. The degree of filling depends on the amount of blood that makes the pulse wave.
Pulse synchrony	Does the pulse match on both hands?
Pulse defficiency	a condition in which not all pulse waves reach the radial artery, the heart rate does not coincide with the pulse, which is determined on the peripheral veins.
"Carotid Dance"	Enhanced pulsation of the carotid artery in aortic defects.

Diagnostic methods	Electrocardiogram (for recognition of rhythm disorders, detection of chamber dilation and hypertrophy, myocardial ischemia). X-ray of the chest organs (to assess the pulmonary vascular pattern, the size of the heart and its outlines, accompanying pulmonary or musculoskeletal anomalies). MRI of the heart (diffusion), echocardiography, holter monitoring, physical stress tests.
Absolute dullness of the heart	A small area of the heart that freely adheres to the chest. A dull sound is heard during its percussion.
Relative dullness of the heart	The part of the heart that is covered by the edges of the lungs. When percussion, it gives a shortened sound and corresponds to the true size of the heart and the projection on the chest.
Sequence of heart percussion:	determination of the standing height of the diaphragm; one rib higher (4th interrcostal space) determine the right border; then - the upper limit; the apical impulse is palpated and along this intercostal space (or along the 4-5th intercostal space) the left border of the heart is determined.
Auscultation of the heart	Listening and analysis of the murmur's phenomena of the heart during systole and diastole in the places of best listening (anatomical projection on the chest) in a certain sequence.
The main points of auscultation of heart valves	1 — the mitral valve is heard at the apex of the heart, 2 — the valve of the pulmonary artery in the II intercostal space to the left of the edge of the sternum, 3 — the aortic valve in the II intercostal space to the right of the edge of the sternum, 4 — the tricuspid valve — in the lower third of the sternum near the point of attachment processus xyphoideus to the sternum. An additional, V point (Botkin — Erba) at the level of the III-IV intercostal space near the left edge of the sternum, where sound phenomena from all heart valves are heard, is very important. They also listen to the axillary area, under the collarbones, the epigastric area, and the back to determine the conduction of murmurs.
I tone	due to mitral and tricuspid valves closing. Weakens - when the contractile function of the myocardium decreases (myocarditis, lengthening of the int. PQ, mitral insufficiency). Increases - with mitral stenosis, reduction of int. PQ, anemia, fever, "athletic heart".
II tone	due to the closing of the valves of the aorta and pulmonary artery, therefore, in the norm, there may be some splitting of it associated with the phases of breathing. Significant splitting - with atrial septal defect, complete blockade of the right leg of the bundle of His. A sharp emphasis of the II tone on the pulmonary artery - with pulmonary hypertension, on the aorta - with arterial hypertension.
III tone	occurs after the second tone, in the early diastole of the heart, is better heard when the patient is on the left side. Caused by the filling of the ventricles with blood during diastole. It is heard above the apex of the heart and in the zone of absolute dullness after a deep breath and slight physical exertion, it is short, deaf. III tone is accentuated, it is typical in children with heart failure against the background of tachycardia, which is perceived as a three-part gallop rhythm.
IV tone	Atrial It is weak, heard at the end of diastole. It rarely occurs in children and infants and **is always pathological**
Heart murmurs	these are additional sounds heard between the sounds of the heart during systole and diastole, they differ from the tones in their longer length and duration, they arise as a result of primary and secondary swirling of the blood flow, sounds formed when blood flows around narrowed openings, when the structural parts of the heart vibrate, which due to the vortex flow of blood
Organic heart murmurs	Occur with congenital or acquired lesions of the heart with anatomical changes of valves or openings, with sclerotic processes in the endomyocardium. associated with the presence of congenital or acquired anatomical changes in the walls, openings or valves of the heart or pericardium.

Organo-functional heart murmurs	caused by heart defects of various origins, but the murmurs that arise in this case are heard **not over the place of the defects** themselves.
Functional murmurs "innocent"	are heard in almost half of children aged 2 to 14 years. Intracardiac functional (inorganic, accidental) murmurs occur in children without structural pathology of the cardiovascular system. Their origin is not always known. These are noises of muscle origin, noises in neurovegetative dysfunction, noises of heart formation. Thyrotoxicosis, anemia, infectious diseases with increased body temperature and tachycardia contribute to the acceleration of blood flow in the heart, and therefore, the formation of blood vortices in the area of valves of large vessels and the formation of systolic noise of a functional nature. Functional murmurs are usually systolic
Diastolic murmur	It is heard during a long pause between the II and I tone. 1) early diastolic murmur — occurs immediately after the II tone, when the pressure in the ventricle becomes lower than in the main vessels. The main reasons: insufficiency of the aortic valve; insufficiency of the pulmonary artery valve; 2) middle diastolic murmur — occurs during the period of early filling of the ventricles due to a mismatch between the valve clearance and blood flow. The main reasons: relative stenosis of the left atrioventricular opening with a defect in the interventricular septum; relative stenosis of the right atrioventricular valve with atrial septal defect; 3) Carey-Coombs murmur is a type of mid-diastolic murmur in acute rheumatic fever. Occurs due to inflammation of the edges of the mitral valve leaflets or excessive accumulation of blood in the left atrium due to mitral regurgitation; 4) Flint's murmur is a type of mid-diastolic murmur in aortic valve insufficiency. The noise occurs when a stream of blood from the aorta hits the front leaflet of the mitral valve
Systolic-diastolic murmurs	- continuous, because they begin in systole and continue through the second tone for part or all of diastole. Occur when maintaining constant blood flow between high and low pressure parts.

5. Theoretical questions that are considered in class.

1. Anatomical features of the heart and blood vessels in children of different age groups.
2. Embryogenesis of circulatory organs and congenital anomalies of the heart and blood vessels.
3. Small and large circle of blood circulation. Hemodynamics.
4. Normal heart rate in different age periods.
5. Blood pressure in children depending on age.
6. Methods of examination of the cardiovascular system. Complaints, history taking. Inspection, palpation.
7. Apical and cardiac beat. Properties of apical beat.
8. Properties of the arterial pulse.
9. Basic rules of heart percussion in children.
10. Normal limits of relative cardiac dullness depending on age. The main reasons for their displacement.
11. Places and order of listening to the heart in children.
12. Characteristics of I and II heart tones, age-related features in children.
13. Cardiac and extracardiac factors of weakening of heart tones?
14. Heart murmurs: differences between organic and functional murmurs.
15. Classification of noises depending on the phase of the cardiac cycle? What pathology is listened to?

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 Видавництво: 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 development was made by assistant. Kupkina A.V.