INTERNATIONAL HIGHER SCHOOL OF MEDICINE

Department of Cardiac Surgery and Radiology

SYLLABUS
Echocardiography

2025-2026 academic year
for students of medical faculty
5th course 10 semester, groups ---
2 credit (60 h, including auditorial 32 h, independent work – 28 h)

Practical classes: **ass. Akhmedova Irina**

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Venue: Science research institute of heart surgery and organ transplantation (SRIHSOT)
Togolok Moldo, 3/1
University clinic «Vedanta», 6 th floor, 606.
Zoom Conference:
https://zoom.us/j/97371704669?pwd=xc9NMKdfMxHmXTKMABnY7qgqncfBMq.1
Идентификатор конференции: 973 7170 4669

Код доступа: 720976

The Syllabus is considered
at the meeting of the department of Natural Sciences Disciplines
Protocol № 1 dated 01.09.2025
Head of the department _____I.H. Bebezov

Course Objective: to equip students with theoretical knowledge and practical skills in applying echocardiography as the primary non-invasive diagnostic method for cardiovascular diseases, including the selection of optimal imaging modalities, interpretation of results, and their integration into clinical patient management.

Knowledge:

- Types of ultrasound waves and their properties (frequency, speed, acoustic impedance);
- biological effects of ultrasound (thermal, mechanical);
- safety protocols in echocardiography (ALARA principle);
- principles of ultrasound image formation (B-mode, M-mode, Doppler methods);
- descriptive terminology for echocardiogram analysis (hyperkinesis, dyskinesis, regurgitation, stenosis);
- variants of echocardiography (transthoracic, transesophageal, stress echocardiography) and their diagnostic applications;
- diagnostic capabilities and limitations of echocardiography;
- indications and contraindications for echocardiography;
- design and operation of ultrasound equipment (transducers, frequency/depth settings);
- normal ultrasound anatomy of the heart and vessels.

Skills:

- Determine clinical indications for echocardiography in cardiovascular pathologies (ischemic heart disease, valvular defects, cardiomyopathies, congenital anomalies);
- complete referrals for echocardiography specifying the objectives of the study and the clinical context;
- prepare the patient for the examination: explain the procedure, position the patient for transthoracic (TTE) and transesophageal (TEE) access;
- perform transthoracic echocardiography according to standard protocols, including assessment of cardiac anatomy and function;
- recognize anatomical structures of the heart in standard projections (parasternal, apical, subcostal) and differentiate normal from pathological findings;
- possess skills in quantitative assessment of standard parameters;
- identify imaging artifacts (reverberation, shadowing) and apply correction methods;
- possess skills and principles of screening echocardiography in children for the detection of congenital heart defects.

Prerequisites: to master the discipline of "Echocardiography," knowledge and skills acquired in the following preceding disciplines are required:

- Human Anatomy (macro- and microstructure of the heart and blood vessels, topography of thoracic organs);
- Normal Physiology (functioning of the cardiovascular system, hemodynamics, regulation of cardiac rhythm);
- Medical Physics (physical principles of ultrasound, acoustic properties of tissues, fundamentals of Doppler imaging);
- Biochemistry (metabolic processes in the myocardium, biomarkers of cardiac injury);
- Latin Language (terminology for describing anatomical structures and pathologies).

Postrequisites: the study of echocardiography forms the foundation for further mastery of clinical disciplines:

- Cardiology (diagnosis of ischemic heart disease, heart failure, arrhythmias);
- Cardiac Surgery (preoperative planning, intraoperative monitoring);

- Pediatrics (detection of congenital heart defects, monitoring children with cardiomyopathies);
- Functional Diagnostics (integration of echocardiography with ECG, Holter monitoring);
- Intensive Care Medicine (hemodynamic assessment in critically ill patients, diagnosis of cardiac tamponade);
- Sports Medicine (screening for pathologies in athletes).

THEMATIC LECTURE PLAN

№	Topic	Hours	Date
1	Principles of Ultrasound Physics and Echocardiographic Modalities	2	1.09.25-29.12.25
2	Standard Echocardiographic Views and Normal Cardiac Anatomy	2	1.09.25-29.12.25
3	Quantitative Assessment of Cardiac Structure and Hemodynamic Function	2	1.09.25-29.12.25
4	Valvular Heart Disease: Stenosis, Regurgitation, and Prosthetic Valve Evaluation. Cardiomyopathies: Hypertrophic, Dilated, and Restrictive Phenotypes	2	1.09.25-29.12.25
5	Ischemic Heart Disease: Acute Coronary Syndromes and Chronic Complications. Pericardial Diseases. Cardiac Masses	2	1.09.25-29.12.25
6	Congenital heart disease. Adult Congenital Heart Disease: Shunts and Complex Lesions. Echocardiographic Diagnosis of Critical Congenital Heart Defects in the Neonatal Period	2	1.09.25-29.12.25
Total		**12 hours**	1.09.25-29.12.25

THEMATIC PLAN OF PRACTICAL CLASSES

№	Topic	Hours	Date
1	Ultrasound Physics and Image Optimization.	2	1.09.25-29.12.25
2	Standard Echocardiographic Views and Anatomical Correlation.	2	1.09.25-29.12.25

3	Quantitative Hemodynamic Assessment.	2	1.09.25-29.12.25
4	Valvular Heart Disease Evaluation.	2	1.09.25-29.12.25
5	Cardiomyopathies and Ischemic Heart Disease	2	1.09.25-29.12.25
6	Pericardial Effusion and Cardiac Masses.	2	1.09.25-29.12.25
7	Adult Congenital Heart Disease	2	1.09.25-29.12.25
8	Critical Congenital Heart Defects in Neonates	2	1.09.25-29.12.25
9	Контроль юнита № 2 (2^{nd} unit control)	2	1.09.25-29.12.25
Total		**18 hours**	1.09.25-29.12.25

THEMATIC PLAN OF INDEPENDENT WORK OF STUDENTS

№	Theme of independent work	Hours	Date
Clinical Applications of Echocardiography in Cardiovascular Diseases	Studying the results of non-invasive research methods. Situational tasks. Abstracts and presentations on specific topics.	18	1.09.25-29.12.25

Recommended reading for the discipline:

1.Basic

№	Authors	Title	The year of publishing	Publisher	Availability in the library of the ISM (quantity)
1	Editor: William F. Armstrong, Thomas Ryan	«Feigenbaum's Echocardiography» (8th Edition)	2018	Lippincott Williams & Wilkins	Electronic library of the department
2	Catherine M. Otto	«Textbook of Clinical Echocardiography» (7th Edition)	2020	Elsevier	Electronic library of the department
3	Thomas Boehmeke	"Pocket Atlas of Echocardiography" (2nd Edition)	2018	Thieme	Electronic library of the department

2.Additional

№	Authors	Title	The year of publishing	Publisher	Availability in the library of the ISM (quantity)
1	Jae K. Oh, Garvan C. Kane	"The Echo Manual" (4th Edition)	**2018**	Wolters Kluwer	Electronic library of the department
2	Scott D. Solomon, Justina C. Wu, Linda D. Gillam	"Essential Echocardiography: A Companion to Braunwald's Heart Disease"	2018	Elsevier	Electronic library of the department
3	Catherine M. Otto, Rebecca G. Schwaegler	"Echocardiography Review Guide" (4th Edition)	2019	Elsevier	Electronic library of the department

Resources of the information and telecommunication network "Internet"

1. **Radiopaedia**:https://radiopaedia.org/search?scope=articles&commit=%D0%9F%D0%BE%D0%B8%D1%81%D0%BA&q=echocardiography
2. **Advance echocardiography:** https://www.vividechoclub.net/emea/home
3. https://www.tomtec.de/excellence-in-digital-healthcare/#

4. **American Society of Echocardiography (ASE) Guidelines**: asecho.org/guidelines

Grading policy and procedures for all types of work

For the period of studying the discipline, the student gains points for the relevant parameters (per unit):
current score - 40 points
independent work - 20 points
control score (final assessment of knowledge per unit) - 40 points
Maximum score - 100 (40+20+40)

Grading system for student's achievements

Grading criteria per discipline				
Maximum score	Intervals			
	«unsatisfactory»	«satisfactory»	«good»	«excellent»
Current control- 40	0-23	24-30	31-35	36-40
Interval description	Not ready for class	Passive, does not participate in the discussion of the lesson topic	Actively participates in the discussion of the topic of the lesson, periodically gets confused in the details.	Actively participates in the discussion of the topic of the lesson, gives a complete and accurate answer to the question.
Independent work – 20	0-11	12-15	16-17	18-20

Interval description	Doesn't answer questions on the topic	Has difficulty answering, has poor knowledge of the topic	Answers well, but occasionally gets confused in some answers	Confident, complete answer. Shows good knowledge of the topic, does not get confused in answers
Control work (module) – 40	0-23	24-30	31-35	36-40
Interval description	Doesn't answer questions	Has difficulty answering, does not know the answer well	Answers well, occasionally gets confused in some answers	Answers all questions correctly, completely. Don't get confused with answers

Conduct Policy: (lateness, absence, behavior in the auditorium, late submission of work).
- Punctuality and completion of tasks.
- Mandatory attendance of classes.
- Attending class in a clean medical uniform.
- Eliminating conversations on a cell phone in the classroom.
- Active participation in the learning process.
- Doing homework on time.
- Academic detention at the time specified by the teacher.

For violations of the Conduct Policy, the total points for discipline might be reduced to 1-10 points.

Academic Ethics Policy.
- Be tolerant, respect the opinions of others.
- Formulate objections in the correct form.
- Constructively support feedback in all classes.
- Plagiarism and other forms of dishonest work are unacceptable. Plagiarism includes the following: the absence of references when using printed and electronic materials, quotes, thoughts and works of other authors or students.
- Prompting and cheating during tests, exams, classes is unacceptable as well as passing an exam for another student, unauthorized copying of materials.

For violations of the Academic Ethics Policy, the total points for the discipline may be reduced to 1-10 points.

Guidelines for the lessons of the discipline
Echocardiography
Key questions covered in lesson 1.

The history of the discovery and development of ultrasound diagnostics, main stages of the introduction of echocardiography. Physical properties of ultrasound waves, concepts of frequency, velocity, and acoustic impedance. Principles of non-ionizing radiation and its differences from other imaging modalities. Main methods of image acquisition in echocardiography: B-mode, M-mode, pulsed-wave and continuous-wave Doppler, color Doppler mapping, 3D/4D imaging. Principles of ultrasound image formation. Factors influencing image quality: depth, gain, focus, frequency. Ultrasound image artifacts and methods of their correction. Safety indices in ultrasound

examinations (thermal and mechanical indices), ALARA principle. Categories of medical personnel involved in ultrasound examinations and requirements for patient preparation.

Recommended reading for the lesson:

1. Editor: William F. Armstrong, Thomas Ryan «Feigenbaum's Echocardiography» (8th Edition) 2018 Lippincott Williams & Wilkins

Key questions covered in lesson 2. Standard echocardiographic views and anatomical correlation. Main transthoracic positions: parasternal long and short axis, apical four-chamber, subcostal position. Anatomical structures visualized in each position. Correlation of ultrasound images with cardiac anatomy. Imaging features in congenital and acquired heart defects. Use of Doppler methods for blood flow assessment. Artifacts specific to various positions and methods for their correction. Patient preparation and transducer selection for image optimization. Requirements for medical personnel involved in the examination.

Recommended reading for the lesson:

1. Editor: William F. Armstrong, Thomas Ryan «Feigenbaum's Echocardiography» (8th Edition) 2018 Lippincott Williams & Wilkins

Key questions covered in lesson 3. Quantitative hemodynamic assessment using echocardiography methods. Key parameters: cardiac output (CO), stroke volume (SV), left ventricular ejection fraction (LVEF), pulmonary artery pressure (PAP). Methods for calculating cardiac output: measurement of left ventricular outflow tract (LVOT) diameter, velocity-time integral (VTI) using pulsed-wave Doppler. Evaluation of pressure gradients in valvular pathologies (aortic/mitral stenosis) with continuous-wave Doppler. Application of tissue Doppler imaging for diastolic function analysis. ASE/EACVI recommendations for measurement standardization. Artifacts in quantitative calculations and correction methods. ALARA principle during prolonged scanning. Patient preparation and transducer selection for measurement accuracy. Requirements for results documentation.

Recommended reading for the lesson:

1. Editor: William F. Armstrong, Thomas Ryan «Feigenbaum's Echocardiography» (8th Edition) 2018 Lippincott Williams & Wilkins
2. Catherine M. Otto «Textbook of Clinical Echocardiography» (7th Edition) 2020 Elsevier
3. Thomas Boehmeke "Pocket Atlas of Echocardiography" (2nd Edition) 2018 Thieme
4. Jae K. Oh, Garvan C. Kane "The Echo Manual" (4th Edition) 2018
5. Wolters Kluwer. Scott D. Solomon, Justina C. Wu, Linda D. Gillam "Essential Echocardiography: A Companion to Braunwald’s Heart Disease" 2018 Elsevier
6. Catherine M. Otto, Rebecca G. Schwaegler "Echocardiography Review Guide" (4th Edition) 2019 Elsevier

Key questions covered in lesson 4.

Evaluation of valvular heart disease using echocardiography. Main methods: transthoracic (TTE) and transesophageal (TEE) echocardiography, 3D imaging. Quantitative parameters: valve orifice area (EOA, PISA), pressure gradients, regurgitation volume. Application of pulsed-wave and continuous-wave Doppler for assessment of stenosis and regurgitation. Continuity equation for calculating aortic valve area (AVA). EACVI/ASE recommendations for classification of disease severity. Artifacts in valve assessment (eccentric flows, shadowing from calcifications) and correction methods. ALARA principle during prolonged examinations. Patient preparation and transducer selection for image optimization. Protocol requirements: etiology of the defect, mechanism of dysfunction, hemodynamic consequences. Advantages and limitations of TTE and TEE methods. Indications. Demonstration and analysis of echocardiographic studies with valvular pathology.Mayur Arun Kulkarni, Saurabh S Patil, Amit M Shetty - Conceptual Review of Radiology.Nothing beyond for PGMEE. 2018 CBS Publishers &Distributors

Recommended reading for the lesson:

1. Editor: William F. Armstrong, Thomas Ryan «Feigenbaum's Echocardiography» (8th Edition) 2018 Lippincott Williams & Wilkins
2. Catherine M. Otto «Textbook of Clinical Echocardiography» (7th Edition) 2020 Elsevier
3. Thomas Boehmeke "Pocket Atlas of Echocardiography" (2nd Edition) 2018 Thieme
4. Jae K. Oh, Garvan C. Kane "The Echo Manual" (4th Edition) 2018 Wolters Kluwer
5. Scott D. Solomon, Justina C. Wu, Linda D. Gillam "Essential Echocardiography: A Companion to Braunwald's Heart Disease" 2018 Elsevier
6. Catherine M. Otto, Rebecca G. Schwaegler "Echocardiography Review Guide" (4th Edition) 2019 Elsevier

Key questions covered in lesson 5. Diagnosis of cardiomyopathies and ischemic heart disease using echocardiography. ASE/EACVI recommendations for the classification of cardiomyopathies (dilated, hypertrophic, restrictive) and risk stratification. Imaging artifacts: false aneurysms, pseudonormal transmitral flow pattern. Protocol requirements: etiology, functional class (NYHA), hemodynamic parameters, integration with angiography or MRI data. Advantages and limitations of TTE and TEE methods. Indications. Demonstration and analysis of echocardiographic studies in dilated cardiomyopathy (diffuse hypokinesia), hypertrophic cardiomyopathy (asymmetric interventricular septal hypertrophy), post-infarction changes (regional wall motion abnormalities).

Recommended reading for the lesson:

1. Editor: William F. Armstrong, Thomas Ryan «Feigenbaum's Echocardiography» (8th Edition) 2018 Lippincott Williams & Wilkins
2. Catherine M. Otto «Textbook of Clinical Echocardiography» (7th Edition) 2020 Elsevier
3. Thomas Boehmeke "Pocket Atlas of Echocardiography" (2nd Edition) 2018 Thieme
4. Jae K. Oh, Garvan C. Kane "The Echo Manual" (4th Edition) 2018 Wolters Kluwer
5. Scott D. Solomon, Justina C. Wu, Linda D. Gillam "Essential Echocardiography: A Companion to Braunwald's Heart Disease" 2018 Elsevier
6. Catherine M. Otto, Rebecca G. Schwaegler "Echocardiography Review Guide" (4th Edition) 2019 Elsevier

Key questions covered in lesson 6. Diagnosis of pericardial effusion: classification by volume (small, moderate, large), etiology (inflammatory, neoplastic, traumatic). Echocardiographic signs of effusion: separation of pericardial layers, collapse of cardiac chambers, diastolic dysfunction of the right ventricle. Diagnosis of cardiac tamponade: right atrial collapse, paradoxical pulse, respiratory flow variations. Cardiac masses: benign (myxomas, fibromas) and malignant (sarcomas, metastases). Localization of masses: atria, ventricles, pericardium. Differential diagnosis: thrombi, endocarditis vegetations. Imaging methods: transthoracic (TTE) and transesophageal (TEE) echocardiography, 3D imaging. Advantages and limitations of TTE and TEE methods. Indications. Demonstration and analysis of echocardiographic studies in pericardial effusion and cardiac masses.

Recommended reading for the lesson:

1. Editor: William F. Armstrong, Thomas Ryan «Feigenbaum's Echocardiography» (8th Edition) 2018 Lippincott Williams & Wilkins
2. Catherine M. Otto «Textbook of Clinical Echocardiography» (7th Edition) 2020 Elsevier
3. Thomas Boehmeke "Pocket Atlas of Echocardiography" (2nd Edition) 2018 Thieme
4. Jae K. Oh, Garvan C. Kane "The Echo Manual" (4th Edition) 2018 Wolters Kluwer

5. Scott D. Solomon, Justina C. Wu, Linda D. Gillam "Essential Echocardiography: A Companion to Braunwald's Heart Disease" 2018 Elsevier
6. Catherine M. Otto, Rebecca G. Schwaegler "Echocardiography Review Guide" (4th Edition) 2019 Elsevier

Key questions covered in lesson 7. Diagnosis of congenital heart defects in adults using echocardiography. Primary methods: transthoracic (TTE) and transesophageal (TEE) echocardiography, 3D imaging. Advantages and limitations of using TTE and TEE methods. Indications. Demonstration and analysis of echocardiographic studies in congenital heart defects. Classification of congenital defects: simple (atrial and ventricular septal defects, patent ductus arteriosus), complex (tetralogy of Fallot, aortic coarctation, transposition of the great arteries). Echocardiographic criteria: anatomy of defects, shunt direction, assessment of pulmonary artery pressure. Diagnosis of complications: pulmonary hypertension, arrhythmias, postoperative changes.

Recommended reading for the lesson:

1. Editor: William F. Armstrong, Thomas Ryan «Feigenbaum's Echocardiography» (8th Edition) 2018 Lippincott Williams & Wilkins
2. Catherine M. Otto «Textbook of Clinical Echocardiography» (7th Edition) 2020 Elsevier
3. Thomas Boehmeke "Pocket Atlas of Echocardiography" (2nd Edition) 2018 Thieme
4. Jae K. Oh, Garvan C. Kane "The Echo Manual" (4th Edition) 2018 Wolters Kluwer
5. Scott D. Solomon, Justina C. Wu, Linda D. Gillam "Essential Echocardiography: A Companion to Braunwald's Heart Disease" 2018 Elsevier
6. Catherine M. Otto, Rebecca G. Schwaegler "Echocardiography Review Guide" (4th Edition) 2019 Elsevier

Key questions covered in lesson 8. Diagnosis of critical congenital heart defects in neonates using echocardiography. Primary methods: transthoracic (TTE) and transesophageal (TEE) echocardiography, 3D imaging. Advantages and limitations of using TTE and TEE methods. Indications. Demonstration and analysis of echocardiographic studies in critical congenital heart defects. Classification of critical defects: ductus-dependent defects (aortic coarctation, hypoplastic left heart syndrome, transposition of the great arteries), defects with hypoxemia (tetralogy of Fallot, pulmonary atresia, total anomalous pulmonary venous return), defects with significant shunting (truncus arteriosus, Ebstein's anomaly). Echocardiographic criteria: anatomy of defects, shunt direction, assessment of pulmonary artery pressure, ventricular function. Diagnosis of complications: cardiogenic shock, pulmonary hypertension, arrhythmias, postoperative changes.

Recommended reading for the lesson:

1. Editor: William F. Armstrong, Thomas Ryan «Feigenbaum's Echocardiography» (8th Edition) 2018 Lippincott Williams & Wilkins
2. Catherine M. Otto «Textbook of Clinical Echocardiography» (7th Edition) 2020 Elsevier
3. Thomas Boehmeke "Pocket Atlas of Echocardiography" (2nd Edition) 2018 Thieme
4. Jae K. Oh, Garvan C. Kane "The Echo Manual" (4th Edition) 2018 Wolters Kluwer
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6. Catherine M. Otto, Rebecca G. Schwaegler "Echocardiography Review Guide" (4th Edition) 2019 Elsevier

Key questions covered in lesson 9. Testing, solving situational problems using the necessary details

(use of echocardiographic images, video loops, digital archives of echocardiographic studies, as well as correlation with data from other imaging modalities (CT, MRI, radiography) for comprehensive analysis of clinical cases.)

Recommended reading for the lesson:

1. Editor: William F. Armstrong, Thomas Ryan «Feigenbaum's Echocardiography» (8th Edition) 2018 Lippincott Williams & Wilkins
2. Catherine M. Otto «Textbook of Clinical Echocardiography» (7th Edition) 2020 Elsevier
3. Thomas Boehmeke "Pocket Atlas of Echocardiography" (2nd Edition) 2018 Thieme
4. Jae K. Oh, Garvan C. Kane "The Echo Manual" (4th Edition) 2018 Wolters Kluwer
5. Scott D. Solomon, Justina C. Wu, Linda D. Gillam "Essential Echocardiography: A Companion to Braunwald's Heart Disease" 2018 Elsevier
6. Catherine M. Otto, Rebecca G. Schwaegler "Echocardiography Review Guide" (4th Edition) 2019 Elsevier

Methodological instructions for the implementation of independent work on the discipline. Radiology basics

Methodological instructions for the implementation of independent work on the discipline. Echocardiography

Every student is given an individual learning project which must be completed. The results should be reported in the form of a presentation.
Every group is given one common learning project which must be completed. The results should be reported in the form of a presentation.

Questions for projects:

- History of echocardiography. Development of ultrasound in cardiology.
- Basic physical principles of echocardiography.
- Types of echocardiographic modalities: M-mode, 2D, Doppler, color Doppler, tissue Doppler, 3D echocardiography.
- Transthoracic echocardiography: methodology, indications, limitations.
- Transesophageal echocardiography: methodology, indications, limitations.
- Stress echocardiography: methodology, clinical applications.
- Echocardiographic assessment of cardiac chambers and valves.
- Echocardiographic diagnosis of cardiomyopathies.
- Echocardiographic assessment in ischemic heart disease.
- Echocardiographic diagnosis of congenital heart diseases in adults and children.
- Echocardiographic evaluation of pericardial diseases.
- Use of contrast agents in echocardiography.
- Artifacts in echocardiography and methods of their correction.
- Integration of echocardiographic data with other imaging modalities (CT, MRI, angiography) for comprehensive clinical analysis.
- Modern digital technologies in echocardiography: image storage, video loops, digital archives.
- Clinical case presentations based on echocardiographic findings.