MINISTRY OF HEALTH PROTECTION OF UKRAINE
ODESSA NATIONAL MEDICAL UNIVERSITY

Medical Faculty №2

Department of radiation diagnostics, therapy and radiation medicine and oncology

I APPROVE
Vice-rector for scientific and pedagogical work
_____ Eduard BURYACHKIVSKY
September 1, 2023

METHODOLOGICAL DEVELOPMENT TO PRACTICAL LESSONS FROM EDUCATIONAL DISCIPLINE

Faculty, MEDICAL course, 2nd year

Educational discipline RADIOLOGY

Odesa-2023

Approved:

Meeting of the Department of the Radiation Diagnostics, Therapy and Radiation Medicine and Oncology
Odessa National Medical University

Protocol No. 1 dated 30.08. 2023

Head of the department _____ Victor SOKOLOV
(signature)

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PRACTICAL TRAINING

Content module 1.
Introduction to radiology. Basic properties of ionizing radiation. Dosimetry. Visualization methods in radiation diagnostics.

Practical lesson No. 1.

Topic 1. Basic properties of ionizing radiation. Biological effect of ionizing radiation on healthy and pathologically changed cells. Radioactivity and dose. Dosimetry of ionizing radiation.

Purpose: familiarization with the nature of ionizing radiation used in medical practice: its types, main properties, effect on the cell; with the principles of dosimetry and methods of determining the radiation dose.

Basic concepts:
Types of radiation used in medical practice. Ionizing and non-ionizing radiation. Sources of radiation. Penetrating ability of ionizing radiation. Biological effect of irradiation. Effect of ionizing radiation on the cell. Somatic, genetic and stochastic effects of ionizing radiation. Species, individual, tissue differences in radiosensitivity. Radiotherapeutic interval and means of its increase. Radiomodifying agents (radiosensitizers and radioprotectors). Bergognier-Tribando rule. Radioactivity, units of radioactivity and methods of their determination. Dose of ionizing radiation. Units of exposure, absorbed, equivalent, effective doses. Types of dosimeters Limiting permissible doses (GDD) for different categories of the population and in emergency situations. Local and general exposure.

Equipment: laptop with presentation, multimedia projector, negatoscope

Plan:
1. Organizational measures (greetings, verification of those present, announcement of the topic, purpose of the lesson,
motivation of students of higher education to study the topic).

2. Control of the reference level of knowledge:
2.1 Requirements for theoretical readiness of students to perform practical classes:
Know:
1. Types of ionizing radiation used in medicine and their sources (X-ray machines, radionuclides, charged particle accelerators, etc.).
2. Qualitative characteristics of ionizing radiation (penetrating and ionizing ability).
3. Quantitative characteristics of ionizing radiation (exposure, absorption and equivalent dose, particle flux density, dose rate).
4. The biological effect of ionizing radiation and the main factors on which it depends.
5. The main types of radiation damage to the body (somatic, somatic-stochastic, genetic) and the conditions of their occurrence.
6. The main means of using radionuclides and other sources of ionizing radiation for diagnostic and therapeutic purposes.
7. Concept of anti-radiation protection and radiation control.
8. Features of the organization of anti-radiation protection of personnel and radiation safety of patients during x-ray examinations.
9. Rules for working with open and closed sources of ionizing radiation.

2.2. Questions to check basic knowledge on the topic of the lesson:

1. Types of corpuscular ionizing radiation:
and. alpha radiation;
b. beta radiation;
in. neutron radiation;
g. gamma radiation.
d. X-ray radiation

2. Types of electromagnetic ionizing radiation:
and. alpha radiation;
in. beta radiation;
in. neutron radiation;
g. gamma radiation.
d. X-ray radiation.

3. α-radiation has:
and. the greatest penetrating ability;
b. the greatest ionizing capacity;
in. the lowest penetrating ability;
d. high speed of air travel;
d. a high degree of absorption by the protective layers of biological tissues

4. Name all sources of natural radiation:
and. internal radiation of Earth origin, external radiation of Earth origin
b. radiation field, magnetic storms
in. solar wind, heliometeotropic reactions
d. external radiation of cosmic origin
d. true a and d

5. Name the sources of artificial radiation:
and. radiation sources used in science, technology and medicine
b. solar wind, cosmic rays
in. magnetic storms
d. laser radiation
d. breezes, cyclones

3. Formation of professional abilities and skills (mastery of communication skills, dispensation, determination of treatment scheme, laboratory research, etc.) to be able to:

1. estimate and calculate the absorbed, exposure, equivalent, lethal, threshold, population dose
2. solve relevant clinical tasks
3. interpret the mechanisms of biological action of ionizing radiation on healthy and pathologically changed cells
4. correctly choose methods and methods of protection against the main types of ionizing radiation under different conditions.

1. **The exposure dose is** :

and. the amount of ionizing radiation energy absorbed by the elementary volume of the irradiated body (body tissues, substance), per unit mass of the substance in this volume;
b. the absorbed dose in the organ and tissue, multiplied by the corresponding weighted coefficient for this type of radiation;
in. dose of quantum radiation, which is determined by the number of ions formed during air ionization;
d. a quantitative measure that reflects the effect of IR on the irradiated object;
d. is characterized by the number of ions formed during air irradiation under conditions of electrical equilibrium.

2. **The absorbed dose is:**
and. the amount of ionizing radiation energy absorbed by the elementary volume of the irradiated body (body tissues, substance), per unit mass of the substance in this volume;
b. absorption dose in an organ and tissue, multiplied by the corresponding weighted coefficient for this type of radiation;
in. dose of quantum radiation, which is determined by the number of ions formed during air ionization;
d. a quantitative measure that reflects the effect of IR on the irradiated object;
d. reflects the degree of radiation damage to biological objects.

3. **The equivalent dose is:**
and. the amount of ionizing radiation energy absorbed by the elementary volume of the irradiated body (body tissues, substance), per unit mass of the substance in this volume;
b. absorption dose in an organ and tissue, multiplied by the corresponding weighted coefficient for this type of radiation;
in. quantum radiation dose determined by the number of ions formed during air ionization;
d. a quantitative measure that reflects the effect of IR on the irradiated object;
d. reflects the degree of radiation danger of chronic exposure.

4. **The collective effective dose is** :
and. the amount of ionizing radiation energy absorbed by the elementary volume of the irradiated body (body tissues, substance), per unit mass of the substance in this volume;
b. the absorbed dose in the organ and tissue, multiplied by the corresponding weighted coefficient for this type of radiation;
in. a quantitative measure that reflects the effect of II on the irradiated object;
d. is the total dose obtained by adding individual EDs for a group of irradiated people;
d. a measure of collective risk, occurrence of stochastic effects of exposure.

5. Name the methods of dosimetry of ionizing radiation:
and. ionization,
b. scintillating,
in. luminescent,
g. biological;
d. photodosimetric

Practical lesson No. 2.

Topic 2. Physical and technical foundations of X-ray diagnostics, computer tomography, ultrasound, magnetic resonance imaging and radionuclide research.

Purpose: To get acquainted with the possibilities and principles of modern methods of radiation diagnostics, namely with X-ray diagnostics, computer tomography, ultrasound, magnetic resonance imaging and radionuclide research.

Basic concepts:
Structure and principle of operation of equipment for X-ray, CT, ultrasound, MRI and radionuclide studies. Characteristics of the radiation used in these studies. Principles of image acquisition in radiation research methods (radiation source and detector). Methodology of X-ray examination: X-ray, X-ray, fluorography, computed tomography (CT). Methods of ultrasound diagnostic research: one-dimensional echography, sonography (ultrasound scanning), dopplerography. Features of visualization of organs and tissues during ultrasound examinations. The essence of the phenomenon of nuclear magnetic resonance and its physical characteristics. Methodology of radionuclide research. Advantages and disadvantages of each of the methods. Indications and contraindications to this or that method of radiographic research, purpose of methods - study of morphology or (and) function, projections and sections of research. Natural and artificial contrast. Contrast agents. Indications and requirements for their use.

Equipment: laptop with presentation, multimedia projector, radiographs, tomograms

Plan:
1. Organizational measures (greetings, verification of those present, announcement of the topic, purpose of the lesson,
motivation of students of higher education to study the topic).

2. Control of the reference level of knowledge:
2.1 Requirements for theoretical readiness of students to perform practical classes:
Know:
1. structure and principle of operation of equipment for radiation research
2. indications and contraindications for each of the research methods
3. principles of obtaining an image with radiation methods of research
4. contrast agents and indications for their use

2.2. Questions to check basic knowledge on the topic of the lesson:
1. What type of radiation is used for ultrasound, CT, MRI, and RND ?
2. What is the biological effect of waves used for diagnostic purposes?
3. What is the principle of image acquisition?
4. Main parts of ultrasound, CT, MRI, RND devices.
5. What are the capabilities of the methods and what do they depend on.
6. Indications and contraindications for ultrasound, CT, MRI, RND.
7. What is the principle of ultrasound, CT, MRI, RND?
8. Is there a danger of the biological effect of radiation applied during ultrasound, CT, MRI, RND on the object being studied?
9. Preparation of the patient for ultrasound, CT, MRI, RND.

1. Who is not recommended to be examined by X-ray computed tomography?
a) children and pregnant women;
b) patients with craniocerebral trauma;
c) patients over 50 years old;
d) patients older than 80 years;
e) patients with hypertensive crisis.

2. What is the registration of the MSCT method based on?
a) X-ray radiation;
b) infrared radiation;
c) γ-radiation;
d) magnetic field.

3. Which method of radiographic imaging of different organs determines tissue density Hounsfield scale?
and). Tomography.
b). MRI.
in). Computed tomography
d). ultrasound
d). Computer thermography.

4. Specify the density of water according to the Hounsfield scale?
and). 0
b). - 30
in). 800
d). 30
d). 70

5. What is the most common method of introducing RFP to a patient?
and. Intra-arterial
b. Intravenous
in. Intramuscular
Mr. Oral
d. Intradermal

6. When examining a pregnant woman, which of the methods does not carry a radiation load (absence of ionizing radiation)?
and. Digital radiology.
b. CT
in. MRI (for vital signs)
g. Radiography
d. ultrasound

3. Formation of professional abilities and skills (mastery of communication skills, dispensation, determination of treatment scheme, laboratory research, etc.) to be able to:

1. correctly choose the area and type of X-ray examination
2. properly issue a referral for research
3. understand in which cases a contrast study should be prescribed
4. correctly give recommendations to the patient regarding preparation for the study
5. groups of radiopharmaceuticals (RFP) relevant in modern practice

1. To study the consequences of a knee joint injury with soft tissue damage, the most informative are:
and. CT
b. Radiography
in. ultrasound
Mr. MRI

2. The most informative method of radiation diagnosis of spine pathology:
and. radionuclide diagnostics
b. MRI
in. CT
g. Ultrasound

3. Among the modern radiological imaging methods in osteology, the best for assessing the state of the bone marrow are:
and. ultrasound
b. MRI
in. CT
Moscow State University

4. What is relaxation time?
and. The relaxation time is the time for the protons to return to the equilibrium state
b. The relaxation time is the response time to the radio frequency signal
in. The relaxation time is the magnetization time

5. For the diagnosis of brain tumors, the most informative study is:
and. craniography
b. Ultrasound of the brain
in. MRI

6. Contraindications for conducting magnetic resonance imaging are:
and. presence of a pacemaker;
b. unconscious state of the patient;
in. condition after radiation therapy, complicated by leukopenia;
d. early postoperative period

Recommendations (instructions) for the performance of tasks (professional algorithms, orientation maps for the formation of practical skills and abilities, etc.)

Procedure for studying radiographs, tomograms:
1. Passport data.
2. Determination of the research area.
3. Determination of the patient's position.
4. Determination of organs on a tomogram.
5. Assessment of organs by: position, size, outline, structure, proton density, time signal relaxation.
6. Identification of the main syndrome of pathological changes.

Control materials for the final stage of the lesson:

1. A patient with heart disease, who has a pacemaker implanted under the skin, was sent for an MRI of the chest organs to assess the condition of the heart. Is it possible to do this?

2. In a patient with a suspicion of subarachnoid hemorrhage, CT artifacts appeared in the form of white lines in the area of the suspected hemorrhage, which interfere with the evaluation of the image. Can an MRI be used to evaluate this department?

3. The patient was suspected of having sclerotic changes in the subcortical nuclei of the brain and its cortex. Which research method will you send him to to clarify the condition: MRI, CT or craniography? Why?

4. You need to examine the child's brain. Which CT or MRI research method do you prefer? would you prefer Why?

4. Summary:

Current evaluation criteria in practical training

Rating	Evaluation criteria
Perfectly "5"	The applicant takes an active part in practical training; demonstrates deep knowledge, gives complete and detailed answers to questions; takes an active part in the discussion of the results of the radiological examination, correctly and consistently compiles the algorithm of the radiological examination in relation to a certain pathology; uses additional educational and methodological and scientific literature; expresses his own reasoning, gives appropriate examples, demonstrates clinical thinking. The test tasks are completed in full, all 100% of the answers to the questions are correct.
Fine "4"	The applicant participates in a practical session; knows the material well; demonstrates the necessary knowledge, but gives answers to questions with some errors; participates in the discussion of the results of radiation research, uses basic educational and methodological and scientific literature. The winner expresses his opinion on the subject of the lesson, demonstrates clinical thinking. The test tasks are completed in full, at least 70% of the answers to the questions are correct.
Satisfactorily "3"	The acquirer sometimes participates in a practical activity; partially speaks and asks questions; makes mistakes when answering questions; shows passive work in practical classes; the radiological research algorithm for a certain pathology is inconsistent with significant errors; shows fragmentary knowledge of the conceptual apparatus and literary sources. The acquirer does not express his opinion on the topic for any reason . The testing is done in full, at least 50% of the answers are correct.
Unsatisfactorily "2"	The acquirer does not participate in the practical session, is only an observer; never speaks or asks questions, disinterested in learning the material; does not take part in the discussion of the results of radiological examination, incorrectly compiles the algorithm of radiological examination for a certain pathology, gives incorrect answers to questions, shows unsatisfactory knowledge of the conceptual apparatus and literary sources. Testing is done, but less than 50% of the answers are correct.

5. List of recommended literature

Main:

1. Kovalsky O.V. Radiology. Radiation therapy. X-ray diagnostics: assistant. for students higher honey. education closing IV level of accreditation / O. V. Kovalskyi, D. S. Mechev, V. P. Danylevich. 2nd edition Vinnytsia: New Book, 2017. 512 p.
2. Radiology (radiodiagnosis and radiation therapy). Test tasks. Part 1. Kyiv: Book plus. 2015. 104 p.
3. Radiology (radiodiagnosis and radiation therapy). Test tasks. Part 2. Kyiv: Book plus. 2015. 168 p.
4. Radiology (radiodiagnosis and radiation therapy). Test tasks. Part 3. Kyiv: Book plus. 2015. 248 p.
5. Methods of radiation diagnostics: a study guide (Protocol of the Medical Center No. 5 dated 05.25.17) N.V. Tumanska, K.S. Barska. 143 p.

Additional:

6. Radiation medicine: Textbook for medical universities 3-4 academic year. approved by the Ministry of Education and Culture / edited by E. Pylypenka Kyiv, 2018. 232 p. kind. "Medicine".
7. Tomographic methods of radiodiagnostics: a study guide (Protocol of the Central Medical Center No. 5 dated 05.25.17) N.V. Tumanska, K.S. Barska, I.P.Jos, 91 p.
8. Diagnostic, treatment and preventive algorithms in internal medicine: teaching method. manual / under the editorship Prof. V. I. Denesyuk; Vinnytsia national honey. University named after M. I. Pirogov, Cafe. internal Medicine No. 3. Kyiv: DZK Center, 2015. 151 p. : fig., tab.
9. Clinical Radiology : The Essentials Fourth Edition by Daffner MDFACR, Dr. Richard H., Hartman MD, Dr. Ma 4th edition. 2014. 546 p.

Electronic information resources:

1. https://radiographia.info/
2. http://nld.by/help.htm
3. http://learningradiology.com
4. http://www.radiologyeducation.com/
5. http://www.radiologyeducation.com/
6. https://www.sonosite.com