Faculty of Medicine in Rijeka

Curriculum
2022/2023

For course

Nuclear medicine

Study program:	**Medical Studies in English (R)** University integrated undergraduate and graduate study
Department:	**Department of Nuclear Medicine**
Course coordinator:	**izv. prof. dr. sc. Bogović Crnčić Tatjana, dr. med.**
Year of study:	**4**
ECTS:	**2**
Incentive ECTS:	**0 (0.00%)**
Foreign language:	**Possibility of teaching in a foreign language**

Course information:

The course NUCLEAR MEDICINE is a compulsory course in the fourth year of the Integrated Undergraduate and Graduate Study of Medicine in English, in VIII. (summer) semester. It consists of 12 hours of lectures, 6 hours of seminars and 12 hours of practicals, a total of 30 hours (2 ECTS credits). It takes place in Clinical Department of Nuclear Medicine and in the lecture hall of Clinical Hospital Center Rijeka.

OBJECTIVES OF THE COURSE: The goal of this course is to encounter students with open ionizing radiation sources used in nuclear medicine (NM) for diagnostic and therapeutic purpose: radionuclides (RN). Students should learn about manipulation and use of the radionuclides, radiopharmaceuticals (RF) and instrumentation that will enable them, as future general practitioners, to correctly understand clinical indications in an individual patient. Methods and rules in radiation protection (Basic Safety Standards) should be acquired, as well as contamination and decontamination concept, specifically for patients receiving RN, nursing staff, other persons in contact with a patient (family) and the environment. The advantages and importance of hybrid imaging methods (SPECT/CT, PET/CT) are introduced, especially in diagnostics, but also in therapy, with consequences regarding radiation protection. Students should acquire general knowledge regarding molecular nuclear medicine imaging and personalized medicine based on theranostics. The importance of nuclear medicine and other methods in thyroid diagnostics and therapy should be conceived.

COURSE DESCRIPTION:

The basic physics of ionizing radiation, radioactive decay, production of radionuclides, and specific RN used in NM are studied. Interactions of ionizing radiation with matter, including persons and environment are discussed. Radionuclides used in NM are demonstrated, their production (generator, cyclotrons), storage and clinical (diagnostic and therapeutic) use. Optimal characteristics of RN for diagnostics and therapy, the most common RN used in nuclear medicine (technetium- 99m, iodine isotopes and fluorine- 18) are analysed. Synthesis of radiopharmaceuticals (RF) and crucial role of their biodistibution is explained. Complexity of radiation exposure arising from hybrid imagining is mentioned. Methods and rules in radiation protection, primarily from gamma radiation are being demonstrated in «hot laboratory», contamination and decontamination concept, specifically for persons, patients and environment. Instrumentation basics- gamma detectors, gamma camera are studied. Imaging diagnostic procedures with RN and RF are described including a static and dynamic (planar) scintigraphy, the types of emission tomographies (single photon- SPECT and positron- PET), hybrid (multimodality) imaging (SPECT/CT, PET/CT), and information on PET/MR. Functional diagnostics of thyroid diseases (thyroid scintigraphy, iodine accumulation), thyroid and neck sonography and fine needle aspiration biopsy are discussed. Diagnostics and therapy of benign and malignant thyroid diseases is described. Radioiodine therapy of benign and malignant diseases is presented. Therapeutic use of other radionuclides and radiopharmaceuticals is mentioned.
Radiopharmaceuticals and imaging protocols for bone scintigraphy and SPECT/CT, lung scintigraphy and SPECT, SPECT/CT diagnostics of neuroendocrine tumours and inflammation are demonstrated. Sentinel lymph node scintigraphy is mentioned. Nuclear medicine procedures and imaging methods in cardiology, nephrourology, paediatrics, neurology and gastroenterology are discussed.
PET/CT diagnostic procedures in oncology (18F-FDG) and other indications are presented. Concept of theranostics and personalized medicine is presented.

LEARNING OUTCOMES: Acquisition of basic and specific competencies defined by objectives, basic knowledge and skills described in this syllabus. The limiting factor is ionizing radiation zone. As students are not allowed to handle radioactive sources (according to the radiation protection legislature), the education is limited to demonstration of work with RN and instructions on specific procedures (use of radiation detectors) by professionals. Required knowledge is adopted theoretically; however practical work is partly enabled by active participation in seminars and practicals (thyroid ultrasound).

BASIC COMPETENCIES that student should acquire are:
1. Radiopharmaceuticals - students should define the term radionuclide and radiopharmaceutical, they should be able to list the most important and common diagnostic radionuclides and their physical properties (gamma energy and physical half- life).
2. Instrumentation - should be able to describe basics of gamma camera (principle of gamma detection), (planar) scintigraphy and basics of reconstruction in SPECT and PET tomography.
3. Students should understand and describe advantages and importance of hybrid technologies (SPECT/CT and PET/CT).
4. Students should be able to describe the most common nuclear medicine imaging radiopharmaceuticals, diagnostic procedures and methods, the physical properties of the most commonly used diagnostic radionuclides and diagnostic procedures in nephrourology, oncology, cardiology, pulmology, paediatrics and neurology.
5. Students should explain the therapeutic procedures in nuclear medicine - distinguish diagnostic from therapeutic applications, summarize physical, chemical and biological grounds for radionuclide therapy application. They should understand the characteristics of an ideal therapeutic radionuclide and name several examples.
6. Define thyroid disease diagnostics and therapy - describe physical properties of iodine-131 and of other iodine isotopes (iodine- 123, iodine- 125 and iodine- 124), understand the aim of iodine uptake test and thyroid scintigraphy in benign thyroid diseases that could be treated with iodine 131. Comprehend the role of thyroid ultrasound and fine needle aspiration biopsy.

7. Understand the aim and explain the procedure of radioiodine ablation in patients with thyroid cancer.
Describe the role of iodine-131 whole body scintigraphy and tomography (SPECT/CT) in thyroid cancer patients.
8. Students should define the term personalized therapy and theranostic in nuclear medicine (radioiodine therapy, therapy of neuroendocrine tumours).
9. Describe open radioactive sources in medicine and recognize the patient as a radioactive source, remember three main physical principles of radiation protection, distinguish difference in handling open
and sealed radioactive sources (x-ray, CT), understand the possibility of contamination.

SPECIFIC COMPETENCIES: As students are not allowed to handle radioactive sources (according to the radiation protection legislature), the education is limited to demonstration of work with RN and
instructions on specific procedures.
1. Obtaining radionuclides (99mTc) from the generator column- understand the elution of the generator.
2. Radiopharmaceutical labelling - understand the mechanism of biodistribution of radiopharmaceuticals, difference between static and dynamic radiopharmaceuticals.
3. Gamma camera scintigraphy, computer analysis of static and dynamic studies – explain the difference between them, understand application of the most important radiopharmaceuticals.
4. Understand which radiopharmaceuticals (static or dynamic) enable emission tomography studies (SPECT, PET) and why.
5. Hybrid imaging diagnostics (SPECT/CT, PET/CT) - understand the basics and advantages of hybrid instrumentation and contribution of „low dose“CT-a (LDCT) in SPECT and PET.
6. Neck and thyroid ultrasound-understand the importance of ultrasound in thyroid diseases, especially in thyroid nodules, contribution of fine needle aspiration biopsy in diagnostics of thyroid malignancies.

COURSE STRUCTURE: Classes are organised in the form of 12 hours of lectures, 6 hours of seminars and 12 hours of practicals, a total of 30 hours (5 weeks). Lectures take place in the Lecture hall, Clinical Hospital Center Rijeka or depending on the epidemiological situation will be online - Merlin or MS Teams. Seminars and practicals take place place in Clinical Department of Nuclear Medicine. Practicals are coordinated with the lectures, and after the topic is elaborated at the lecture, it should be demonstrated during the consecutive practical. At the end of the class, students must pass the final oral exam. In order to take final oral exam, seminar presentation must be completed (presented and submitted).

List of assigned reading:

1. Lectures; Practicals (Merlin, MS Teams)

2. Fred A. Mettler Jr., and Milton J. Guiberteau. Essentials of Nuclear medicine and Molecular imaging, Seventh edition, 2019 by Elsevier, Inc.

3. European Nuclear Medicine Guide A joint publication by EANM and UEMS/EBNM Edited by: Roland Hustinx and Kristoff Muylle

https://www.nucmed-guide.app/#!/home

List of optional reading:

Diagnostic Radiology Physics: A Handbook for Teachersand Students, International atomic energy agency Vienna, 2014

STANDARD OPERATING PROCEDURES FOR PET/CT: A PRACTICAL APPROACH FOR USE IN ADULT ONCOLOGY, IAEA Human Health Series No. 26, International atomic energy agency Vienna, 2013

NUCLEAR CARDIOLOGY: GUIDANCE AND RECOMMENDATIONS FOR IMPLEMENTATION IN DEVELOPING COUNTRIES, IAEA HUMAN HEALTH SERIES No. 23, INTERNATIONAL ATOMIC ENERGY AGENCY VIENNA, 2012 IAEA HUMAN HEALTH SERIES No. 23

Curriculum:

Student obligations:

STUDENTS' OBLIGATIONS:

Students are required to attend classes regularly and actively participate in all forms of teaching. The attendance at seminars and practicals is mandatory. If necessary, a student can be absent from 30% of the classes of the overall course workload, but has to make up for the practicals and seminars he/she failed to attend.

During the classes, students are required to prepare one seminar presentation on the given seminar topic (S 1, 2, 3, 4, 5, 6,7) and present it during seminars. **The seminar presentation (paper) must end with a short concluding opinion (summary) and sources of literature.** After the class, the seminar paper should be submitted as Power Point or Word document in electronic form. Students are required to actively participate in discussion during seminars. Seminars will be evaluated. Successful completion of seminar is mandatory for taking final oral exam. If student does not satisfy, he/she will have the opportunity to repeat the presentation of the seminar paper. For a detailed description of obligations during classes, see the section "Assessment".

Exam (exam taking, description of the written/oral/practical part of the exam, point distribution, grading criteria):

Student assessment is carried out in accordance with the current University of Rijeka Study Regulations and the Student Regulations at the Faculty of Medicine Rijeka (adopted by the Faculty Council of the Faculty of Medicine Rijeka). Students' performance will be evaluated during the course and at the final exam. Out of a total of 100 credits, a student can earn 50 credits (50%) during the course, and 50 credits (50%) at the final exam.

Students are allowed to take the final oral exam if they acquire a minimum of 25 credits during the classes. During the course credits are gained by attendance at classes, active participation in practicals (max 20 credits) and successful completion of seminar (seminar evaluation-maximum of 30 credits). Students who gain less than 25 credits during the course (activity on practicals and seminar evaluation) or for justifiable reasons could not attend seminars or practicals, will have the opportunity for repeating the presentation of seminar paper or practicals (between first and second exam period) and if they satisfy, they will be able to take the final oral exam.

A student who acquires less than 25 credits during the course has failed the course and is graded with F and must retake the course NUCLEAR MEDICINE. The main assigned reading for final exam is lectures and practicals (Merlin or MS Teams). Student assessment is performed using ECTS (A-F) and number system (1-5).

Assessment during the class is up to a maximum of 50 credits (50% of the final grade):

The student acquires credits by completing the tasks as follows:

attendance at classes, activity on practicals (obligatory clinical skills) - max. credits 20

seminar presentation, activity on seminars- max. credits 30

Which gives a total of 50 points.

Activity on practicals:

By actively participating on practicals, students can gain maximum of 20 credits. In order to get the maximum credits, they must acquire knowledge about the most important radionuclides, their properties (99mTc pertechnetate and I131) and their application (diagnostics, therapy) and participate in obligatory clinical skills

Seminars: (required for taking final exam)

Successfully completed seminar is mandatory for taking the final oral exam.

During classes students are required to prepare and present one seminar presentation on the given topic (S 1, 2, 3, 4, 5, 6,7) in Power Point (4-8 slides) and hand it over as Power Point or Word document at Department or electronically after the seminar. **The seminar presentation must end with a short concluding opinion (summary) and sources of literature.** S**tudents are required to actively participate in discussion with teaching assistants during seminars.** Seminars are evaluated with maximum of 30 credits.

To take the final oral exam, a student must collect a minimum of 25 points during the course (attendance, activity on practicals, seminar presentation with active participation). If student does not satisfy, he/she will have the opportunity to repeat the presentation of the seminar paper. It is not possible to write/submit a new seminar paper due to the correction of the grade (credits).

Final oral exam:
Final oral exam is scored up to maximum of 50 credits (50% of the final evaluation).
The main assigned reading for final exam is lectures and practicals (Merlin or MS Teams).
It will take place in Clinical department of nuclear medicine.

It is scored as follows
unsatisfactory (1) 0-24
sufficient (2) 25-30
good (3) 31 - 37
very good (4) 38- 44
excellent (5) 45 – 50

For a passing grade during classes and on the final oral exam, student has to obtain minimum of 50 credits.

The ECTS grading system is defined by the following criteria:

A (5) – 90 -100% credits
B (4)– 75 - 89,9% credits
C (3) – 60 - 74,9% credits
D (2) -- 50 - 59,9% credits
F (1) – 0 - 49,9% credits

Other notes (related to the course) important for students:

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COURSE HOURS 2022/2023

Nuclear medicine

List of lectures, seminars and practicals:

EXAM DATES (final exam):
