

Module title:	Advanced imaging techniques	ECTS	2
Polish translation:	Nowoczesne techniki obrazowania		
Course:	Veterinary Medicine		

Module language:	English	Stage: JM	
Form of studies:	<input checked="" type="checkbox"/> intramural <input type="checkbox"/> extramural	Type of module:	<input type="checkbox"/> basic <input checked="" type="checkbox"/> directional <input checked="" type="checkbox"/> mandatory <input type="checkbox"/> elective
		Semester: 8	<input type="checkbox"/> winter semester <input checked="" type="checkbox"/> summer semester
		Academic year:	2020/2021
		Catalogue number:	(do uzupełnienia)

Module coordinator:	Prof. Zdzisław Gajewski Dr Sc., PhD, DVM; Maria Sady, PhD, DVM
Teachers responsible for the module:	Academic teachers of Center for Translational Medicine (CMT), PhD students, visiting professors and other specialists in the field of study
Unit responsible for the module:	Center for Translational Medicine (CMT)
Faculty in charge:	Faculty of Veterinary Medicine

Objectives of the module:	<p>The aim of the course is to familiarize students with modern imaging techniques that offer veterinarians a range of tools to significantly expand the diagnostic capabilities used in clinical practice (companion animals, livestock, laboratory animals).</p> <p>One of the objectives of the course is to visualize to students the amount and quality of data obtained through the use of methods such as computed tomography, magnetic resonance imaging or positron emission tomography in comparison with conventional radiology or ultrasonography, and then prepare students to make the right choice from among a wide range of imaging techniques and opportunities for clinical and scientific applications. This goal is achieved through the active participation of students in imaging studies performed using the latest technical solutions. Such an opportunity, as the only one in Poland, is provided by the unique infrastructure and equipment of the Center for Translational Medicine at WULS in Warsaw, which has, among others, CT, MRI, DWI MRI, MRI-FUS, PET-MR, as well as the highest-class angiograph and ultrasound machines. The educational content of the lectures provides a theoretical basis for the student to learn, recognize and understand modern imaging methods, taking into account physical phenomena and learning the basics of selected imaging studies (CT, MRI, PET, hybrid methods). The main purpose of the implementation of exercise classes of a clinical nature is to prepare students for the practical performance of the examination and evaluation of the results obtained using the most modern imaging diagnostic equipment necessary for making a final diagnosis.</p> <p>Lectures: Physical basis, safety principles, examination methodology and clinical application of modern imaging techniques.; Computed tomography (CT) imaging – fundamentals, principles of operation, clinical applications.; Magnetic resonance imaging (MRI) - fundamentals, principles of operation, clinical applications.; Magnetic Resonance Guided Focused Ultrasound (MRg-FUS) imaging and therapy.; Hybrid methods - imaging by Positron Emission Tomography with Magnetic Resonance (PET-MR), PET-CT, SPECT-CT.; Digital angiography systems - imaging basics, clinical applications.; Imaging with modern endoscopic techniques (3D endoscopy, cystoscopy) and ultrasound (3D ultrasound, elastography) - imaging basics, clinical applications.</p> <p>Clinical exercises Preparation, performance and evaluation of the results of the examination performed by of computed tomography (CT).; Preparation, performance and evaluation of of the results of the examination performed by magnetic resonance imaging (MRI) findings and application of MR-FUS in cancer therapy.; Preparation and evaluation of the results of Positron Emission Tomography with Magnetic Resonance (PET-MR) and other hybrid methods.; Preparation, performance and evaluation of examination results using modern ultrasound techniques, endoscopic and digital intraoperative systems.; Analysis of images and evaluation of the results of studies performed with selected imaging methods (MRI and MRg-FUS, CT, Angio).; Comparison of clinical applications of selected imaging methods - indications and contraindications.; Evaluation of the use of contrast agents and radiopharmaceuticals</p>
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Teaching forms, number of hours:	<p>a) Lectures: 8 hours</p> <p>b) Clinical exercises: 22 hours</p>
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Teaching methods:	Lectures: original informative and problem-based lectures supported by multimedia presentations Clinical exercises: prelections combined with discussion, preparation and conduct of imaging tests using modern equipment like CT, MRI, MRg-FUS, PET-MR, angiography, endoscopy, ultrasound; clinical case-based presentations and discussion; analysis of results; supplementary materials.
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Formal prerequisites and initial requirements:	Passing the courses: Animal anatomy, Animal physiology, Biophysics, Biochemistry, Veterinary pharmacology, Pathomorphology.		
Learning outcomes:	<p>Knowledge:</p> <p>01 - the student knows the physical interactions used in modern imaging methods;</p> <p>02 - the student knows the principles of preparing the patient for imaging under general anesthesia;</p> <p>03 - the student knows the safety rules and procedures during the CT examination including the use of contrast media;</p> <p>04 - the student knows the safety rules and procedures during the MRI examination including the use of contrast media;</p> <p>05 - the student knows the rules and safety procedures during the PET / MR examination including the use of contrast media and radioactive isotopes;</p> <p>06 - the student knows the rules and safety procedures during angiographic, endoscopic and ultrasound examinations;</p>	<p>Skills:</p> <p>07 - the student can conduct an interview and a clinical examination aimed at selecting or excluding the use of modern imaging techniques;</p> <p>08 - the student can choose a modern imaging technique for the clinical situation;</p> <p>09 - the student can prepare the patient for CT, MRI, PET / MR examination,</p> <p>10 - the student can assess the basic results of CT, MRI, PET / MR examination;</p> <p>11 - the student can use scientific sources in assessing the results of an imaging study;</p>	<p>Competences:</p> <p>12 - the student is ready to choose a modern imaging technique based on specialist knowledge;</p> <p>13 - the student is aware of their knowledge and benefits of using modern imaging techniques;</p> <p>14 - the student is aware of the need for continuing education and is ready to deepen knowledge using scientific sources;</p> <p>15- the student acquires competence in cooperation with a radiologist in the selection and evaluation of the results of modern imaging tests;</p>
Assessment methods:	<p>Effects 01-11- written short test in the form of open questions in exercise classes Effects 04-15 final written exam.</p> <p>During classes, a written test (so-called "entrance test") in the form of a short open questions will be performed to check the student's preparation for the topic of the classes. The results of these tests will be a part of the final grade. Unexcused absence at classes results in 0 points from the entrance test. A minimum of 51% of the entrance tests are required to complete the exercises and take the exam. If a student does not obtain the required number of points from the entrance examinations, he/she is obliged to take the exit test covering the whole material of the classes. A student who has not obtained the specified minimum number of points from the exit exam is not allowed to take the exam and does not receive credit for the course. The exit exam consists of open questions and the minimum pass mark is 51%. The final exam covers all the learning content of the course (classes and lectures). Written exam in the form of a mixed test (open questions and/or fill-in and/or single/multiple choice). Minimum pass mark is 51%. Term I and Term II of exams take place in the same format. In the case of a top-down suspension of the realization of classes at the University and the need for remote/hybrid teaching, other forms of verification of learning outcomes are permitted in a manner adequate to the situation.</p>		
Formal documentation of learning outcomes:	Short written test, written exam. Record into the eHMS system and documentation contained in the 'Course File' (i.e. individual student assessment cards, attendance lists, database of questions for written forms, students' essays)		
Elements impelling final grade:	<p>A student who has not obtained a minimum acceptable number of points from the evaluation of short written (so-called entrance) does not obtain credit for the course.</p> <p>The final course grade is influenced by the following elements and their weights:</p> <ul style="list-style-type: none"> - the short written tests (20% of the final grade), - final written exam (80% of the final grade). 		
Teaching base:	Classrooms, lecture halls, laboratories of CMT and FVM		
	<p>Literature:</p> <ol style="list-style-type: none"> 1. „Textbook of Veterinary Diagnostic Radiology“, D. E. Thrall, Elsevier, 2018. 2. „Veterinary Computed Tomography“, T. Schwarz, J. Saunders J. Wiley-Blackwell, 2011. 3. „Atlas of Small Animal CT and MRI“, E. Wisner, A. Zwingenberger, Wiley-Blackwell, 2015. 4. „Diagnostic MRI in dogs and cats“, W. Mai, CRC Press, 2018. 5. „Handbook of Small Animal MRI“, I. Elliott, G. Skerritt , Wiley-Blackwell, 2010. 6. „Atlas of Small Animal Ultrasonography“, D. Penninck , M.-A. D'anjou, Wiley Blackwell, 2015. 7. „Diagnostic Radiology and Ultrasonography of the dog and cat“, H. McAllister , J. K. Kealy , J. P. Graham, Elsevier Saunders 2010. 8. Additional materials and reviewed publications recommended by teachers. 		
ADNOTATIONS	Protective clothing is required during clinical classes.		

Quantitative summary of the module:

Estimated number of work hours per student (contact and self-study) essential to achieve presumed learning outcomes of the module - base for quantifying ECTS:	60 h
Total ECTS points, accumulated by students during contact learning:	2 ECTS

Learning outcomes of the module relative to the learning outcomes of the subject:

Outcome category	Learning outcomes:	Learning outcomes relative to the course outcomes	Impact on the each for course outcomes
Knowledge	01 - the student knows the physical interactions used in modern imaging methods;	B.W.4, B.W.6	for each 3
Knowledge	02 - the student knows the principles of preparing the patient for imaging under general anesthesia;	B.W.4, B.W.5	for each 3
Knowledge	03 - the student knows the safety rules and procedures during the CT examination including the use of contrast media;	B.W.4, B.W.6	for each 3
Knowledge	04 - the student knows the safety rules and procedures during the MRI examination including the use of contrast media;	B.W.4, B.W.6	for each 3
Knowledge	05 - the student knows the rules and safety procedures during the PET / MR examination including the use of contrast media and radioactive isotopes;	B.W.4, B.W.6	for each 2
Knowledge	06 - the student knows the rules and safety procedures during angiographic, endoscopic and ultrasound examinations;	B.W.4, B.W.6	for each 2
Skills	07 - the student can conduct an interview and a clinical trial aimed at selecting or excluding the use of modern imaging techniques;	B.U.1, B.U.2, B.U.3	for each 3
Skills	08 - the student can choose a modern imaging technique for the clinical situation;	A.U.1, B.U.7, C.U.3	for each 3
Skills	09 - the student can prepare the patient for CT, MRI, PET / MR examination,	A.U.1, B.U.1, B.U.7, B.U.11	for each 2
Skills	10 - the student can assess the basic results of CT, MRI, PET / MR examination;	A.U.1, B.U.7, C.U.3	for each 2
Skills	11 - the student can use scientific sources in assessing the results of an imaging study;	A.U.1, A.U.21, B.U.7, C.U.3	for each 2
Competences	12 - the student is ready to choose a modern imaging technique based on specialist knowledge;	KS.1, KS.2, KS.5	for each 3
Competences	13 - the student is aware of their knowledge and benefits of using modern imaging techniques;	KS.1, KS.2, KS.4, KS.5	for each 2
Competences	14 - the student is aware of the need for continuing education and is ready to deepen knowledge using scientific sources;	KS.4, KS.8	for each 2
Competences	15- the student acquires competence in cooperation with a radiologist in the selection and evaluation of the results of modern imaging tests;	KS.3, KS.5, KS.6, KS.7, KS.9	for each 3