Polymer Nanoparticles for Drug Delivery (PoND)

Imaging Methods for Cancer Treatment

Magdalena Bazalova-Carter

This module will cover the main anatomical and functional imaging methods for cancer treatment of laboratory small animals. The topics will include computed tomography (CT) with its novel applications in combinations with nanoparticle injection (dual-energy CT, x-ray fluorescence CT, x-ray luminescence CT), magnetic resonance imaging (MRI), single-photon emission CT (SPECT), positron emission tomography (PET), and bioluminescence imaging (BLI). The basic physical principles of all imaging methods will be explained, their advantages and limitations highlighted, and practical applications discussed. In addition, a laboratory in spectral CT imaging demonstrating its strengths and weaknesses will be offered remotely.

The course will consist of six recorded lectures, six discussion sessions, a spectral CT laboratory demonstration (virtually) and a final project with a presentation. All presentations will be posted on the UVic BrightSpace platform and discussion sessions will be delivered virtually on Zoom.

The module will start on Tuesday October 6, 2020 and will run for seven weeks. The timeline is shown at the end of the syllabus. Each lecture will run from 10am-11:30am.

Students will have ~one week to listen to presentations and read a publication on the presented topic. The 1.5-h lectures will consist of a discussion section (~ 1 h) and a journal club (~ 30 min). Each student will be assigned at least one figure to discuss.

A final project will also be part of the module. Students will write a proposal on multi-modality imaging, using the knowledge acquired in class. The proposal will be 3 pages long and the module will be concluded by student presentations of their proposal (10-20 minutes long depending on number of students in class).

Grading will be based on three components of the course:

1) Discussion session: answers to questions (40%, see rubric below) and overall discussion participation in discussion sessions (20%, see rubric below)
2) Journal club presentations (10%)
3) Project proposal (30%)

Journal club presentation

The accuracy and completeness of a figure/section presentation and its relationship to the publication as a whole will be evaluated.

Project proposal

The project part will simulate a proposal on multi-modality imaging of cancer for a 1-year project. The proposal will be 2-pages long and will consist of three sections: Specific Aims, Research Strategy, and Budget. Project proposals will then be evaluated by the module instructor based on significance, research plan, references and timeline and budget (15% of total mark). Students will then present and evaluate the projects in the last class and they will evaluate the proposal presentation of their peers in terms of based on the rubric below (15% of total mark).

Discussion session rubric

DISCUSSION SESSIONS RUBRIC					
Category	**3**	**2**	**1**	**0.5**	**0**
Answers Question(s) Correctly (including use of figures, etc.)	Technically flawless response to question and discussion beyond the scope of required materials, adding significant insight of relevance	Correct response and understanding of material offering some insight of relevance	Correct and satisfactory response	Acceptable response, but missing fundamental piece/point.	Unsatisfactory understanding of material and question
Contribution / Discussion (over the entire class)		Student offers relevant material and discussion beyond the scope of required material, significantly enhancing the class experience	Student participates discussion	-	Student does not participate in discussion.

DISCUSSION SESSION MARKING SCHEME						
5 = A+	4=A	3=A-	2=B+	1=B	0.5 = B-	0.5<C
100-90	89-85	84-80	79-77	76-73	70-72	69->
Exceptional work	Outstanding work	Excellent work	Very good work	Acceptable work/ fulfills expectations	Unacceptable	

Project proposal presentation rubric (assuming 8-minute presentation time)

Completeness /Accuracy of Content	**Clarity in Presentation**	**Question Responses**	**References**	**Timeliness**
0 – contained several incorrect statements, inaccurate or irrelevant content	0 – presentation lacked focus, introduction, logical flow, poor use of figures and text	0 – lacks basic understanding of material to adequately answer questions	0– no mention of literature in presentation	0- over limit by 2 minutes or more
2- material covered was sufficient, content was minimal but accurate	1- presentation was sufficiently organized but was not clearly presented, sufficient use of figures and text	1- answered few questions, but missing key questions	1- appropriate citing of literature in presentation	1 – over limit by 1-2 min
3- well covered material, with appropriate level of content presented accurately	3- presentation was organized, well introduced and presented clearly, good use of figures and text	2- answered questions sufficiently		2 – under time limit of 8 minutes, but poor time management (ex: rushed)
4 – covered material and more, and presented all material accurately and exceptionally well.	4-outstanding presentation, clearly presented slides, excellent use of figures and text	3-outstanding responses to questions, demonstrating mastery in knowledge		3 – well timed presentation under 8 minutes

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Week	Date (all 2020)	Lecture	Details
1	October 6	Introduction to cancer imaging	Why and how we image cancer in patients and small animals
2	October 13	CT imaging	History, interaction of x-rays with matter, components of a CT scanner
3	October 20	CT imaging	Image acquisition and reconstruction, image artifacts and applications for cancer treatment.
4	October 27	Novel CT imaging modalities	Novel imaging modalities – dual energy CT, x-ray fluorescence CT and x-ray luminescence CT, their basic principles and (potential) applications.
5	November 3	PET and SPECT	History, PET and SPECT scanner components, image acquisition and reconstruction principles, radiotracers, imaging applications and limitations.
6	November 10	MRI and BLI	MRI: history, scanner components, image acquisition principles, image reconstruction, MRI applications and limitations. BLI: principles, apparatus description, image acquisition and reconstruction, BLI imaging agents and applications.
7	November 17	Project presentations	Student presentations of projects.