SEMINAR NOTICE

Dosimetry of Brachytherapy Radiation Sources

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1:00 P.M. ROOM 333 - DUFF MEDICAL BUILDING
3775 UNIVERSITY ST.

The overall aim of my research is to enable patient specific radiotherapy delivery by developing fast model-based radiation dose calculation engines and dose planning algorithms, introducing new radiation sources and delivery systems, investigate the difference in outcome between different radiation sources and modalities and develop new radiation detectors. With my research I hope to reduce the side effects related to radiation therapy and improve the outcomes, with a better quality of life for the patients. There are currently five main research lines in my group.

1. Monte Carlo (MC) based dosimetry: MC method is considered to provide the best calculation engine available today in medical imaging and medical radiation physics and plays a key role in medical physics research. My group is developing MC-based radiation dose calculation engines for use in intensity modulated brachytherapy as well as clinical conventional brachytherapy and intravascular brachytherapy.

2. Intensity Modulated Brachytherapy: High dose rate (HDR) brachytherapy is a form of radiotherapy that utilizes radioactive sources temporarily implanted inside or near the tumours. Image-guided brachytherapy treatment planning has provided improved target delineation and indicated the need for brachytherapy techniques with increased target dose conformity. Sources used in brachytherapy have conventionally provided isotropic dose distributions, delivering high doses to tumours but often with poor tumour dose conformity due to the non-symmetrical shape of the tumours. Intensity modulated brachytherapy is a form of brachytherapy, providing azimuthally anisotropic dose distributions that can be dynamically directed towards the tumour and away from healthy tissue by incorporation of partially-shielded brachytherapy sources. By developing and enabling intensity modulated brachytherapy, my research sets out to significantly improve the potential of brachytherapy with reduced toxicity, improved therapeutic ratio and clinical outcomes as end-goal.

3. Radiation source development for use in brachytherapy: The motivation behind design and development of novel brachytherapy radiation sources is to enable patient specific dose delivery and be able to maximise the dose to the tumour and spare healthy tissues. Currently my group is developing new radiation sources in collaboration with McMaster Nuclear Reactor with energies much lower than the currently used brachytherapy radiation source, 192Ir.

4. Radiobiology and Microdosimetry: We investigate radiobiological differences between different brachytherapy radiation sources. Low energy photons used in brachytherapy have a higher linear energy transfer (LET), associated

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with higher relative biological effectiveness (RBE = dose of reference radiation (photons)/dose of test radiation). The greater radiobiological effect is the outcome of greater energy delivered per photon that the cell traverses. The RBE of photons increases with decreasing photon energy. RBE is dependent of radiation quality, i.e. LET, biological system or endpoint, i.e. cell type, cell cycle, survival level, radiation dose, dose rate and dose per fraction. When changing one radionuclide with another, it is important to understand the difference in RBE between the two radiation sources for the same end point.

5. **Detector development**: The major challenge in radiation therapy is to deliver and quantify an accurate dose of radiation to the tumour. Dosimetry is the practice of quantitatively determining the energy deposited in a medium by an ionising radiation. Several dosimetric techniques are available to measure the radiation dose, but they have limitations. In particular, the non-tissue equivalence of the detector housing/material and the sensitive volume leads to perturbations of the radiation fluence and necessitates correction factors. Another constraint placed on conventional dosimetric techniques is the limited resolution. The fifth research line is detector development for quality assurance in radiation therapy.

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