AbstractID: 14595 Title: Advanced MR Spectroscopy Methods for Studying Metabolism and Radiation Treatment Response in Brain Tumors

Magnetic resonance spectroscopy imaging (MRSI) provides completely non-invasively detailed metabolic information which correlates with physiological or pathological conditions. Hence, it is becoming a valuable tool in image guided radio(proton)therapy where it can probe dose conformity (radiation delivered over the tumor volume and surrounding tissues) and could provide in-vivo new insights about the biology of tumor response to radiation.

Traditionally, in-vivo MRSI faces several challenges that may limit its potential, such as: 1) inaccuracy in signal localization (chemical shift displacement error and voxel bleeding); 2) low spatial resolution; and 3) long acquisition times for 3D volumetric scans. However, recent advances in hardware and pulse sequence design can mitigate many of these problems. Use of adiabatic pulses can provide precise and uniform signal excitation and together with fast acquisition schemes of the k-space such as spiral trajectories allows fast acquisition of high resolution 3D MRSI scans. In addition, real-time motion correction and shimming strategies can improve the reliability of MRSI scans. Moreover, MRSI scans that have multiple frequency dimensions (such as 2D chemical shift correlation spectra) can now be performed in-vivo to unambiguously identify overlapped metabolite signals.

This lecture will begin with an overview of the basic principles of in-vivo MRS which will be followed by details of advanced MRSI methods such as adiabatic excitation, fast spiral acquisition of 3D MRSI data, and 2D chemical shift correlation spectra. Examples of in-vivo MRSI data obtained on brain tumor patients treated with conventional radiotherapy and proton beam therapy will be shown in the end.

Learning objectives:

1. Basic principles of MRSI.
2. Understand the critical artifacts that might confound MRS and the importance of improved methods for reliable MRSI.
3. Clinical applications of MRSI to monitor radiation therapy for brain tumors.