AbstractID: 7863 Title: Advanced MRI Techniques: Current and Future Applications in Radiation Therapy

Newer radiation therapy (RT) modalities and devices are able to deliver radiation more precisely and accurately to irregular three-dimensional target volumes and have generated renewed interest in optimized targeting and dosing with the goal to increase radiation effectiveness while reducing side effects. These RT approaches offer great potential in redefining the value of RT in certain disease sites. However, the more conformal and precise the RT delivery the more important becomes the definition of target volumes, placing a premium on definition of the tumor's spatial location, its extent, heterogeneity and possible spread in order to direct more or less dose to appropriate areas while sparing as much normal tissue as possible. CT and MRI have provided the morphological information used for target definition and treatment planning for several decades. They describe the anatomic relationship of the tumor and surrounding structures well but fail to provide biologic information. In addition, they have oftentimes proven nonspecific in assessing treatment related changes.

Recently introduced advanced MR-based techniques have shown promise as a means of providing information on the tumor's biological characteristics. Three-dimensional Proton Magnetic Resonance Spectroscopy Imaging (MRSI) provides information on cellular metabolism, energetics and hypoxia through its ability to distinguish signals from cellular metabolites allowing the detection of tumor suggestive metabolism relative to surrounding same organ tissues. Diffusion Weighted Imaging (DWI) provides additional information on cellularity, cell membrane permeability, intra- and extracellular diffusion, and tissue architecture and integrity. Perfusion Weighted Imaging (PWI) provides insight into overall blood volume, tissue microvasculature and angiogenesis as well as vessel permeability. These imaging modalities complement each other greatly as they provide metabolic, physiologic and functional information relative to the underlying anatomy.

Two major disease sites have been studied at UCSF with respect to the potential and actual incorporation of advanced MR imaging into the treatment planning process for RT: prostate cancer and brain gliomas. Brain gliomas have traditionally proved difficult to image using standard means due to their literally "non-visible" infiltrative behavior and heterogeneous composition. The extent and location of prostate cancer are similarly difficult to determine without the aid of particularly MRSI because although MRI has good sensitivity it has relatively low specificity.

The combination of these metabolic and physiologic modalities with standard anatomic MR modalities will enhance our current understanding of tumor biology, heterogeneity and extent and will provide guidance as to how to optimize current treatment approaches. In addition to assisting in image guidance for RT, these imaging tools show promise for assessing and predicting therapeutic response and to help distinguish treatment effect from tumor progression. The latter becomes even more important in light of the increasing use of combined radiation and chemotherapeutic or molecularly targeted treatment approaches.

Educational objectives are to become familiar with the application of advanced Magnetic Resonance Imaging (MRI) techniques to Radiation therapy of brain and prostate cancer patients. Specifically, to understand the current technology, molecular information attainable, and to become familiar with current and future clinical applications.