AbstractID: 9868 Title: MRI and MRS as agents for Molecular Imaging

Combined MRI/MRSI has shown promise for improved radiotherapy selection, planning and follow-up in individual prostate cancer patients. As with MRI, MRSI uses a strong magnetic field and radiowaves to non-invasively obtain metabolic information (spectra) based on the relative concentrations of endogenous chemicals (metabolites) that exist in the cytosol of the cell and in extracellular ducts. A combined MRI/MRSI staging exam of prostate cancer patients can be performed in less than an hour using a standard clinical 1.5 T MR scanner and commercially available coils. The MRI/MRSI exam has just been released as a commercial product, and 3800 MRI/MRSI patient studies have been performed at UCSF, many of which were radiation patients.

For radiotherapy selection the promise is that MRI/MRSI can better stage prostate cancer by providing an improved assessment of cancer extent and aggressiveness. In a study of 53 patients it was found that tumor volume per lobe was significantly ($p<0.01$) higher in patients with extracpsular spread (2.14±2.3cc) than in patients without (0.98±1.1cc), and the addition of this information significantly increased the accuracy of MRI (from 0.77 to 0.83) in predicting early extracpsular cancer spread. Another critical parameter that is utilized in therapeutic selection is the aggressiveness of the cancer. In a MRI/MRSI study of 26 prostate cancer patients, a linear correlation between the magnitude of the decrease of citrate and the elevation of choline with pathologic Gleason score was observed, with choline being significantly ($P<0.0001$) higher in cancers having Gleason scores of 7+8 versus 5+6.

For radiation planning the promise is that MRI/MRSI can provide improved target volumes for radiotherapy that would then allow the delivery of extra dose to reduced areas of confined disease, and/or the delivery of lower dose to other broader areas in order to preserve normal surrounding tissue. High spatial resolution MRI can provide improved anatomical definition of the prostate and MRI/MRSI can be used to define the distribution of dominant regions of cancer within the prostate. A study of 53 biopsy proven prostate cancer patients prior to radical prostatectomy and step-section pathologic examination demonstrated a significant improvement in cancer localization within the gland (91%-specificty, 95%-sensitivity) versus MRI alone.

For radiation therapy follow-up the promise is that MRI/MRSI can detect residual/recurrent disease and provide a time-course of therapeutic response that is predictive of patient outcome. Residual or recurrent prostate cancer after radiation therapy can be identified as regions having elevated levels of choline (Choline/Creatine ≥ 1.5) with an overall accuracy of 81%. There is also evidence that MRI/ MRSI can provide a measure of the time course of metabolic response to radiation therapy. This information may have prognostic value similar to changes in serum PSA after radiation therapy, however, this will need to be demonstrated in outcome studies.

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Educational Objectives:
1) To understand the current MRI/MRSI technology and molecular information attainable.
2) To become familiar with current and future clinical applications to Radiation therapy of prostate cancer patients.