AbstractID: 2764 Title: Multimodality small animal imaging: registration of functional EPR images with MRI anatomy

Purpose: Electron paramagnetic resonance imaging (EPRI) is a spectroscopic imaging modality being developed for functional and molecular imaging in small animals, and has potential for ultimate translation to clinical imaging. By utilizing contrast agents ("spin probes") whose EPR spectra are modified by the local environment, it is possible to produce images which directly measure important physiologic quantities. In studies of tumor response to radiation-mediated gene therapy we have utilized EPR oxygen images, which provide 3D oxygen maps with resolution of ~1mm spatially and ~3 Torr in oxygen partial pressure. Like functional nuclear medicine images, EPR oxygen images do not depict anatomy directly. Analysis is facilitated by the ability to use an anatomic image as a "roadmap" for interpretation of the functional images. We have developed methods for registration of EPRI with MRI to allow anatomically-based analysis of these functional images.

Method and Materials: EPRI is performed using locally developed spectroscopic imaging systems. MRI is performed on a 4.7T dedicated small animal system. Several registration techniques have been newly developed or adapted from clinical multimodality imaging. Fiducial markers visible in both EPRI and MRI can be attached to the animal or to the immobilization device. Simple point-to-point registration is possible using this method. Surface-based and intensity-based registration methods have also been applied. Customized immobilization devices are fabricated using a polymer dental impression material, analogous to foam cradles used in radiotherapy.

Results: Both anatomically directed analysis of functional EPR images and analysis of serial changes in defined anatomical regions during a course of therapy are enabled by the use of customized immobilization and anatomic/functional image registration.

Conclusion: Image registration is critical for accurate interpretation of multimodality anatomic/functional small animal imaging. Techniques analogous to those in clinical use can be used with success in this setting.