AbstractID: 8407 Title: Mapping of viable tumor regions using Gd-DTPA DCE-MRI

Purpose: To establish a criterion for distinguishing viable and necrotic tumor cells using the initial relative slope of the Gd-DTPA DCE-MRI and to apply this criterion to optimize the specificity of tumor hypoxia imaging based on ^{18}F-FMISO PET.

Method and Materials: Three nude rats with Dunning R3327-AT prostate adenocarcinoma xenografts were imaged by dynamic MRI following tail vein injection of gadopentetate dimeglumine, with imaging parameters of 1-mm slice thickness, 0.5-mm spacing, and 0.13mm × 0.13mm voxel size. The time-intensity curve of each voxel was obtained at 1-min interval to 25-min post-injection. Histologic (standard H&E stain and high-power microscopy) examination was performed of 8-μm thick slices parallel to the DCE-MRI imaging axis and the necrotic regions were identified. The initial relative slope, $(I(t)-I_0)/I_0$where I_0 and I(t) are MR image intensity before injection and at time t, was calculated for different times and compared with the pathologically defined necrotic region to determine the threshold that best distinguishes viable and necrotic cells. This criterion was then used to study the specificity of FMISO PET with the same xenografts scanned with DCE-MRI and ^{18}F-FMISO PET.

Results: The optimal criterion for identifying viable and necrotic tumor regions was that a DCE-MRI voxel was necrotic if $(I(t)-I_0)/I_0<0.1$ at 2 minutes after contrast injection. When this criterion was applied to the ^{18}F-FMISO PET images of three xenografts, necrotic region was found to have a wide range of image intensities, which is inconsistent with the hypothesis that high image intensity exclusively identifies hypoxic viable tumor. Among the 319 hypoxic voxels determined from the three animals' ^{18}F-FMISO PET, only 75% corresponded to viable cells.

Conclusion: A criterion was established to identify necrotic/viable tumor cells using DCE-MRI. Using ^{18}F-FMISO PET alone for hypoxia imaging is problematic because the specificity might be compromised by necrotic regions with high PET image intensity.