

AbstractID: 8409 Title: Gd-DTPA DCE-MRI assisted image-guided pO₂ measurements in rodent tumor xenografts

Purpose: To optimize the correlation between interstitial pO₂ readings and PET-derived ¹⁸F-FMISO/¹⁸F-FDG concentrations in tumors using co-registered Gd-DTPA DCE-MRI to distinguish viable and necrotic tumor cells.

Method and Materials: Nude rats with Dunning R3327-AT xenografts were positioned in a custom-fabricated mold and imaged by (1) T2-weighted MRI imaging; (2) DCE-MRI following IV injection of gadopentetate dimeglumine; (3) microPET for 1/2 hr post-IV injection of ¹⁸F-FDG or ¹⁸F-FMISO. The MRI and PET images were used to direct intra-tumoral pO₂ measurements using an image-guided robot system. PET- and MRI-visible fiducial markers were used to register the respective image and robot coordinate systems. pO₂ was measured at 0.5-mm increments along different tracks within the tumor using an OxyLite™ 4000 Oxygen probe advanced by the robot, providing point-to-point correspondence between the pO₂ measurement and image-voxel intensity. Measurement points in the necrotic region and those outside tumor region, identified by DCE-MRI and T2-weighted MRI, were excluded from the correlation analysis. Necrotic tissue was identified as having $(I(t)-I_0)/I_0 < 0.1$ at t=2 min after contrast injection, where I₀ and I(t) are MR image intensities before injection and at time t.

Results: The registration error between images and the robot is <0.3mm. For three FMISO studies with 539 measurements and 21 tracks, the correlation between interstitial pO₂ readings and ¹⁸F-FMISO intensities was not improved - $r = -0.71 \pm 0.14$ (mean± SD) vs $r = -0.73 \pm 0.16$ (p = 0.50). Four animals were studied using ¹⁸F-FDG with 423 measurements and 20 tracks. The negative correlation improved significantly (p = 0.00118) - $r = -0.36 \pm 0.35$ vs $r = -0.65 \pm 0.24$ - if only viable-tumor points were considered.

Conclusion: The negative correlation between ¹⁸F-FDG voxel intensities and intra-tumoral pO₂ was improved when DCE-MRI was used to exclude necrotic tissue pO₂s. Exclusion of necrotic points did not improve the correlation for ¹⁸F-FMISO, however.