AbstractID: 4713 Title: pO2 measurements in animal tumors using an image-guided robotic system

Purpose: To develop and evaluate an image-guided robotic system for measuring pO_2 in animal tumors.

Method and Materials: The robot consists of an X-Y horizontal platform holding the rodent bed, a dual-axis vertical arm for positioning the measurement probe and cannula, and fiducial markers for registering the coordinates of the imaging and robotic systems. Anesthesized and immobilized tumor-bearing rats are injected with the hypoxia tracer ^{18}F-FMISO and imaged in the rodent bed using an animal PET scanner. The reconstructed PET images are then uploaded into the robot computer, the rodent bed affixed to the X-Y platform, and the coordinates of the robot and PET registered. Based on the tumor hypoxia image displayed on the robot computer, motion of the robotic X-Y platform and vertical arm are coordinated to guide the positioning and percutaneous insertion of a probe (OxyLite-Optronix) to measure pO_2 at various locations in the tumor. The pO_2 readings (cps/voxel) are then compared to the respective image intensity of the measurement points.

Results: The registration accuracy between the robot and image coordinate system was better than 0.2mm. Although the ^{18}F-FMISO in the bladder produced characteristic starburst artifacts in the surrounding, low-intensity regions, we successfully measured the pO_2 for three tracks. The ^{18}F-FMISO image voxel values were found to be inversely correlated with the intra-tumoral pO_2 of the three tracks with (Pearson product moment) correlation coefficients of -0.899, -0.420 and -0.857. The scatter plot of pO_2 vs. image intensity resembled a sigmoidal, rather than a linear relationship.

Conclusion: PET-guided pO_2 measurement is feasible using this prototype image-guided robot system. To our knowledge, this is the first system of its kind - allowing direct point-by-point correlation of physiological probe measurements and image voxel values or, more generally, a physical action at a set of anatomic points identified on a preoperative image.