Purpose: Real-time biological imaging is being investigated to delineate positive tumor margins which may provide feedback during intraoperative radiation therapy. We investigated the feasibility of identifying prostate cancer invasion through the capsule of the prostate intraoperatively in a mouse model using Cerenkov optical emission from Fluorodeoxyglucose (FDG). The potential benefit of using Cerenkov emission is that it provides real-time images of glucose uptake while avoiding signal from the bladder and surrounding structures beyond the surgical margin. We investigated the performance of a Cerenkov imaging system during surgical prostatectomy in vivo in a tumor mouse model.

Methods: All Cerenkov images were collected with a commercial optical imaging system. A transgenic adenocarcinoma of the mouse prostate (TRAMP) mouse model was used to investigate the feasibility of imaging local invasion of the cancer beyond the prostate capsule. A mouse with a ~1cm prostate tumor with questionable invasion as determined by T2-W MRI was injected with 1.2mCi of FDG. The injection was followed by PET/CT after 75 minutes, and subsequent sacrifice; surgery commenced 3:45 later. After prostatectomy, Cerenkov images were acquired during an attempt to clear the surgical margin.

Results: In all, 8 tissue resections were performed in the surrounding tissues including the seminal vesicles, rectum, and other nearby organs. Cerenkov imaging identified tissues both before surgical resection in vivo, and confirmed their successful excision after surgical intervention ex vivo. The Cerenkov imaging confirmed uptake in the seminal vesicles, as is expected in this tumor model. In addition, several hyperintense regions that were not identified in PET/CT were visible with the interventional system.

Conclusions: This proof-of-concept study explored the feasibility of using Cerenkov based imaging for the interventional identification of tumor tissue that had spread beyond the prostate. A more in-depth analysis is currently underway to determine the potential benefit to intraoperative radiation therapy.

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