

Clinical Evaluation of MR-guided Prostate Biopsy

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Introduction: Prostate cancer is routinely diagnosed by needle biopsy prompted by an elevated PSA level or a palpable nodule in the gland. The standard clinical method uses transrectal ultrasound (TRUS) to guide the biopsy. It is limited by low sensitivity and low positive predictive value¹. The TRUS approach samples the gland in a sextant manner but does not routinely target focal lesions. Therefore we have developed a system for MR-guided prostate biopsy using needles guided by real-time MR (Signa SP-General Electric medical systems 0.5T). MR imaging of the prostate provides a comprehensive set of images of the entire prostate, including substructures such as the peripheral zone (PZ). The purpose of this study is to evaluate the clinical usefulness of an MR-guided prostate biopsy system.

Methods: We enrolled patients in a prospective clinical trial with the following eligibility criteria: men who have had 2 prior normal TRUS guided biopsies or men with prior rectal surgery precluding transrectal access, and elevated PSA levels (>4ng/ml). All patients required an endorectal coil MRI at 1.5T. Pre-biopsy MRI protocol included standard multiplanar T1 and T2WIs, post-Gadolinium dynamic images, spectroscopy, and line scan diffusion images. In an open 0.5T interventional MR unit utilized for MR-guided brachytherapy, each patient underwent general anesthesia and was placed in lithotomy position. T2WIs were obtained and downloaded to the 3D Slicer image software program², to guide needle



Figure 1. Coronal T2W 0.5T Signa SP image showing high signal PZ (left). Coronal FGR real-time image shows needle artifact (middle). Fused image shows combining coronal T2 FGR data (right).

placement through a transperineal approach. Images were analyzed to divide the prostate into sextants and define targets. Targets were defined from the 1.5T data sets. All are available in the 3D Slicer at the time of biopsy. Biopsy was performed with MR compatible 18G biopsy guns. Both targeted and sextant biopsy samples were obtained with guidance by 3D Slicer^{3,4}. (Fig.1) The MR images guided all sextant samples to be from the PZ and with the transperineal approach, the length of the core was coronally oriented to sample only the PZ. For each biopsy patient, the following variables were collected: age, PSA, prostate volume, PSA density, and site-specific pathology. Statistical methods used summary statistics and one-sided two-sample Student's t-tests.

Results: MR-guided biopsy was performed in 44 patients; 2 patients underwent 2 biopsy sessions. All biopsies were successful and no serious adverse events occurred. Eight men had transient urinary retention requiring discharge with urinary catheter. Overall 17/46 (39%) MR-guided prostate biopsy cases had abnormal biopsies. Analysis of pre-biopsy variables showed that both prostate gland volume, as calculated from 3 axis MR measurements, and PSA density were significantly different ($P < 0.03$ and 0.01 respectively) in those with abnormal biopsies. The mean gland volumes were 42 ccs and 60 ccs in the patients with abnormal versus normal biopsies. The mean PSAD was 0.4 and 0.2 in the abnormal versus normal group. Neither age nor PSA alone were significantly different in the 2 groups.

Conclusions: MR-guided prostate biopsy offers an excellent second-line alternative for those who have failed to achieve a diagnosis with conventional methods. We performed this procedure successfully in 44 men, and 39% had abnormal biopsies. The biopsy is more likely to be abnormal in patients with smaller gland volumes and those with higher PSA density.

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