

Magnetic Resonance Imaging-Transrectal Ultrasound Fusion Improves Biopsy Yield

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PURPOSE: Carcinoma of the prostate (CaP) is the most common non-cutaneous cancer and the second leading cause of cancer death in American men. Conventionally, it is detected by physical exam and PSA screening followed by transrectal ultrasound (TRUS) guided 14-core sextant biopsy. These are falsely negative in up to 30% of cases. MRI has been shown useful for identifying targets after negative biopsy, usually with MR-guided biopsy or repeat TRUS based on suspicious MRI findings, but hemorrhage from prior biopsy can limit specificity. Fusion of MRI data with TRUS in real time has been shown accurate in biopsy targeting. We purport to show the advantage of realtime fusion of MRI data with ultrasound for initial or repeat TRUS biopsy compared with sextant biopsy.

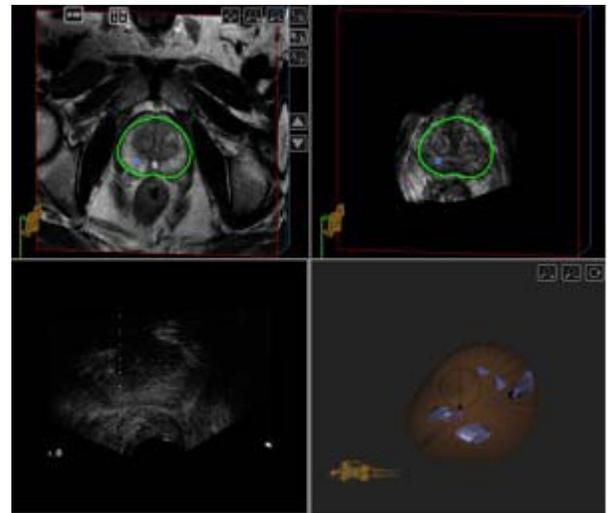
MATERIALS AND METHODS: An IRB-approved prospective study of 54 consecutive men who underwent diffusion weighted imaging with apparent diffusion coefficient (ADC) map (EPI; b = 0, 50, 150 and 400, 600, 1000 mm/s²; TR 1600-2300 TE 75-90 ms, 5 gap 1.65 mm, 256 x 154 matrix, FOV 35 x 26 cm) and dynamic contrast enhanced (DCE) perfusion (TWIST, TR/TE/FA 5.7/2.8 ms/250 or 2.7/1.1 ms/100, 1.5 mm, matrix 320 x 225, 28 x 30 cm FOV, 28-42 acquisitions every 6.1-7.5 s, 0.01 mg/kg gadopentetate dimeglumine) in addition to T2-weighted imaging (TSE, TR 3800-5040 TE 101 ms, ETL 13, 3 mm, no gap, matrix 256 x 205, 14 x 14 cm FOV) on a Siemens Magnetom 3.0 T Trio with an external phased array coil. Targets were chosen based on either decreased T2 signal or abnormally decreased ADC or abnormal DCE. Level of suspicion was scored on a 1-5 scale for each parameter by a urologist with 6 years experience in prostate imaging. These men then underwent ultrasound-guided biopsies using MR/ultrasound fusion software (Artemis, Eigen) in addition to standard 14-core sextant biopsies.

FINDINGS: In 49 patients 86 suspicious areas were identified by MRI, with 61 targets biopsied at least once in 40 patients (remaining targets were considered low probability by ADC and DCE and deferred). In 9 patients the guided biopsy was converted to freehand, largely due to patient motion or discomfort. The technique was optimized with parallax views after the first 25 patients. Positive targets were found in 14 targets, including 11 Gleason >3+3 (79%). For all cases, 14 of 61 suspicious areas were found positive (23%) but 8 of 17 were found positive (47%) after optimization.

Using Fisher exact test and Wilcoxon signed rank test, no correlation was found with Gleason score and suspicion score for either ADC or DCE, possibly due to small numbers of positive patients. Positive cores were found in 3 patients with no targets, and on target biopsy only (not in systematic cores) in 3. Cores were positive in systematic but not targeted biopsies in 14 patients (29%), but in only 1 patient (7%) after technique was optimized. Of the patients where only systematic cores were positive, 8 (57%) had <1 mm cancer, including the patient with optimized technique, and 5 additional patients had cancer in the same sextant as the target, which may reflect misregistration prior to parallax imaging.

CONCLUSION: MRI-TRUS fusion for targeted prostate biopsies appears to find additional cancers, and (with optimized technique) does not appear to miss significant cancers.

CLINICAL RELEVANCE: The improved accuracy of MRI-TRUS fusion biopsies may be able to replace systematic biopsies, avoiding the discomfort and risks associated, and improve diagnostic yield, and improve confidence for patients with a small amount of low-grade cancer who opt for active surveillance.



Above: example of counted source T2, angled T2 with corresponding US, and corresponding prostate volume with targets highlighted

Parameter	Systematic	Targeted	p
Total cores taken	652	150	
Total cores positive	38 (5.8%)	26 (17%)	0.14
Optimized cores taken	113	57	
Optimized cores positive	8 (7.1%)	19 (37%)	0.04