Comparative Analysis of Transperineal Template Saturation Prostate Biopsy Versus Magnetic Resonance Imaging Targeted Biopsy with Magnetic Resonance Imaging-Ultrasound Fusion Guidance

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Purpose: Multiparametric magnetic resonance imaging and magnetic resonance imaging targeted biopsy may improve the detection of clinically significant prostate cancer. However, standardized prospective evaluation is limited.

Materials and Methods: A total of 294 consecutive men with suspicion of prostate cancer (186 primary, 108 repeat biopsies) enrolled in 2013 underwent 3T multiparametric magnetic resonance imaging (T2-weighted, diffusion weighted, dynamic contrast enhanced) without endorectal coil and systematic transperineal cores (median 24) independently of magnetic resonance imaging suspicion and magnetic resonance imaging targeted cores with software registration (median 4). The highest Gleason score from each biopsy method was compared. McNemar's tests were used to evaluate detection rates. Predictors of Gleason score 7 or greater disease were assessed using logistic regression.

Results: Overall 150 cancers and 86 Gleason score 7 or greater cancers were diagnosed. Systematic, transperineal biopsy missed 18 Gleason score 7 or greater tumors (20.9%) while targeted biopsy did not detect 11 (12.8%). Targeted biopsy of PI-RADS 2—5 alone overlooked 43.8% of Gleason score 6 tumors. McNemar's tests for detection of Gleason score 7 or greater cancers in both modalities were not statistically significant but showed a trend of superiority for targeted primary biopsies (p=0.08). Sampling efficiency was in favor of magnetic resonance imaging targeted prostate biopsy with 46.0% of targeted biopsy vs 7.5% of systematic, transperineal biopsy cores detecting Gleason score 7 or greater cancers. To diagnose 1 Gleason score 7 or greater cancer, 3.4 targeted and 7.4 systematic biopsies were needed. Limiting biopsy to men with PI-RADS 3–5 would have missed 17 Gleason score 7 or greater tumors (19.8%), demonstrating limited magnetic resonance imaging sensitivity. PI-RADS scores, digital rectal examination findings and prostate specific antigen greater than 20 ng/ml were predictors of Gleason score 7 or greater disease.

Conclusions: Compared to systematic, transperineal biopsy as a reference test, magnetic resonance imaging targeted biopsy alone detected as many Gleason score 7 or greater tumors while simultaneously mitigating the detection of lower grade disease. The gold standard for cancer detection in primary biopsy is a combination of systematic and targeted cores.

Abbreviations and Acronyms

DRE = digital rectal examination

GS = Gleason score

mp-MRI = multiparametric magnetic resonance imaging

MRI = magnetic resonance imaging

PCa = prostate cancer

PI-RADS = Prostate Imaging Reporting and Data System

PSA = prostate specific antigen

SB = systematic, transperineal biopsy

START = Standards of Reporting for MRI-targeted Biopsy Studies

TB = targeted biopsy

TRUS = transrectal ultrasound

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RECENTLY the 10 to 12-core extended transrectal ultrasound guided prostate biopsy has been challenged as standard of care for men with suspicion of prostate cancer. Systematic saturation protocols and MRI targeted biopsies have been shown to detect more significant PCa than conventional TRUS guided biopsies.[1–3] Although mp-MRI could help reduce under detection of aggressive tumors and over diagnosis of indolent PCa, mp-MRI has not been approved as a secondary screening test until now.[4] Siddiqui et al published their experience with MRI targeted biopsy compared to 12-core TRUS biopsy.[2] In this cohort of 582 men with suspicion of PCa on mp-MRI, TB upgraded the Gleason score in 32% of patients confirming that mp-MRI preferentially detects higher grade PCa while missing low grade tumors.[2] Furthermore, mp-MRI has been compared to prostatectomy specimens demonstrating excellent negative predictive values and moderate positive predictive values for significant PCa.[5,6]

Recent reviews have summarized the fast growing literature of TB with regard to outcome and possible cost-effectiveness, but it remains difficult to come to conclusive results due to inhomogeneous biopsy protocols and different MRI scoring systems.[7,8] Therefore, an international consortium formulated START of the prostate to overcome these limitations.[9] Additionally, the ESUR (European Society of Urogenital Radiology) has published the PI-RADS.[10] Similarly to the National Institutes of Health scoring system, PI-RADS has been validated in primary and repeat biopsy cohorts.[5,11,12] Unfortunately, multicenter trials to evaluate MRI targeted prostate biopsy for initial biopsy are still in their infancy despite joint efforts.

We present the first comparative analysis to our knowledge of TB with software registration adhering to START and PI-RADS vs transperineal saturation as a reference test for PCa detection. The robustness of transperineal saturation biopsy as a reference test has recently been demonstrated.[5] Conventional 12-core biopsy was not used as a reference standard because of high false-negative rates and cancer underestimation.[5] Similarly, prostatectomy specimens were not chosen as a reference test due to positive selection bias.[13]

MATERIALS AND METHODS

Study Population

Consecutive patients were enrolled in a prospective database assessing TB at University Hospital Heidelberg between January and December 2013. Institutional review board approval was obtained (S011/2011) and all subjects provided written informed consent. A total of 294 men without previous treatment or diagnosis of PCa underwent 3T mp-MRI and transperineal saturation biopsy with additional MRI targeted cores in case of MRI suspicious lesions, including 186 patients with increased PSA and/or suspicious DRE for initial biopsy and 108 with previously negative TRUS biopsy. None of these patients were analyzed in previous publications.

Imaging

All mp-MRI (T2-weighted, diffusion weighted, dynamic contrast enhanced) was performed using a 3T system without endorectal coil (Siemens, Erlangen, Germany, supplementary table 1, http://jurology.com/). Image analyses were performed or supervised by dedicated uroradiologists with 6 and more than 10 years of experience, respectively (MR, HPS) in prostate MRI according to the 2012 ESUR guidelines.[10] Lesions were reported using a 27-region form sheet.[14] Reflecting clinical routine the radiologists were not blinded to clinical data.

Biopsy Protocol

All patients underwent transperineal template saturation biopsy (median 24 cores) as a reference test according to the Ginsburg biopsy scheme independently of mp-MRI results (see supplementary figure, http://jurology.com/).[15] In general, 4 cores were taken from the posterior, mid and anterior sectors per side. Depending on the prostate volume additional basal cores were taken for larger prostates or fewer cores for smaller glands using custom-made software that calculates spatial organ coverage by biopsy cores (unpublished data). Grid directed transperineal sector biopsies performed with the patient under general anesthesia are the standard technique at our center because of minimal infectious complications and easy sampling of the whole gland. Patients with suspicious lesions on mp-MRI underwent additional transperineal TB with rigid software registration using the BiopSee® system.[16] The BiopSee operator had access to all mp-MRI data with radiologist marked lesions of interest. All targets were sampled under live TRUS visualization with at least 2 biopsies, depending on lesion size. Targeted and systematic cores were potted and reported separately under supervision of a dedicated uropathologist (WR).

Data Analysis

Data were collected in a START consistent database.[9] Clinically significant PCa was defined as GS 7 or greater. McNemar's tests were used to determine differences among collected variables (detection accuracy of TB vs SB for all and for significant cancers, and according to various PI-RADS scores). Potential predictors of significant cancer were calculated using univariate logistic regression analysis. Statistical analyses were performed using SPSS®V20 and $p < 0.05$ was considered statistically significant.