Accuracy of Magnetic Resonance Imaging/Ultrasound Fusion Targeted Biopsies to Diagnose Clinically Significant Prostate Cancer in Enlarged Compared to Smaller Prostates

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Purpose: We assessed the accuracy of magnetic resonance imaging/transrectal ultrasound fusion biopsies to diagnose prostate cancer according to gland size.

Materials and Methods: A prospective study was performed in 232 men with a first round biopsy, multiparametric magnetic resonance imaging with a lesion, a Likert score of 2 or greater and prostate specific antigen less than 10 ng/ml. All men underwent a standard 12-core protocol plus a protocol of 2 or 3 targeted cores. Significant prostate cancer was defined as at least 1 core with a Gleason score of 7 (3 + 4) or 6 with a greater than 4 mm maximal cancer core length.

Results: Mean ± SD patient age was 64 ± 6.4 years, mean prostate specific antigen was 6.65 ± 1.8 ng/ml and mean prostate volume was 40 ± 24.3 ml. The overall detection rate of clinically significant prostate cancer was 44%. The detection rate of clinically significant prostate cancer by magnetic resonance imaging-transrectal ultrasound fusion guided biopsy was 77% for prostate glands less than 30 cm^3, and 61%, 47% and 34% for glands 30 to less than 38.5, 38.5 to less than 55 and 55 to 160 cm^3, respectively ($p = 0.001$). Differences in prostate cancer detection rates between the standard and targeted protocols were not significant for patients with a prostate volume of 40 cm^3 or less ($p = 0.8$). Conversely 12 patients with a prostate volume greater than 40 cm^3 had clinically significant prostate cancer using the targeted but not the standard protocol and in 3 prostate cancer was detected by the standard but not the targeted protocol ($p = 0.04$).

Conclusions: Magnetic resonance imaging-transrectal ultrasound fusion biopsies increased the yield of first round prostate biopsies in patients with a prostate volume greater than 40 cm^3.

Key Words: prostatic neoplasms, biopsy, ultrasonography, magnetic resonance imaging, diagnostic imaging

Abbreviations and Acronyms

3D = 3-dimensional
MRI = magnetic resonance imaging
PCa = prostate cancer
STD = standard
TAR = targeted
TRUS = transrectal ultrasound
US = ultrasound

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See Editorial on page 615.

According to the 2014 EAU (European Association of Urology) guidelines the current standard method to diagnose PCa remains TRUS guided prostate biopsy.[1,2] In daily practice TRUS guided prostate biopsies have improved the diagnosis and management of PCa but remain imperfect with regard to accuracy, notably for first round biopsies.[3–6] It is now well

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understood that systematic 12-core TRUS biopsies can under sample apical and anterior areas of the prostate, particularly in large glands.[7] Thus, prostate biopsy protocols have evolved during the years toward protocols that propose increasing the number of biopsies,[8,9] selecting the number of biopsy cores according to prostate volume, eg the Vienna nomogram,[10] or combining biopsy with new markers, eg prostate cancer antigen 3 or the PHI (Prostate Health Index).[11,12]

Several studies show that PCa detection rates are less than 30% in men with a prostate volume greater than 40 cm^3 while, in contrast, detection rates are improved for smaller glands.[13–15] In the last few years it has been possible to perform these biopsies using 3D endorectal ultrasound guidance, which improved the mapping of prostate tissue while also increasing yields up to 50%.[16] MRI-TRUS fusion devices have also been proposed to target suspect lesions visualized on MRI.[17–19] Few studies have aimed to assess the impact of MRI-TRUS fusion guided biopsy in enlarged prostates.[20]

Thus, the aim of our study was to assess the accuracy of MRI-TRUS targeted biopsies to diagnose PCa in a range of prostate volumes.

PATIENTS AND METHODS

Study Population

Men were recruited prospectively between January 2010 and May 2014. We consecutively included all men with no history of prostate biopsy (first round) in whom prostate biopsy was indicated and who had PSA less than 10 ng/ml. All of these men underwent multiparametric MRI and then MRI-US fusion biopsy.

Each patient underwent a STD 12-core protocol and a TAR protocol of 2 or 3 cores targeted on the MRI index lesion. Significant PCa was defined as at least 1 core with a Gleason score of 7 (3 + 4) or 6 with a maximum cancer core length of 4 mm or greater. All biopsies were examined by 1 senior pathologist (EC). The current study was approved by the institutional review board.

1.5 Tesla Multiparametric MRI

All men underwent multiparametric MRI using a 1.5 Tesla MRI system (Achieva, Philips Medical Systems, Best, The Netherlands and Aera, Siemens Healthcare, Erlangen, Germany) and a pelvic phased array coil. This study was performed according to START (Standards of Reporting for MRI-targeted Biopsy Studies) Consortium guidelines.[21] All MRI examinations were done according to the same protocol.[22]

Image Analysis

Images were analyzed by a seasoned dedicated radiologist (RR-P) with more than 10 years of experience with prostate MRI.[23,24] Analyses were performed on the respective workstation (Extended WorkSpace, Philips Healthcare and Syngovia, Siemens Healthcare). Data are reported according to largest size in mm, Likert grade and localization according to the consensus criteria for the use of MRI in the diagnosis and staging of PCa based on a scheme using 27 regions of interest.[21] The reader provided a score for each area using a Likert range of 1 to 5. The largest lesion on the MRI was defined as the index target. This lesion was graded on a Likert scale according to ESUR (European Society of Urogenital Radiology) prostate MRI guidelines.[24–26]

MRI/Ultrasound Biopsy Procedure

MRI and standard biopsies were performed at our institution during the same session by the same individual. There were 2 MRI targeted operators. The practitioner was blinded to targets during STD biopsies and did not view the MRI before performing STD or TAR biospies. We used the UroStation® and a V10 ultrasound system (Medison, Seoul, Republic of Korea) with an endfire 3D transrectal transducer for 3D TRUS. The UroStation implements elastic registration to fuse the MRI and 3D TRUS images, and enables guidance and recording of core localizations on the 3D TRUS and MRI images.[22] Patients underwent the STD protocol (12 systematic cores independent of MRI results) followed by sampling of 2 or 3 cores in the index target by the same operator. During the STD protocol the clinician was blinded to the exact MRI target localization. The target was only visible on the UroStation screen for TAR biopsies.

Statistical Analyses

The proportion of men with positive cores and with clinically significant disease were compared using the McNemar chi-square test for paired percentages. Patients were then stratified into 2 groups of similar size according to prostate volume, including group 1—40 cm^3 or less and group 2—greater than 40 cm^3. Multivariate logistic regression analysis was performed to determine the predictive factors of additional significant PCa diagnosed by the TAR protocol. Analyses were performed with R (http://www.r-project.org/).

RESULTS

A total of 232 patients underwent initial TRUS guided prostate needle biopsy between January 2010 and May 2014. Table 1 shows descriptive statistics on patient characteristics. Abnormal digital rectal examination findings were not used to direct biopsy. Figure 1 shows a flow chart of the study.

The median number of cores taken per prostate was 12 for the STD 12-core protocol vs 2 for the

Table 1. *General patient characteristics*

Mean ± SD age	64 ± 6.4
Mean ± SD prostate vol (cm^3)	47 ± 24.3
Mean ± SD PSA (ng/ml)	6.5 ± 1.8
Mean ± SD PSA density (ng/ml/ml)	0.17 ± 0.09
Mean ± SD days MRI-biopsy	44 ± 52
No. Likert score (%):	
2	13 (5.6)
3	58 (24.9)
4	78 (33.6)
5	83 (35.8)