Prostate Magnetic Resonance Imaging (MRI) at 3 Tesla: Prostate Cancer Detection and Localization in Patients with Repeat Negative Biopsies using High Spatial Resolution Dynamic Contrast Enhanced and T2-W MRI in Routine Clinical Practice.

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Purpose: The aim of the study was to prospectively determine the value of high spatial resolution dynamic contrast enhanced (DCE-) with high spatial resolution T2 weighted (T2-W) endorectal(ER) coil magnetic resonance imaging (MRI) at 3 Tesla for detection and localization of prostate cancer in patients with repeat negative biopsies and raising prostate specific antigen (PSA) , using histopathology of the subsequent biopsy as the reference standard. **Methods and Materials:** The study was approved by the Internal Review Board of the institution. MRI of the prostate at 3 Tesla was performed with combined surface and ER coils in 42 patients (mean age: 65; range: 52-77) referred for prostate MRI, because of repeat negative biopsy (mean number of biopsies prior to MRI: 3; range: 1-10) and raising PSA. High spatial resolution T2-W fast spin-echo and high spatial resolution DCE 3D gradient echo images were acquired using Gd-DTPA. DCE-images were analyzed with a computer generated color-coded scheme.[1, 2] Four different readers in a routine clinical setting evaluated the MRI exams. Prediction and localization of prostate cancer (as noted in the clinical reports) was compared with histopathologic results of the subsequently performed biopsies. For the detection of cancer foci sensitivity, specificity, positive predictive value, and negative predictive value were calculated. MR accuracy was determined by the area under the receiver operating characteristic (AUC) using the Wilcoxon-Mann-Whitney index of diagnostic accuracy. **Results:** In 9/42 patients MRI showed no malignancy. Subsequent Biopsy was positive for cancer in 2/9 patients. (2 false negative; 7 true negative MR results). In 33/42 patients MR could localize areas suspicious for malignancy. Subsequent Biopsy was positive in 19/33 patients (including high-grade PIN) and negative in 14/33 patients. (14 false positive; 19 true positive MR results). Therefore, MR based Biopsy resulted in 58% of the patients in detection of prostate cancer. In 12 patients the tumor was located in the anterior gland, as predicted by MRI. These results are 16%-48% better than previously reported results of randomly performed repeat biopsies. The mean sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) for all readers was 91%, 33%, 58% and 78%, respectively. The mean overall accuracy for all readers was 62%. These results suggest an improvement over previously reported results of randomly performed repeat biopsies or targeted sextant biopsies with emphasis on anterior and lateral tissue sampling [3-5]. Figure 1 shows a patient with 3x repeat negative biopsies (total 63 negative cores) and a rising PSA (27 ng/ml) prior to the MR exam. A targeted ultra-sound guided biopsy based on the MRI findings confirmed cancer in the anterior gland. Consequently, the patient underwent prostatectomy.

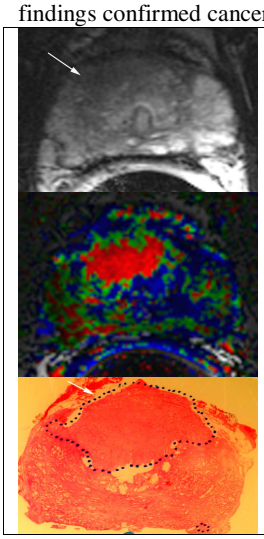

Figure 1a.
Axial T2-W FSE (7050/156) 2.2-mm-thick image of the mid-third of the prostate. Note the subtle hypointense area in the anterior aspect of the gland (white arrow) - the cancer is not readily seen.

Figure 1b.
Corresponding color-coded DCE 3D-Gradient-Echo (6.9/2.1) 2.6-mm-thick image. Note the large anterior tumor easily seen in bright red, adjacent to the pseudo-capsule.

Figure 1c.
Whole mount histopathology proved cancer (black dotted line) in the anterior gland, with a final pathologic stage pT3a with minimal ECE right anteriorly (white arrow) – as reported by MRI.

Conclusion: This prospective study demonstrates that high spatial resolution 3 Tesla MRI improves positive prostate biopsy rates substantially by 16-48%, when compared to standard repeat biopsy. This data suggests that MRI can assist in the reduction of repeat negative biopsies in patients with raising PSA, foremost in patients with anterior (central gland) tumors, and can facilitate earlier appropriate treatment.

References:

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