

# PROSTATE CANCER DETECTION IN PATIENTS WITH TOTAL SERUM PROSTATE-SPECIFIC ANTIGEN LEVELS BETWEEN 4 AND 10 NG/ML: DIAGNOSTIC EFFICACY OF MULTI-PARAMETRIC MR IMAGING

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**Purpose:** When PSA levels are relatively low, such as within the so-called gray-zone of 4-10 ng/mL, the positive predictive value for detecting prostate cancer using transrectal ultrasound (TRUS)-guided biopsy or radical retropubic prostatectomy is only 30-42%. Accordingly, about 70% of men with gray-zone PSA levels may undergo unnecessary biopsy. Accurate detection and localization of prostate cancer is thus prerequisite to avoiding unnecessary biopsies in men with gray-zone PSA levels. The aim of this study was to evaluate the utility of T2-weighted imaging (T2WI), dynamic contrast-enhanced magnetic resonance (MR) imaging (DCE-MRI) and diffusion-weighted imaging (DWI) for detecting prostate cancer with total serum prostate-specific antigen (PSA) levels of 4-10 ng/ml.

**Methods and Materials:** Fifty male patients (mean age, 70 years) with gray-zone PSA levels underwent MR imaging of prostate before TRUS-guided 12-core biopsy. T1WI, T2WI, DCE-MRI and DWI were performed using a 1.5-T MR unit. According to the sites of biopsy, the prostate was divided into eight regions (6 from peripheral zone and 2 from transition zone) on MR images. These regions were individually evaluated for the following features: 1) detectability of prostate cancer on per-region and per-patient basis; and 2) differences in tumor size (a ratio of total cancer length and biopsy specimen length) and Gleason score for pathologically diagnosed prostate cancer between regions of positive and negative MR findings for tumor detection. Prostate cancer was diagnosed independently on each MR images according to the standard criteria and the detectability was calculated considering the result of biopsy as gold standard. Statistical evaluations included McNemar and Mann-Whitney U tests.

**Results:** Biopsy demonstrated prostate cancer in 35 of 50 patients (70%), 103 of 400 regions (26%). Among the 103 positive regions, 74 (72%) were located in the PZ and the rest were in the TZ. PZ lesions consisted of 19 in the base, 33 in the middle, and 22 in the apex. On a per-region basis, sensitivity, specificity and accuracy of tumor detection were 36%, 97% and 82% for T2WI, 43%, 95% and 82% for DCE-MRI, 38%, 96% and 81% for DWI, and 53%, 93% and 83% for the combined method of MRI, respectively. Sensitivity of combined MRI to detect tumor was significantly higher than those for the individual methods ( $P < 0.001$  to  $P = 0.001$ ), although specificity was significantly decreased ( $P < 0.001$  to  $P = 0.031$ ). Tumor size was significantly larger in regions of positive MR findings than in regions of negative MR findings ( $P = 0.004$ ). Conversely, Gleason score for regions of positive MR findings was comparable to that for regions of negative MR findings, with no significant difference. On a per-patient basis, sensitivity, specificity and accuracy of combined MRI to detect prostate cancer were 85%, 80% and 82%, respectively. Among the 55 lesions with positive MRI findings, 29% were detectable by only one MRI method. All other remaining lesions were detectable by a combination of 2 or 3 MRI methods.

**Conclusions:** These results indicate that an MR imaging protocol including T2WI, DWI, and DCE-MRI can provide clinically useful information to urologists confronting the problem of managing patients with gray-zone PSA levels, and may be potentially useful for avoiding unnecessary prostate biopsy in patients with gray-zone prostate-specific antigen levels.

**Table: Detection of prostate cancer using various MR imaging methods in 50 patients with gray-zone PSA levels**

MRI method	Sensitivity	Specificity	Accuracy	PPV	NPV
<b>Per-region basis (n=400)</b>					
T2WI	36 (37/103)	97 (289/297)	82 (326/400)	82 (37/45)	81 (289/355)
DWI	38 (39/103)	96 (286/297)	81 (325/400)	78 (39/50)	82 (286/350)
DCE-MRI	43 (44/103)	95 (282/297)	82 (326/400)	75 (44/59)	83 (282/341)
Combined MRI	53 (55/103)	93 (277/297)	83 (332/400)	73 (55/75)	85 (277/325)
<b>Per-patient basis (n=50)</b>					
Combined MRI	85 (29/35)	80 (12/15)	82 (41/50)	91 (29/32)	67 (12/18)