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# Value of prostate multiparametric magnetic resonance imaging for predicting biopsy results in first or repeat biopsy

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AIM: To assess multiparametric magnetic resonance imaging (mp-MRI) in predicting prostate biopsy results.

MATERIALS AND METHODS: Patients who underwent mp-MRI prior to prostate biopsy were prospectively included. The prostate was subdivided into 14 sectors and mp-MRI findings assessed using a five-level subjective suspicion score (SSS). Biopsy included targeted samples of abnormal sectors and systematic samples of normal peripheral zone sectors.

RESULTS: Two hundred and eighty-eight patients were included [153 biopsy naïve, 135 with negative ($n = 51$) or positive ($n = 84$) prior biopsy]. Biopsy was positive in 168 patients. mp-MRI area under the receiver operating characteristic (ROC) curve (AUC) was 69.1% (95% CI: 67.1–70.9%), 72.5% (95% CI: 69.5–76%), and 73.8% (95% CI: 68.3–79.3%) at per sector, per lobe, and per patient analysis, respectively. At the per sector level, the AUC was significantly larger if detection was limited to cancers with a Gleason score of $\geq$7 (72.6%; 95% CI: 69.8–75.8%; $p < 0.01$) or $\geq$8 (87.1%; 95% CI: 78.3–95.7%; $p < 0.01$). mp-MRI performance was significantly influenced by prostate volume ($p = 0.02$), the presence of a concordant hypoechoic area ($p < 0.001$), but not by prostate-specific antigen (PSA) value, status of prior biopsy, or radiologists' experience. SSS was significantly associated with the Gleason score in true-positive lobes and patients ($p < 0.0001$). Using a SSS threshold of $\geq$3, cancer was missed in 13/102 lobes and 4/72 patients with cancers of Gleason score $\geq$7.

CONCLUSION: mp-MRI provides a good detection of cancers with a Gleason score of $\geq$7 in candidates suitable for prostate biopsy.



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## Introduction

Because prostate cancer is difficult to detect at ultrasound (US), transrectal US (TRUS)-guided biopsy is based on systematic sampling of the gland. The false-negative (FN) rate of the current 10–12 sample protocols may be as high as 47%,[1] raising diagnostic concerns of missed cancers, particularly in patients with clinical suspicion of cancer and repeated negative biopsies. Additional sampling may detect additional cancers, but this strategy raises concern of over-detection of non-significant cancers, which may lead to overtreatment.[1–5]

Correlation with radical prostatectomy specimens has shown that multiparametric magnetic resonance imaging (mp-MRI) had excellent sensitivity for detecting aggressive cancers with a Gleason score of ≥7 and much poorer results in detecting small foci with Gleason scores of ≤6.[6–9] As a result, it has been proposed by some authors as a triage test for candidates for biopsy, in an attempt to both increase detection of aggressive cancers and reduce over-detection of non-significant foci.[10,11]

However, the population of candidates suitable for prostate biopsy is different from the selected population of patients treated with radical prostatectomy. Particularly, the cancer prevalence is not 100% and patients with benign conditions known to increase the level of prostate-specific antigen (PSA) and be the cause of false-positive (FP) findings at mp-MRI (e.g., prostatitis) may be over-represented, especially in the subgroup of candidates for repeat biopsy. Thus, mp-MRI performance in the difficult population of candidates for biopsy remains a matter of controversy[12] and is a current hot topic in urology.[13–31]

In the present study, the results of mp-MRI and subsequent prostate biopsy were evaluated in 288 consecutive candidates who underwent prostate biopsy.

## Materials and methods

### *Study population*

At Hôpital Edouard Herriot, mp-MRI is used as a triage test before prostate biopsy. All patients who underwent mp-MRI before prostate biopsy between September 2008 and January 2013 were asked to have their mp-MRI and biopsy data entered into a prospective database. All patients included in the database gave written consent for the use of their MRI and biopsy data for research purposes and signed the Institutional Review Board-approved consent form. The database was also registered with the appropriate administrative authority (Commission Nationale de l'Informatique et des Libertés), as requested by our national law.

Only patients imaged between January 2011 and January 2013 were taken into consideration for the present study, because the same MRI protocol was used during this period. Patients with clinically advanced cancer (stage ≥T3) or history of prior treatment for prostate cancer were excluded. When a given patient underwent several mp-MRI examinations and biopsies during the study period, only his first mp-MRI examination results and biopsy were taken into consideration.

### *MRI technique*

All prostate mp-MRI examinations were performed using a 3 T MRI machine (Discovery MR750, General Electric Medical Systems, Milwaukee, WI, USA) and a pelvic phased-array coil. They included axial and coronal T2-weighted (T2W) images, axial diffusion-weighted (DW) images and axial dynamic contrast-enhanced (DCE) images (Table 1).

### *MRI image analysis*

Thirteen senior uroradiologists, with 0.5–13 years of experience in prostate imaging, interpreted the mp-MRI images during the study period, as part of their daily routine. They were aware of all relevant clinical information concerning the patient. During the study period, mp-MRI interpretation was strictly standardized. As part of the routine interpretation for all patients, the uroradiologist noted the position of all abnormal lesions using a diagram featuring 14 prostate sectors, i.e. the six sextants of the peripheral zone (PZ), the six sextants of the transition zone (TZ), and the two seminal vesicles (SV).

In the PZ, all lesions showing low-signal intensity on T2W images and/or on apparent diffusion coefficient (ADC) maps, and/or showing early enhancement on DCE images were taken into consideration. In the TZ, only homogeneous, low-signal intensity areas on T2W images, with ill-defined margins, no visible capsule, and no cystic component were interpreted as suspicious.[32–34] Focal areas within the seminal vesicles (SVs) showing low-signal intensity on T2W images or ADC maps, and/or early enhancement on DCE images were also noted as suspicious. The presence and degree (none, mild, marked) of post-biopsy blood artefacts within each focal lesion was also evaluated on the first (unenhanced) T1-weighted DCE acquisition.

Finally, as recommended by recent European guidelines,[35,36] the likelihood of malignancy of each focal lesion was assessed using a five-level subjective suspicion score (SSS; 1: definitely benign, 2: probably benign, 3: indeterminate, 4: probably malignant, 5: definitely malignant). The

**Table 1**
Magnetic resonance imaging parameters.

| Receive coil type | 32-channel PPA coil | | |
|---|---|---|---|
| Sequence | T2W | DW | DCE |
| Repetition time (ms) | 5000 | 5000 | 3.9 |
| Echo time (ms) | 104 | 90 | 1.7 |
| Field of view ($mm^2$) | 220 × 220 | 380 × 380 | 240 × 192 |
| Acquisition matrix | 384 × 256 | 128 × 128 | 180 × 160 |
| Flip angle (degrees) | 90/180 | 90 | 12 |
| *b* values ($s/mm^2$) | | 0, 2000 | |
| Section thickness (mm) | 3 | 3 | 3 |
| No. of temporal acquisitions | | | 32 |
| Temporal resolution (s) | | | 7 |

PPA, pelvic phased-array; T2W, T2-weighted imaging; DW, diffusion-weighted imaging; DCE, dynamic contrast-enhanced imaging.