PI-RADS v2 for predicting prostate cancer Gleason score at final pathology after radical prostatectomy

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Aims and objectives

Prostate cancer (PCa) is the second most common cancer in men worldwide [1,2]; it is a heterogeneous disease that ranges clinically from indolent to highly aggressive. The prevalence of prostate cancer increases with age; 34% of men in the 5th decade of life and up to 70% aged 80 years or older have histologic evidence of prostate cancer. Sixteen percent of males will develop prostate cancer during their lifetime [3-5], but only a small proportion of those patients will die because of PCa.

Multiparametric Magnetic Resonance Imaging (mpMRI) can be considered nowadays a common exam performed for different indications, including staging of locally advanced cancer, monitoring active surveillance of a known prostate tumor and identification of new cancers [6-10]. Differentiating patients according to a risk classification may help radiologists and clinicians to offer a more precise patient management.

The Prostate Imaging Reporting and Data System (PI-RADS) is the result of an extensive international collaborative effort. PI-RADS version 2 (PI-RADS v2) provides a complete set of guidelines for the interpretation and reporting of prostate multiparametric magnetic resonance imaging. PI-RADS v2 introduces important changes to the original system used to assess the level of suspicion for clinically significant cancer with multiparametric MR imaging. PI-RADS v2 assessment uses a 5-point scale based on the probability that a combination of mpMRI findings on T2-weighted (T2W) sequences, Diffusion-Weighted Imaging (DWI), and dynamic contrast-enhancement (DCE) correlates with the presence of a clinically significant cancer for each lesion in the prostate gland. PI-RADS v2 can improve detection, localization and staging of prostate cancer [11-15]. PI-RADS v2 could help in distinguishing low grade from intermediate-high grade tumors, with possible implications in patients management and prognosis.

The purpose of our study is therefore to evaluate the correlation between PI-RADS v2 and Gleason score of prostate cancer after radical prostatectomy in the pathological specimen.
Methods and materials

Patients

This retrospective single-institution study was approved by our institutional review board (IRB) and informed consent was waived for all patients enrolled. The images of 135 consecutive men who underwent mp-MRI examinations at our institution between May 2015 and May 2016 were considered for inclusion in our retrospective study. The inclusion criteria consisted of: (a) 1.5-Tesla mp-MRI of the prostate; (b) radical prostatectomy performed at our institution within 2 months after MRI. The exclusion criteria included: (a) prior prostate cancer treatment, including hormone therapy or radiation (n=7); (b) incomplete acquisition (n=4); or (c) radical prostatectomy not available (n=30). Our final study population consisted of 94 patients. The median age of patient group was 63 years (range, 45-73 years). The median PSA was 9.1 ng/ml (range, 4.5-50 ng/ml). The clinical data of patients enrolled are summarized in Table 1.

MRI acquisition protocol

All images were acquired on a 1.5-Tesla MRI system (Avanto Siemens AG, Erlangen, Germany). A body coil was used for excitation; a pelvic 16-channel phased-array coil was used for signal reception. Gastrointestinal peristalsis was suppressed by intramuscular administration of 20 mg of scopolamine-butylbromide (Buscopan, Boehringer Ingelheim), in absence of contraindications. Axial T1-weighted (T1w), axial, coronal and sagittal T2-weighted (T2w), Diffusion-Weighted Imaging (DWI) with \( b \) values of 50, 600 and 1000 sec/mm\(^2\) and dynamic contrast-enhancement (DCE) sequences were acquired.

Image Interpretation

Images were analyzed on a dedicated workstation by a radiologist with 5 years of experience, blinded to clinical data (prostate-specific antigen level, number of positive specimens and localization of the lesion) and to histopathologic findings at radical prostatectomy. Mp-MRI was assessed according to the European Society of Urogenital Radiology guidelines according to the Prostate Imaging and Reporting and Data System score [16]. At imaging the diagnosis of PCa was based on one or more of the following findings: a nodular hypointense lesion in the peripheral zone or a very pronounced hypointense sickle-shaped lesion in the transition zone of the prostate gland on the T2w images; focal or diffuse hyperintense area on DWI on high \( b \)-value, with or without an associated markedly hypointense nodular lesion on ADC maps. When T2w and DWI are of diagnostic quality, DCE plays a minor role in determining PI-RADS Assessment Category [16]. In case of multiple lesions, the largest one was considered as the reference lesion (Index Lesion). For PI-RADS v2, clinically significant cancer is defined with pathology/histology as Gleason score (GS)#7 (including 3+4 with prominent but
not predominant Gleason 4 component), and/or volume#0.5cc, and/or extra prostatic extension (EPE) [16].

**Histopathologic examination**

In all 94 patients, prostate cancer was proven histopathologically after radical prostatectomy. All the slides obtained from the whole-mount pathologic step-section slices were reviewed by an experienced pathologist who was unaware of the MRI findings.

**Statistical analysis**

Receiver operating characteristic (ROC) curve was generated to determine the area under the curve (AUC) for discrimination between low-grade tumors with GS 6 and intermediate-high grade tumors with GS#7. Relationships between PI-RADS v2 and tumor GS were assessed using Spearman’s rank correlation coefficient. \( P<0.05 \) was considered significant. Sensitivity (se), specificity (sp), positive predicting value (PPV), negative predicting value (NPV) and accuracy (acc) in discriminating Gleason score 6 tumors from Gleason score#7 tumors by using PI-RADS v2 were determined. Statistical analysis was performed using software GraphPad 6 (GraphPad Software Inc. La Jolla, CA, USA).
<table>
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<td>PSA (ng/ml)</td>
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<td>Gleason score, no. (%) of patients</td>
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<td>7</td>
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<td>8</td>
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<td>9</td>
<td>11 (12)</td>
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**Table 1:** Summary of Clinical and Pathologic Characteristics.
Results

Ninety-four patients with a median age of 63 years (range, 45-73 years) and a median PSA of 9.1 ng/ml (range, 4.5-50 ng/ml) were retrospectively studied after mpRM and radical prostatectomy. The median diameter of the lesions was 11 mm. The median Gleason score was 7 (range, 6-9). Gleason score 6 tumors were detected in 31 patients, Gleason score#7 tumors were detected in 63 patients (44 were GS 7, 8 were GS 8 and 11 were GS 9). Considering all 94 patients, mpMRI was able to diagnose tumors in 89 patients (94%). In all 5 (6%) patients with a negative multiparametric MRI examination, the histologic analysis showed a biopsy Gleason score of 3+3, indicating a well-differentiated tumor, with two or fewer pathologic cores, each one containing 10% or less malignant cells (not clinically significant tumors). In other 89 patients (94%) who underwent radical prostatectomy, the mp-MRI was able to clearly detect the tumor. Only 4/89 lesions (5%) originated from the transition zone, whereas the 85/89 (95%) lesions originated from peripheral zone.

At the imaging evaluation we assessed a PI-RADS v2 category of 2 in 5/94 (5%) patients, a PI-RADS v2 category of 3 was found in 26/94 (28%) patients, a PI-RADS v2 category of 4 in 38/94 (40%) patients and a PI-RADS v2 category of 5 in 25/94 (27%) patients (Table 2). A statistically significant difference was found in the PI-RADS v2 values for low-grade tumors (Gleason score 6) and for intermediate-high grade tumors (Gleason score#7) (p<0.001). The PI-RADS v2 values in low-grade tumors were #3 in 29/31 lesions (93.5%) and >3 in 2/31 lesions (6.5%) (Figure 1): in these two cases there was a positive DCE with a focal and early enhancement. In intermediate-high grade tumors the PI-RADS v2 values were >3 in 57/63 lesions (90.5%) and #3 in 6/63 lesions (9.5%) (Figure 2, 3). In all these six cases the tumor was diffuse and sparse and this distribution can underrates the real burden of the disease [17].

PI-RADS v2 values of tumors increased significantly in parallel to an increase at the final GS. For a cut-off level of PI-RADS v2 of 3, the tumor PI-RADS v2 values for discriminating low-grade tumors from intermediate-high grade tumors showed a sensitivity of 90%, a specificity of 94%, a positive predicting value of 97% and a negative predicting value of 83% with a diagnostic accuracy of 91%.
Table 2: At the imaging evaluation we assessed a PI-RADS v2 category of 2 in 5/94 (5%) patients, a PI-RADS v2 category of 3 was found in 26/94 (28%) patients, a PI-RADS v2 category of 4 in 38/94 (40%) patients and a PI-RADS v2 category of 5 in 25/94 (27%) patients. The PI-RADS v2 values in low-grade tumors were #3 in 29/31 lesions (93.5%) and in 2/31 lesions (6.5%) were >3; in intermediate-high grade tumors the PI-RADS v2 values were >3 in 57/63 lesions (90.5%) and #3 in 6/63 lesions (9.5%). GS=Gleason score

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Fig. 1: Gleason score 6 (3+3) Prostate cancer confirmed at final histopathology after radical prostatectomy. PSA 4.31 ng/ml. T2w image (A) shows some aspecific alterations of normal intensity of peripheral zone of prostate without any focal early enhancement in DCE (B) or focal alterations in DWI (C) or ADC maps (D).

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Fig. 2: PI-RADS 4 lesion of the peripheral zone of prostate. Gleason score 7 (4+3) Prostate cancer confirmed at final histopathology after radical prostatectomy. PSA 8.64 ng/ml. T2w image (A) shows a 11 mm focal lesion in the peripheral zone of the left lobe. The lesion demonstrates a moderate enhancement in DCE (B), a markedly hyperintensity on high b value DWI (C) and focal markedly hypointensity on ADC maps (D).

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Fig. 3: PI-RADS 5 lesion of the peripheral zone of prostate. Gleason score 9 (4+5) Prostate cancer confirmed at final histopathology after radical prostatectomy. PSA 16.58 ng/ml. T2w image (A) shows a 18 mm focal lesion in the peripheral zone of the left lobe, with extra-prostatic extension. The lesion demonstrates an early enhancement in DCE (B), a markedly hyperintensity on high b value DWI (C) and focal markedly hypointensity on ADC map (D). In peri-rectal fat can be recognized a suspicious lymph node (arrow in A and C).

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Conclusion

PI-RADS v2 values were significantly higher in intermediate-high grade prostate cancer; a significant correlation between PI-RADS v2 values and GS in prostatic tumors was determined. This finding may be useful in the non-invasive assessment of the aggressiveness of prostate cancer, which is an important predictor for patient outcome and prognosis and may provide valuable additional information in the planning of patient-tailored treatment.
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References


