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PI-RADS version 2: Preoperative role in the detection of normal-sized pelvic lymph node metastasis in prostate cancer

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ABSTRACT

Objectives: To analyze whether Prostate Imaging Reporting and Data System (PI-RADSv2) scores are associated with a risk of normal-sized pelvic lymph node metastasis (PLNM) in prostate cancer (PCa).

Materials and methods: A consecutive series of 221 patients who underwent magnetic resonance imaging and radical prostatectomy with pelvic lymph node dissection (PLND) for PCa were retrospectively analyzed under the approval of institutional review board in our institution. No patients had enlarged (≥0.8 cm in short-axis diameter) lymph nodes. Clinical parameters [prostate-specific antigen (PSA), greatest percentage of biopsy core, and percentage of positive cores], and PI-RADSv2 score from two independent readers were analyzed with multivariate logistic regression and receiver operating-characteristic curve for PLNM. Diagnostic performance of PI-RADSv2 and Briganti nomogram was compared. Weighted kappa was investigated regarding PI-RADSv2 scoring.

Results: Normal-sized PLNM was found in 9.5% (21/221) of patients. In multivariate analysis, PI-RADSv2 (reader 1, $p = 0.009$; reader 2, $p = 0.026$) and PSA (reader 1, $p = 0.008$; reader 2, $p = 0.037$) were predictive of normal-sized PLNM. Threshold of PI-RADSv2 was a score of 5, where PI-RADSv2 was associated with high sensitivity (reader 1, 95.2% [20/21]; reader 2, 90.5% [19/21]) and negative predictive value (reader 1, 99.2% [124/125]; reader 2, 98.6% [136/138]). However, diagnostic performance of PI-RADSv2 (AUC = 0.786–0.788) was significantly lower than that of Briganti nomogram (AUC = 0.890) for normal-sized PLNM ($p < 0.05$). The inter-reader agreement was excellent for PI-RADSv2 of 5 or not (weighted kappa = 0.804).

Conclusion: PI-RADSv2 scores may be associated with the risk of normal-sized PLNM in PCa.

1. Introduction

Pelvic lymph node metastases (PLNM) in prostate cancer (PCa) are often small on preoperative imaging [1]. Thus, with a size criterion such as a threshold of 0.8–1.0 cm in short-axis diameter, the nodal stage can be underestimated due to a low sensitivity, even in high–risk patients [2,3]. As an advanced imaging modality, magnetic resonance imaging (MRI) with ultra-small particles of iron oxide (USPIOs) or choline positron emission tomography/computed tomography (PET/CT) has shown promise in the detection of normal-sized PLNM on MRI [4–7]. However, these techniques still have limitations in less-availability [8]. Thus, the selection of optimal candidates could maximize the effectiveness of the advanced nodal imaging or pelvic lymph node dissection (PLND).

Recently, the revised version of Prostate Imaging Reporting and Data System (PI-RADSv2) was developed to detect clinically significant cancers (CSC) by use of multiparametric magnetic resonance imaging (mpMRI) [9]. Based on recent studies, a higher PI-RADSv2 score seems to be associated with higher tumor stage, Gleason score (GS), or biochemical recurrence [10–12]. On the basis of these results, a higher

Abbreviations: PI-RADSv2, Prostate Imaging Reporting and Data System version 2; PLNM, pelvic lymph node metastasis; PLND, pelvic lymph node dissection; LN, lymph nodes; PCa, prostate cancer; MRI, magnetic resonance imaging; mpMRI, multiparametric magnetic resonance imaging; USPIO, ultra-small particles of iron oxide; CSC, clinically significant cancer; GS, Gleason score; T2WI, T2-weighted imaging; DWI, diffusion-weighted imaging; ADC, apparent diffusion coefficient; DCEI, dynamic contrast-enhanced imaging; PSA, prostate-specific antigen; ECE, extracapsular extension; SVI, seminal vesicle invasion; ROC, receiver operating-characteristic; AUC, area under the curve; CCC, concordance correlation coefficient

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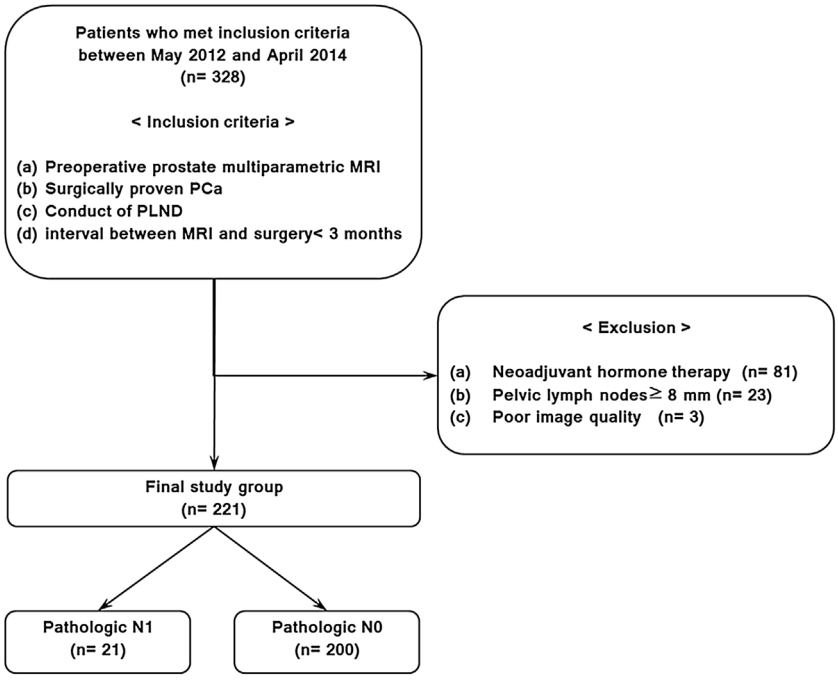

Fig. 1. Flowchart of the study group.

Table 1
Prostate MRI protocol for interpreting PI-RADSv2.

Parameter	T2WI	DWI	DCEI
Orientation	Axial	Axial	Axial
TR (ms)	3142–4420	3000–5000	3.4
TE (ms)	80–100	56–60	1.7
Flip angle (°)	90	90	10
Matrix	448 × 352	80–128 × 120–128	256 × 254
NEX	3	4	1
Field of view (cm)	24	24	24
Slice thickness (mm)	3–4	3–4	4–5
Temporal resolution (s)			4–7

PI-RADSv2 = Prostate Imaging Reporting and Data System version 2, T2WI = T2-weighted imaging, DWI = diffusion-weighted imaging, DCEI = dynamic contrast-enhanced imaging, TR = repetition time, TE = echo time, and NEX = number of excitation.
Two b-values (0 and 1000 s/mm^2) were used for DWI.
Gadoterate meglumine (Dotarem; Guerbet, Paris, France) was used for DCEI.

PI-RADSv2 score seems to be associated with more aggressive PCa or poor clinical outcomes. Accordingly, we hypothesized that PI-RADSv2 score may also be associated with the risk of PLNM in PCa. Because mpMRI is now widely accepted as a preoperative diagnostic modality, the identification of normal-sized PLNM with mpMRI may be useful in the selection of patients who need additional node-specific imaging or PLND.

The purpose of this study was to analyze whether PI-RADSv2 scores are associated with the presence of normal-sized PLNM in PCa.

2. Materials and methods

2.1. Study subjects

The institutional review board at our institution approved of this retrospective study, and the requirement for informed consent was waived. Between May 2012 and April 2014, a consecutive series of 328 patients who met all of the following inclusion criteria were found though a search of the medical record (Fig. 1): (a) presence of preoperative prostate mpMRI with T2-weighted imaging (T2WI), diffusion-weighted imaging (DWI), and dynamic contrast-enhanced imaging (DCEI); (b) presence of surgically proven PCa; (c) PLND during surgery; and (d) interval between MRI and surgery less than 3 months. Of the patients, 107 were excluded from analysis due to the following reasons: (a) neoadjuvant hormone therapy (n = 81); (b) presence of enlarged pelvic lymph nodes (LN) ≥ 8 mm in short-axis diameter (n = 23), based on the previously reported size threshold for a normal-size LN [1,6]; (c) poor image quality due to patient motion or rectal peristalsis (n = 3). Thus, a total of 221 patients (median age, 66 years; range 45–79 years) were finally included in our study. Of these, 200 patients had no PLNM (pN0 group) and 21 had normal-sized PLNM (pN1 group).

2.2. Prostate MRI

The study patients underwent prostate MRI 2–6 weeks after transrectal ultrasound-guided biopsy and within 3 months before surgery. The patients underwent MRI using one of four types of 3T scanners (Discovery MR750, GE Medical Systems; Discovery MR750w, GE Medical Systems; Intera Archieva, Philips Medical System; TrioTim, Siemens) using a phased-array body coil. All MRI included axial T2WI, DWI, and DCEI. The MRI protocols are summarized in Table 1.

For the evaluation of pelvic LNs, axial contrast-enhanced T1-weighted gradient-echo imaging was performed following DCEI. The acquisition parameters were as follows: TR/TE, 3.4–5.7/1.1–2.8 ms; flip angle, 10–12°; field of view, 36–40 cm; matrix, 300–512 × 200–512; slice thickness, 4–5 mm; interval, 0 mm. The gradient-echo technique allowed whole pelvic imaging with a single breath hold. The images covered the pelvic area from the aortic bifurcation to the inguinal area, where the common, external, and internal iliac, and obturator chains were included. In the final study group (n = 221), there was no patient with an enlarged pelvic LN ≥ 8 mm in short-axis diameter. All of the MRI scans were archived using PACS (PathSpeed Workstation, GE Healthcare) for image analysis.

2.3. Data analysis

2.3.1. Clinical and pathologic parameters

Preoperative and postoperative clinical parameters were recorded retrospectively. The preoperative parameters consisted of patient age,