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Diagnostic Performance of Prostate Imaging Reporting and Data System Version 2 for Detection of Prostate Cancer: A Systematic Review and Diagnostic Meta-analysis

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Article info

Abstract

Context: In 2015, the updated Prostate Imaging Reporting and Data System version 2 (PI-RADSv2) for the detection of prostate cancer (PCa) was established. Since then, several studies assessing the value of PI-RADSv2 have been published.
Objective: To review the diagnostic performance of PI-RADSv2 for the detection of PCa.
Evidence acquisition: MEDLINE and EMBASE databases were searched up to December 7, 2016. We included diagnostic accuracy studies that used PI-RADSv2 for PCa detection, using prostatectomy or biopsy as the reference standard. The methodological quality was assessed by two independent reviewers using the Quality Assessment of Diagnostic Accuracy Studies-2 tool. Sensitivity and specificity of all studies were calculated. Results were pooled and plotted in a hierarchical summary receiver operating characteristic plot with further exploration using meta-regression and multiple subgroup analyses. Head-to-head comparison between PI-RADSv1 and PI-RADSv2 was performed for available studies.
Evidence synthesis: Twenty-one studies (3857 patients) were included. The pooled sensitivity was 0.89 (95% confidence interval [CI] 0.86–0.92) with specificity of 0.73 (95% CI 0.60–0.83) for PCa detection. Proportion of patients with PCa, magnetic field strength, and reference standard were significant factors affecting heterogeneity ($p < 0.01$). Multiple subgroup analyses showed consistent results. In six studies performing head-to-head comparison, PI-RADSv2 demonstrated higher pooled sensitivity of 0.95 (95% CI 0.85–0.98) compared with 0.88 (95% CI 0.80–0.93) for PI-RADSv1 ($p = 0.04$). However, the pooled specificity was not significantly different (0.73 [95% CI 0.47–0.89] vs 0.75 [95% CI 0.36–0.94], respectively; $p = 0.90$).
Conclusions: PI-RADSv2 shows good performance for the detection of PCa. PI-RADSv2 has higher pooled sensitivity than PI-RADSv1 without significantly different specificity.
Patient summary: We reviewed all previous studies using Prostate Imaging Reporting and Data System version 2 (PI-RADSv2) for prostate cancer detection. We found that the updated PI-RADSv2 shows significant improvement compared with the original PI-RADSv1.
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1. Introduction

Prostate cancer (PCa) is the second leading cause of cancer-related mortality in Western men [1]. With the recent technological advancements and growing availability, multiparametric magnetic resonance imaging (mpMRI) currently is increasingly being used for guiding several aspects of PCa management, including detection, staging, and treatment planning [2]. Despite abundant evidence in the literature reporting high accuracy of mpMRI for PCa diagnosis, widespread acceptance has been hampered by several factors including difficulty of interpretation, lack of standardized criteria for interpretation (ie, use of Likert scales based on the radiologist's subjective level of suspicion for PCa), and resulting substantial inter-reader variability [3,4].

To bring standardization to the evaluation and reporting of mpMRI of the prostate, the European Society of Urogenital Radiology (ESUR) published a guideline termed Prostate Imaging Reporting and Data System (PI-RADS) in 2012 [5]. PI-RADS was generated based on expert consensus and provides a detailed scoring system for each MRI sequence (T2-weighted imaging [T2WI], diffusion-weighted imaging [DWI], dynamic contrast-enhanced MRI [DCE-MRI], and MR spectroscopy) for the presence of clinically significant PCa (csPCa). Several investigators have validated the accuracy and reproducibility of PI-RADS, and a recent meta-analysis reported pooled sensitivity and specificity of 0.78 and 0.79, respectively [6]. However, as there was no guideline for the generation of an overall score, different research groups utilized various measures for this purpose—some used a sum of the scores from each sequence (ranging from 3 to 15), whereas others used an overall score of 1–5 [7,8]. Furthermore, emerging data questioned the value of curve-type analysis of DCE-MRI [9]. In addition, investigators suggested that some sequences may be more important in determining the likelihood of PCa (ie, DWI in the peripheral zone [PZ] and T2WI in the transition zone [TZ]) rather than equal weighting for all sequences [10].

To address these issues, the ESUR and American College of Radiology recently released the updated PI-RADS version 2 (PI-RADSv2) [11]. The main changes from PI-RADSv1 to PI-RADSv2 are the following: (1) introduction of dominant sequences according to zonal anatomy (DWI for the PZ and T2WI for the TZ), (2) limited contribution of DCE-MRI data as merely presence and absence of early focal enhancement, and (3) generation of an overall score (1–5) integrating findings across all MRI sequences.

Since then, several studies assessing the value of PI-RADSv2 have been published. However, the diagnostic performance of this new scoring system has not been evaluated systematically. Therefore, the purpose of our study was to assess the diagnostic performance of PI-RADSv2 for the detection of PCa. In addition, we aimed to compare the diagnostic performance of PI-RADSv1 and PI-RADSv2 in studies available for head-to-head comparison.

2. Evidence acquisition

This meta-analysis was performed and written according to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines [12].

2.1. Literature search

A computerized search of MEDLINE and EMBASE up to December 7, 2016, was performed in order to identify studies evaluating the diagnostic performance of PI-RADSv2 for the detection of PCa. The search query combined synonyms for PCa, MRI, and PI-RADS as follows: (prostate cancer OR prostatic cancer OR prostate neoplasm OR prostatic neoplasm OR prostate tumor OR prostatic tumor OR prostate carcinoma OR prostatic carcinoma OR PCa) AND (magnetic resonance imaging OR MRI OR MR) AND (prostate imaging reporting and data system OR pi-rads OR pi rads OR pirads). Bibliographies of identified articles were also screened to expand the scope of search. Our search was limited to publications in English.

2.2. Study selection

2.2.1. Inclusion criteria
Studies were included if they satisfied all the following requirements according to the PICOS criteria [12]: (1) included patients with suspected or diagnosed PCa; (2) for index test, mpMRI of the prostate including all required sequences of T2WI, DWI, and DCE-MRI was performed and assessed with a PI-RADSv2 scoring system; (3) for comparison, a reference standard based on the histopathological examination of radical prostatectomy or biopsy was used; (4) results were reported in sufficient detail for the reconstruction of 2×2 tables and determination of sensitivity and specificity at specified cutoff values for evaluating the diagnostic performance of PI-RADSv2; and (5) studies had to be original articles.

2.2.2. Exclusion criteria
Studies were excluded if any of the following criteria were met: (1) studies involving <10 patients; (2) review articles, guidelines, consensus statements, letters, editorials, and conference abstracts; (3) studies using only PI-RADSv1 for the evaluation of mpMRI of the prostate; (4) studies focusing on topics other than using the PI-RADSv2 system for diagnosing PCa (ie, staging and prediction of biochemical recurrence); and (5) studies with overlapping patient population.

Two reviewers (S.W. and C.H.S., with 3 yr of experience in performing systematic reviews and meta-analyses) independently evaluated the eligibility of the selected studies from the literature. Disagreements, if present between the two reviewers, were resolved by consensus via discussion with a third reviewer (S.Y.K.).

2.3. Data extraction and quality assessment

We extracted the following data regarding study design and results from the selected studies using a standardized form: