MRI-derived PRECISE score for predicting pathologically-confirmed progression in prostate cancer patients on active surveillance

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Citation: Carletti F, Crimì F, Randazzo G, et al. MRI-derived PRECISE score for predicting pathologically-confirmed progression in prostate cancer patients on active surveillance. Cent European J Urol.2024; doi:10.5173/ceju.2024.59 [Epub ahead of print]

Article history
Submitted: Apr. 26, 2024
Accepted: Apr. 26, 2024
Published online: May 10, 2024

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Introduction The utilization of magnetic resonance imaging (MRI) in active surveillance (AS) of prostate cancer (PCa) remains a topic of debate. The Prostate Cancer Radiological Estimation of Change in Sequential Evaluation (PRECISE) scoring system is used to evaluate the progression of MRI lesions in men undergoing AS.
This study aims to evaluate the predictive capacity of the PRECISE score in monitoring PCa patients on AS.
Material and methods A cohort of 63 men enrolled in an AS program between 2017 and 2021 was analyzed. Sequential MRIs within the AS protocol were assessed by a specialized radiologist using the PRECISE score. Data on biopsy outcomes, pathological progression, and treatment progression were documented. The relationship between progression and the PRECISE score was examined. Univariate logistic and Cox regression analyses were conducted to determine the baseline clinical and mpMRI parameters associated with disease progression.
Results The cohort exhibited ISUP progression and biopsy progression rates of 27.6% (16/63) and 48.3% (28/63), respectively. At the second MRI, a PRECISE score exceeding 3 was observed in 31 patients (53.4%), with 25 patients (43.1%) showing new lesions. Overall, 23 patients (39.7%) underwent active treatment during a median follow-up of 117 months. The PRECISE score emerged as the sole predictor, in univariate analysis, of ISUP progression (OR: 3.2, IQR: 1.1–9.7, p = 0.04), biopsy progression (OR: 3.2, IQR: 1.1–9.7, p = 0.03), and active treatment (HR: 1.1, IQR: 1.0–1.6, p = 0.05).
Conclusions The PRECISE scoring system facilitates the identification of patients at risk of ISUP and biopsy progression within an AS protocol utilizing mpMRI. These findings underscore the significance of mpMRI in AS.

Key Words: PRECISE ‹› PRECISE score ‹› PRECISE scoring system ‹› MRI ‹› mpMRI ‹› prostate ‹› AS ‹› active surveillance ‹› follow up ‹› prostate cancer ‹› PCa

INTRODUCTION

Active Surveillance (AS) is the recommended management strategy for low-risk and selected favorable intermediate-risk prostate cancer (PCa) [1]. While traditional clinical, biochemical, and pathological parameters have been used for AS, magnetic resonance imaging (MRI) has gained increasing importance in the assessment of PCa [2]. A baseline MRI is now considered essential for accurate diagnosis and risk classification [3]. Standardized MRI reporting, utilizing the Prostate Imaging Reporting and Data System (PI-RADS) score, along with MRI-guided transperineal targeted biopsy, has demonstrated

improved patient selection for AS and a reduced risk of disease reclassification [3, 4, 5]. However, the role of serial MRI scans during the surveillance phase remains controversial, with uncertainties regarding the optimal timing and triggers for additional imaging due to limited data and a lack of standardized reporting.

To address these challenges, the Prostate Cancer Radiological Estimation of Change in Sequential Evaluation (PRECISE) recommendations were proposed as a standardized approach to prostate MRI reporting in AS [7]. The aim of the present study is thus to evaluate the PRECISE's predictive value for disease progression, aiming to understand its role in guiding management of PCa patients under active surveillance.

MATERIAL AND METHODS

Study population

This study was conducted in compliance with ethical guidelines and approved by the relevant institutional review board. A retrospective analysis was conducted on a cohort of PCa patients enrolled in the Active Surveillance (AS) program at a single tertiary referral center between January 2017 and September 2021. The inclusion criteria for AS were, according to PRIAS protocol, as follows: patient fit for curative treatment, prostate-specific antigen (PSA) ≤10 ng/mL, or ≤20 ng/ml if mpMRI performed, PSA density less than 0.2, clinical stage cT1c or cT2, Biopsy confirmed prostate cancer: ISUP 1 with maximum 15% of posititive cores if saturation biopsy was performed o no maximum limit if mpMRI was performed; ISUP 2 without invasive cribriform and intraductal carcinoma, with ≤50% of the biopsy cores allowed to be positive (multiple positive cores from the same lesion on MRI count for one positive core). In our analysis we included 63 patients enrolled in active surveillance who underwent mpMRI and prostate biopsy. Biopsy was repeated after 1, 4, 7, 10 years and then after 5 years or with a PSA doubling time >10 years.

MRI Re-reporting and scoring

A uro-radiologist, blinded to original MRI reports and patient outcomes, used PI-RADS version 2.1 guidelines to assess suspicious lesions on MRI scans retrospectively. PI-RADS scores were given to indicate malignancy likelihood. Follow-up scans were compared to the most recent one, and changes were visually assessed to assign a PRECISE score for radiological progression likelihood, ranging from 1 to 5. Scores 1–2 showed regression, 3 stability, and 4–5 progression A score of 1 signifies the absence of enhancement in previously enhanced areas, while a score of 2 indicates a discernible reduction in the size or visibility of suspicious features. Score 3 suggests the absence of new lesions and the stability of existing ones. A score of 4 implies an observable increase in size or visibility of features suspicious for prostate cancer, potentially including lesions detectable on diffusion-weighted imaging. Lastly, a score of 5 indicates definitive radiological progression, such as extracapsular extension or bone metastasis, indicative of advanced disease.

MRI acquisition

Around 90% of MRI scans were conducted at the study center using a 1.5 Tesla scanner (Magnetom Avanto Fit, Siemens Healthineers, Tubingen, Germany) without an endorectal coil. These multiparametric scans included high-resolution axial T2-weighted sequences, axial diffusion-weighted imaging (DWI) sequences with b values, and dynamic fat-saturated T1-weighted sequences following intravenous injection of gadobutrol (Gadavist, Bayer-Schering, Berlin, Germany) at 0.1 ml/kg with an injection rate of 2–3 ml/s, followed by a saline flush of 10 ml. Before the scan, patients received a rectal enema, and intravenous scopolamine was administered. A limited number of patients were scanned outside with consequently slightly different scan protocols were also included and re-reported.

Data Collection and study outcomes

Patient and tumor characteristics, including age, PSA levels, clinical stage, biopsy results, and pathological findings, were gathered from medical records. Additionally, the PRECISE and PI-RADS scores from MRI scans were noted at the time of biopsy. Biopsy progression was defined as identifying higher-grade cancer or an increase in cores involved compared to previous biopsies. Active treatment included radical prostatectomy or radiation therapy after active surveillance.

Prostate Biopsy

All biopsies were conducted using a free hand transperineal route.

The patient is positioned lithotomically and administered light sedation using either Fentanyl (0.05–0.1 mg) or Midazolam (2.5 mg). The biopsy procedure and software-based registration utilized the Hitachi Preirus ultrasound system with Real-time Virtual Sonography – RVS and the Hitachi

EUP-CC531S transrectal probe. Peripheral nerve block involved injecting 10 ml of 2% lidocaine solution at the prostate apex and bilaterally at the vesical-prostatic angle. Biopsies were conducted using a spring-loaded biopsy gun equipped with an 18-G needle. For cases with suspicious lesions, defined as PI-RADS ≥3, an MRI-guided technique was used to assist in the biopsy procedure. A repeat biopsy was conducted approximately one year after the initial biopsy, following a second prostate MRI scan. ISUP progression was defined as any increase in the ISUP grade, biopsy progression were defined as any increase ≥3 positive cores or maximum core involment (CI) >50% per core for ISUP 1 and any incresead number of positive core for ISUP 2, respectively [2].

Statistical Analysis

Continuous variables were presented as median with interquartile range, and categorical variables as frequencies and percentages Kaplan-Meier statistics and the log-rank test assessed differential progression-free survival. Univariate logistic regression was used to asses predictors of ISUP and disease progression, while Cox regression was used to assess predictors of Active treatment during follow up. IBM SPSS Statistics software, version 28, was used for analysis, with a significance set at P <0.05.

RESULTS

Table 1 outlines the characteristics of 63 patients in the study, noting that 69% had PI-RADS scores of ≥3 at the first MRI, while 31% had scores <3. In the second MRI, 15.3% had PRECISE scores ≤2, 31% had a score of 3, and 61.3% had a score >3. Notably, 43.1% had new lesions, 27.6% showed ISUP progression, and 48.3% had biopsy progression. The median follow-up was 117 months, with 39.7% receiving active treatment. At univariate Logistic regression analysis, the PRECISE score was a significant predictor of ISUP progression (OR = 3.8, 95% CI = 1.1–13.0, p = 0.04) and of biopsy progression (OR = 3.2, 95% CI = 1.1–9.7, p = 0.03) while age, initial PSA, PI-RADS score, and prostate volume were not predictive. At univariate Cox regression PRECISE score was also predictor of active treatment in analysis (HR = 1.1, 95% CI = 1.0–1.6, p = 0.05), unlike the other factors as age, initial PSA, PI-RADS score, and prostate volume (Table 2). Figure 1 illustrates the active treatment free survival estimates stratified by PRECISE score. A PRECISE >3, showed a higher probability of active treatments during follow up (p = 0.05).

Table 1. *Patients' characteristics*

Initial PSA (median, IQR)	6 (4.1–7.9)
Age (years, median IQR)	64 (59–70)
Prostate volume (ml, Median IQR))	51 (36–82)
cT1c	63 (100)
Active treatment	23 (39.7)
PI_RADS (at first MRI)	
1	9 (15.5)
2	9 (15.5)
3	15 (25.9)
4	19 (32.8)
5	6 (10.3)
PRECISE score (at second MRI)	
1	6 (10.1)
2	3 (5.2)
3	18 (31)
4	31 (53.4)
5	5 (7.9)
New lesions (second MRI)	25 (43.1)
ISUP progression	16 (27.6)
Biopsy progression	28 (48.3)
Follow up (months, Median IQR)	117 (62–148)

MRI – magnetic resonance imaging; IQR – interquartile range

Table 2. *Univariate logistic regression assessing predictors of ISUP and biopsy progression at second biopsy and Univariate Cox regression assessing predictors of Active treatment during follow up*

ISUP progression at second biopsy			
Parameter	OR	95% CI	P value
Age (continuous)	1.0	0.9–1.1	0.3
Initial PSA	0.9	0.8–1.3	0.9
PI-RADS ≥3 vs <3	0.8	0.5–1.3	0.3
Prostate volume (continuous)	1.0	0.9–1.0	0.7
PRECISE score >3 vs ≤3	3.8	1.1–13.0	0.04
Biopsy progression at second biopsy			
Parameter	OR	95% CI	P value
Age (continuous)	1.00	0.9–1.1	0.5
Initial PSA	0.9	0.7–1.1	0.7
PI-RADS ≥3 vs <3	0.8	0.5–2	0.4
Prostate volume (continuous)	0.9	0.9–1.1	0.4
PRECISE score >3 vs ≤3	3.2	1.1–9.7	0.03
Active treatment			
Parameter	HR	95% CI	P value
Age (continuous)	0.9	0.9–1.1	0.9
Initial PSA	1.1	0.8–1.3	0.5
Prostate volume (continuous)	0.9	0.9–1.0	0.8
PRECISE score >3 vs ≤3	1.1	1.0–1.6	0.05

OR – odd ratio; CI – confidence interval; PSA – prostate-specific antigen

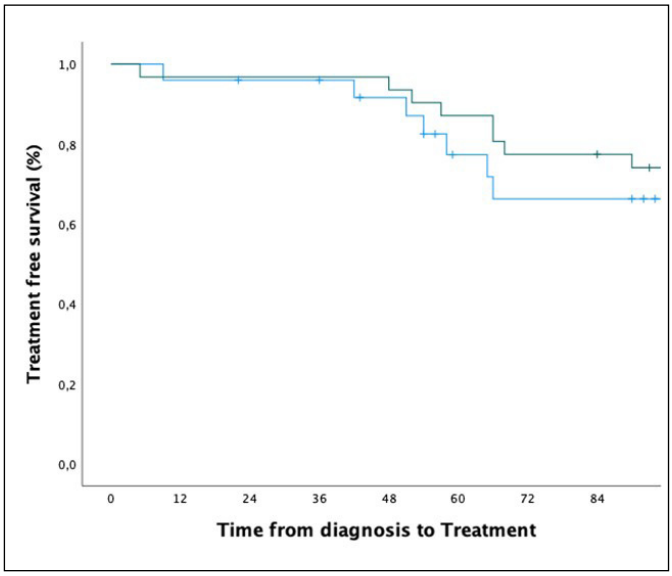

Figure 1. *Time from diagnosis to active treatment (blue PRECISE>3, green PRECISE ≤3). Log rank = 0.05.*

DISCUSSION

There is growing interest in MRI-based surveillance, whereby routine prostate biopsy can be avoided in the absence of radiological progression [2]. After all, prostate biopsy forms a barrier to patient adherence and tolerability. Our findings highlight the importance of the PRECISE score as a predictor of disease progression in patients undergoing active surveillance for prostate cancer, with consistent results with current literaturę [8]. A higher PRECISE score >3 was associated with an increased risk of biopsy progression suggesting that it may have some utility in identifying patients who requiring more aggressive treatment. The implementation of PRECISE scoring in a clinical setting is feasible and offers prognostic value [9–11].

While clinicians already have good experience with the PI-RADS recommendations, PRECISE offers more subtle information on the evolution of the lesions in time [12]. By utilizing the PRECISE Score, we identified the key strengths and potential additional benefits of the scoring system. However, we gained insights into potential weaknesses associated with the PRECISE scoring system, which can be addressed in future studies to enhance its value in AS practices [13, 14].

It is also important to note that PI-RADS 3 and PRECISE 3 are very similar in name and may cause confusion in daily practice as they have a completely different meaning. PI-RADS 3 is generally regarded as 'probably suspicious' (indeterminate lesion, usually considered as a positive MRI), while PRECISE 3 should rather be interpreted as 'not suspicious' (no progression). In our experience, PRECISE scoring already has added value in clinical practice. Future research will further determine the place of MRI in AS, in particular the ideal interval for repeat MRI, and its safety in replacing routine biopsies and the exact triggers for performing early prostate biopsy. Furthermore, it contributes to standardized MRI reporting, enabling more reliable data collection and synthesis, and will therefore help to develop future guideline recommendations. Ensuring quality control and utilizing the same MRI device during follow-up are crucial for optimizing diagnostic accuracy in the MRI-directed prostate cancer diagnostic pathway [15]. It is necessary to consider image quality when applying PRECISE scoring to maintain reliable results. Recent data from the PRECISION trial revealed that only 60% of MRI scans met the criteria for good quality [16].

The use of different MRI devices for patients on active surveillance (AS) presents challenges due to variations in noise, resolution, and ADC values. However, there is a lack of specific data on this topic. Consistent image quality is crucial over time, and quantitative thresholds for disease progression, compared with baseline and recent prior exams, aid in planning biopsies. Clarification is needed on deriving patient-level scores for cases with multiple lesions, understanding the relevance of PRECISE score 5, and categorizing new lesions in patients with previously MRI-invisible disease. To optimize the MRI-directed prostate cancer diagnostic pathway, experienced clinicians, optimized equipment, effective interdisciplinary communication, and standardized workflows are essential. Quality assurance processes, such as the Prostate Imaging-Reporting and Data System guidelines, help minimize variation, while quality control systems ensure consistency of outcomes and maximize the benefits of the MRI-directed pathway. [17].

We acknowledge that this is a small single center retrospective analysis. In our real-life cohort adherence to the PRIAS-protocol was not strict, certainly when it comes to the compliance with routine repeat prostate biopsies. All scans were re-reported by one single radiologist. Interobserver variability could therefore not be assessed, however expert radiologists achieved substantial reproducibility for the PRECISE scoring system [18]. Nevertheless, it was our objective to evaluate the feasibility of PRECISE scoring in clinical practice. Our work is an early step towards its validation and promotes structured data collection.

CONCLUSIONS

Our study provides insights of the prognostic value of PRECISE score. By identifying patients at increased risk of disease progression, PRECISE score

is a tool for guiding clinical decision-making. However, the integration of PRECISE score into clinical practice requires careful consideration of standardized reporting protocols and quality control measures to ensure diagnostic accuracy and reliability. Future research efforts should focus on further validating the predictive value of PRECISE scoring through larger prospective studies, facilitating its adoption.

DECLARATIONS

The authors did not receive support from any organization for the submitted work. All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript. All included patients undergoing radical treatment provided written informed consent for surgery.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This study was conducted in compliance with ethical guidelines and approved by the relevant institutional review board. Patient confidentiality and privacy were strictly maintained throughout the study, with all data anonymized and securely stored.

Informed consent was obtained from all individual participants included in the study.

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