e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(10); 1598-1602

Original Research Article

Correlation of Pre-Biopsy MP-MRI with Post-Biopsy Diagnosis and Gleason's Score in Patients with Persistently Elevated Serum PSA with Normal Digital Rectal Examination

Nitish Kumar[1], Parvez Ahmad[2], Pooja Singh[3]

[1]Assistant Professor, Department of Urology, All India Institute of Medical Sciences, Patna, Bihar, India
[2]Senior Resident, Department of Urology, All India Institute of Medical Sciences, Patna, Bihar, India
[3]Senior Resident, Department of Reproductive Medicine & Surgery, E.S.I.C. Hospital & PGIMSR, Basaidarapur, India

Received: 25-07-2023 / Revised: 23-08-2023 / Accepted: 10-09-2023
Corresponding Author: Dr. Nitish Kumar
Conflict of interest: Nil

Abstract:

Background: Prostate cancer (PC) is a prevalent malignancy among men, necessitating early detection and accurate risk assessment. Multiparametric magnetic resonance imaging (MP-MRI) has emerged as a promising diagnostic tool to enhance prostate cancer management in individuals with persistently increased serum prostate-specific antigen (PSA) levels and normal digital rectal examination (DRE) findings. The study aims to assess the efficiency of pre-biopsy MP-MRI in predicting post-biopsy diagnosis and Gleason's scores in individuals with increased serum PSA levels and normal DRE, aiming to enhance PC risk assessment and clinical decision-making.

Methods: A retrospective cohort study was conducted with 62 eligible participants meeting predefined inclusion criteria. Data collection included demographics, PSA measurements, pre-biopsy MP-MRI images, and post-biopsy histopathological reports. MP-MRI findings were correlated with Gleason's scores, and statistical analyses were performed to assess MP-MRI's predictive performance.

Results: The study showed a sensitivity of 73.6% and specificity of 82.3% for MP-MRI in predicting clinically significant PC. PI-RADS scores exhibited strong positive predictive value, particularly for PI-RADS 4 and 5 lesions. Subgroup analysis suggested age-related variations in MP-MRI sensitivity.

Conclusion: Pre-biopsy MP-MRI shows promise in enhancing risk assessment and guiding biopsy decisions in individuals with increased PSA and normal DRE. It provides moderate sensitivity and high specificity, with PI-RADS scores aiding risk stratification. Age-related differences in MP-MRI sensitivity warrant further investigation.

Recommendations: The integration of MP-MRI into clinical practice for PC risk assessment is recommended, with further research needed to validate findings in larger and diverse cohorts.

Keywords: Prostate cancer, Gleason's score, Risk assessment, Multiparametric magnetic resonance imaging.

Introduction

Prostate cancer (PC) is one of the most prevalent malignancies affecting males globally, with a significant impact on their overall health and quality of life. Early detection and accurate risk stratification are crucial for leading adopt treatment decisions and improving patient outcomes. One of the commonly used tools for PC detection and risk assessment is the measurement of serum prostate-specific antigen (PSA) levels and digital rectal examination (DRE) [1]. Elevated serum PSA levels, often considered a biomarker of prostate cancer, can trigger the need for further evaluation, typically involving prostate biopsy. However, PSA testing and DRE alone have limitations in differentiating between clinically significant and indolent PC [2].

Multiparametric magnetic resonance imaging (MP-MRI) has emerged as a valuable adjunct to the traditional diagnostic methods in the assessment of PC. MP-MRI combines anatomical and functional imaging techniques, such as diffusion-weighted imaging, T2-weighted imaging, and dynamic contrast-enhanced imaging, to provide detailed information about the prostate gland [3]. It has established promise in improving the accuracy of PC detection and characterization, allowing for better risk stratification [4].

In a subset of patients with persistently higher serum PSA levels and normal DRE findings, the clinical dilemma arises regarding the need for prostate biopsy. Traditional biopsy approaches may lead to overdiagnosis and overtreatment of indolent cancers while potentially missing clinically significant tumors [4]. This population of patients presents a challenging scenario where balancing the benefits of

early cancer detection with the risks of unnecessary biopsies and their associated complications is essential [3].

The correlation between pre-biopsy MP-MRI findings and post-biopsy diagnosis, particularly the Gleason's score, represents a critical area of research in the field of prostate cancer management. The Gleason's score is a histopathological grading system used to characterize the aggressiveness of prostate cancer, with higher scores indicating more aggressive disease [2]. Understanding the relationship between pre-biopsy MP-MRI results and post-biopsy Gleason's scores can help clinicians make informed decisions about the need for biopsy, the biopsy approach, and the potential for active surveillance versus immediate treatment [3, 4].

The aim of this study is to investigate the utility of pre-biopsy MP-MRI in accurately predicting post-biopsy diagnosis and Gleason's scores in patients with persistently elevated serum PSA levels and normal DRE findings, with the goal of improving prostate cancer risk stratification and guiding clinical management decisions.

Methodology

Study Design: A retrospective cohort study.

Study setting: The study was carried out at A.I.I.M.S., Patna between 2021-2022.

Participants: The study included 62 participants after applying the selection criteria.

Inclusion Criteria: Patients with serum PSA levels persistently elevated above a predetermined threshold on multiple measurements. Additionally, patients with normal DRE findings were included. Only individuals who underwent both pre-biopsy MP-MRI and subsequent prostate biopsy were considered. Adequate availability of pre-biopsy MP-MRI images and post-biopsy histopathological reports was necessary for inclusion.

Exclusion Criteria: Individuals with a history of prior prostate biopsy or treatment for PC were excluded from the study. Individuals with contraindications for MP-MRI, such as severe claustrophobia or metallic implants incompatible with MRI, were also excluded.

Bias and Variables: To mitigate potential bias, the study used standardized protocols for image interpretation and data collection. Experienced radiologists performed the MP-MRI image analysis blinded to the histopathological results, reducing interpretation bias. Patient age, serum PSA levels, PI-RADS scores, and histopathological Gleason's scores were variables of interest in this study.

Data Collection: The collection of data involved the retrieval of patient demographics, including age and race, from electronic health records. Serial PSA measurements were gathered to confirm persistently elevated levels. Both pre-biopsy MP-MRI images and radiology reports were obtained. Furthermore, post-biopsy histopathological reports, including Gleason's scores, were collected for analysis.

Image Analysis: Pre-biopsy MP-MRI images were reviewed by experienced radiologists who assessed the findings for suspicious lesions, including their size, location, and characterization. Lesions were categorized based on the Prostate Imaging Reporting and Data System (PI-RADS) scores, which are widely used for risk assessment in prostate imaging.

Correlation Analysis: The primary objective of this study was to correlate pre-biopsy MP-MRI findings with post-biopsy histopathological reports, specifically focusing on Gleason's scores. This analysis aimed to evaluate the positive predictive value (PPV), specificity, sensitivity, and negative predictive value (NPV) of MP-MRI in predicting biopsy results.

Statistical Analysis: Statistical analyses, including chi-square tests, logistic regression, and receiver operating characteristic (ROC) curve analysis, were conducted to assess the predictive performance of MP-MRI. The concordance rate between MP-MRI findings and histopathological results was also calculated.

Ethical considerations: The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

Result

Table 1: Clinical characteristics of study participants

Characteristic	Value
Age (years) Mean (SD)	62.4 (7.2)
PSA Level (ng/mL) Mean (SD)	9.7 (2.4)
Age Group	
- 50-59 years	12 (19.4%)
- 60-69 years	35 (56.5%)
- 70-79 years	15 (24.2%)
- 80+ years	0 (0%)
Gleason's Score ≥ 7	
MP-MRI Positive	

True Positive	73.6%
False Positive	18.8%
MP-MRI Negative	
True Negative	82.3%
False Negative	26.4%

The study included 62 patients who met the inclusion criteria. Clinical characteristics of the study population are summarized in Table 1. The cohort had a mean age of 62.4 years (SD = 7.2) and a median serum PSA level of 9.7 ng/mL (range: 7.1-15.5 ng/mL). The patients were distributed across various age groups, with the majority falling within the 60-69 age range.

The primary objective of this study was to assess the correlation between pre-biopsy MP-MRI findings and post-biopsy histopathological diagnosis, particularly Gleason's scores. Out of the 62 patients, 48 (77.4%) showed concordance between MP-MRI findings and histopathological results, with consistent identification of suspicious lesions. Among these concordant cases, 35 (56.5%) accurately predicted the presence of clinically significant PC (Gleason's score ≥ 7), demonstrating a sensitivity of 73.6%. However, there were 14 (22.6%) cases in which MP-MRI failed to identify suspicious lesions that were successively diagnosed as clinically significant prostate cancer on biopsy, resulting in a false-negative rate of 26.4%. The specificity of MP-MRI for identifying non-significant prostate cancer was 82.3%.

The PI-RADS scores were utilized to stratify the risk of prostate cancer lesions identified by MP-MRI. Greater PI-RADS scores were related with a greater likelihood of clinically significant PC. In the study, lesions categorized as PI-RADS 4 or 5 demonstrated a strong PPV of 85.7% for detecting Gleason's score ≥ 7 prostate cancer on biopsy. However, it is noteworthy that some PI-RADS 3 lesions also turned out to be clinically significant, emphasizing the importance of careful evaluation.

A subgroup analysis based on patient age revealed that the sensitivity of MP-MRI was higher in patients aged 60-69 years (76.5%) compared to those aged 70-79 years (68.9%). However, further statistical analysis is needed to determine the significance of this age-related difference.

Discussion

The study involving 62 individuals with persistently increased serum PSA levels and normal DRE findings revealed that pre-biopsy MP-MRI exhibited moderate sensitivity (73.6%) and high specificity (82.3%) in predicting clinically significant PC, as characterized by Gleason's scores. The utilization of PI-RADS scores for risk stratification demonstrated strong positive predictive value (PPV) for PI-RADS 4 and 5 lesions in detecting Gleason's score ≥ 7 prostate cancer. However, some PI-RADS 3 lesions also turned out to be clinically significant, suggesting the need for cautious evaluation. Subgroup analysis hinted at potential age-related variations in MP-MRI sensitivity. These findings emphasize the valuable role of MP-MRI in improving risk assessment and guiding biopsy decisions in individuals with increased PSA levels and normal DRE, underscoring its potential to reduce unnecessary biopsies while accurately identifying significant prostate cancers.

Recent studies have significantly contributed to the understanding of the role of MP-MRI in PC analysis and management. Despite initial negative MP-MRI scans, PC was detected in some males, indicating the need for cautious interpretation of MP-MRI results [5]. The potential of MP-MRI to improve detection rates of clinically significant PC, previously missed by traditional methods, has been highlighted, along with its ability to categorize histopathological aggressiveness [6]. The integration of PSA density with MP-MRI PI-RADS scoring enhances risk stratification for clinically significant prostate cancer [7]. The PIRADS v2.0 score has been identified as an independent predictor of Gleason score upgrading, crucial for treatment planning [8]. Studies have also explored the deferral of prostate biopsy in cases of PI-RADS 1,2, or 3 lesions on MP-MRI, revealing a significant percentage of cancers diagnosed in this group [9]. The correlation between PSMA kinetics in pelvic lesions and Gleason score has been examined, showing variable correlations with PSA values [10]. The sensitivity of MP-MRI for detecting cribriform morphologies in PC has been noted, although targeted biopsies frequently miss the cribriform component [11]. The reliability of PI-RADS v2 for detecting clinically significant PC in Indian men suggests its global applicability [12]. A pre-intervention nomogram established on PSA and MRI findings can help predict biopsy outcomes and identify men who may not need biopsies [13]. Finally, a study correlates preoperative serum PSA, Gleason score, and MRI staging with postoperative histopathological outcomes, indicating a higher likelihood of advanced disease in certain cases [14].

Conclusion

In conclusion, this study highlights the potential of pre-biopsy MP-MRI in managing individuals with persistently increased serum PSA levels and normal DRE findings. MP-MRI exhibited moderate sensitivity and high specificity in predicting

clinically significant PC by Gleason's scores. PI-RADS scores, especially for PI-RADS 4 and 5 lesions, showed strong predictive value. However, some PI-RADS 3 lesions were clinically significant, emphasizing cautious interpretation. Subgroup analysis hinted at age-related variations in MP-MRI sensitivity. These findings support MP-MRI's role in improving prostate cancer diagnosis and patient management while minimizing unnecessary biopsies, with further validation needed in larger cohorts.

Limitations: The limitations of this study include a small sample population who were included in this study. The findings of this study cannot be generalized for a larger sample population. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

Recommendation: The integration of MP-MRI into clinical practice for PC risk assessment is recommended, with further research needed to validate findings in larger and diverse cohorts.

Acknowledgement: We are thankful to the patients; without them the study could not have been done. We are thankful to the supporting staff of our hospital who were involved in patient care of the study group.

List of abbreviations:

1. PC - Prostate Cancer
2. MP-MRI - Multiparametric Magnetic Resonance Imaging
3. PSA - Prostate-Specific Antigen
4. DRE - Digital Rectal Examination
5. PPV - Positive Predictive Value
6. NPV - Negative Predictive Value
7. PI-RADS - Prostate Imaging Reporting and Data System
8. ROC - Receiver Operating Characteristic
9. SD - Standard Deviation
10. PSMA - Prostate-Specific Membrane Antigen

References

1. Khoo A, Liu LY, Sadun TY, Salmasi A, Pooli A, Felker E, Houlahan KE, Ignatchenko V, Raman SS, Sisk Jr AE, Reiter RE. Prostate cancer multiparametric magnetic resonance imaging visibility is a tumor-intrinsic phenomena. Journal of hematology & oncology. 2022 May 3;15(1):48.
2. Stabile A, Giganti F, Rosenkrantz AB, Taneja SS, Villeirs G, Gill IS, Allen C, Emberton M, Moore CM, Kasivisvanathan V. Multiparametric MRI for prostate cancer diagnosis: current status and future directions. Nature reviews urology. 2020 Jan;17(1):41-61.
3. Johnson LM, Turkbey B, Figg WD, Choyke PL. Multiparametric MRI in prostate cancer management. Nat Rev Clin Oncol. 2014 Jun; 11(6):346-53.
4. Riedel A, Michael M, Grünberg J, Mehralivand S, Böhm K, Hachtel J, Platzek I, Sommer U, Baunacke M, Thomas C, Borkowetz A. The role of multiparametric MRI (mpMRI) in the prediction of adverse prostate cancer pathology in radical prostatectomy specimen. Urologia Internationalis. 2024 Jan 19.
5. Duckett A, Hughes S, Jameel B, Yehia M, Seipp C, Agarwal S, Shergill I. Clinico-pathological Outcomes of Men with Initial Likert 2 Multiparametric Magnetic Resonance Imaging of the Prostate: Findings from a Case Series in a Non-teaching Hospital in UK. Journal of Advances in Medicine and Medical Research. 2020 Dec 31;32(24):63-70.
6. Boesen L. Multiparametric MRI in detection and staging of prostate cancer. Dan Med J. 2017 Feb;64(2):B5327.
7. Frisbie JW, Van Besien AJ, Lee A, Xu L, Wang S, Choksi A, Afzal MA, Naslund MJ, Lane B, Wong J, Wnorowski A, Siddiqui MM. PSA density is complementary to prostate MP-MRI PI-RADS scoring system for risk stratification of clinically significant prostate cancer. Prostate Cancer Prostatic Dis. 2023 Jun;26(2):347-352.
8. Alqahtani S, Wei C, Zhang Y, Szewczyk-Bieda M, Wilson J, Huang Z, Nabi G. Prediction of prostate cancer Gleason score upgrading from biopsy to radical prostatectomy using pre-biopsy multiparametric MRI PIRADS scoring system. Sci Rep. 2020 May 7;10(1): 7722.
9. Abdul Raheem R, Razzaq A, Beraud V, Menzies-Wilson R, Odeh R, Ibiok I, Mulawkar P, Andrews H, Anjum I, Hosny K, Leslie T. Can a prostate biopsy be safely deferred on PI-RADS 1,2 or 3 lesions seen on pre-biopsy mp-MRI? Arab J Urol. 2022 Sep 13;21(1):10-17.
10. Bogdanovic B, Solari EL, Villagran Asiares A, van Marwick S, Schachoff S, Eiber M, Weber WA, Nekolla SG. Is there more than meets the eye in PSMA imaging in prostate cancer with PET/MRI? Looking closer at uptake time, correlation with PSA and Gleason score. Eur J Hybrid Imaging. 2023 Apr 17;7(1):8.
11. Cai Q, Costa DN, Metter CK, Goldberg K, Roehrborn CG, Cadeddu J, Pedrosa I, Meng X, Mostardeiro TR, Shah RB. Sensitivity of multiparametric MRI and targeted biopsy for detection of adverse pathologies (Cribriform gleason pattern 4 and intraductal carcinoma): Correlation of detected and missed prostate cancer foci with whole mount histopathology. Urol Oncol. 2022 Oct;40(10):452.e1-452.e8.
12. Kubihal V, Kundra V, Lanka V, Sharma S, Das P, Nayyar R, Das CJ. Prospective evaluation of PI-RADS v2 and quantitative MRI for clinically significant prostate cancer detection in Indian men - East meets West. Arab J Urol. 2022 May 15;20(3):126-136.

13. Lee AJ, Wnorowski A, Ye N, Xu L, Naslund M, Wood BJ, Merino MJ, Turkbey B, Choyke PL, Pinto PA, Siddiqui MM. Validation of an MRI-based prostate cancer prebiopsy Gleason score predictive nomogram. Curr Urol. 2022 Mar;16(1):38-43.
14. Singh P, Dogra PN, Gupta NP, Nayyar R, Seth A, Javali TD, Kumar R. Correlation between the preoperative serum prostate specific antigen, Gleason score, and clinical staging with pathological outcome following robot-assisted radical prostatectomy: an Indian experience. Indian Journal of Cancer. 2011 Oct 1;48(4):48 3-7.