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Research Article

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Evaluation of Prostate Cancer Screening Efficiency with PSA and MRI in Northern India: A Retrospective Analysis

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ABSTRACT

Background: Prostate cancer poses a significant health concern in males, exhibiting diverse manifestations ranging from slow to aggressive progression. Diagnostic challenges persist due to limitations of conventional methods like DRE and PSA tests, prompting interest in MRI screening for its enhanced sensitivity and specificity thereby reducing unnecessary biopsy.

Methods: This retrospective study, conducted in (Govt Doon Medical College Hospital, a tertiary care centre in Uttarakhand, Northern India, enrolled 100 participants with prostate-specific antigen (PSA) levels above 3 ng/ml. Patients underwent Magnetic resonance imaging (MRI) screening and clinical evaluation, with biopsy confirmation if abnormalities were detected. Primary outcomes assessed prostate cancer incidence over seven years, with secondary outcomes including high-grade disease detection and overall survival. Statistical analyses utilized SPSS 27 for correlations and logistic regression.

Results: The study includes 100 prostate cancer cases, categorized into locoregional and advanced prostate cancer groups. Locoregional cases (60 in number, were in the age range of 65-69 yrs, exhibited T3 TNM classification (41.6%) with unknown nodal involvement (66.6%) and absence of distant metastasis (63.3%). Advanced cases (40 in number) shared similar demographics, notably with 82.5% aged 65-69. Comparing MRI and biopsy outcomes, the experimental group detected more cancers (100%) than the reference group (66%). MRI-targeted biopsies showed promise in detecting significant cancers while identifying more clinically insignificant ones.

Conclusion: The study demonstrates MRI's potential in detecting prostate cancer, particularly in cases with higher PSA levels or advanced stages. The findings underscore the importance of MRI as a complementary tool in prostate cancer screening, warranting further investigation.

Key-words: Prostate cancer, MRI screening, PSA, Biomarkers, Distant metastasis, Early detection

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INTRODUCTION

Prostate cancer is the second-most common cancer among men [1] worldwide. The World Health Organization recommends early detection of prostate cancer using two strategic approaches: screening and early diagnosis.

Manifestations of prostate cancer often occur in later stages, with symptoms such as urinary difficulties, hematuria, erectile dysfunction, pelvic, back, or chest

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pain, as well as sensory deficits in the lower extremities. [2] Diagnostic approaches for prostate cancer typically involve a combination of a digital rectal examination (DRE) and PSA blood test. Nonetheless, these conventional methods possess limitations and may yield false positives, leading to unnecessary biopsies and patient distress. [3]

MRI is the diagnostic imaging technique of choice in early diagnosis, location, and staging of prostate cancer.[4-6] Because of the high disease incidence of prostate cancer, parameters for the early detection of prostate cancer are controversial.[7] Multi-parametric MRI (mp-MRI) of the prostate involves anatomic sequences such as high-resolution T2-weighted (T2W) images and functional sequences such as diffusion and perfusion imaging that not only evaluate anatomy but also cellularity and tissue vascularity, resulting in improved diagnostic accuracy.[8] In 2012, the European Society of Urogenital Radiology published a series of guidelines recommending the interpretation of mp-MRI images to describe and obtain a report called Prostate Imaging Reporting and Data System.[9] Later, the prostate imaging reporting and data system (PI-RADS) was improved and updated to PI-RADS v2 version 2 (PI-RADS v2) by American College of Radiologists and EUSR. [10]

MRI-based screening for prostate cancer entails the utilization of magnetic fields and radio waves to generate detailed images of the prostate gland. Distinguished by its non-ionizing radiation nature, MRI offers superior delineation of tumor size, localization, and aggressiveness compared to conventional.

However, challenges associated with MRI screening for prostate cancer include cost considerations, accessibility issues, and the requirement for specialized expertise in image interpretation. In summary, prostate cancer represents a prevalent malignancy predominantly affecting males. While traditional screening modalities include DRE and PSA testing, MRI is a promising adjunct for enhancing detection sensitivity and reducing unnecessary biopsies. Nonetheless, efforts are warranted to address challenges and optimize the potential impact of MRI on prostate cancer diagnosis and management.

MATERIALS AND METHODS

Study Design- The study is retrospective, where data was collected from medical records of patients referred to the cancer outpatient department, Govt Doon Medical College Hospital, a tertiary care centre in the hilly region of Uttarakhand, Northern India. Patients with elevated PSA levels total or free were included who underwent MRI and later on biopsy were found to have confirmed diagnosis of prostate cancer.

Participants and Randomization- The study enrolled 100 patients with suspicion of prostate cancer on presentation to the outpatient department (raised S. PSA levels and abnormal/normal digital rectal examination). A detailed history was recorded, and the patient was subjected to MRI using Siemens 1.5 Tesla MRI scanner using sense body coil. T2W sequence was performed in axial, coronal, and sagittal planes. The Field of view (FOV) of 12–20 cm and slice thickness/gap of 3 mm/0.3 mm were used. TSE T1-weighted (T1W) sequence was done in an axial plane using an FOV of 12–20 cm and slice thickness/gap of 3 mm/0.3 mm. Diffusion-weighted imaging (DWI) was performed in axial planes using the Echo Planar Imaging sequence with FOV of 16–22 cm and slice thickness/gap of 3 mm/0.3 mm. Corresponding Apparent Diffusion Coefficient images were also obtained. Pre contrast T1W images were obtained, followed by post contrast dynamic images.

Mp-MRI images were reviewed, and lesions involving the peripheral zones were evaluated. The size of the lesion was obtained in all three planes, and the largest value was considered. Patterns of enhancement on dynamic contrast-enhanced (DCE) sequences were noted. PI-RADS v2 scoring was performed, and local staging done by MRI examination only (no radical prostatectomy performed). Extraprostatic Disease (T3a) was identified on MRI by recommendations of Weinreb *et al*. [10] and included (a) Capsular Abutment, (b) Capsular irregularity, spiculation, or retraction, (c) Neurovascular bundle asymmetry or thickening, (d) Obliteration of the rectoprostatic angle, tumor-capsular contact >10 mm, and (f) Bulge or loss of capsule. All patients were subjected to trans rectal ultrasound (TRUS) guided biopsy using Bard Trucut Biopsy Needle. Histopathological examination was performed on all biopsy specimens and interpreted by a single pathologist. The results were tabulated, and Statistical analysis was performed using the Statistical package.

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Statistical Analysis- Statistical analyses were conducted using SPSS 27. The study employed Pearson's correlation with Yates' correction to assess the relationships between baseline parameters and prostate cancer risk. Logistic regression was used to evaluate associations between prostate cancer risk and high-grade disease. Variables in the analyses included age, family history of prostate cancer, race, and PSA. Analytical tools like ANOVA and bivariate correlation have been applied to analyse MRI as a screening tool for the detection of prostatic cancer.

Ethical Approval- Approval for this study was obtained from the relevant ethical committee, ensuring that all research procedures adhered to ethical standards and guidelines for protecting participants' rights and confidentiality.

RESULTS

Hundred patients were included in the study. The mean age of the patients in our study was 66.5±9.6 years. S. PSA levels ranged from 4.8 ng/ml to 98 ng/ml. PI-RADS v2 scoring was performed in all patients. The majority of cases (45.5%) had PI-RADS v2 score of 5 followed by score 4 (33.3%). Four patients had PI-RADS v2 score of 3 and were subjected to DCE imaging. No abnormal contrast washout was seen, and score was kept at 3 only. Two cases of PI-RADS v2 score 2 and a single case of PI-RADS v2 score 1 were also seen in our study.

The majority of patients with PI-RADS v2 score 5 (46.7%) had S. PSA levels >40 ng/ml, while most of the patients with PI-RADS v2 score 4 (45.5%) had S. PSA levels between 20 and 39.9 ng/ml. 50% of patients with PI-RADS v2 score 3 had S. PSA levels between 10 and 19.9. Solitary case of PI-RADS 1 and single case each of PI-RADS 2 and 5 had S. PSA levels between 4 and 9.9 ng/ml (Table 1).

Table 1: Distribution of patients according to serum prostatic-specific antigen level and prostate imaging reporting and data system version score (n=100) (p=0.01)

PSA	1	2	3	4	5
4- 9.9	20	18	5	3	1
10-19.9	5	5	8	1	1
20-39.9	1	2	3	2	5
40 and above	0	0	5	7	13

PI-RADS v2: Prostate imaging reporting and data system version; PSA: Prostatic-specific antigen; MRI: Magnetic resonance imaging Serum PSA level (ng/ml); PI-RADS v2 Score on MRI

PI-RADS v2 score 1 and PI-RADS v2 score 2 were considered negative for cancer in our study, whereas PI-RADS v2 scores 3, 4, and 5 were considered positive. Local (T) staging was also performed in all cases. Majority (53.2%) cases were T3 lesions followed by T4 disease (34.4%). T2 disease on MRI was seen in 15.7% of cases. The majority of patients with PI-RADS v2 score 5 were T3 and T4 lesions, while 60% of patients with PI-RADS v2 score 3 had T2 disease (Table 2).

Table 2: Distribution of patients according to local stage (T) and prostate imaging reporting and data system version score (n=32 as one patient was negative for malignancy on biopsy) (p=0.000)

T Stage	1	2	3	4	5
T1	1	0	0	0	0
T2	0	1	3	1	0
T3	0	0	1	8	8
T4	0	0	0	2	7

PI-RADS v2: Prostate imaging reporting and data system version; MRI: Magnetic resonance imaging Local stage of disease (T); PI-RADS v2 score on MRI

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The biopsy was performed in all cases. All patients with PI-RADS v2 scores 3, 4, and 5 had evidence of malignancy on histopathology. Among two patients with PI-RADS v2 score 2, one was negative for malignancy on biopsy, whereas the second patient was positive on biopsy with Gleason Grade 2 (Gleason Score 3 + 4). Solitary case of PI-RADS v2 score 1 had changes suggestive of benign disease on biopsy, but due to strong clinical suspicion of malignancy, immunohistochemistry was performed, which was positive of carcinoma with Gleason Grade 1 (Gleason Score 3 + 3). Sensitivity, specificity, positive predictive value, and negative predictive value of PI-RADS v2 in diagnosing prostate cancer were 93.75%, 100%, 100%, and 33.33%, respectively.

PI-RADS v2 score obtained in each case was correlated with S. PSA levels and T staging and it revealed a significant correlation with P values of 0.01 and 0.001, respectively (Table 3).

Table 3: Distribution of prostate biopsy grade by PSA and MRI arm

Histology grade	PSA ARM (ng/ml)			MRI ARM	
	2.6- 4	4.1 - 10	10.1 - 20	PIRADS 4	PIRADS 5
Gleason score 6	0	4		4	0
Gleason score 7					
(3+4)	1	0	1	3	3
(4+3)	1	0	0	3	0
Gleason score 8–10	0	1	0	2	0

DISCUSSION

Worldwide prostate cancer is the second commonest malignancy in males.[1] On clinical and/or biochemical suspicion, MRI can help in the detection and localization of prostate CA.[11] The introduction of the mp-MRI as a screening test to define the patients with suspected tumours, who need to be submitted to biopsy can significantly change the current scenario.[12,13] PI-RADS v2 uses a 5-point scoring scale on T2W and DWI with a 2-point scale for DCE for assessment of clinically significant prostate cancer. [11] Score 1 represents very low likelihood of clinically significant cancer, while score 5 represents very high likelihood of clinically significant prostatic cancer with PI-RADS v2 score 3 being equivocal.[11] DCE is helpful only in the category 3 peripheral zone lesions.[14] In our study, the DWI score was taken as the final score and no up-gradation of category 3 lesions occurred on DCE sequences.

In our study, among all negative patients on mp-MRI (PI-RADS v2 score 1 and 2), 2 patients had clinically significant tumors at biopsy. All positive patients on mp-MRI in our study (PI-RADS v2 score 3 and above) had evidence of malignancy on biopsy. Hence, mp-MRI had a high sensitivity (93.75%) and specificity (100%) in diagnosing prostatic cancer. The results were similar to previously published studies in literature. [9,13,14]

Another significant aspect of our results was that all patients with clinically significant tumors had PI-RADS v2 3–5 score, signifying that PI-RADS v2 score 3 can be considered as cutoff value for biopsy. Similar conclusions were also derived by Rozas *et al*. [9] in their study. Both the false-negative tumors in our study were low-grade cancers with Gleason score 6. So, patients with PI-RADS v2 mp-MRI scores of 1 and 2 can be followed with S. PSA levels and repeat mp-MRI without needs for an invasive biopsy.

Furthermore, in our study, there was a highly significant correlation between the incremental PI-RADS v2 score with incremental S. PSA levels and the local stage of the disease. The results were similar to study by Singh *et al.* [11] who correlated PI-RADS v2 score with S. PSA levels, T staging, and ADC values and obtained a highly significant correlation with $p<0.005$ [15-18].

CONCLUSIONS

The study has shown that MRI can be used to detect prostate cancer, specially with higher PSA or advanced stage. In conclusion, the comparative analysis of MRI assessment and biopsy outcomes between the experimental and reference groups provides valuable insights into the efficacy of different biopsy strategies for prostate cancer detection. PI-RADS v2 should be

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routinely incorporated in the reporting protocol of prostate cancer. Mp-MRI has high sensitivity and specificity in diagnosing clinically significant prostate cancer. A significant correlation was observed in our study between lesion score on PI-RADS v2, S. PSA levels, and local stage of disease. Predominant MRI sequence for prostate cancer is diffusion-weighted sequence with no additional benefit of DCE sequences. Mp-MRI can also safely identify which patients can be excluded for biopsy due to its high sensitivity and specificity to identify clinically significant prostate tumours.

While MRI-targeted biopsies may enhance the early detection of significant cancers, they may also increase the identification of clinically insignificant cancers. These findings underscore the potential of MRI as a reliable diagnostic tool for prostate cancer detection, warranting further research to optimize its clinical utility.

CONTRIBUTION OF AUTHORS

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REFERENCES

[1] Tourinho-Barbosa RR, Pompeo AC, Glina S. Prostate cancer in Brazil and Latin America: Epidemiology and screening. Int Braz J Urol., 2016; 42: 1081–90.

[2] Yu KK, Hricak H. Imaging prostate cancer. Radiol Clin North Am. 2000; 38: 59–85. viii.

[3] Heiken JP, Forman HP, Brown JJ. Neoplasms of the bladder, prostate, and testis. Radiol Clin North Am., 1994; 32: 81–98.

[4] Turkbey B, Pinto PA, Mani H, Bernardo M, Pang Y, McKinney YL, et al. Prostate cancer: Value of multiparametric MR imaging at 3 T for detection–histopathologic correlation. Radiol., 2010; 255: 89–99.

[5] Fütterer JJ. MR imaging in local staging of prostate cancer. Eur J Radiol., 2007; 63: 328–34.

[6] Fütterer JJ, Briganti A, De Visschere P, Emberton M, Giannarini G, et al. Can clinically significant prostate cancer be detected with multiparametric magnetic resonance imaging? A systematic review of the literature. Eur Urol., 2015; 68: 1045–53.

[7] Heidenreich A. Consensus criteria for the use of magnetic resonance imaging in the diagnosis and staging of prostate cancer: Not ready for routine use. Eur Urol., 2011; 59: 495–7.

[8] Hoeks CM, Barentsz JO, Hambrock T, Yakar D, Somford DM, Heijmink SW, et al. Prostate cancer: Multiparametric MR imaging for detection, localization, and staging. Radiol., 2011; 261: 46–66.

[9] Rozas GQ, Saad LS, Melo HJ, Gabrielle HA, Szejnfeld J. Impact of PI-RADS v2 on indication of prostate biopsy. Int Braz J Urol., 2019; 45: 486–94.

[10] Weinreb JC, Barentsz JO, Choyke PL, Cornud F, Haider MA, Macura KJ. PI-RADS prostate imaging – Reporting and data system: 2015, Version 2. Eur Urol., 2016; 69: 16–40.

[11] Singh K, Gupta K, Thukral CL, Goyal P, Arora V, Singh I. PI-RADS v2 in prostate cancer and correlation with T staging, PSA levels and ADC values. Iran J Radiol., 2018; 15: e14038.

[12] Abraham NE, Mendhiratta N, Taneja SS. Patterns of repeat prostate biopsy in contemporary clinical practice. J Urol., 2015; 193: 1178–84.

[13] Ahmed HU, El-Shater Bosaily A, Brown LC, Gabe R, Kaplan R, et al. Diagnostic accuracy of multi-parametric MRI and TRUS biopsy in prostate cancer (PROMIS): A paired validating confirmatory study. Lancet, 2017; 389: 815–22.

[14] Sarkarian M, Kheradmand A, Haghiabi H, Kolbadinezhad M. Diffusion-weighted magnetic resonance imaging (DW-MRI) as a diagnostic method for prostate cancer. Nephro Urol Mon., 2018; 10: e82856.

[15] Kvale R, Møller B, Wahlqvist R, Fosså SD, Berner A, Busch C, et al. Concordance between Gleason scores of needle biopsies and radical prostatectomy specimens: A population based study. BJU Int., 2009; 103: 1647–54.

DOI: 10.21276/SSR-IIJLS.2024.10.3.23

[16]Divrik RT, Eroglu A, Sahin A, Zorlu F, Ozen H. Increasing the number of biopsies increases the concordance of Gleason scores of needle biopsies and prostatectomy specimens. Urol Oncol., 2007; 25: 376–82.

[17]Tomioka S, Nakatsu H, Suzuki N, Murakami S, Matsuzaki O, et al. Comparison of Gleason grade and score between preoperative biopsy and prostatectomy specimens in prostate cancer. Int J Urol., 2006; 13: 555–9.

[18]Rajinikanth A, Manoharan M, Soloway CT, Civantos FJ, et al. Trends in Gleason score: Concordance between biopsy and prostatectomy over 15 years. Urol., 2008; 72: 177–82.