Original Article

Correlation between Prostate Imaging Reporting and Data System Version 2, Prostate-Specific Antigen Levels, and Local Staging in Biopsy-Proven Carcinoma Prostate: A Retrospective Study

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Abstract

Background: Multi-parametric magnetic resonance imaging (mp-MRI) is a promising tool in the diagnosis of clinically significant prostate cancer. Morphologic assessment using T2-weighted (T2W) images and functional assessment with diffusion-weighted imaging is the cornerstone for the diagnosis of prostate cancer on mp-MRI. **Aim/Objectives:** The aim of this study is to evaluate the role of mp-MRI based prostate imaging reporting and data system version 2 (PI-RADS v2) for the assessment of prostate cancer and its correlation with serum prostate specific antigen (S.PSA) levels, local (T) staging on MRI and histopathology. **Materials and Methods:** The study was carried out from June 2019 to February 2020. All patients with raised S.PSA levels and abnormal digital rectal examination who underwent mp-MRI of the prostate were included. MRI findings were characterized on the basis of PI-RADS v2 grading. All the patients underwent biopsy and histopathology. The score was correlated with S.PSA levels and the local stage of disease on MRI. Statistical analysis was performed, and results interpreted. **Results:** Carcinoma prostate was reported in 32/33 cases on biopsy. A significant correlation was observed between PI-RADS v2 score and S.PSA Levels and between PI-RADS v2 score and T stage of disease in our study. MRI was highly sensitive (93.75%) and specific (100%) in the diagnosis of prostate cancer in our study. **Conclusions:** Significant correlation between lesion score on PI-RADS v2 with the local stage and S.PSA levels was seen, thus signifying the importance of mp-MRI in detecting clinically significant prostate cancer. Diffusion-weighted and T2W sequences were the primary diagnostic sequence for the prostate cancer with no additional role of dynamic contrast enhanced sequences.

Keywords: *Carcinoma, diffusion-weighted imaging, prostate, prostate-specific antigen*

Introduction

Prostate cancer is the second-most common cancer among men[1] and its detection remains a diagnostic challenge. The World Health Organization recommends early detection of prostate cancer using two strategic approaches: screening and early diagnosis. Primary obstacles in the early diagnosis of prostate cancer include the inability of rectal exam and serum prostate-specific antigen (S.PSA) to distinguish benign and subclinical conditions and clinically significant prostate cancer.[2,3] There is a need of diagnostic technique and protocol to categorize patients with elevated S.PSA levels and/or altered rectal examination and recommend further investigations to reduce the number of unnecessary biopsies and improve diagnostic accuracy.

Magnetic resonance imaging (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, prostate imaging reporting and data system (PI-RADS) was

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improved and updated to PI-RADS v2 version 2 (PI-RADS v2) by American College of Radiologists, EUSR and AdMe Tech Foundation.[10]

Materials and Methods

Thirty-three patients with suspicion of prostate cancer (raised S. PSA levels and abnormal digital rectal examination) formed the material of the study. A detailed history was recorded, and the patient subjected to MRI using Siemens 1.5 T Essenza MRI scanner using sense body coil. Turbo spin-echo (TSE) 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. B-values of 0, 400, 800, and 1200 were used. Corresponding Apparent Diffusion Coefficient images were also obtained. Precontrast T1W images were obtained, followed by postcontrast 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 for the Social sciences.

Results

Thirty-three 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 192.2 ng/ml. PI-RADS v2 scoring was performed in all patients. The majority of cases (45.5%) had PI-RADS v2 score of 5 [Figure 1] 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 [Figure 2]. 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].

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].

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) [Figure 3]. 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 [Tables 1 and 2].

Discussion

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

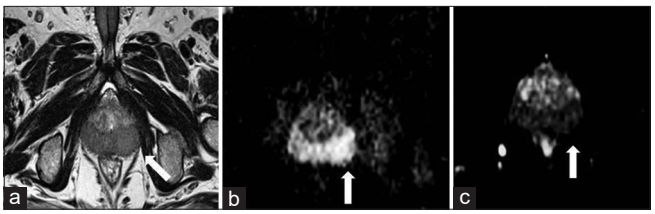

Figure 1: (PI-RADS v2 Score 5 Lesion). Axial T2WI (a) sequence reveals large ill-defined hypointensity in the peripheral zone of the prostate on the left side (white arrow), extending into the contralateral side. The corresponding area appears markedly hyperintense (white arrow) on DWI (b) and markedly hypointense (white arrow) on ADC maps (c). The patient had S. PSA level of 38.1 ng/ml and biopsy of the lesion revealed high-grade adenocarcinoma (Gleason Grade 5, Gleason score 4 + 5)

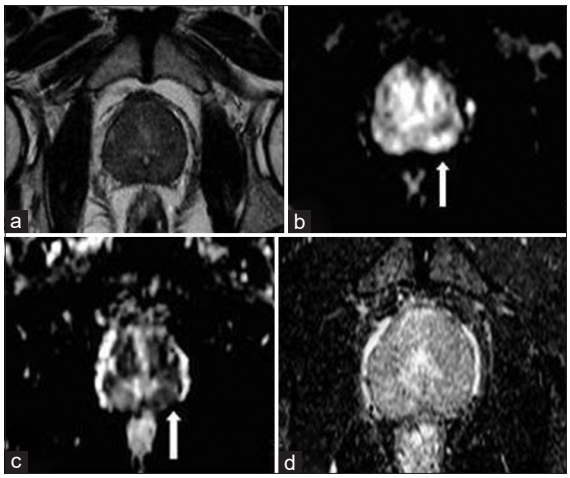

Figure 2: (PI-RADS v2 Score 3 Lesion). Axial T2-weigthed image (a) sequence reveals no definite hypointensity in the peripheral zone of the prostate. The corresponding diffusion-weighted imaging (b) images reveal small, subtle hyperintensity in the left posterior peripheral zone (white arrow). On ADC (c) images, the corresponding area reveals subtle hypointensity (white arrow). No early enhancement on dynamic post-contrast images (d) seen. The patient had S. PSA level of 15 ng/ml, and biopsy of the lesion revealed low-grade adenocarcinoma (Gleason Grade 2, Gleason score 3 + 4)

Table 1: Distribution of patients according to serum prostatic-specific antigen level and prostate imaging reporting and data system version score (*n*=33) (*P*=0.01)

Serum PSA level (ng/ml)	PI-RADS v2 Score on MRI				
	1	2	3	4	5
4-9.9	1	1	1	-	1
10-19.9	-	1	2	4	2
20-39.9	-	-	1	5	5
40 and above	-	-	-	2	7

PI-RADS v2: Prostate imaging reporting and data system version; PSA: Prostatic-specific antigen; MRI: Magnetic resonance imaging

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)

Local stage of disease (T)	PI-RADS v2 score on MRI				
	1	2	3	4	5
T1	1	-	-	-	-
T2	-	1	3	1	-
T3	-	-	1	8	8
T4	-	-	-	2	7

PI-RADS v2: Prostate imaging reporting and data system version; MRI: Magnetic resonance imaging

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

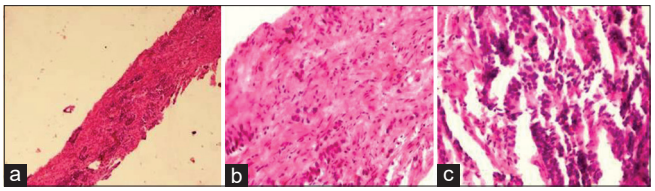

Figure 3: (Grade 2 Adenocarcinoma Prostate, Gleason Score 3 + 4). (a) Low power view showing tumor cells composed of single cells and gland-like structures in core biopsy prostate. (b) High power view showing tumor predominantly composed of glands of variable size (Gleason 3). (c) High power view showing the second component composed of single cells infiltrating into the stroma (Gleason 4)

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 $P < 0.005$.

One of the limitations of our study was the small sample size, and more such studies should be carried out in future to further substantiate the results obtained in our study. Another limitation of the study was that we considered TRUS guided biopsy as a reference standard and not prostatectomy specimens. Few previous studies have suggested that histological analysis of TRUS guided biopsy samples underestimate the Gleason score in 26%–41% of patients as compared to prostatectomy.[15-18]

Conclusions

PI-RADS v2 should be 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.

Ethical clearance

Study was conducted after approval from the Institutional Ethics Committee.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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. Radiology 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, Kirkham A, *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. Radiology 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, Parmar MK, *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. Kvåle 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 populationbased study. BJU Int 2009;103:1647-54.
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, Shimazaki J. 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, Soloway MS. Trends in Gleason score: Concordance between biopsy and prostatectomy over 15 years. Urology 2008;72:177-82.