www.jmscr.igmpublication.org
Impact Factor 5.84
Index Copernicus Value: 83.27
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v5i2.151

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Research Article

Role of Multiparametric MRI Prostate as A Screening Tool for Cancer Detection

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Abstract
Diagnostic screening for prostate cancer includes digital rectal examination and serum PSA. However several studies have shown that screening using serum PSA and digital rectal examination, did not significantly decrease prostate cancer-specific mortality. The advent of MR in prostate imaging has changes this and the ESUR published prostate MR guidelines in 2012 and also the PIRADS reporting system. Our study aims to assess the ability of mp-MRI to serve as a screening tool for detection of prostate cancer, to evaluate the ESUR PIRADS scoring system for prostate cancer detection using multiparametric MRI, to find a threshold PI-RADS sum (PIRADS-S) score for detection of prostate cancer and to evaluate the usefulness of mp-MRI in patients with serum PSA of ≤10 ng/mL in diagnosing prostate cancer. From the 54 subjects included, a total of 274 sectors were taken for analysis. All patients underwent mpMRI which included T2,DWI and dynamic contrast enhanced imaging. Using ESUR guidelines individual PI-RADS scores (T2WI, DWI and DCEI) were assigned for all sectors of prostate, following which PI-RADS sum (PIRADS-S = T2WI+DWI+DCEI) score was calculated for each sector. TRUS guided modified sextant biopsy of prostate was done for all patients and correlated with imaging. Statistical analysis was done using independent samples t test and ROC analysis. Sensitivity, specificity, predictive values and likelihood ratios were calculated at various cut-off levels. Optimal cut-off point was calculated by using Youden's statistics. From this study, ESUR PIRADS scoring system showed good diagnostic performance for detection of prostate cancer by using mpMRI and DWI showed the best diagnostic performance. The ROC analysis of PIRADS-S score revealed area AUC of 0.933 with p value of < 0.001. The reported AUC of PIRADS-S score in detecting carcinoma prostate was 0.768 to 0.93. The diagnostic performance of mpMRI was analysed in a group of subjects with serum PSA of ≤ 10 ng/mL. mpMRI showed high negative predictive value which indicates the ability of the test to predict the absence of disease with high confidence, thereby helping to avoid a prostate biopsy.

Introduction

Prostate cancer is the second most frequently diagnosed cancer of men and fourth most common cancer overall. In 2012, 1.1 million men were diagnosed with prostate cancer worldwide, accounting for 15% of cancers diagnosed in men. Incidence rates vary more than 25-fold worldwide, the highest rates being in Australia/New Zealand and North America, the lowest in Eastern Asia and South-Central Asia, and intermediate in Central and Eastern Europe. Almost 70% of new cases are being detected in developed countries, because of the widespread practice of serum prostate specific antigen (S.PSA) testing and subsequent biopsy. Incidence rates are low in South-Central Asian population with estimated incidence rates of 4.5. In India 19,000 men were diagnosed with prostate cancer in 2012 with a 5 year prevalence of 64,000. [(1)] The main aim of screening methods is to reduce disease specific and overall mortality and morbidity. Screening for prostate cancer is to be performed in the absence of any symptoms or indications of disease, which include digital rectal examination (DRE) and serum prostate-specific antigen (PSA) assay. Digital rectal examination (DRE) as a screening tool has limited utility due to poor reliability, low sensitivity and a predominant assessment of the peripheral zone. This is especially so for small tumours that have not reached the prostatic capsule. [(2)] The reported sensitivity and specificity of DRE in prostate cancer detection is 37% and 91% with even lower sensitivity with normal serum PSA levels (0 – 4ng/mL). [(3)] Serum PSA estimation: PSA is an enzyme secreted by the epithelial cells of prostate, which is the main source of serum PSA. The normal range of serum PSA is taken as 0–4 ng/mL. Serum PSA levels are elevated in patients with a range of prostatic diseases including carcinoma prostate, benign hypertrophy, prostatitis and prostatic infarction.[(4)] After introduction of this test in clinical practice the incidence of prostate cancer increased significantly with a concomitant lowering of stage at diagnosis. However the specificity is low especially between the levels of 4 – 10 ng/mL. Hence 60–75% of men with PSA levels greater than 4 ng/mL undergo unnecessary biopsy.[(5)] Similarly using this cut-off value (4 ng/mL) for men of all ages, results in exclusion of a high number of patients with clinically significant early-stage disease, as, approximately 20% to 50% of clinically significant organ-confined carcinoma prostate occurs in men with serum total PSA of less than 4 ng/mL.[(6)] Because of the low specificity and relatively low sensitivity of serum PSA estimation, various methods have been proposed to increase the specificity of PSA, including age-specific PSA reference ranges, PSA density (PSAD) and percent free PSA (% f PSA). Percent free PSA increases the specificity with maintained high sensitivity compared to age specific PSA ranges and PSA density.[(7)] Combined meta-analysis of five RCTs showed that prostate cancer screening using serum PSA and digital rectal examination, did not significa-ntly decrease prostate cancer-specific mortality. So, men who have a life expectancy of less than 10 to 15 years are unlikely to benefit from screening.[(8)] The advent of MR in prostate imaging has changes this. Until recently there was no definite accepted guideline for prostate cancer detection and staging on MRI. In 2011 Dickinson L et al, presented recommendations on a standardized method for the conduct, interpret-ation, and reporting of prostate mp-MRI for prostate cancer detection and localization.[(9)] Following this the European Society of Urogenital Radiology (ESUR) proposed the ESUR prostate MR guidelines in 2012. This report provides the guidelines for magnetic resonance imaging (MRI) in prostate cancer (minimal and optimal imaging acquisition protocols) and a structured reporting system which was described as PIRADS (Prostate Imaging Reporting And Data System) scoring system.[(10)] This study was designed with the following objectives in mind.

Primary Objective: To assess the ability of mp-MRI to serve as a screening tool for detection of prostate cancer

Secondary Objectives:

1. To evaluate the ESUR prostate imaging reporting and data (PIRADS) scoring system for prostate cancer detection using multiparametric MRI (mpMRI).
2. To find a threshold PI-RADS sum (PIRADS-S) score for detection of prostate cancer.
3. To evaluate the usefulness of mp-MRI in patients with serum PSA of ≤10 ng/mL in diagnosing prostate cancer.

Materials and Methods

The study was designed as a prospective single institutional study and was approved by institutional review board. Patients with either increased serum PSA or abnormal DRE, who were referred for mpMRI and TRUS guided prostate biopsy were included as study subjects. Between January 2013 to September 2014, 54 consecutive patients were registered as study subjects. Patients with previous history of other pelvic malignancy, contraindication for MRI or TRUS biopsy were excluded from the study. All patients underwent mpMRI which includes T2 weighted imaging, diffusion weighted imaging and dynamic contrast enhanced imaging at 1.5T. Endorectal coil (ERC) was used for optimal signal reception and bowel preparation was done with cleansing enema. High resolution axial fast spin echo T2 weighted images were taken initially perpendicular to the plane of prostatic urethra, followed by sagittal and coronal high resolution T2 weighted images. Diffusion weighted images at two b values (0 and 800) were obtained in the same plane as axial T2W sequence and ADC maps were generated using standard post processing software. DCE MRI was obtained by a 3D T1 weighted GRE sequence in the same plane as axial T2W sequence with a temporal resolution of 15 sec for 5 mins, following an intravenous bolus injection of 0.1mmol/kg body weight of gadolinium based contrast. MRI interpretation was done on GE Centricity PACS work station by a single qualified radiologist. The prostate gland was divided into 8 segments, 6 from peripheral zone (basal, mid and apical third on both sides) and 2 from central gland (right and left). On mid sagittal high resolution T2W image the supero-inferior dimension of the prostate was measured, which was then divided into 3 equal portions on both sides of the peripheral zone. Central gland was divided into right and left on axial high resolution T2W images. On high resolution T2W images each sector was examined for focal lesion or signal intensity changes, followed by DWI-ADC and DCEI analysis. Using ESUR guidelines (Table 1) (10) individual PI-RADS scores (T2WI, DWI and DCEI) were assigned for all sectors of prostate, following which PI-RADS sum (PIRADS-S = T2WI+DWI+DCEI) score was calculated for each sectors. Representative images given in figures I-X.

TRUS guided modified sextant biopsy of prostate was done for all patients by a separate radiologist blinded from the results of the MR scan, within 1 week to 2 month period, using an ultrasound scanner with a 6 MHz transrectal probe and biopsy adapter. Similar to MRI interpretation, on mid sagittal view, supero-inferior dimension of prostate was measured, and was divided into 3 equal portions on both sides of peripheral zone. Central zone was divided into two. Biopsy cores (one each) were obtained from the sextants of the peripheral zone. All cores were obtained using an 18-gauge biopsy gun. All cores were labelled according to their sextant topographic location as the base, mid gland and apex, from each side of the gland. Histopathology of all sextants were recorded with Gleason score. Each sector scored by PIRADS system was then compared with histopathology of the corresponding core. Statistical analysis: Independent samples t test was applied in mean of serum PSA between adenocarcinoma positive and negative groups. Diagnostic accuracy of individual (T2W, DWI and DCEI) PIRADS score and PIRADS-S score were assessed by using receiver operating characteristic (ROC) analysis. The area under the ROC curve (AUC) is a measure of how well a

parameter can distinguish between two diagnostic groups. Sensitivity, specificity, predictive values and likelihood ratios were calculated at various cut-off levels. Optimal cut-off point was calculated by using Youden's statistics. A two-tailed p value of 0.001 or less was considered statistically significant.

Results

Fifty four subjects were included in the study with median age of 56 years and range of 52 to 86 years (Table 2, Fig XI) . Twenty seven out of fifty four subjects were positive for carcinoma prostate (Fig XII). Serum PSA ranged from 1 to 120 ng/mL in carcinoma prostate positive group and 3 to 69 ng/mL in negative group (Fig XIII) . Mean serum PSA of carcinoma prostate positive and negative patients were 29.96 (±28.86) and 19.33 (±17.86) respectively with mean difference of 7.63 and p value of 0.248 (Table 3). A total of 274 sectors (76 positive and 198 negative for malignancy) were taken for final analysis. In 76 malignant positive cores Gleason score of 3+3 was the most common (28 in 76), followed by 3+4 (21 in 76) (Fig XIV). ROC analysis was done for each MRI sequence PIRADS score (T2WI, DWI and DCEI) and PIRADS sum (PIRADS-S) score, using the biopsy result as the gold standard. Area under the ROC curve (AUC) of T2WI, DWI and DCEI PIRADS score were 0.841 (0.792-0.882), 0.897 (0.855-0.931) and 0.836 (0.787-0.878) respectively with p<0.001. The sensitivity and specificity were 88.2%/47% for T2WI, 81.6%/92.4% for DWI and 65.8%/95.4% for DCEI with cut-off score 3 (Table 4, 5 and 6). The AUC of PIRADS-S score was 0.933 (0.896-0.959) with p<0.001 (Table 7). Youden selected threshold for PIRADS-S score was 9 with sensitivity, specificity and Youden index of 79%, 95.5% and 0.744 (0.6395-0.8211) respectively. Summary of diagnostic performance of T2WI, DWI, DCEI and PIRADS-S score are given in table 3, 4,5 & 6.

Eighteen out of fifty four subjects had serum PSA of ≤10 ng/mL, with 9 subjects showed positive for malignancy. Number of available sectors with corresponding biopsy cores in that group were 86 (Positive - 20, Negative - 66). Gleason score 3+3 was the most common score encountered in this group with 14 out of 20 positive cores (70%) (Fig XXIX) . ROC curve analysis of PIRADS-S score showed area under the curve (AUC) of 0.93 with p value of < 0.001. Youden selected threshold for PIRADS-S score for detection of prostate cancer in patients with S.PSA ≤10 ng/mL was 8 with the sensitivity, specificity, positive and negative predictive values of 85%, 87.88%, 68% and 95.1% respectively (Table 8).

Table 1: ESUR PIRADS criteria for T2WI, DWI and DCEI. (10)

PIRADS scoring system		
	Score	Criteria
T2WI for peripheral zone	1	Uniform high signal intensity (SI)
	2	Linear, wedge shaped, or geographic areas of lower SI, usually not well demarcated
	3	Intermediate appearances not in categories 1/2 or 4/5
	4	Discrete, homogeneous low signal focus/mass confined to the prostate
	5	Discrete, homogeneous low signal intensity focus with extra-capsular extension/invasive behaviour or mass effect on the capsule (bulging), or broad (>1.5 cm) contact with the surface
T2WI for central gland	1	Heterogeneous TZ adenoma with well-defined margins: "organized chaos"
	2	Areas of more homogeneous low SI, however well marginated, originating from the TZ/BPH
	3	Intermediate appearances not in categories 1/2 or 4/5
	4	Areas of more homogeneous low SI, ill defined: "erased charcoal sign"
	5	Same as 4, but involving the anterior fibromuscular stroma or the anterior horn of the PZ, usually lenticular or water-drop shaped
DWI	1	No reduction in ADC compared with normal glandular tissue. No increase in SI on any high b-value image (≥b800)
	2	Diffuse, hyper SI on ≥b800 image with low ADC; no focal features, however, linear,

		triangular or geographical features are allowed
	3	Intermediate appearances not in categories 1/2 or 4/5
	4	Focal area(s) of reduced ADC but iso-intense SI on high b-value images (≥b800)
	5	Focal area/mass of hyper SI on the high b-value images (≥b800) with reduced ADC
DCEI	1	Type 1 enhancement curve
	2	Type 2 enhancement curve
	3	Type 3 enhancement curve
	+1	For focal enhancing lesion with curve type 2–3
	+1	For asymmetric lesion or lesion at an unusual place with curve type 2–3

Table 2: Age distribution of study population

Age group	Positive	Negative	Total
51 to 60	2 (3.7%)	4 (7.4%)	6 (11.1%)
61 to 70	16 (29.6%)	12 (22.2%)	28 (51.8%)
71 to 80	9 (16.7%)	8 (14.8%)	17 (31.5%)
81 to 90	0 (0%)	3 (5.6%)	3 (5.6%)
Total	27 (50%)	27 (50%)	54 (100%)

Table 3: Distribution of serum PSA in study population

	Serum PSA ng/mL			
Group	Mean	Standard deviation	Median	Range
Malignant (Positive)	29.96	28.86	19	1 to 120
Benign (Negative)	19.33	17.86	12	3 to 69

Table 4: Diagnostic performance of T2WI at cut-off PIRADS score of 2, 3 and 4.

Cut-off PIRADS score	Sensitivity% (95% CI)	Specificity% (95% CI)	Youden index	+LR (95% CI)	-LR (95% CI)	PPV%	NPV%
2	100 (95.3 - 100)	13.13 (8.8 - 18.6)	0.131	1.15 (1.1-1.2)	0.00	30.6	100
3	88.16 (78.7-94.4)	46.97 (39.9-54.2)	0.352	1.66 (1.4-1.9)	0.25 (0.1-0.5)	39	91.2
4	72.37 (60.9-82)	86.87 (81.4-91.2)	0.592	5.51 (3.8-8.1)	0.32 (0.2-0.5)	67.9	89.1

Table 5: Diagnostic performance of DWI at cut-off PIRADS score of 2, 3 and 4.

Cut-off PIRADS score	Sensitivity% (95% CI)	Specificity% (95% CI)	Youden index	+LR (95% CI)	-LR (95% CI)	PPV%	NPV%
2	94.74 (87.1-98.5)	40.4 (33.2-47.6)	0.351	1.59 (1.4-1.8)	0.13 (0.05-0.3)	37.9	95.2
3	81.58 (71-89.5)	92.42 (87.8-95.7)	0.74	10.77 (6.5-17.7)	0.2 (0.1-0.3)	80.5	92.9
4	61.84 (50-72.8)	96.46 (92.9-98.6)	0.543	17.49 (8.3-37)	0.40 (0.3-0.5)	87	86.8

Table 6: Diagnostic performance of DCEI at cut-off PIRADS score of 2, 3 and 4.

Cut-off PIRADS score	Sensitivity% (95% CI)	Specificity% (95% CI)	Youden index	+LR (95% CI)	-LR (95% CI)	PPV%	NPV%
2	76.32 (65.2-85.3)	81.31 (75.2-86.5)	0.576	4.08 (3-5.6)	0.29 (0.2-0.4)	61.1	89.9
3	65.79 (54-76.3)	93.43 (89-96.5)	0.592	10.02 (5.8-17.4)	0.37 (0.3-0.5)	79.4	87.7
4	43.42 (32.1-55.3)	98.99 (96.4-99.9)	0.424	42.99 (10.6-174.8)	0.57 (0.5-0.7)	94.3	82

Table 7: Diagnostic performance of PIRADS-S score at threshold level.

Youden-selected threshold PIRADS-S	> 8
Sensitivity at threshold(95% CI)	78.95(68.1-87.5)
Specificity at threshold(95% CI)	95.45(91.5-97.9)
+LR(95% CI)	17.37(9.1-33.2)
-LR(95% CI)	0.22(0.1-0.3)
PPV %	87
NPV %	92.2
Youden index at threshold(95% CI)	0.744(0.639-0.821)
p value	< 0.001

Table 8: Diagnostic performance of PIRADS-S score at threshold level in patients with serum PSA ≤ 10 ng/mL.

AUC(95% CI)	0.930 (0.853-0.974)
Youden-selected threshold	>7
Sensitivity at threshold(95% CI)	85 (62.1-96.8)
Specificity at threshold(95% CI)	87.88 (77.5-94.6)
+LR(95% CI)	7.01 (3.6-13.8)
-LR(95% CI)	0.17 (0.06-0.5)
PPV %	68
NPV %	95.1
Youden index at threshold(95% CI)	0.729 (0.494-0.854)
p value	< 0.001

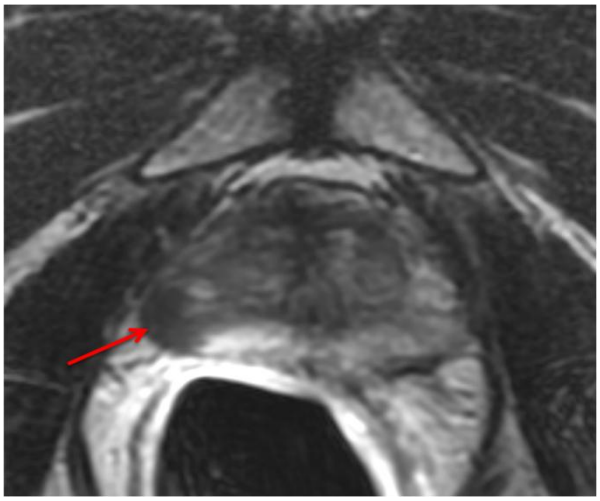

Fig I: T2WI PIRADS score 4 (Peripheral zone) - Discrete, homogeneous low signal focus confined to the prostate.

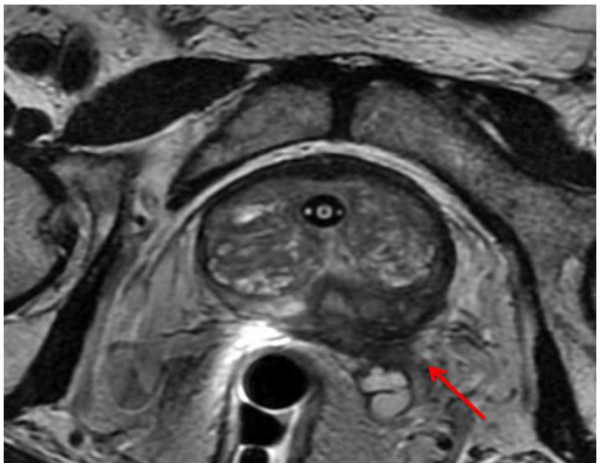

Fig II: T2WI PIRADS score 5 (Peripheral zone) - Discrete, low signal intensity focus with extra-capsular extension/invasive behaviour.

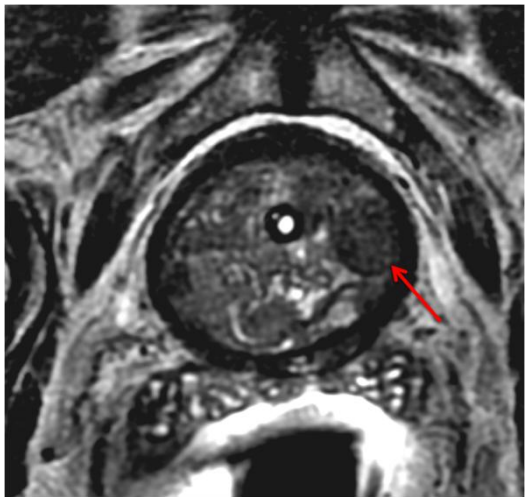

Fig III: T2WI PIRADS score 2 (Central gland) -Areas of more homogeneous low SI, however well marginated.

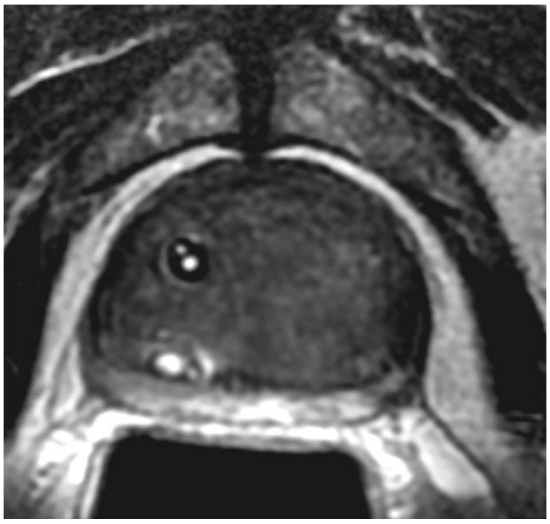

Fig IV: T2WI PIRADS score 4 (Central gland) - Areas of more homogeneous low SI, ill defined: "erased charcoal sign".

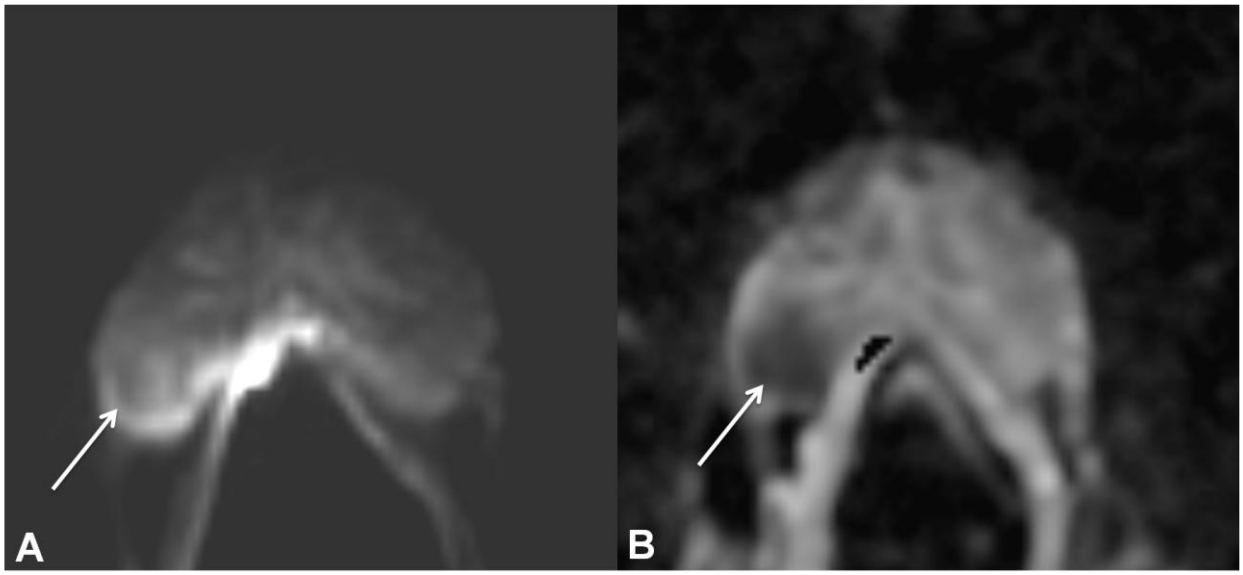

Fig V: (A-DWI, B-ADC) DWI PIRADS score 4 - Focal area of reduced ADC but iso-intense SI on high b-value image.

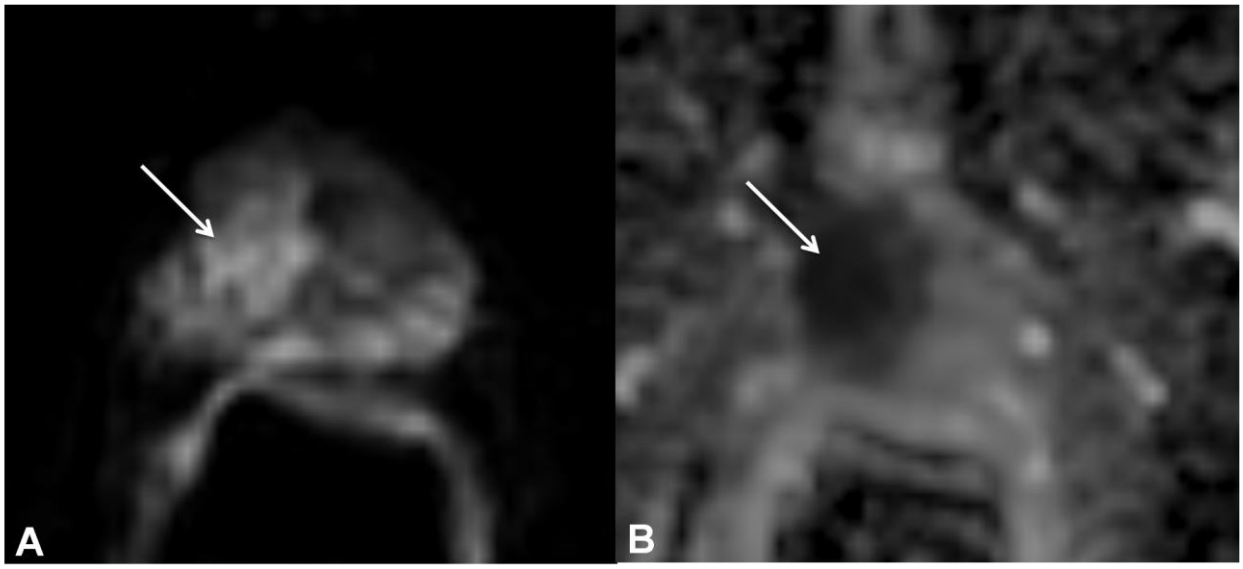

Fig VI: (A-DWI, B-ADC) DWI PIRADS score 5 Focal area/mass of hyper SI on the high b-value image with reduced ADC.

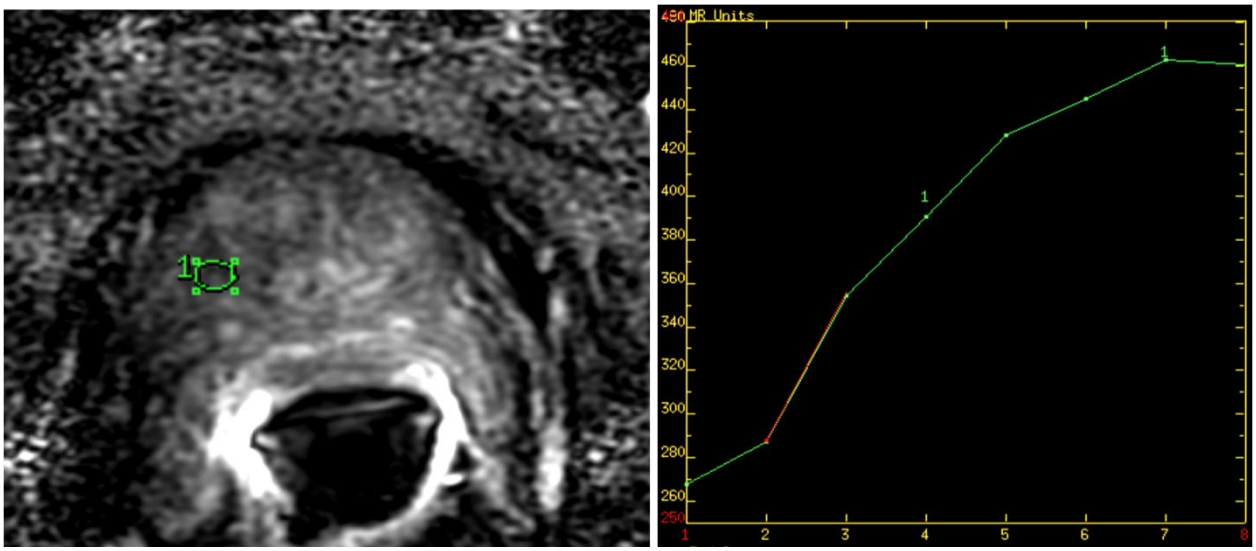

Fig VII: DCEI PIRADS score 1 - Type 1 enhancement curve.

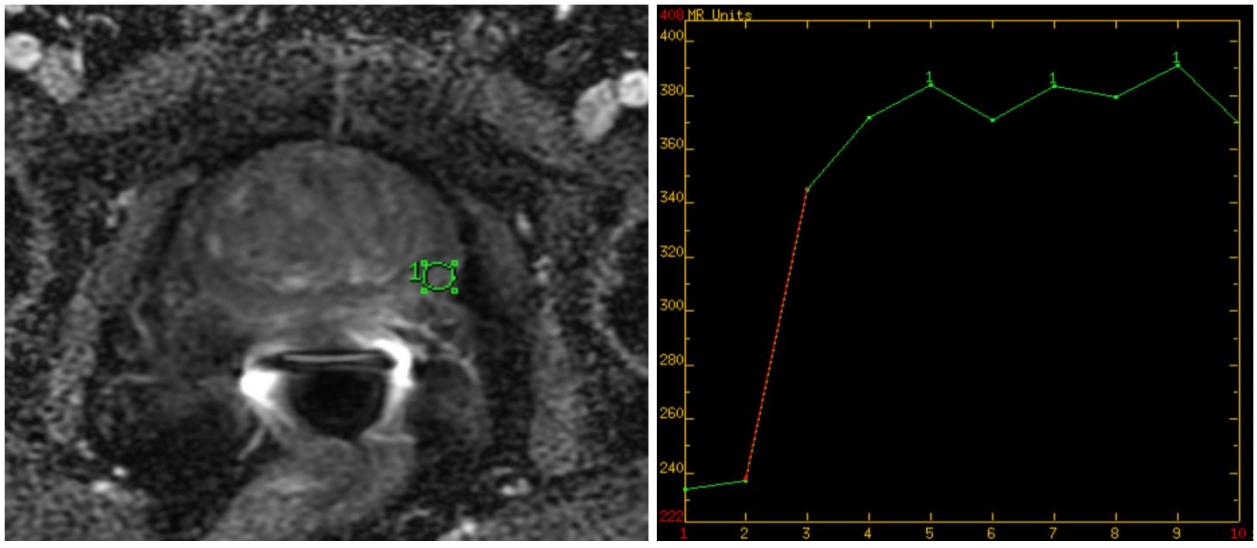

Fig VIII: DCEI PIRADS score 2 - Type 2 enhancement curve.

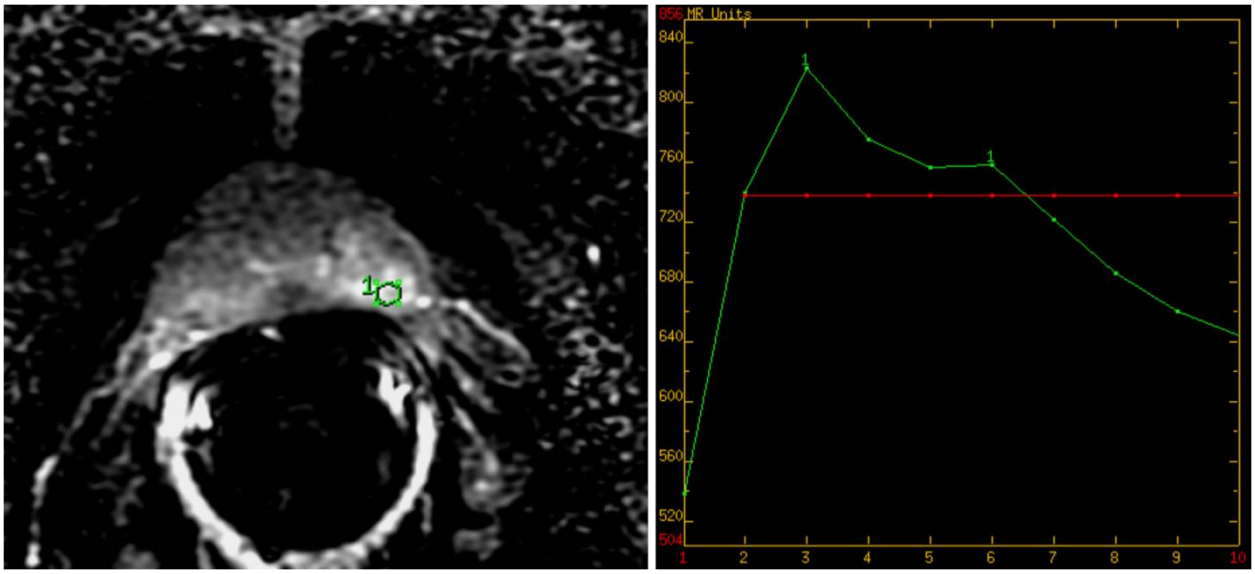

Fig IX: DCEI PIRADS score 4 - Type 3 enhancement curve + Focal lesion.

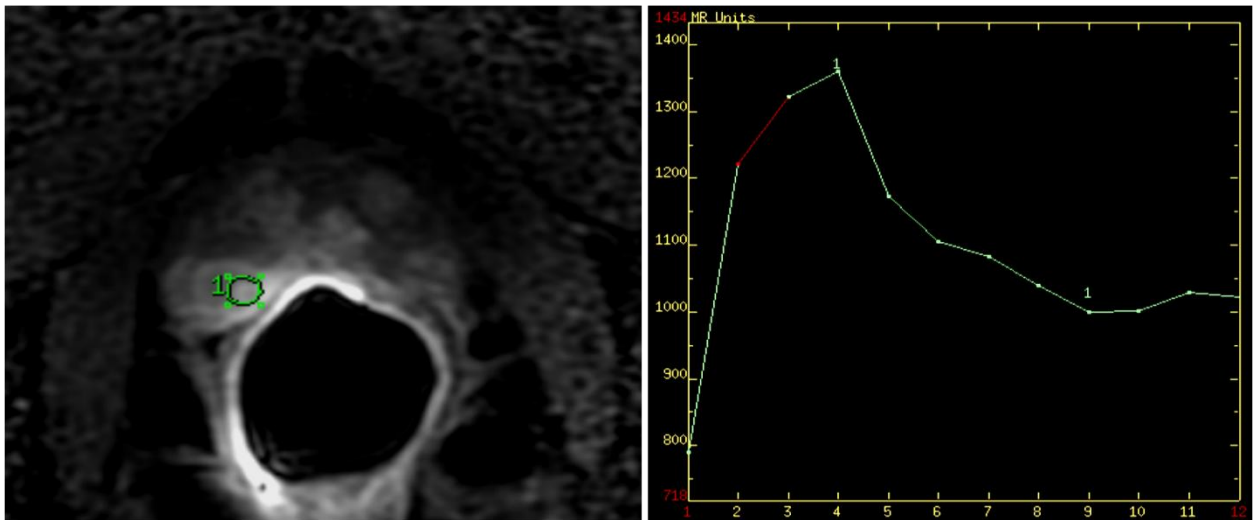

Fig X: DCEI PIRADS score 5 - Type 3 enhancement curve + Asymmetric lesion + Focal enhancement.

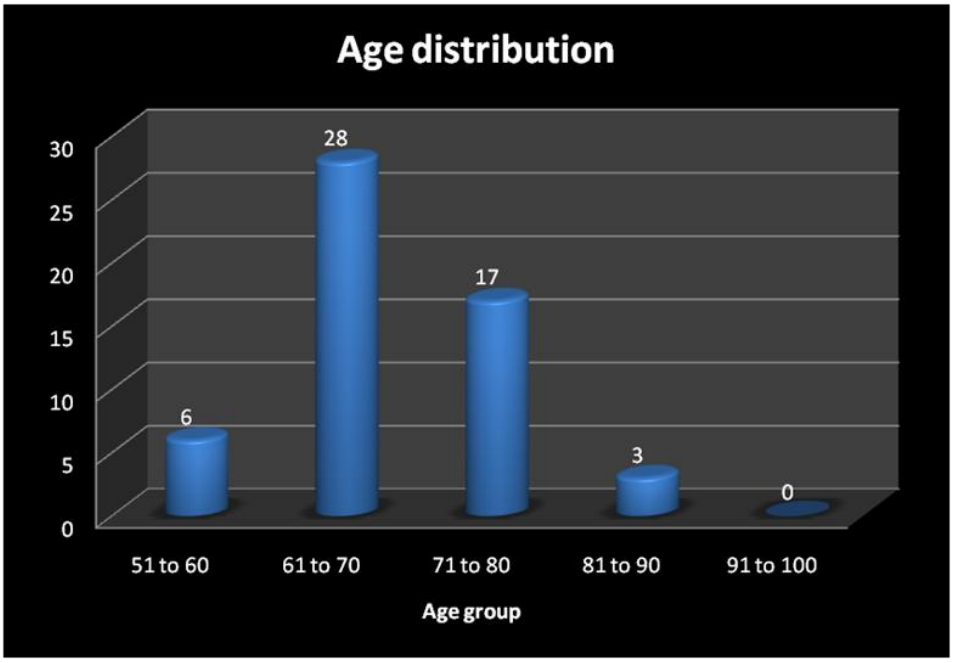

Fig XI: Age distribution of study population

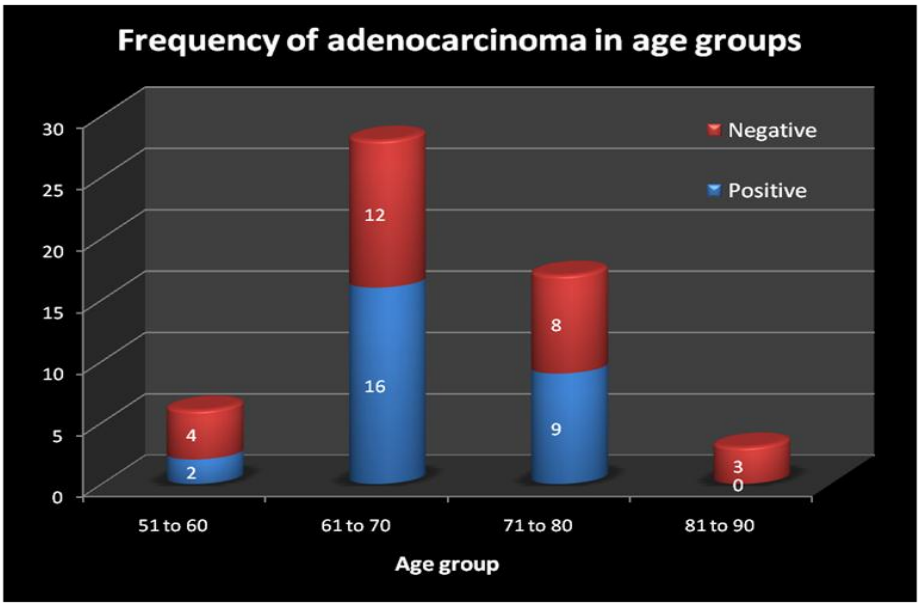

Fig XII: Frequency of adenocarcinoma in age groups

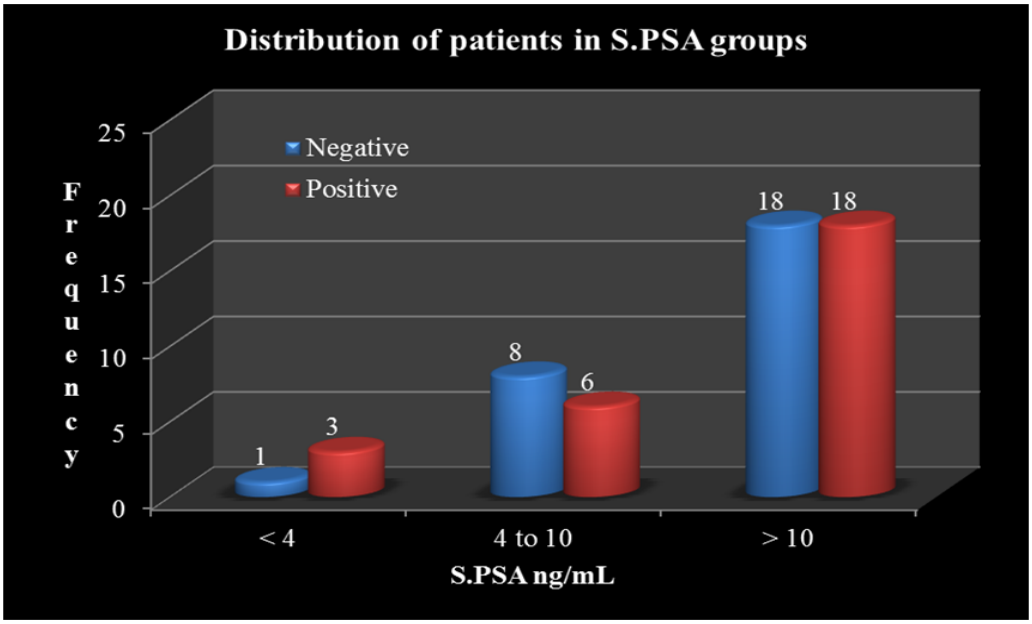

Fig XIII: Distribution of study population in serum PSA groups

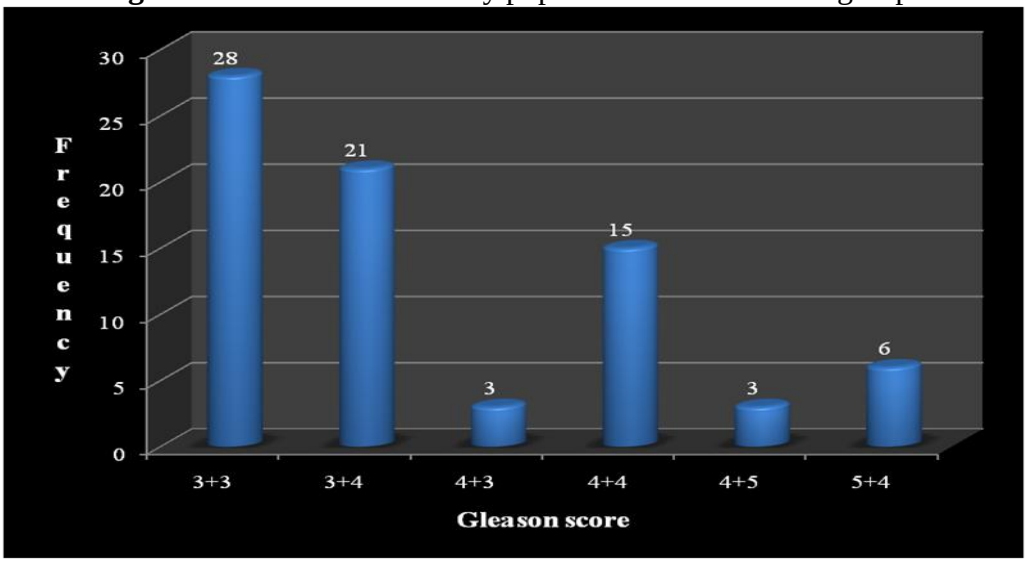

Fig XIV: Distribution of Gleason score

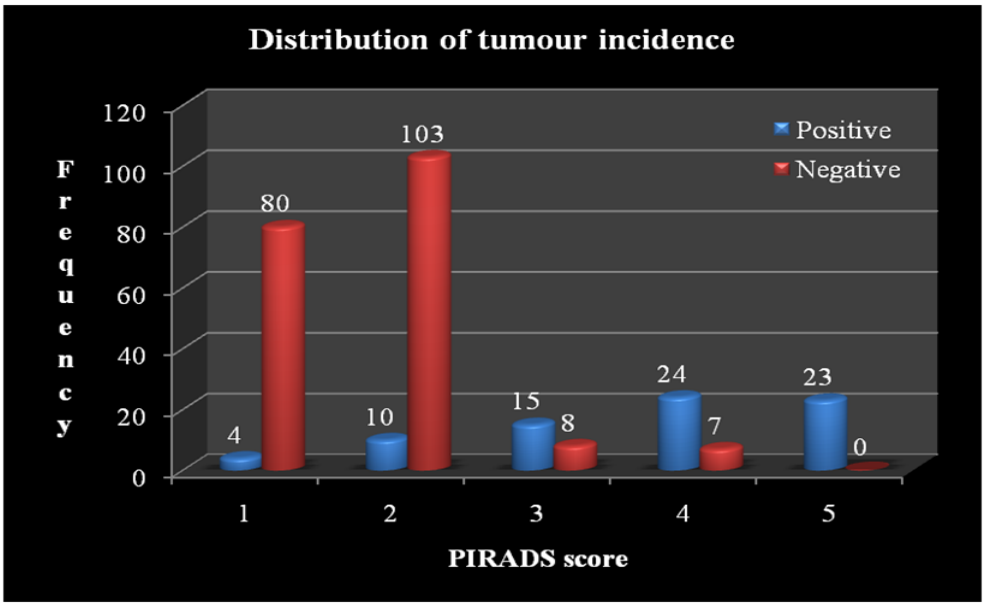

Fig XV: Distribution of tumour incidence chart - DWI PIRADS score

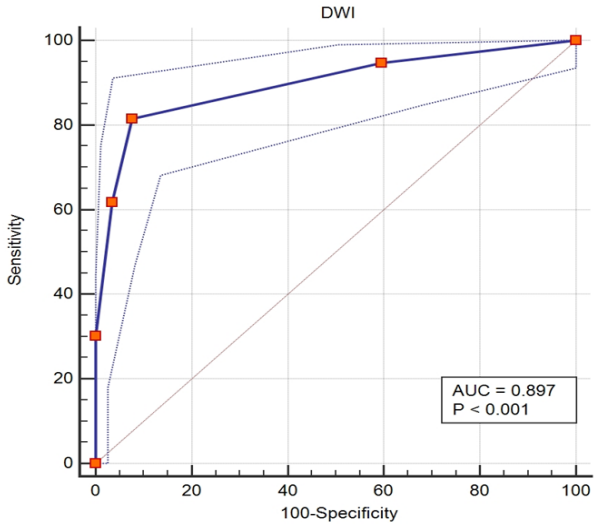

Fig XVI: ROC curve for DWI

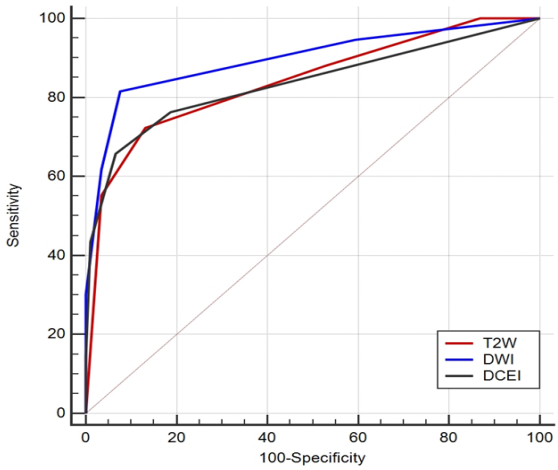

Fig XVII: ROC curves of T2WI, DWI and DCEI

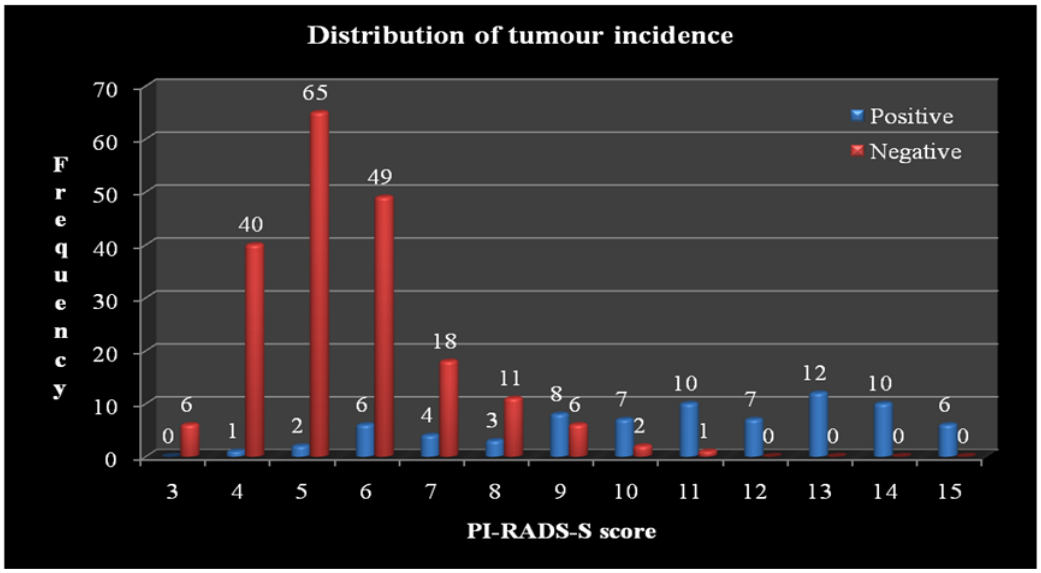

Fig XVIII: Distribution of tumour incidence chart - PIRADS-S score

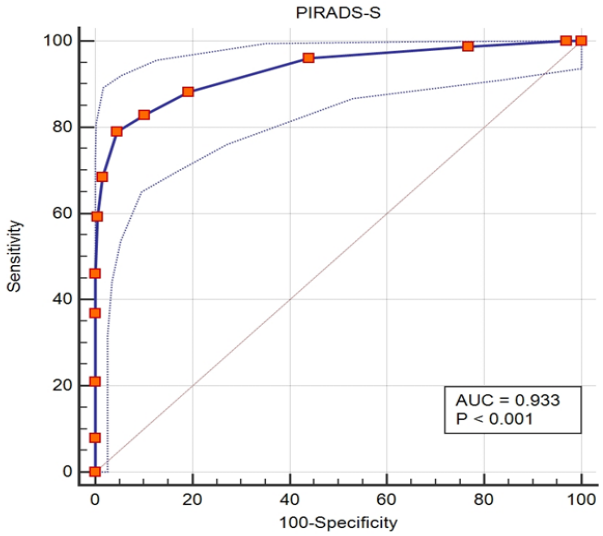

Fig XIX: ROC curve for PIRADS-S score

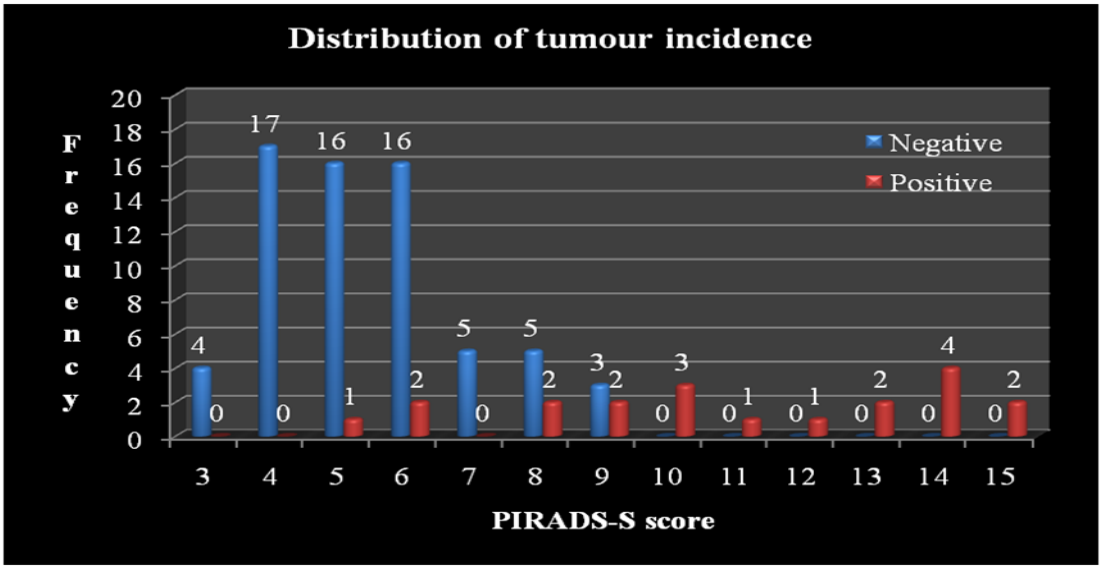

Fig XX: Distribution of tumour incidence of PIRADS-S score in serum PSA ≤10 ng/mL

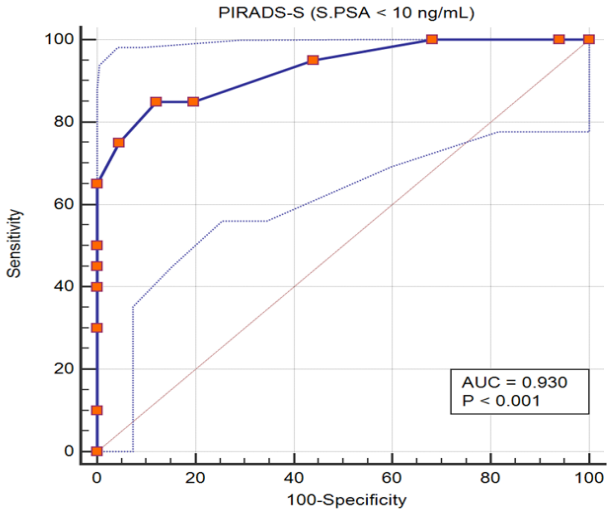

Fig XXI: ROC curve for PIRADS-S score

Discussion and Conclusion

From this study, ESUR PIRADS scoring system showed good diagnostic performance for detection of prostate cancer by using mpMRI. Median PSA level of 29.96 ng/mL in biopsy proven carcinoma prostate was higher in comparison to the non-cancer group with 19.33 ng/mL, but this difference was not statistically significant as p value was 0.248 (Independent samples t test).

The ROC analysis of T2WI revealed area under the curve (AUC) of 0.841 with p value of < 0.001. The reported AUC of T2WI PIRADS score in detecting carcinoma prostate was 0.7 to 0.88. The sensitivity, specificity, positive predictive and negative predictive value of T2WI were 88.16%, 46.97%, 39% and 91.2% respectively with a cut-off of 3. Roethke et al reported a sensitivity and specificity of 85.2% and 64.9% with a cut-off of 3. Even though the sensitivity of T2WI for detecting prostate cancer is high (88.16%) in our study, it has low specificity (only 46.97% at cut-off 3) and positive predictive value (only 39% at cut-off 3). This reduced specificity and positive predictive value may be explained by the presence of prostatitis, granulomatous disease and hyperplasia in tumour negative cores. However T2WI shows good negative predictive value of 91.2% at cut-off 3 and 100% at cut-off 2. Youden selected threshold T2WI PIRADS score was 4 (> 3) with Youden index, sensitivity, specificity, positive predictive and negative predictive value of 0.5924, 72.37%, 86.87%, 67.9% and 89.1% respectively. By changing the T2WI PIRADS threshold cut-off from 3 to 4, there was significant increase in specificity (from 46.97% to 86.87%) with 16% reduction in sensitivity (88.16% to 72.37%) and maintained negative predictive value (91.2% to 89.1%). Reported threshold T2WI PIRADS score by Roethke et al was 3 with Youden index of 0.5.

The ROC analysis of DWI revealed area under the curve (AUC) of 0.897 with p value of < 0.001. The reported AUC of DWI PIRADS score in detecting carcinoma prostate is 0.768 to 0.93. The sensitivity, specificity, positive predictive and negative predictive value of DWI were 81.58%, 92.42%, 80.5% and 92.9% respectively with a cut-off of 3. Roethke et al reported sensitivity and specificity of 81.5% and 64.9% with a cut-off of 3. DWI showed good specificity with preserved sensitivity and predictive values. Only 7.1% sectors which were scored ≤ 2 (score 1 and 2) turned out to be malignant. Only 19.5% sectors were negative for malignancy with score ≥ 3 (score 3, 4 and 5). This indicates that DW Imaging which depends on cellularity is specific for carcinoma prostate. Youden selected threshold DWI PIRADS score was also 3 (≥ 3) with Youden index (J) of 0.74.

The ROC analysis of DCEI revealed area under the curve (AUC) of 0.836 with p value of < 0.001. The reported AUC of DCEI PIRADS score in

detecting carcinoma prostate was 0.74 to 0.76. The result of our study is slightly higher than reported data. The sensitivity, specificity, positive predictive and negative predictive value of DCEI were 65.79%, 93.43%, 79.4% and 87.7% respectively with a cut-off of 3. Roethke et al showed sensitivity and specificity of 59.3% and 89.2% with a cut-off of 4. Even though DCEI showed good level of specificity (93.43%), it suffered from reduced sensitivity (only 65.79%) at cut-off 3. Only 20.6% were negative for malignancy with score ≥ 3 (score 3, 4 and 5). But only 12.3% sectors were positive for malignancy, which were scored ≤ 2 (score 1 and 2). This shows that DCEI has high specificity for carcinoma prostate detection with reduced sensitivity. Youden selected threshold DCEI PIRADS score was also 3 (≥ 3) with Youden index (J) of 0.592.

On comparison of the three imaging modalities (T2WI, DWI and DCEI), DWI showed better diagnostic performance with higher area under curve. DCEI showed the lowest area under curve. Youden selected threshold values were 4, 3 and 3 for T2WI, DWI and DCEI respectively. In the study by Roethke et al, T2WI provided the highest area under curve followed by DWI. T2WI showed good sensitivity with reduced specificity. DCEI showed good specificity with reduced sensitivity. DWI showed good specificity with maintained sensitivity. All three modalities showed comparable negative predictive values (T2WI – 89.1% at cut-off 4, DWI – 92.9% at cut-off 3, DCEI – 87.7 at cut-off 3), which indicates the ability of the test to predict the absence of disease with high confidence.

The ROC analysis of PIRADS-S score revealed area under the curve (AUC) of 0.933 with p value of < 0.001. The reported AUC of PIRADS-S score in detecting carcinoma prostate was 0.768 to 0.93. The result of our study was similar to the study by Alexander et al. The sensitivity and specificity of PIRADS-S score were 78.95% and 95.45% respectively with a cut-off of 9 (score of ≥ 9) and 68.4% and 98.5% with a cut-off of 10. Roethke et al showed sensitivity and specificity of 66.7% and 91.9% with the cut-off of 10, which is comparable with our study. In our study, Youden selected threshold PIRADS-S score was 9 (≥ 9) with Youden index (J) of 0.744. By lowering the PIRADS-S cut-off score from 10 to 9, we can achieve relatively good sensitivity (68.4% to 78.95%) with preserved specificity (98.5% to 95.45%).

The diagnostic performance of mpMRI was analysed in a group of subjects with serum PSA of ≤ 10 ng/mL. ROC analysis of PIRADS-S score showed area under the curve (AUC) of 0.93 with p value of < 0.001 for the detection of prostate cancer. 13 sectors were scored ≥ 10 and all were positive for malignancy with 100% positive predictive value. Youden selected threshold cut-off was 8 (≥ 8) with sensitivity, specificity, positive predictive and negative predictive value of 85%, 87.88%, 68% and 95.1% respectively. mpMRI showed high negative predictive value with PIRADS-S score cut-off 8, which indicates the ability of the test to predict the absence of disease with high confidence. This factor can be used to limit unnecessary biopsy of prostate.

From the above observations, it is safe to say that mp-MRI is able to predict the presence or absence of disease with accuracy levels much greater than that of serum PSA estimation or DRE, which form the mainstay of screening in current clinical practice. The projected high cost of MR for application as a screening tool often downplays the volume of information that is obtained regarding the prostate in general, including the ability to perform a retrospective staging analysis. These factors justify that MR cannot be out rightly rejected as a screening tool based on costs alone. Furthermore, it can also reduce the tendency to take a large number of cores (12 - 18) as is currently followed by some centres. Our study shows that even with a randomly done sextant biopsy, detection rates are reasonably high. This study had a few limitations. Firstly, it lacked a whole mount prostate as the histopathologic reference standard. The mpMRI findings were correlated only with the results of TRUS-guided

prostate biopsy cores. A suspected malignant focus in prostate on mpMRI might not be accurately targeted at TRUS-guided prostate biopsy. Secondly, random prostatic biopsy might have missed a few small malignant foci. Despite these limitations, the results show that MR can often predict the presence or absence of disease at clinically acceptable level. Further studies in this direction can cement the role of mp-MRI as a screening tool detection of prostate cancer.

Sources of support, grants – NIL

References

1. International Agency for Research on Cancer.GLOBOCAN 2012. Available at: http://globocan.iarc.fr/Pages/fact_sheets_cancer.aspx.
2. Gamber S. Screening for prostate cancer. International Urology and Nephrology 2001;33:249–57.
3. Fritz H. Schroder, Paul vander Maas, Petra Beemsterboer, Arto Boeken Kruger, Robert Hoedemaeker, John Rietbergen, et al. Evaluation of the Digital Rectal Examination as a Screening Test for Prostate Cancer. J Natl Cancer Inst 1998;90 (23):1817-1823.
4. AF Nash and I Melezinek. The role of prostate specific antigen measurement in the detection and management of prostate cancer. Endocrine-Related Cancer. 2000;7:37–51.
5. Stamey TA, Freiha FS, McNeal JE, Redwine EA, Whittemore AS, Schmid HP. Localized prostate cancer: relationship of tumor volume to clinical significance for treatment of prostate cancer. Cancer 1993;71(3 suppl):933–938.
6. Schroder FH, van DI, De Koning HJ, et al. Prostate cancer detection at low prostate specific antigen. JUrol 2000;163:806–812.
7. Catalona WJ, Southwick PC, Slawin KM, Partin AW, Brawer MK, Flanigan RC, et al. Comparison of percent free PSA, PSA density, and age-specific PSA cutoffs for prostate cancer detection and staging. Urology. 2000;56(2):255–260.
8. Ilic D, O'Connor D, Green S, Wilt TJ. Screening for prostate cancer. Cochrane Database of Systematic Reviews 2006, Issue 3. Art. No.: CD004720. DOI: 10.1002/14651858.CD004720.pub2.
9. Dickinson L, Ahmed HU, Allen C, Barentsz JO, Carey B et al (2011) Magnetic resonance imaging for the detection, localisation, and characterisation of prostate cancer: recommendations from a European consensus meeting. EurUrol 59:477-494.
10. Barentsz JO, Richenberg J, Clements R, Choyke P, Verma S, Villeirs G, et al. ESUR prostate MR guidelines 2012. EurRadiol 2012;22:746–57.
11. Roethke MC, Kuru TH, Schultze S, Tichy D, Kopp-Schneider A, Fenchel M, et al. Evaluation of the ESUR PI-RADS scoring system for multiparametric MRI of the prostate with targeted MR/TRUS fusion-guided biopsy at 3.0 Tesla. EurRadiol 2014;24(2):344-352.
12. Alexander DJ, Andreas M, Tobias F, Ergin K, Alexander H, Carsten S et al. Evaluation of the Prostate Imaging Reporting and Data System for the Detection of Prostate Cancer by the Results of Targeted Biopsy of the Prostate. Invest Radiol 2014;49(6):411-420.
13. Schimmöller L, Quentin M, Arsov C, Hiester A, Buchbender C, Rabenalt R, et al. MR-sequences for prostate cancer diagnostics: validation based on the PI-RADS scoring system and targeted MRguided in-bore biopsy. EurRadiol 2014;24(10):2582-2589.