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CONNECTING THE DOTS: INVESTIGATING CORRELATION BETWEEN PIRADS SCORE AND SERUM PSA IN PROSTATE CANCER DIAGNOSIS THROUGH TRUS-GUIDED BIOPSY

Radio-Diagnosis

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ABSTRACT

Background: Prostate cancer diagnosis relies heavily on prostate specific antigen (PSA) levels and transrectal ultrasound-guided biopsy (TRUS-biopsy). However, limitations exist in both methods. PI-RADS scoring, a standardized MRI-based system for assessing prostate lesions, has emerged as a promising adjunct. This study investigated the correlation between PSA, PI-RADS scores, and histopathological evidence of prostate cancer obtained through TRUS-biopsy.

KEYWORDS

Prostate cancer, PSA, PI-RADS, TRUS-biopsy, diagnosis, correlation

INTRODUCTION

India, a nation synonymous with rich cultural heritage and rapid socio-economic transformation, faces a growing public health concern – prostate cancer. While traditionally perceived as a disease prevalent in Western countries, prostate cancer incidence rates in India have witnessed a significant upward trend in recent years (1).

In this context, the Prostate-Specific Antigen (PSA) has emerged as a pivotal biomarker, playing a central role in the detection, monitoring, and management of prostate cancer (2). PSA is a protein produced by the prostate gland, and its levels in the blood can offer valuable insights into the health of the prostate (3). Elevated levels of PSA may indicate the presence of prostate cancer, prompting further diagnostic investigations such as biopsies (2). However, the use of PSA is not without controversy, as elevated levels can also result from non-cancerous conditions such as prostatitis or benign prostatic hyperplasia (BPH) (4).

Certainly, the recommendation for men aged 60 years or older presenting with lower urinary tract symptoms to undergo serum prostate-specific antigen (PSA) testing reflects a strategic approach in the early detection and assessment of prostate cancer (5)(6). Setting the threshold at 2.5 ng/ml for individuals younger than 60 years and at 4 ng/ml for all age groups provides a framework for identifying potential cases that warrant further investigation, specifically through prostate biopsy. Elevated PSA levels above these thresholds signal a potential cause for concern, prompting the need for a more definitive diagnostic procedure to assess the presence of prostate cancer (7).

In recent years, the landscape of prostate imaging has undergone a revolutionary transformation with the advent of MRI technology (8). This shift has significantly influenced the clinical approach to detecting and characterizing prostate lesions. Among the various advancements, the Prostate Imaging–Reporting and Data System (PI-RADS) classification system has emerged as a cornerstone in prostate imaging (9).

This structured reporting scheme integrates both anatomical and functional information derived from advanced MRI techniques, including diffusion-weighted imaging (DWI), magnetic resonance spectroscopy (MRS), dynamic contrast-enhanced imaging (DCE), and traditional T1 and T2-weighted imaging. By combining these modalities, PI-RADS not only offers detailed anatomical insights but also provides valuable functional data, enhancing the accuracy of prostate cancer diagnosis and risk assessment (10).

Each lesion is assigned a score from 1 to 5 indicating the likelihood of clinically significant cancer: (11)

PI-RADS 1: very low (clinically significant cancer is highly unlikely to be present)

PI-RADS 2: low (clinically significant cancer is unlikely to be present)

PI-RADS 3: intermediate (the presence of clinically significant cancer is equivocal)

PI-RADS 4: high (clinically significant cancer is likely to be present)

PI-RADS 5: very high (clinically significant cancer is highly likely to be present)

PI-RADS X: component of exam technically inadequate or not performed.

Pirads Scoring:

Prostate Imaging–Reporting and Data System (PI-RADS) assessment category for each lesion relies on the evaluation of T2-weighted imaging (T2W), diffusion-weighted imaging (DWI) with apparent diffusion coefficient (ADC) mapping, and dynamic contrast-enhanced imaging (DCE) sequences, taking into consideration the zonal anatomy of the prostate (10).

This process involves scoring each sequence to assess abnormalities in different regions, such as the peripheral zone, transition zone, and central zone. T2W imaging provides anatomical details, helping identify potential lesions. DWI and ADC mapping analyse water molecule motion, highlighting areas of restricted diffusion, particularly useful for detecting lesions in the peripheral zone (11).

This comprehensive evaluation, aligned with zonal anatomy, contributes to a standardized and precise PI-RADS assessment, facilitating informed clinical decisions based on the likelihood of clinically significant prostate cancer. Given that the primary sequence for PI-RADS evaluation in the peripheral zone differs from that in the transition zone, it is crucial to determine the zonal location of a lesion.

Peripheral Zone

The peripheral zone, located on the posterior and lateral aspects of the prostate and encircling the transition zone, relies primarily on DWI/ADC as the dominant technique for assigning the PI-RADS assessment category. A lesion initially categorized as suspicion category 3 based on ADC/DWI retains a PI-RADS score of 3 in the absence of focal enhancement (negative); however, it elevates to a PI-RADS score of 4 with the presence of focal enhancement (positive) (12).

Transitional Zone

The transition zone encompasses the prostatic urethra and undergoes enlargement in aging men due to benign prostatic hyperplasia. In the context of the transition zone, T2-weighted (T2W) imaging serves as the primary determinant sequence (dominant technique) for assigning the PI-RADS assessment category. Lesions in the transition zone with

a T2W score 2 remain a PI-RADS score 2 score if the DWI/ADC score is ≤ 3, however, they become a PI-RADS score 3 score if the DWI/ADC score is ≥ 4 (12).

MATERIALS AND METHODS:

Prospective study was done on 30 patients who were referred to the Department Of Radio-Diagnosis at Travancore Medical College for TRUS biopsy of the prostate. TRUS biopsy was performed using the Twelve core biopsy technique and samples were sent to Department of Pathology for histopathological evaluation, results were documented. MRI and S.PSA levels were collected and results were analysed based on frequency and percentage.

This study includes patients with elevated PSA levels (>4 ng/ml) and / or suspicious prostatic lesions noted on TRUS. Informed consent was obtained from all participants, and a full explanation about the procedure risks involved and post procedure complications were explained to the patients.

Before the procedure, the patients were given broad spectrum antibiotics (inj. amikacin) to protect them against infection, they also had intra-rectal instillation of 20 ml of local anaesthetic gel often mixed with betadine solution was used to alleviate pain and discomfort during the procedure.

A transrectal ultrasound probe (6-12 MHz range) with a combination of end-viewing and side-viewing transducer attached to machine was used.

Local anaesthetic gel was applied over a latex condom applied onto the probe. All patients were examined in the left lateral decubitus position and it was well tolerated.

- The prostate was imaged in both axial and sagittal planes with assessment of volume, echogenicity, surface, calcification, and the presence of nodules.
- Biopsies were obtained using automatic BARD biopsy gun (18G, 25 automatic).

The most commonly used protocol was the "targeted plus systematic" Twelve-core biopsy protocol and an additional sample from the suspicious lesion if noted were taken. After biopsy samples were obtained, they were persevered in formaldehyde solution and were sent to the Pathology section for histo-pathological analysis.

Inclusion Criteria:

1. PSA (Prostate Specific Antigen) >4 ng/ml and / or.
2. High PIRADS score (3 or more)

Exclusion Criteria:

1. Uncooperative patient

Statistical Analysis:

The data were entered and analysed in SPSS. Frequency and Percentages of all the variables were computed.

The chi-square test was used to compare the association presenting symptoms, prostate size and volume, echo-texture, calcification, radiological findings, serum PSA levels and PIRADS score. The results were considered statistically significant if the p-value was <0.05.

Research Question:

How effective is the combination of PSA levels and PI-RADS scores in predicting histopathological evidence of prostate cancer?

AIM

To investigate the correlation between Prostate Specific Antigen (PSA) levels and PI-RADS scores in the diagnosis of prostate cancer, utilizing histopathological evidence obtained through Transrectal Ultrasonography (TRUS)-guided prostate biopsy.

OBJECTIVE:

To assess the relationship between PSA levels and PI-RADS scores in patients undergoing diagnostic evaluation for prostate cancer.

- To explore the role of combined PSA levels and PI-RADS scores in improving the overall accuracy of prostate cancer diagnosis.

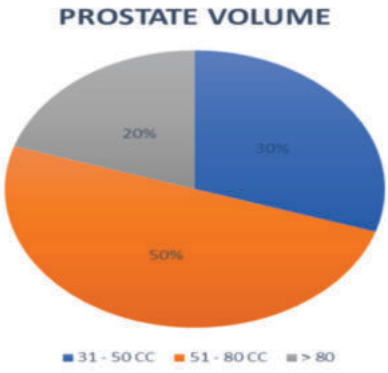
RESULTS:

1. Age Distribution:

Out of 30 patients studied age group was from 55 – 83 years. Incidence of cancer in our study was found in subjects belonging to elderly group ranging between 60-80yrs. In our study we found that the prostatic cancer was seen in elderly. The mean age was 69 yrs.

2. Correlation of Prostate Volume And Malignancy

In our study out of 30 subjects, 30%, 50% and 20% of subjects had prostate gland with volumes of 31-50 cc, 51-80 cc and >81 cc respectively.



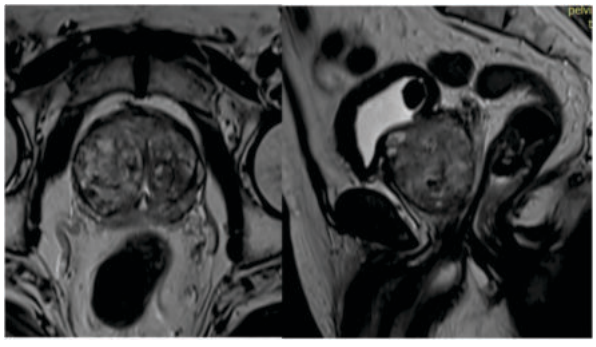


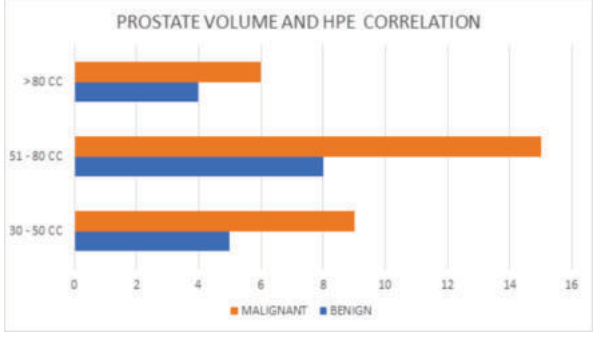
Figure 1: T2WI shows, prostate gland is grossly enlarged, measures 4.4cm x 4.8cm x 4.9cm, (CC x AP x TR), Approximate volume measures 51cc.

And 46% of the malignancies were found in subjects having prostate volume of 51 – 80cc on HPE correlation, which was statistically not significant (p value: 0.895).

Prostate size	Histopathology		Total
	Benign	Malignant	
31 – 50 cc	5 (55.6%)	9 (44.6%)	9 (100%)
50 – 80 cc	8 (53.3%)	15 (46.7%)	15 (100%)
> 80cc	4(66.7%)	6 (33.3%)	6 (100%)

Table 1. Correlation of Prostate Size and Volume with HPE

Xa test, p valve – 0.895



3. Correlation between Radiological (PIRADS) and Histological Diagnosis

In a cohort of 30 individuals for our study, each one presented with a clinical diagnosis of prostatic disease. When scrutinized radiologically, all participants exhibited a prostate volume exceeding

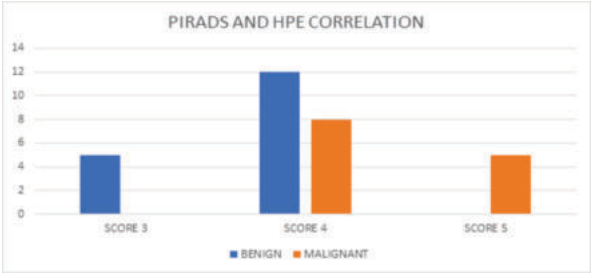
30cc and a PI-RADS score of 3 or higher, setting the stage for an identification for pathology.

In the context of PI-RADS scoring, our findings revealed distinct outcomes for different categories. Notably, for PI-RADS 3, all five patients (100%) were determined to have benign conditions upon histopathological examination. And for PI-RADS 4, a majority of 60% (12 patients) exhibited benign characteristics, contrasting with the remaining 40% (8 patients) diagnosed with malignancy. Lastly, in the case of PI-RADS 5, with all five patients (100%) confirming malignancy upon histopathological scrutiny.

PIRADS	HPE Findings		Total
	Benign	Malignant	
Score 3	5 (100%)	0 (0%)	5 (100%)
Score 4	12 (60%)	8 (40%)	20 (100%)
Score 5	0 (0%)	5 (100%)	5 (100%)

Table 3. Correlation between Radiological (PIRADS) and HPE Findings

X_2 test, p valve = 0.003



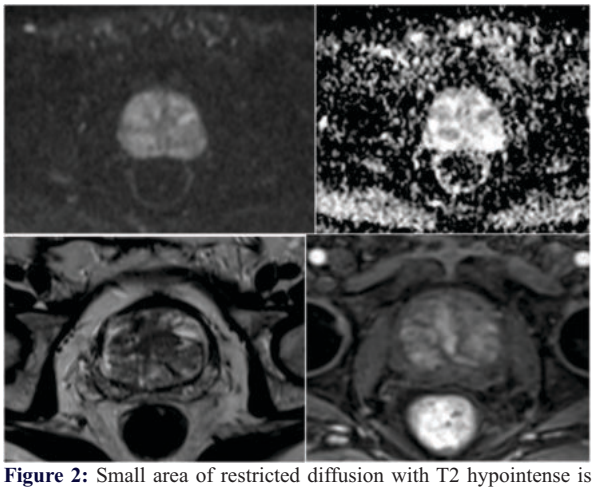


Figure 2: Small area of restricted diffusion with T2 hypointense is seen in left lateral mid gland, measuring ~9mm x 7mm. Early contrast enhancement noted. PIRADS – 4 lesion. Serum. PSA: 20ng/ml. Histopathology – Adenomatous hyperplasia of prostate.
(Left to right: DWI, ADC, T2WI and post-contrast images)

4. Correlation of PSA with HPE

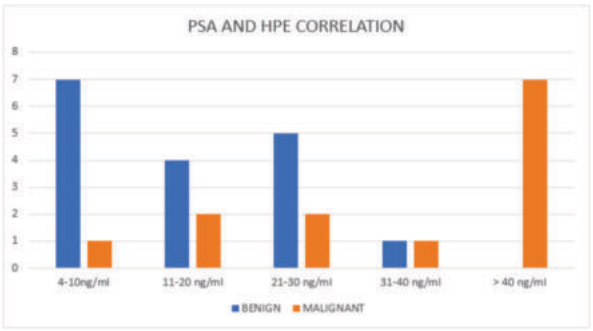
Out of 30 patients 13 patients who were found to be malignant, 4 patients had PSA levels of >41 ng/ml, 17 patients who were benign on HPE correlation patients had PSA levels between 4-40 ng/ml.

In our study with serum PSA levels 4-10 ng/ml, TRUS guided biopsy detected cancer in 12.5% cases, while the detection rate was 33%% with serum PSA levels 11-20 ng/ml, 28.6%% levels of 21-30 ng/ml, 50% with levels of 31-40 ng/ml and detection rate was 100 % with serum PSA levels of >41 ng/ml.

Serum PSA	Histopathology		Total
	Benign	Malignant	
4-10 ng/ml	7 (87.5%)	1 (12.5%)	8 (100%)
11-20 ng/ml	4 (66.7%)	2 (33.3%)	6 (100%)
21-30 ng/ml	5 (71.4%)	2 (28.6%)	7 (100%)
31-40 ng/ml	1 (50%)	1 (50%)	2 (100%)
>41 ng/ml	0 (0%)	7 (100%)	7 (100%)

Table 3. Correlation between PSA Levels and HPE

X_2 test, p valve = 0.013



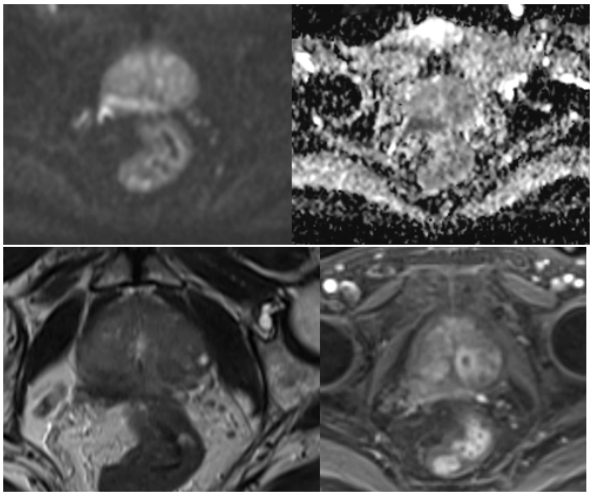


Figure 3: Focal ill-defined T2 hypointensity is seen in the right posterior peripheral zone of apex of prostate, with marked restricted diffusion (DWI score 5) and early enhancement in dynamic contrast series (DCE +ve). Focal extra-capsular extension is also noted at this site with asymmetry of the right neurovascular bundle with obliteration of the recto-prostatic angle. PIRADS – 5 lesion. Serum PSA: 49ng/ml. Histopathology: Adenocarcinoma prostate.
(Left to right: DWI, ADC, T2WI and post-contrast images)

DISCUSSION

Age:

The age range of the subjects, spanning from 55 to 83 years, is representative of an older demographic, highlighting the relevance of prostate cancer as a condition primarily affecting individuals in the later stages of life. Significantly, the incidence of cancer was prominently identified in the elderly subgroup, specifically in individuals aged between 60 and 80 years.

This finding aligns with the well-established understanding that the risk of prostate cancer tends to increase with advancing age, underscoring the importance of vigilant screening and diagnostic measures, particularly in the elderly population.

The mean age of 69 years for those diagnosed with prostatic cancer in our study provides a central tendency that further emphasizes the prevalence of this condition in the elderly.

Prostate Volume

The distribution of prostate gland volumes among the 30 subjects in our study reveals an interesting pattern, with 30%, 50%, and 20% of individuals exhibiting volumes within the ranges of 31-50 cc, 51-80 cc, and >81 cc, respectively. Notably, when considering malignancies, 46% of the cases were identified in subjects with prostate volumes falling within the 51-80 cc range.

However, upon statistical analysis, the association between prostate volume in this range and the incidence of malignancy was deemed not significant (p-value: 0.895).

The absence of statistical significance suggests that the observed occurrence of malignancies in individuals with prostate volumes between 51-80 cc may be incidental or influenced by factors beyond prostate size alone.

While our study did not establish a statistically significant correlation between prostate volume and malignancy in the 51-80 cc range, it is essential to acknowledge the limitations of our sample size and consider the multifactorial nature of prostate cancer development. Larger-scale studies with diverse populations and comprehensive data may be required to further elucidate the intricate relationship between prostate volume and cancer risk.

PIRADS and Histopathological Correlation

In our study, comprising a cohort of 30 individuals with a clinical diagnosis of prostatic disease, the radiological evaluation played a pivotal role in identifying potential pathology.

Our investigation into the PI-RADS scoring system yielded distinctive outcomes across different categories. Remarkably, for PI-RADS 3, all five patients (100%) were histopathologically confirmed to have benign conditions. This concordance between radiological assessment and pathological findings underscores the reliability of PI-RADS in accurately characterizing lesions with lower suspicion levels, providing valuable reassurance in clinical decision-making.

For PI-RADS 4, the findings revealed a nuanced scenario. A majority of 60% (12 patients) manifested benign characteristics upon histopathological examination, while the remaining 40% (8 patients) were diagnosed with malignancy. This intriguing split within the PI-RADS 4 category highlights the complexity inherent in interpreting lesions with intermediate suspicion levels. It emphasizes the need for caution in clinical decision-making, acknowledging the potential for both benign and malignant outcomes within this category.

In the case of PI-RADS 5, the highest suspicion level, the radiological assessment seamlessly aligned with histopathological scrutiny. All five patients (100%) within this category were confirmed to have malignancy. This robust correlation underscores the precision of PI-RADS 5 in identifying clinically significant lesions, reinforcing its crucial role in guiding subsequent diagnostic and therapeutic interventions.

Overall, our study affirms the clinical relevance of PI-RADS in enhancing diagnostic precision and facilitating informed decision-making in the realm of prostatic disease.

PSA Levels and Histopathological Correlation

The investigation into serum Prostate-Specific Antigen (PSA) levels in our study of 30 patients with prostatic conditions revealed intriguing associations with malignancy.

Among the 13 patients identified as having malignancies, a notable 4 exhibited elevated PSA levels exceeding 41 ng/ml, constituting a distinctive subgroup within the malignant cohort. Concurrently, 17 patients with benign histopathological correlations displayed a spectrum of PSA levels between 4-40 ng/ml, emphasizing the heterogeneity in PSA values within the benign category.

When evaluating the impact of serum PSA levels on cancer detection through Transrectal Ultrasonography (TRUS)-guided biopsy, our findings demonstrated a nuanced relationship. In cases where PSA levels ranged from 4 to 10 ng/ml, the detection rate was 12.5%. This observation aligns with the clinical understanding that lower PSA levels are associated with a lower likelihood of cancer detection. However, as PSA levels increased, a corresponding rise in cancer detection rates was evident. Notably, with PSA levels between 11-20 ng/ml, the detection rate surged to 33%, emphasizing the increased sensitivity of TRUS-guided biopsy in this intermediate PSA range. Further escalation in PSA levels, particularly in the range of 31-40 ng/ml, resulted in a detection rate of 50%. The most striking finding was the 100% detection rate in cases where PSA levels exceeded 41 ng/ml, underscoring the heightened diagnostic precision of TRUS-guided biopsy in instances of markedly elevated PSA levels.

These observations underscore the significant correlation between serum PSA levels and the likelihood of detecting prostate cancer. The 100% detection rate in the highest PSA category reinforces the utility of TRUS-guided biopsy in cases of substantially elevated PSA, highlighting its effectiveness in identifying clinically significant prostate malignancies.

CONCLUSION:

TRUS guided Twelve core biopsy is a safe and effective procedure in diagnosing prostate cancer and has high diagnostic rates for patients with PSA levels of >40 ng/ml and PIRADS score of 4 or more.

In conclusion, our study has provided a comprehensive examination of the diagnostic landscape for prostate cancer by combining Prostate Imaging–Reporting and Data System (PI-RADS) scores with serum Prostate-Specific Antigen (PSA) levels. The distinctive outcomes across PI-RADS categories underscore the strength of radiological assessments, with PI-RADS 3 offering a reassuring low malignancy likelihood, PI-RADS 4 presenting a nuanced challenge with a mix of benign and malignant outcomes, and PI-RADS 5 demonstrating high specificity in identifying clinically significant malignancies.

The synergy between PI-RADS scores and PSA levels is particularly evident in cases with intermediate PI-RADS scores. While PI-RADS scores provide valuable radiological insights, PSA levels contribute biochemical information, enhancing diagnostic precision. The combination of these parameters allows for a more nuanced understanding of prostate cancer, guiding tailored clinical decisions.

TRUS-guided biopsy serves as the bridge between radiological and biochemical assessments, offering a tangible confirmation of malignancy and facilitating precise risk stratification. Its role in confirming or refuting the suspicions raised by PI-RADS scores and PSA levels ensures a robust and clinically relevant diagnosis.

Limitations:

It's a short-term study hence long-term changes in the prostate are not studied. The size of the study population was very small and sample size was very low. Long term follow-up of those patients with elevated serum PSA and normal HPE is necessary.

Acknowledging these limitations is crucial for a transparent interpretation of the study's outcomes. Future research with larger, more diverse cohorts, prospective designs, and consideration of additional variables could further refine our understanding of the diagnostic interplay between PI-RADS scores, PSA levels, and Transrectal Ultrasonography (TRUS)-guided biopsy in prostate cancer.

REFERENCES:

1. Gupta R, Mahajan M, Sharma P. 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. Int J Appl Basic Med Res. 2021 Jan-Mar;11(1):32-35. doi: 10.4103/ijabmr.IJABMR_115_20. Epub 2021 Jan 26. PMID: 33842293; PMCID: PMC8025949..
2. Dvorácek J. [Adenocarcinoma of the prostate]. Cas Lek Cesk. 1998 Aug 31;137(17):515-21.
3. Schedlich LJ, Bennetts BH, Morris BJ. Primary structure of a human glandular kallikrein gene. DNA. 1987 Oct;6(5):429-37
4. Stamey TA, Yang N, Hay AR, McNeal JE, Freiha FS, Redwine E. Prostate-specific antigen as a serum marker for adenocarcinoma of the prostate. N Engl J Med. 1987 Oct 08;317(15):909-16
5. US Preventive Services Task Force. Grossman DC, Curry SJ, Owens DK, Bibbins-Domingo K, Caughey AB, Davidson KW, Doubeni CA, Ebell M, Epling JW, Kemper AR, Krist AH, Kubik M, Landefeld CS, Mangione CM, Silverstein M, Simon MA, Siu AL, Tseng CW. Screening for Prostate Cancer: US Preventive Services Task Force Recommendation Statement. JAMA. 2018 May 08;319(18):1901-1913.
6. Jain MA, Leslie SW, Sapra A. Prostate Cancer Screening. In: *StatPearls*. Treasure Island (FL): StatPearls Publishing; October 26, 2023.
7. Oesterling JE, Jacobsen SJ, Chute CG, Guess HA, Girman CJ, Panser LA, Lieber MM. Serum prostate-specific antigen in a community-based population of healthy men. Establishment of age-specific reference ranges. JAMA. 1993 Aug 18;270(7):860-4
8. 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.
9. Scott R, Misser SK, Cioni D, Neri E. PI-RADS v2.1: What has changed and how to report. SA J Radiol. 2021 Jun 1;25(1):2062. doi: 10.4102/sajr.v25i1.2062. PMID: 34230862; PMCID: PMC8252188.
10. Barrett T, Rajesh A, Rosenkrantz AB, Choyke PL, Turkbey B. PI-RADS version 2.1: one small step for prostate MRI. Clin Radiol. 2019;74(11):841-852. doi:10.1016/j.crad.2019.05.019
11. Prostate Imaging Reporting & Data System - PI-RADS 2015 version2 (full text document). ACR American College of Radiology
12. Turkbey B, Rosenkrantz AB, Haider MA, et al. Prostate Imaging Reporting and Data System Version 2.1: 2019 Update of Prostate Imaging Reporting and Data System Version 2. *Eur Urol*. 2019;76(3):340-351. doi:10.1016/j.eururo.2019.02.033