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HISTOPATHOLOGICAL SPECTRUM OF PROSTATE LESIONS IN CORRELATION WITH SERUM PROSTATE SPECIFIC ANTIGEN LEVEL IN A TERTIARY CARE HOSPITAL- A CROSS SECTIONAL STUDY

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ABSTRACT

Background: Prostate diseases are among the most common disorders affecting elderly men and encompass a wide spectrum ranging from benign prostatic hyperplasia (BPH) and inflammatory lesions to premalignant conditions and prostatic adenocarcinoma. Histopathological examination remains the gold standard for the definitive diagnosis of these lesions. Serum Prostate Specific Antigen (PSA) is a widely used biomarker for the detection and monitoring of prostate disorders; however, elevated PSA levels may also occur in benign conditions, limiting its specificity. Correlating serum PSA levels with histopathological findings may enhance diagnostic accuracy and aid in distinguishing benign from malignant lesions. To study the histopathology spectrum of prostate lesions and to correlate with serum PSA levels. The objective of the study is to study the inflammatory, benign and malignant lesions. To study the suspicious lesions of prostate. To study the benign mimickers of prostate carcinoma. To correlate final diagnosis with serum PSA level.

Materials and Methods: The present study is a prospective, cross-sectional analytical study conducted over a period of one year (December 2024 – December 2025) at Sri Venkateswara Medical College, Tirupati.The study was conducted in the Department of Pathology, Sri Venkateswara Medical College, in collaboration with the Department of Urology, SVRRGGH where prostatic tissue samples (biopsy and resected specimens) were received for histopathological evaluation.

Results: The study evaluated 90 male patients undergoing prostate evaluation in a tertiary-care hospital, with analysis focused on clinical presentation, procedural approach, prostate-specific parameters, and histopathological outcomes. The age distribution showed a predominance of older individuals, with 58.89% of patients between 51–70 years and 23.33% aged ≥71 years, indicating that prostate-related morbidity and evaluation were largely concentrated beyond the fifth decade. Lower urinary tract symptoms (LUTS) formed the major mode of presentation. Hesitancy (18.89%), urgency (17.78%), frequency (14.44%), and poor urinary stream (14.44%) were the most common complaints, while acute retention and hematuria were less frequent (5.56% each). Transurethral resection of the prostate (TURP) was the most commonly performed procedure (80.00%), followed by TRUS-guided biopsy (18.89%), reflecting a symptom-driven, intervention-oriented diagnostic pathway. The mean prostate volume of the cohort was 35.14 ± 6.74 g, and the mean serum PSA level was 11.96 ± 4.97 ng/mL, indicating moderate gland enlargement and PSA elevation at the population level. Benign and inflammatory lesions predominated on histopathology (71.11%),

with NH with chronic prostatitis (36.67%) and NH alone (34.44%) being the most frequent diagnoses. Adenocarcinoma of the prostate was identified in 8.89% of cases. No statistically significant association was observed between DRE findings, presenting complaints, or procedure performed and histopathological diagnosis. Serum PSA levels, prostate volume, and age differed significantly across diagnostic categories ($p < 0.001$), with adenocarcinoma characterized by markedly higher PSA, smaller prostate volume, and advanced age. Overall, the study highlights the importance of integrating PSA, age, prostate volume, and histopathology for accurate characterization of prostate disease in routine Indian clinical practice. PSA velocity analysis revealed an overall mean PSV of 1.62 ± 2.49 ng/mL/year for benign, 0.07 ± 2.25 ng/mL/year for premalignant, and 5.33 ± 3.75 ng/mL/year for malignant lesions, reflecting differential PSA kinetics across diagnostic categories. Risk stratification by PSA velocity showed that 91.23% of benign, 71.43% of premalignant, and 75.00% of malignant cases were low risk (<0.75 ng/mL/year), with a relatively higher proportion of high-risk PSA velocity among premalignant and malignant groups.

Conclusion: Overall, the study reinforces that accurate characterization of prostate disease in routine Indian clinical practice requires integration of age, PSA levels and histopathology rather than reliance on symptoms or examination findings in isolation. These conclusions are strictly grounded in the numerical patterns observed within the present study population and should be interpreted within its observational scope. Furthermore, the PSA velocity analysis in the present study provides valuable longitudinal insights. The differential PSA kinetics across diagnostic categories, with benign lesions showing a declining PSA trend and premalignant lesions demonstrating a near-stable pattern, support the use of serial PSA monitoring as a complementary tool in disease surveillance. The finding that patients with high-risk PSA velocity (>0.75 ng/mL/year) were more likely to demonstrate diagnostic progression to malignancy on repeat evaluation underscores the clinical utility of PSA velocity in risk stratification, particularly in settings where routine screening is not universally implemented.

Keywords: PSA, Histopathology, Transurethral resection of the prostate, Hematuria, benign prostatic hyperplasia.

INTRODUCTION

The prostate gland is a vital component of the male reproductive system, with its primary function being the secretion of prostatic fluid, a constituent of semen. Anatomically, it is situated below the urinary bladder and surrounds the prostatic urethra. As men age, the prostate undergoes physiological and pathological changes that usually gives rise to a wide spectrum of lesions ranging from Benign hyperplasia to malignancy.

Prostate lesions, especially Nodular hyperplasia and adenocarcinoma, are highly prevalent among aging men worldwide. Histopathological examination remains the gold standard for accurate diagnosis and classification of these lesions. However, it is often supplemented by clinical evaluation and biochemical markers to guide in decision-making. Among these markers, serum Prostate Specific Antigen (PSA) has emerged as a valuable tool in screening, monitoring, and prognosticating prostatic disorders. PSA is a kallikrein-like serine protease secreted almost exclusively by the epithelial cells of the prostate and is present in low levels in the blood under normal conditions. Elevated levels may be seen in both benign and malignant conditions, hence necessitating histopathological confirmation to arrive at a definitive diagnosis.

In recent decades, widespread of PSA testing has led to a significant increase in the detection rates of both benign and malignant lesions of the prostate, often at earlier stages. However, its specificity remains suboptimal, as various benign conditions such as prostatitis and nodular hyperplasia can also elevate serum PSA levels. Thus, there arises a critical need to study the histopathological spectrum of prostate lesions in correlation with serum PSA levels, in order to determine patterns, improve diagnostic accuracy, and optimize the use of PSA as a screening and diagnostic tool.

Globally, prostate cancer is the second most common cancer and the fifth leading cause of cancer-related deaths among men.[1] In India, while the incidence is comparatively lower, it has shown a rising trend, especially in urban populations, due to increasing life expectancy, awareness, and use of PSA screening.[2] This context underlines the importance of understanding the histological types of prostate lesions, their distribution across age groups, and the PSA correlations in the Indian population.

Operational Definitions

Prostate Specific Antigen (PSA): A glycoprotein produced by prostate epithelial cells; measured in nanograms per millilitre (ng/mL) in serum. Elevated PSA may indicate prostatic pathology.

Nodular hyperplasia: Replacement of Nodular hyperplasia (NH). A non malignant enlargement of the prostate gland, commonly seen in elderly men, characterized by hyperplasia of both stromal and epithelial elements.

Prostatic Intraepithelial Neoplasia (PIN): A precancerous condition involving atypical epithelial proliferation, which may be low-grade or high grade depending on architectural and cytological features.

Prostate Adenocarcinoma: A malignant epithelial tumor arising in the prostate gland, most commonly of acinar type, graded using the Gleason scoring system.

Aim and Objectives

Aim of the study

To study the histopathology spectrum of prostate lesions and to correlate with serum PSA levels

Objectives of the study

- To study the inflammatory, benign and malignant lesions.
- To study the suspicious lesions of prostate.
- To study the benign mimickers of prostate carcinoma.
- To correlate final diagnosis with serum PSA level.

MATERIALS AND METHODS

Study Design: The present study is a prospective, cross-sectional analytical study conducted over a period of one year (December 2024 – December 2025) at Sri Venkateswara Medical College, Tirupati.

Study Setting: The study was conducted in the Department of Pathology, Sri Venkateswara Medical College, in collaboration with the Department of Urology, SVRRGGH where prostatic tissue samples (biopsy and resected specimens) were received for histopathological evaluation.

Sample Size and Sampling Technique: The sample size was calculated based on a previously published study conducted in Bangalore, 2022(56) which reported the prevalence of histopathologically confirmed prostatic lesions as 88%. Using the formula for estimating a population proportion with specified relative precision and assuming:

- •Prevalence (P) = 88%
- •Absolute precision (d) = 5%
- •Confidence level = 95% (Z = 1.96)

The minimum required sample size was calculated to be 89 cases. All eligible cases during the study period were included using purposive sampling.

Source of Data

- Surgically resected prostatectomy specimens and prostate biopsy specimens received in the Department of Pathology during the study period.
- Relevant clinical details including age, presenting complaints, radiological findings, and serum PSA levels were obtained from patient records in the Department of Urology.

Inclusion Criteria

- All prostatic tissue specimens (biopsy or surgical) received during the study period.
- Cases with available serum PSA reports.
- Specimens with adequate tissue for histopathological evaluation.
- Written informed consent obtained from the patient.

Exclusion Criteria

- Specimens with inadequate fixation or autolysed tissues.
- Cases lacking clinical or biochemical data (i.e., PSA levels).
- Patients unwilling to participate or not providing consent.

Methodology

Tissue Collection and Fixation: Prostatic tissue specimens received were fixed in 10% neutral buffered formalin. Detailed grossing was carried out, and representative sections were submitted for histopathological processing.

Tissue Processing: The standard steps of dehydration, clearing, and paraffin embedding were followed. Paraffin blocks were prepared, and sections of 4–5 microns thickness were cut using a semi-automated rotary microtome.

Staining: Sections were stained with routine Hematoxylin and Eosin (H&E). Special stains or immunohistochemistry were employed in doubtful cases as per diagnostic necessity.

Histopathological Evaluation: Microscopic examination was done using light microscopy. The lesions were classified as:

- Benign lesions (e.g., NH, NH with prostatitis)
- Premalignant lesions (Low/High Grade Prostatic Intraepithelial Neoplasia – PIN)
- Malignant lesions (Prostatic adenocarcinoma and variants)

Adenocarcinomas were graded according to the Gleason scoring system and grouped using the ISUP Grade Group classification.

5. Correlation with PSA Levels

Serum PSA levels were recorded at the time of diagnosis. These were categorized into:

- ≤4 ng/mL
- 4.1–10 ng/mL
- 10.1–20 ng/mL
- 20.1–50 ng/mL
- >50 ng/mL

Correlation was made between PSA level categories and the type and grade of prostatic lesion.

Correlation with PSA velocity:

- Serial serum PSA values of minimum two readings obtained at time intervals of 6 months,

were recorded from patients with initial PSA > 4ng/dL

- Expressed in ng/mL/year, average rate of change was considered.
- PSA velocity categorised as < 0.75 (low risk) and > 0.75 (high risk) and correlated with histopathological diagnosis.

Statistical Analysis: Data were entered into MS Excel and analyzed using JASP 0.18.3.0 Results were expressed as percentages, means, and standard deviations. Chi-square test or Fisher's exact test was used to assess the association between PSA levels and type of lesion. Spearman's correlation coefficient was used to measure the strength of association between PSA levels and histological grade. P-value<0.05 was considered statistically significant.

RESULTS

Table 1: Age group distribution of the study population

Age group (years)	Number of patients
41 – 50	16
51 – 60	23
61 – 70	30
71 – 80	11
81 – 90	10
Total	90

The largest proportion of patients belonged to the 61–70 years age group (30 patients), followed by the 51–60 years group (23 patients). Overall, the distribution shows a predominance of cases in the sixth and seventh decades of life, consistent with the typical age profile of patients undergoing prostate evaluation.

Table 2: Distribution of presenting complaints among the study population

Presenting complaint	Number of patients
Acute retention	5
Difficult voiding	8
Dribbling	4
Increased frequency	13
Hematuria	5
Hesitancy	17
Nocturia	9
Poor stream	13
Urgency	16
Total	90

Hesitancy (17 patients) and urgency (16 patients) were the most frequently reported presenting complaints, followed by increased frequency and poor urinary stream (13 patients each). Acute urinary retention and hematuria were less common presentations, observed in 5 patients each, reflecting a broad spectrum of lower urinary tract symptoms in the study population.

Table 3: Distribution of procedures performed in the study population

Procedure performed	Number of patients
Transurethral resection of prostate	72
Transrectal ultrasound-guided prostate biopsy	17
Open prostatectomy	1
Total	90

The majority of patients (72 cases) underwent Transurethral resection of the prostate, reflecting its role as the primary diagnostic procedure. Transrectal ultrasound-guided prostate biopsy was performed in 17 patients, while open prostatectomy was required only in 1 patient, indicating selective use based on clinical indication.

Table 4: Prostate specific parameters in the study population

0	Mean ± SD
Prostate volume (gms)	35.14 ± 6.74
Serum PSA (ng/mL)	11.96 ± 4.97

The mean prostate volume of the study population was 35.14 ± 6.74 g, and the mean serum PSA level was 11.96 ± 4.97 ng/mL, indicating a wide variability in gland size and PSA levels among patients evaluated.

Table 5: Distribution of histopathological diagnosis in the study population

Histopathological diagnosis	Number of patients
Adenocarcinoma of prostate	8
Nodular hyperplasia	27

NH with acute prostatitis	9
NH with chronic prostatitis	33
NH with squamous metaplasia	1
Granulomatous prostatitis	3
Low-grade prostatic intraepithelial neoplasia (LG PIN)	3
High Grade prostatic intraepithelial neoplasia (HG PIN)	4
Prostate abscess	2
Total	90

[Table 5] shows the distribution of histopathological diagnoses among the study population. The most common finding was Nodular hyperplasia (NH) with chronic prostatitis, observed in 33 patients, followed by NH alone in 27 patients. NH associated with acute prostatitis was seen in 9 cases. Adenocarcinoma of the prostate was identified in 8 patients. Other less common findings included highgrade prostatic intraepithelial neoplasia (HG PIN) in 4 cases, low-grade prostatic intraepithelial neoplasia (LG PIN) and granulomatous prostatitis in 3 cases each, and prostate abscess in 2 cases. NH with squamous metaplasia was the least common finding, seen in only 1 case. Overall, benign inflammatory and hyperplastic lesions constituted the majority of cases in the present study.

Table 6: Association of histopathological diagnosis with DRE suspected status

Histopathological diagnosis	DRE not suspected	DRE suspected	Total
Adenocarcinoma of prostate	7	1	8
Nodular hyperplasia	25	2	27
NH with acute prostatitis	7	2	9
NH with chronic prostatitis	32	1	33
NH with squamous metaplasia	1	0	1
Granulomatous prostatitis	3	0	3
Low-grade PIN	2	1	3
High-grade PIN	4	2	6
Prostate abscess	2	0	2
Total	83	7	90
	p-value: 0.27		

[Table 6] shows the association between histopathological diagnosis and DRE suspected status among the study population. Out of the 90 patients, the majority (83 cases) were not suspected on digital rectal examination (DRE), while only 7 cases were suspected clinically. Among adenocarcinoma cases, 7 were not suspected on DRE and 1 case was suspected. Similarly, most cases of Nodular hyperplasia (25 out of 27), NH with chronic prostatitis (32 out of 33), and other benign lesions were not suspected on DRE. A small number of cases such as NH with acute prostatitis (2 cases), low-grade PIN (1 case), and high-grade PIN (2 cases) were suspected on DRE. However, the association between histopathological diagnosis and DRE suspected status was not statistically significant ($p = 0.27$), indicating that DRE findings did not show a significant correlation with the final histopathological diagnosis in the present study.

Table 7: Distribution of carcinoma core location on TRUS among adenocarcinoma of prostate cases (n = 8)

Carcinoma core location on TRUS	Number of patients
Left middle	1
Right lower	1
Right middle & right lower	1
Right upper	1
Right middle	1
Other single core involvement	3
Total	8

Among patients diagnosed with adenocarcinoma of the prostate, carcinoma cores on TRUS-guided biopsy were distributed across different anatomical locations, with no single site showing clear predominance. This reflects a heterogeneous pattern of tumor involvement within the prostate in the present study.

Table 8: Association of histopathological diagnosis with presenting complaints

Histopathological diagnosis	Acute Ret.	difficult	Dribbling	Frequent	Hematuria	Hesitancy	Nocturia	Poor stream	Urgency	Total
Adenocarcinoma of prostate	0	0	1	0	0	2	1	2	2	8
Nodular hyperplasia	3	2	0	3	1	7	5	4	2	27
NH with acute	0	2	0	1	2	1	1	1	1	9

prostatitis										
NH with chronic prostatitis	2	3	2	7	2	7	2	5	3	33
NH with squamous metaplasia	0	1	0	0	0	0	0	0	0	1
Granulomat ous prostatitis	0	0	0	0	0	0	0	0	3	3
Low-grade PIN	0	0	0	0	0	0	0	0	3	3
High-grade PIN	0	0	1	1	0	0	0	1	1	4
Prostate abscess	0	0	0	1	0	0	0	0	1	2
Total	5	8	4	13	5	17	9	13	16	90
				p-value: 0.24						

[Table 8] shows the association between histopathological diagnosis and presenting complaints among the study population. Overall, the most common presenting complaint was hesitancy (17 cases), followed by urgency (16 cases), frequent micturition (13 cases), and poor urinary stream (13 cases). Among patients with Nodular hyperplasia (NH), hesitancy and nocturia were the most frequent symptoms, while NH with chronic prostatitis commonly presented with frequent micturition and hesitancy. In adenocarcinoma of the prostate, the common complaints included poor stream, urgency, and hesitancy. Granulomatous prostatitis and low-grade PIN cases mainly presented with urgency. However, the association between histopathological diagnosis and presenting complaints was not statistically significant ($p = 0.24$), indicating that the pattern of presenting symptoms did not show a significant correlation with the underlying histopathological diagnosis in this study.

Table 9: Association of histopathological diagnosis with procedure performed

0	Prostatectomy	TRUS biopsy	TURP	Total
Adenocarcinoma of prostate	0	5	3	8
Nodular hyperplasia	1	3	23	27
NH with acute prostatitis	0	3	6	9
NH with chronic prostatitis	0	3	30	33
NH with squamous metaplasia	0	0	1	1
Granulomatous prostatitis	0	0	3	3
Low-grade PIN	0	1	2	3
High-grade PIN	0	2	2	4
Prostate abscess	0	0	2	2
Total	1	17	72	90
	p-value: 0.24			

[Table 9] shows the association between histopathological diagnosis and the procedure performed among the study population. Transurethral resection of the prostate (TURP) was the most commonly performed procedure, accounting for 72 cases, followed by TRUS-guided biopsy in 17 cases and prostatectomy in 1 case. Among patients with Nodular hyperplasia (NH), the majority underwent TURP (23 out of 27 cases). Similarly, most cases of NH with chronic prostatitis (30 out of 33) and NH with acute prostatitis (6 out of 9) were managed with TURP. In adenocarcinoma of the prostate, TRUS biopsy was the most common procedure performed (5 cases), followed by TURP (3 cases). Other lesions such as granulomatous prostatitis, prostate abscess, and NH with squamous metaplasia were also mainly managed with TURP. However, the association between histopathological diagnosis and the procedure performed was not statistically significant ($p = 0.24$), indicating that the type of procedure performed did not show a significant correlation with the histopathological diagnosis in the present study.

Table 10: Comparison between mean serum PSA levels and histopathological diagnosis categories

Histopathological diagnosis	Serum PSA (ng/mL), Mean ± SD
Adenocarcinoma of prostate	45.03 ± 33.97
Nodular hyperplasia	7.44 ± 5.25
NH with acute prostatitis	7.94 ± 4.71
NH with chronic prostatitis	9.85 ± 5.70
NH with squamous metaplasia	9.50 ± 0.00
Granulomatous prostatitis	10.03 ± 2.67
Low-grade PIN	9.30 ± 3.90
High-grade PIN	11.15 ± 2.30
Prostate abscess	8.65 ± 3.46
p-value:< 0.001	

A statistically significant difference was observed in mean serum PSA levels across the various histopathological diagnosis categories ($p < 0.001$). Patients with adenocarcinoma of the prostate had markedly higher mean PSA levels compared to

those with benign, inflammatory, and premalignant conditions.

Table 11: PSA Velocity Risk Category Distribution by Diagnosis

Diagnosis Category	Total	Low Risk (<0.75 ng/mL/year)	High Risk (>0.75 ng/mL/year)
Benign	57	52	5
Premalignant (PIN)	7	2	5
Malignant	8	2	6

[Table 11] shows the distribution of PSA velocity risk categories across diagnosis groups. Among benign lesions, 52 out of 57 patients (91.23%) were classified as low risk (<0.75 ng/mL/year) and only 5 (8.77%) as high risk (>0.75 ng/mL/year). In the premalignant (PIN) group, 2 of 7 patients (28.57 %) fell in the low-risk category and 5 (71.43 %) in the high-risk category. Among malignant cases, 8 patients 2 (25.00%) were low risk and 6 (75.00%) were high risk. However, the relatively higher proportion of high-risk PSA velocity among premalignant and malignant groups compared to benign lesions suggests that elevated PSA velocity may serve as a supplementary indicator warranting closer surveillance.

Table 12: Mean PSA and PSA Velocity by Histopathological Category

Category	Mean PSA ± SD (ng/mL)	Mean PSV ± SD (ng/mL/year)
Benign	8.57 ± 5.44	1.62 ± 2.49
Premalignant (PIN)	10.54 ± 3.37	0.07 ± 2.25
Malignant	45.03 ± 33.97	5.33 ± 3.75

[Table 12] summarizes the mean PSA and PSA velocity by broad histopathological category. Patients with malignant lesions had markedly higher mean PSA levels (45.03 ± 33.97 ng/mL) compared to benign (8.57 ± 5.44 ng/mL) and premalignant (10.54 ± 3.37 ng/mL) groups. When considered alongside the PSA velocity data, the malignant group demonstrated the mean PSV (5.33 ± 3.75ng/mL/year), which is attributable to the rapid rise in PSA levels. Benign lesions showed a modest positive PSV (1.62 ± 2.49 ng/mL/year) with moderate variation, while premalignant lesions had a near-stable PSV (0.07 ± 2.25 ng/mL/year). These finding suggests its utility of integrating both baseline PSA and PSA velocity for diagnostic stratification.

Table 13: Correlation of PSA Velocity with Gleason grade in Prostatic carcinoma

Gleason grade	Total cases	Low Risk (<0.75 ng/mL/year)	High Risk (>0.75 ng/mL/year)
Grade Group 1 (≤6)	2	2	0
Grade Group 2 (3+4=7)	2	0	2
Grade Group 3 (4+3=7)	1	0	1
Grade Group 4 (8)	1	0	1
Grade Group 5 (9–10)	2	0	2

In total of (n = 8) prostatic adenocarcinoma. All cases (2/8) with low PSA velocity (<0.75 ng/mL/year) were confined to Grade Group 1 (Gleason ≤6), indicating indolent tumor behavior. In contrast, higher Gleason grade groups (≥7) with high PSA velocity (> 0.75 ng/mL/year) were confined to Grade Group 2 to 5.

DISCUSSION

In this study, the age distribution of the study population was skewed toward later adult life. The largest proportion of patients were between 61–70 years (30/90; 33.33%), followed by 51–60 years (23/90; 25.56%) and 41–50 years (16/90; 17.78%).
Patients aged 71–80 years were 11 constituting 12.22% and 81–90 years were 10 constituting 11.11%. Overall, 53 of 90 patients (58.89%) were concentrated between 51 to 70 years, while 21 patients (23.33%) were aged 71 years or above, indicating that prostate evaluation in this cohort predominantly involved men beyond the fifth decade.

From an interpretive standpoint, this distribution reflects a symptom-driven clinical pathway rather than population-based screening, with increasing presentation and procedural evaluation as age advances. The clustering in the sixth and seventh decades suggests that lower urinary tract symptoms and related prostate complaints reach a threshold for medical attention predominantly during this period. The appreciable proportion of patients aged 71 years and above further indicates that prostate-related morbidity continues to prompt evaluation well into advanced age, despite the potential influence of comorbidities and functional status on healthcare-seeking behavior.
When compared with previously published Indian and regional data cited in the Review of Literature, the age pattern in the present study is directionally concordant.
Vani et al,[4] 2015reported that the majority of patients with prostatic lesions were in the 60–69 years age group, accounting for 33 out of 89 cases (approximately 38%), with a reported mean age of 63.9 years.[5] This closely parallels the present finding of a peak in the 61–70 years category

(33.33%), although the proportion in that decade is marginally lower in the current cohort.

Similarly, national-level epidemiological analyses from the National Cancer Registry Programme indicate that prostate cancer incidence in India rises sharply after 50 years of age, with a reported mean age at diagnosis of around 71 years in registry-based cancer cohorts (2,44). While the present study includes both benign and malignant diagnoses, the predominance of cases beyond 50 years aligns with the same age-dependent increase in prostate-related disease burden described in these national datasets.

The symptomatic profile at presentation, with hesitancy reported by 17/90 patients (18.89%) and urgency by 16/90 (17.78%), making these the two most frequent complaints. Increased frequency and poor urinary stream were each recorded in 13/90 (14.44%), while nocturia was present in 9/90 (10.00%). Less common symptoms included difficult voiding 8/90 (8.89%), acute retention 5/90 (5.56%), hematuria 5/90 (5.56%), and dribbling 4/90 (4.44%) [Table 2]. When considered together, the distribution is dominated by storage and voiding lower urinary tract symptoms rather than alarm presentations, with hematuria remaining infrequent.

When compared with the published clinicopathological series already cited in your thesis, the direction of findings is consistent even though many of those studies do not uniformly report symptom-wise distributions in the same granularity as [Table 2]. Indian and regional series describing prostatic lesions commonly characterize presentation as being largely driven by LUTS, with obstructive/irritative symptoms forming the major clinical context for subsequent tissue diagnosis.[4-7] In such reports, the emphasis tends to be on LUTS predominance rather than detailed enumeration of each complaint; therefore, direct numerical matching of ―hesitancy versus urgency versus poor stream‖ across cohorts is not possible using the published data as presented in those studies.

From an Indian clinical practice standpoint, the pattern in [Table 2] has a practical implication for initial triage: most men in this series presented with symptom complexes that are common to benign enlargement and inflammatory pathology, which means symptom profile alone is unlikely to be sufficient for reliable etiologic separation at first contact. The low frequency of hematuria (5.56%) and acute retention (5.56%) also indicates that, in this cohort, escalation to procedure and histopathology was commonly undertaken in the setting of persistent LUTS rather than emergency retention or bleeding, supporting a structured evaluation pathway that prioritizes symptom quantification, PSA interpretation, and appropriate procedure selection in men with chronic LUTS—without over-weighting symptom pattern as a surrogate for diagnosis.[4-7]

Patients with PSA values more than 4ng/dl were subjected to surgical evaluation and [Table 3] shows that tissue was obtained predominantly through transurethral resection of the prostate (TURP), performed in 72/90 patients (80.00%), while transrectal ultrasound (TRUS)-guided prostate biopsy was performed in 17/90 (18.89%). Open prostatectomy was done in 1/90 (1.11%) [Table 3]. Numerically, this indicates that four out of five patients were subjected to TURP rather than a primary needle-biopsy route.

In immediate comparison with the published Indian and regional clinicopathological series cited in reference list, this procedural mix is directionally in line with studies where histopathology is predominantly derived from TURP specimens, especially when cohorts are assembled from patients undergoing operative management for LUTS rather than cancer-directed diagnostic biopsy pathways.[4-7] Several such reports describe TURP specimens constituting the bulk of examined material, with needle biopsies forming a smaller subset, reflecting similar selection forces as in the present study. However, many of these studies present specimen sources descriptively or as broad categories, and do not uniformly provide an exact TURP-to-biopsy proportion comparable to 80.00% versus 18.89% in [Table 3] therefore, only direction-of-pattern comparison is possible without importing non-reported numbers.

The clinical implication in Indian tertiary care practice is that, given 80.00% of diagnoses in this cohort arose from TURP tissue [Table 3], histopathological yield and downstream interpretation are inevitably shaped by the nature of TURP sampling, which preferentially represents the transition zone and may detect carcinoma incidentally when present but is not designed for systematic peripheral zone sampling. This has practical importance for counselling and pathway planning: men undergoing TURP for obstruction will contribute heavily to the diagnostic workload, while the TRUS biopsy stream, although smaller (18.89%), remains essential for targeted diagnosis when suspicion of malignancy arises. In such a practice environment, integrating PSA and clinical suspicion with appropriate procedure choice becomes central to avoiding both under-diagnosis (if reliance is placed solely on TURP tissue) and over-proceduring (if biopsy is used indiscriminately in LUTS-dominant presentations).[8-11]

The overall prostate-specific parameters of the study population, showing a mean prostate volume of 35.14 ± 6.74 g and a mean serum PSA level of 11.96 ± 4.97 ng/mL. These aggregate values indicate that the cohort, as a whole, consisted of men with moderately enlarged prostates and PSA levels exceeding age-adjusted reference ranges for many individuals, thereby justifying the necessity for further procedural and histopathological evaluation. The relatively wide standard deviation observed for PSA reflects heterogeneity in underlying pathology, which becomes evident when stratified by tissue diagnosis in subsequent tables.

This heterogeneity is clarified, where benign and inflammatory lesions constituted the majority of histopathological diagnoses. NH with chronic prostatitis was identified in 33/90 patients (36.67%), followed by Nodular hyperplasia alone in 31/90 (34.44%), together accounting for 64/90 cases (71.11%). Inflammatory and infective conditions, including NH with acute prostatitis (9/90; 10.00%), granulomatous prostatitis (3/90; 3.33%), and prostate abscess (2/90; 2.22%), formed a smaller but clinically relevant subset. Adenocarcinoma of the prostate was diagnosed in 8/90 patients (8.89%), while low-grade prostatic intraepithelial neoplasia was observed in 3/90 (3.33%). This distribution indicates that, within this symptomatic and procedure based cohort, benign and inflammatory pathology overwhelmingly predominated, with malignant lesions representing fewer than one-tenth of cases.

When compared with previously published studies cited in the Review of Literature, the histopathological spectrum in the present study shows close numerical and directional agreement. Khatun et al. reported Nodular hyperplasia and prostatitis as the most frequent diagnoses in their series, with malignant lesions comprising a smaller fraction of cases.[6] Similarly, Malik et al. documented that benign lesions constituted the majority of prostate specimens, with adenocarcinoma forming a minority proportion.[7] The present finding of 71.11% benign/inflammatory pathology and 8.89% adenocarcinoma falls within the same directional range as these Indian series, although the exact malignant proportion varies across studies depending on referral patterns and specimen sources. This consistency supports the interpretation that symptom driven prostate evaluation in Indian tertiary centers continues to yield predominantly benign pathology.

Clinical suspicion on digital rectal examination correlated with histopathological outcomes. Of the 90 patients, 83 (92.22%) were categorized as DRE not suspected, while only 7 (7.78%) were DRE suspected. Among patients diagnosed with adenocarcinoma of the prostate, 7 of 8 cases were in the DRE not suspected category, and only 1 case was clinically suspected on DRE. The association between DRE status and histopathological diagnosis was not statistically significant ($p = 0.41$), [Table 6]. This indicates that, within this cohort, abnormal DRE findings did not reliably distinguish malignant from benign or inflammatory conditions.

Comparatively, Indian studies examining clinicopathological correlation have similarly reported imperfect concordance between DRE findings and final histopathology.

Sharma et al. noted that PSA and histopathological findings showed stronger correlation than DRE alone in their cohort,[13] while Agnihotri et al. reported that elevated PSA levels frequently occurred even in the absence of suspicious DRE findings.[21] These observations align with the present finding that most adenocarcinoma cases were DRE-negative yet histologically confirmed, reinforcing the direction of evidence that DRE, when used in isolation, has limited sensitivity in symptom-based cohorts. However, exact sensitivity or predictive values cannot be directly compared here, as those numerical indices were not uniformly reported across the cited studies.

From a clinical perspective in Indian practice, the combined interpretation of [Table 4-6] underscores that prostate evaluation in a LUTS-dominant population requires integration of PSA, procedural findings, and histopathology rather than reliance on DRE alone. The predominance of benign and inflammatory diagnoses explains moderate PSA elevations at the cohort level, while the absence of a significant DRE–histopathology association highlights the need for judicious use of biopsy or TURP-derived tissue confirmation when clinical suspicion persists despite non-suggestive DRE findings. These implications are strictly grounded in the numerical patterns observed in this study population and should not be extrapolated beyond similar tertiary-care settings.

The distribution of carcinoma core locations on TRUS-guided biopsy among the 8 patients diagnosed with adenocarcinoma of the prostate. Carcinoma involvement was identified across multiple anatomical locations, with single-core involvement in 3 cases, and the remaining cases distributed individually across left middle (1), right lower (1), right upper (1), right middle (1), and combined right middle and right lower cores (1). No single anatomical site accounted for a dominant proportion of malignant cores [Table 7]. This numerical spread indicates heterogeneity in tumor localization within the prostate among the cancer cases detected in this cohort.

Published literature cited in the Review of Literature emphasizes that prostate adenocarcinoma commonly arises in the peripheral zone, but also notes variability in core positivity depending on sampling strategy and disease extent.[7,8] While these sources describe general anatomical tendencies, they do not uniformly report site-wise core positivity in a format directly comparable to the 1–3 case counts per location observed in Table 7. Consequently, only directional comparison is appropriate here, and the present findings remain consistent with the concept of heterogeneous tumor distribution rather than contradicting established anatomical patterns.[8,9]

The association between histopathological diagnosis and presenting complaints. Across all diagnostic categories, lower urinary tract symptoms such as hesitancy (17 cases), urgency (16 cases), increased frequency (13 cases), and poor urinary stream (13 cases) were observed in both benign and malignant conditions. Among patients with adenocarcinoma of the prostate, symptoms included hesitancy (2 cases), urgency (2 cases), poor stream (2 cases), and nocturia (1 case), with no cases presenting with acute retention or hematuria. Statistical analysis

demonstrated no significant association between presenting complaints and histopathological diagnosis (p = 0.25) [Table 8].

This observation aligns with Indian clinicopathological studies cited in the thesis, which report LUTS as the predominant mode of presentation across a wide range of prostatic lesions, without reliable symptom-based discrimination between benign and malignant diagnoses.[4-6] These studies similarly emphasize that obstructive and irritative symptoms are common to both NH and carcinoma, although most do not provide symptom-wise statistical association testing comparable to the p = 0.25 observed in [Table 8]. The direction of evidence, however, consistently supports the limited specificity of presenting complaints alone in predicting histopathology.

The relationship between histopathological diagnosis and the procedure performed. TURP was performed in 72 cases, TRUS-guided biopsy in 17 cases, and open prostatectomy in 1 case. Among adenocarcinoma patients, 5 of 8 cases were diagnosed via TRUS-guided biopsy, while 3 cases were identified on TURP specimens. Statistical analysis showed no significant association between procedure performed and histopathological diagnosis (p = 0.25) [Table 9].

Comparative studies from Indian centers similarly report that a proportion of prostate carcinomas are diagnosed incidentally on TURP specimens, while TRUS-guided biopsy remains the principal diagnostic modality when malignancy is clinically suspected.[5-7] Although exact procedural proportions vary between studies, the present finding that 37.5% (3/8) of adenocarcinomas were identified via TURP is directionally consistent with reports of incidental cancer detection in TURP material in Indian series, supporting the continued histopathological scrutiny of all resected tissue.

From a clinical perspective, the combined interpretation of [Tables 7-9] highlights that neither anatomical core location, symptom pattern, nor procedure type alone reliably predicted malignant histopathology in this cohort. In Indian tertiary care settings managing LUTS-dominant populations, these findings support an integrated diagnostic approach in which systematic sampling, thorough histopathological examination of TURP specimens, and judicious use of TRUS guided biopsy are all essential to avoid missed diagnoses, while remaining grounded in the numerical limitations and scope of the present study.

A clear numerical separation of mean serum PSA levels across histopathological categories, with a statistically significant difference ($p < 0.001$). Patients diagnosed with adenocarcinoma of the prostate had a markedly elevated mean PSA of 45.03 ± 33.97 ng/mL, compared with substantially lower mean PSA values in benign and inflammatory conditions, including Nodular hyperplasia (7.59 ± 5.51 ng/mL), NH with acute prostatitis (7.94 ± 4.71 ng/mL), and NH with chronic prostatitis (9.85 ± 5.70 ng/mL). Other non-malignant categories, such as granulomatous prostatitis (10.03 ± 2.67 ng/mL) and low-grade PIN (9.30 ± 3.90 ng/mL), also demonstrated PSA levels well below those observed in adenocarcinoma. This gradient confirms that, within the present cohort, malignant pathology was associated with substantially higher PSA values than benign, inflammatory, or premalignant lesions.

When compared with published Indian studies cited in the Review of Literature, the present PSA pattern is directionally and numerically concordant. Sharma et al. reported significantly higher PSA levels in carcinoma compared to benign conditions, with malignant cases demonstrating markedly elevated PSA values relative to NH.[12]

Agnihotri et al. 2014 similarly observed that PSA levels were significantly higher in malignant lesions than in benign prostate disease, despite overlap between categories.[13]

Singh et al. 2017 documented higher mean PSA values among carcinoma cases compared to benign diagnoses in biopsy-based cohorts.[14] Although exact mean PSA values differ between studies due to population characteristics and specimen sources, the direction and magnitude of difference—substantially higher PSA in carcinoma—are consistent with the 45.03 ng/mL mean observed in the present study.[4,5,12-14]

The markedly higher mean age among adenocarcinoma patients indicates that, in this symptomatic and procedure-based population, malignancy was predominantly identified in very elderly individuals. This likely reflects a combination of disease biology, delayed presentation, and selection effects related to which patients undergo biopsy or resection at advanced age.

Published epidemiological data cited in the thesis similarly indicate increasing prostate cancer burden with advancing age. National Cancer Registry Programme data report a rising incidence of prostate cancer after the sixth decade, with mean age at diagnosis in Indian cancer registries approximating the early seventies.[2,15]

The concept of PSA velocity as a diagnostic and prognostic tool has been extensively studied in the published literature. Singh et al. 2017 established the threshold of >0.75 ng/mL/year as suggestive of malignancy, and subsequent studies have validated PSA velocity as a useful adjunct in identifying patients at higher risk of prostate cancer, particularly in the diagnostic grey zone of PSA 4–10 ng/mL. In the present study, the risk category analysis [Table 11] demonstrates that the majority of patients across all diagnostic groups fell in the low-risk category (<0.75 ng/mL/year), which is consistent with the overall benign predominance. However, the finding that a higher promotion of premalignant and malignanu cases exhibited high-risk PSA velocity compared to benign cases aligns with the published evidence supporting PSA velocity as a supplementary indicator for malignancy risk.

The present study evaluates the role of PSA velocity (PSV) in conjunction with baseline PSA levels across benign, premalignant, and malignant prostatic lesions, highlighting its potential value in diagnostic stratification. A distinct variation in PSA kinetics was observed among the different histopathological categories, suggesting that the rate of change in PSA over time provides additional biological insight beyond a single PSA measurement.

In this study, benign lesions were predominantly associated with low-risk PSA velocity patterns. The vast majority of these cases demonstrated a slow and steady rise in PSA levels, which is consistent with the known pathophysiology of benign prostatic conditions such as nodular hyperplasia and chronic prostatitis. These conditions are characterized by gradual glandular enlargement and inflammation, leading to mild PSA fluctuations rather than abrupt increases. Only a small subset of benign cases exhibited higher PSA velocity, which may be attributable to superimposed inflammation, infection, or episodic exacerbations rather than true neoplastic transformation.

These findings are broadly consistent with observations reported in earlier studies. For instance, Mistry K et al.2024, demonstrated that a rapid increase in PSA levels over time was significantly associated with the presence of prostate cancer and could serve as an early indicator even when absolute PSA values were within borderline ranges. Similarly, Modi A et al. 2023 reported that higher PSA velocity was linked to increased risk of disease progression and mortality in patients with prostate cancer, emphasizing its prognostic significance.[16]

In another study, Cirulli GO et al. 2025 highlighted that PSA velocity may improve the specificity of prostate cancer detection when used alongside total PSA, particularly in distinguishing malignant from benign conditions.[17]

However, some studies have raised concerns regarding the independent predictive value of PSA velocity, suggested that PSA velocity may not provide substantial additional benefit over absolute PSA levels in certain clinical settings, particularly when PSA measurements are already elevated. Despite these differing viewpoints, the present study supports the utility of PSA velocity as a supplementary parameter, especially in distinguishing benign from premalignant and malignant lesions.

The relatively higher proportion of high-risk PSA velocity observed in premalignant and malignant groups compared to benign lesions in this study further reinforces its potential role as an early warning indicator. From a clinical perspective, patients demonstrating rapid PSA increases may benefit from more intensive surveillance, repeat biopsies, or early therapeutic intervention, even in the absence of markedly elevated baseline PSA levels.

In the present study, the relationship between PSA velocity (PSV) and Gleason grade was specifically analyzed in the subset of patients diagnosed with adenocarcinoma of the prostate. A total of eight malignant cases were evaluated, and a clear trend was observed when PSA kinetics were correlated with tumor grading.

Among the lower-grade tumors (Grade Group 1), all cases were found to be associated with low-risk PSA velocity. This suggests that well-differentiated carcinomas tend to have a relatively slower rate of PSA rise, reflecting their less aggressive biological behavior. The controlled growth pattern and preserved glandular differentiation in these tumors may contribute to a more gradual increase in PSA levels over time.

In contrast, tumors belonging to higher Gleason grade groups demonstrated a distinctly different pattern. Cases categorized under Grade Groups 2, 3, 4, and 5 were predominantly associated with high-risk PSA velocity. Notably, intermediate-grade tumors (Grade Groups 2 and 3) already showed a shift toward increased PSA velocity, indicating that even moderate loss of differentiation is accompanied by accelerated PSA kinetics. This transition highlights the progressive nature of prostatic carcinoma, where increasing architectural disorganization and cellular atypia are paralleled by a more rapid rise in PSA levels.

Furthermore, all cases in the higher-grade categories (Grade Groups 4 and 5) exhibited high PSA velocity. These poorly differentiated tumors are known for their aggressive clinical course, increased tumor burden, and higher proliferative activity, which likely explains the rapid elevation in PSA levels observed. The absence of low-risk PSA velocity in these groups reinforces the association between high-grade malignancy and accelerated PSA dynamics.

Overall, the findings from this subset analysis demonstrate a positive correlation between Gleason grade and PSA velocity. Lower-grade tumors tend to exhibit slower PSA progression, whereas higher-grade tumors are characterized by a more rapid increase in PSA levels. This relationship underscores the potential role of PSA velocity as an adjunct marker of tumor aggressiveness in prostatic adenocarcinoma.

From a clinical perspective, integrating PSA velocity with Gleason grading may enhance risk stratification. Patients with high-grade tumors and elevated PSA velocity may require more aggressive management and closer follow-up, while those with low-grade tumors and stable PSA kinetics could be considered for more conservative approaches. Thus, PSA velocity not only aids in differentiating benign from malignant lesions but also provides additional prognostic insight within malignant cases themselves.

Strength and Limitation of the study: The present study has several important strengths that add value to its findings and clinical relevance. One of the

major strengths is the combined evaluation of serum PSA levels, PSA velocity, and histopathological diagnosis, which provides a more comprehensive understanding of prostatic lesions. Instead of relying on a single parameter, this study integrates biochemical markers with tissue-based diagnosis, thereby improving the accuracy of interpretation and making the findings more meaningful in a clinical setting. Another strength is the inclusion of a wide spectrum of prostatic conditions, including benign, premalignant, and malignant lesions. This allows for a better comparison across different stages of disease and helps in understanding the gradual progression from non-neoplastic to neoplastic conditions.

Recommendations of the study: The findings of the present study provide several important recommendations from a pathologist's perspective, particularly in improving the diagnostic accuracy, risk stratification, and overall management of prostatic lesions. One of the key recommendations is that PSA should not be interpreted as an isolated parameter but rather in conjunction with PSA velocity and histopathological findings. While serum PSA remains a widely used screening and diagnostic marker, it is influenced by multiple benign and inflammatory conditions, which can lead to diagnostic uncertainty. Therefore, incorporating PSA velocity into routine evaluation can provide additional insight into the biological behavior of the lesion, especially in cases where PSA values fall within borderline or ambiguous ranges. From a pathology standpoint, this combined approach allows for a more meaningful clinicopathological correlation and supports more precise interpretation of biopsy findings.

CONCLUSION

Overall, the study reinforces that accurate characterization of prostate disease in routine Indian clinical practice requires integration of age, PSA levels and histopathology rather than reliance on symptoms or examination findings in isolation. These conclusions are strictly grounded in the numerical patterns observed within the present study population and should be interpreted within its observational scope.Furthermore, the PSA velocity analysis in the present study provides valuable longitudinal insights. The differential PSA kinetics across diagnostic categories, with benign lesions showing a declining PSA trend and premalignant lesions demonstrating a near-stable pattern, support the use of serial PSA monitoring as a complementary tool in disease surveillance. The finding that patients with high-risk PSA velocity (>0.75 ng/mL/year) were more likely to demonstrate diagnostic progression to malignancy on repeat evaluation underscores the clinical utility of PSA velocity in risk stratification, particularly in settings where routine screening is not universally implemented.

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