RJNMSR
Review Journal of Neurological & Medical Sciences Review

Volume 4, Issue 5, 2026

DETERMINATION OF TUMOUR MARKER PSA AND RFTs IN PROSTATIC CANCER PATIENTS

Abiha Zulfiqar[1], Umair Shafique[2], Dr. Tahira Batool[*3], Rizwan Ali[4]

[*3]*Assistant professor*
[1,2,3] *Department of Medical Laboratory Technology, Allied Health Sciences, Superior University Lahore, Pakistan.*
[4]*Centers for Biomedical Engineering, University of Science and Technology of China, Hefei, China*

[1]abihazulfiqar02@gmail.com, [2]umairmian2015@gmail.com , [3]tahira.batool@superior.edu.pk, [4]rizwanali35@yahoo.com

Corresponding Author: *
Dr. Tahira Batool
DOI: https://doi.org/10.5281/zenodo.20152874

Received	Accepted	Published
15 March 2026	24 April 2026	13 May 2026

ABSTRACT

Background: *Prostate cancer is one of the most common malignancies among older men worldwide, with increasing incidence in Pakistan. Serum prostate-specific antigen (PSA) remains the cornerstone biomarker for diagnosis and monitoring, while renal function tests (serum urea and creatinine) may be affected by tumour-related obstructive uropathy.*

Objective: *To determine the levels of serum PSA, serum urea, and serum creatinine in confirmed prostate cancer patients.*

Methods: *This cross-sectional study included 100 histologically confirmed prostate cancer patients attending the Department of Oncology at Cancer care Hospital and Research Centre. Serum PSA, urea, and creatinine were measured using standard laboratory methods. Patients were categorized into surgical and non-surgical management groups. Statistical analysis included independent t-tests, Pearson correlation, and chi-square tests.*

Results: *The mean age of patients was 67.01 ± 10.64 years, with 68% aged above 60 years. Mean serum PSA was 57.48 ng/mL (median: 14.45 ng/mL), with 58% of patients having PSA >10 ng/mL. Surgically managed patients had significantly higher mean PSA (203.34 ng/mL) compared to non-surgical patients (16.33 ng/mL; $p < 0.001$). Surgical patients showed significantly higher urea (62.32 vs. 39.54 mg/dL) and creatinine (2.18 vs. 1.42 mg/dL) than non-surgical patients ($p < 0.001$ for both). Moderate positive correlations were observed between PSA and urea ($r = 0.445$, $p < 0.001$) and between PSA and creatinine ($r = 0.413$, $p < 0.001$). A strong correlation was found between urea and creatinine ($r = 0.779$, $p < 0.001$). Chi-square analysis revealed a significant association between surgical status and elevated urea ($\chi^2 = 18.378$, $p < 0.001$), with 81.8% of surgical patients having elevated urea compared to 28.2% of non-surgical patients.*

Conclusion: *Prostate cancer patients in this study demonstrated significantly elevated PSA, serum urea, and serum creatinine, with more pronounced abnormalities in surgically managed patients. The moderate positive correlations between PSA and renal biomarkers suggest that higher tumour burden is associated with progressive renal impairment, likely due to obstructive uropathy.*

Keywords: *Prostate cancer, PSA, serum urea, serum creatinine, renal function, obstructive uropathy.*

INTRODUCTION

Prostate cancer is one of the most common malignancies in men worldwide and a major cause of cancer-related mortality. It arises from the glandular epithelium of the prostate and shows a wide spectrum of biological behavior ranging from indolent tumors to highly aggressive metastatic disease. Early detection has significantly improved with the introduction of tumour markers, particularly Prostate-Specific Antigen (PSA), which has transformed screening, diagnosis, and monitoring of treatment response. Despite this, PSA lacks complete specificity, as elevated levels may also occur in benign conditions such as prostatitis and benign prostatic hyperplasia. This diagnostic limitation has driven ongoing research into more accurate and reliable biomarkers for prostate cancer detection. (1)

The etiology of prostate cancer is multifactorial, involving complex interactions between genetic, hormonal, and environmental influences. Key molecular mechanisms include mutations in tumor suppressor genes such as p53 and PTEN, along with dysregulation of androgen receptor signaling, which plays a central role in tumor development and progression. Chronic inflammation has also been implicated as a contributing factor, where prolonged inflammatory states may promote DNA damage and cellular transformation through oxidative stress and genomic instability. Clinically, prostate cancer often remains asymptomatic in early stages and is frequently detected incidentally through elevated PSA levels or abnormal digital rectal examination findings. As the disease progresses, patients may develop lower urinary tract symptoms that resemble benign prostatic conditions, complicating early diagnosis. (2)

The disease follows a well-defined pathological progression from normal epithelium to high-grade prostatic intraepithelial neoplasia and eventually invasive carcinoma, with metastasis commonly affecting bone in advanced stages. Advanced prostate cancer may progress to castration-resistant prostate cancer (CRPC), where tumor growth continues despite androgen deprivation therapy due to androgen receptor mutations and alternative signaling pathways. Risk factors include increasing age, family history, and inherited genetic mutations such as BRCA1 and BRCA2, which are associated with more aggressive disease forms. Racial disparities are also well documented, with men of African descent showing higher incidence and mortality rates compared to other populations. (3)

Diagnosis of prostate cancer relies on a combination of serum biomarkers, imaging, and histopathological confirmation. While PSA remains the most widely used screening tool, its limitations have led to the development of additional biomarkers such as free PSA ratio, PCA3, and TMPRSS2-ERG gene fusion. These newer markers aim to improve diagnostic specificity and reduce unnecessary biopsies, although none have fully replaced PSA in clinical practice. Definitive diagnosis is achieved through transrectal ultrasound-guided biopsy with histological evaluation. Emerging techniques such as liquid biopsy, circulating tumor cells, and cell-free DNA analysis are also being explored for their potential role in precision oncology and early detection strategies. (4)

In conclusion, prostate cancer represents a significant global health burden with complex biological behavior and variable clinical outcomes. Although PSA has revolutionized early detection, its limitations highlight the need for more precise biomarkers to improve diagnostic accuracy and treatment decision-making. Advances in molecular diagnostics, including PCA3 and gene fusion markers, offer promising improvements but require further validation for widespread clinical use. A better understanding of genetic, hormonal, and environmental risk factors is essential for effective risk stratification. Continued research in biomarker development and personalized medicine will play a crucial role in reducing overtreatment while ensuring timely intervention for aggressive disease. (5)

Litaerature Review

Majewska et al., 2025 narrative review highlights tumor biomarkers in prostate cancer emphasizing PSA limitations and rising role of genomic and urinary markers. The authors report that PCA3, TMPRSS2-ERG, Prolaris, Decipher,

ConfirmMDx, ExoDx and SelectMDx significantly improve diagnostic specificity and risk stratification compared to PSA alone. They further emphasize that single marker dependence leads to misclassification of indolent and aggressive disease, whereas multi-marker integration improves early detection and clinical decision-making. Overall findings support a precision oncology approach combining serum, urine and genomic assays for improved prostate cancer management and reduced unnecessary biopsies and overtreatment in routine clinical practice settings globally today evidence strongly supports multimarker diagnostic strategies in modern urologic oncology practice worldwide clinical settings today

Fang et al., 2025 systematic review evaluates biomarkers in PSA gray zone prostate cancer and reports improved diagnostic accuracy using Prostate Health Index, PCA3, TMPRSS2-ERG, microRNAs and proteomic signatures. The authors demonstrate that PHI and free-to-total PSA ratio provide higher sensitivity and specificity than conventional PSA testing, while molecular markers help distinguish benign from malignant disease and reduce unnecessary biopsies. They conclude that combining serum and molecular biomarkers enhances risk stratification in clinically ambiguous cases and supports more precise biopsy decision-making in suspected prostate cancer patients within contemporary urological diagnostic pathways. Overall evidence supports multi biomarker panels improving diagnostic performance and reducing unnecessary invasive procedures in prostate cancer evaluation settings

Tosoian et al., 2022 large cohort study validates urinary PCA3 test demonstrating higher expression in prostate cancer compared to benign conditions with significant diagnostic accuracy. The study reports AUC of 0.71 and shows PCA3 reduces unnecessary biopsies by approximately 40 percent at optimal cutoff values. Additionally PCA3 levels correlate positively with Gleason score indicating association with tumor aggressiveness. Complementary findings from McKiernan et al., 2021 further show ExoDx urine exosome assay outperforms PSA alone in detecting high-grade cancer. Together these studies highlight the clinical utility of urine-based biomarkers for improving prostate cancer risk stratification and reducing invasive diagnostic procedures in practice supporting noninvasive diagnostic advancement in oncology settings clinical today

Kretschmer et al., 2021 prospective cohort study evaluates circulating tumour cells in metastatic castration resistant prostate cancer and demonstrates strong prognostic value compared to PSA alone. Patients with higher CTC counts showed significantly reduced survival, while dynamic changes in CTC levels during treatment better predicted therapeutic response than PSA fluctuations. Supporting evidence from Herreros-Villanueva et al., 2022 meta-analysis of cell-free DNA confirms that genomic alterations such as AR amplification, TP53 mutation and PTEN loss are associated with poor prognosis and treatment resistance. These findings collectively establish liquid biopsy techniques as powerful tools for real-time monitoring of advanced prostate cancer progression and treatment response transforming advanced disease management strategies clinically today

Methodology

The present study employed a cross-sectional research design aimed at assessing the levels of tumor markers in patients diagnosed with prostatic cancer. This design was selected because it allows the measurement of exposure and outcome variables simultaneously, providing a snapshot of biomarker levels within a defined population. The study was conducted in the Department of Urology and Oncology of a Cancer Care Hospital over a duration of four months following approval of the synopsis. A total of 100 prostatic cancer patients fulfilling the inclusion criteria were enrolled using a non-probability consecutive sampling technique to ensure feasibility and timely recruitment of eligible participants within the study period.

Participants included adult male patients above 18 years of age with a confirmed diagnosis of prostatic cancer who were willing to provide written informed consent. Patients receiving chemotherapy or hormonal therapy, those with

severe systemic illnesses such as uncontrolled hepatic, renal, or cardiac disease, and individuals with active infections or inflammatory conditions were excluded to avoid confounding effects on tumor marker levels. Patients who were unwilling to participate or unable to provide consent were also excluded from the study. This careful selection of inclusion and exclusion criteria ensured that the study population was relatively homogeneous and appropriate for evaluating serum tumor marker levels.

For laboratory assessment, venous blood samples were collected under aseptic conditions using sterile syringes or vacutainers following proper patient identification and consent. The collected blood was allowed to clot and then centrifuged to obtain serum, which was stored appropriately for analysis. Serum prostate-specific antigen (PSA) levels were measured using ELISA or chemiluminescence immunoassay (CLIA) techniques on an automated immunoassay analyzer. Standard laboratory equipment including centrifuge machines, micropipettes, ELISA kits, and personal protective equipment was used to ensure accuracy, safety, and standardization of the testing procedure throughout the study.

Data collection was carried out using both laboratory findings and patient medical records to obtain demographic and clinical information. Independent variables included age, clinical diagnosis, disease stage, and treatment status, while serum PSA level was considered the dependent variable. All collected data were systematically recorded, coded, and entered into Microsoft Excel before being transferred to SPSS version 25.0 for statistical analysis. Descriptive statistics such as frequency, percentage, and mean were used to summarize the data, while inferential analysis using chi-square test was applied to assess associations between variables, with a p-value of less than 0.05 considered statistically significant.

Results

A total of 100 male patients diagnosed with prostatic cancer were included in this cross-sectional study conducted at the Department of Oncology, Cancer Care Hospital and Research Centre. The participants were evaluated for demographic characteristics and biochemical parameters including serum prostate-specific antigen (PSA), serum urea, and serum creatinine. The mean age of patients was 67.01 ± 10.64 years, with most cases clustered in the 61–70 year age group, reflecting the established epidemiological trend of prostate cancer as a disease of older men. The overall dataset demonstrated heterogeneity in disease severity as reflected by wide variations in PSA and renal function parameters.

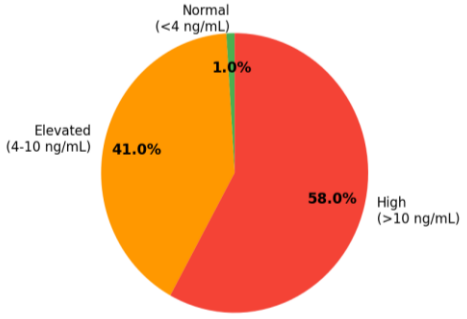

Figure 1: Pie chart showing the distribution of PSA categories.

Serum PSA levels showed marked variability ranging from 2.97 to 831.00 ng/mL, with a mean of 57.48 ± 140.56 ng/mL and a median of 14.45 ng/mL, indicating a right-skewed distribution. A large proportion of patients (58%) had PSA levels above 10 ng/mL, suggesting advanced or active disease, while 41% were within the mildly elevated range of 4–10 ng/mL and only 1% had normal PSA values. Similarly, serum urea levels ranged from 17 to 88 mg/dL with 40% of patients showing elevated values, while creatinine levels also demonstrated elevation above the normal range in a considerable proportion of patients, indicating concurrent renal function impairment in part of the study population.

When stratified by treatment status, significant differences were observed between surgical and non-surgical patients. Patients who had undergone surgical intervention exhibited substantially higher mean PSA levels (203.34 ± 241.80 ng/mL) compared to non-surgical patients (16.33 ± 26.85 ng/mL), along with significantly higher urea and creatinine levels. Independent sample t-tests confirmed that these differences were statistically

significant for all three biomarkers ($p < 0.001$), suggesting that surgically managed patients presented with a higher disease burden and more pronounced systemic involvement, including renal dysfunction.

Biomarker Comparison Between Surgical and Non-Surgical Patients

Parameter	Surgical (n=22) Mean ± SD	Non-Surgical (n=78) Mean ± SD	p-value
PSA (ng/mL)	203.34 ± 241.80	16.33 ± 26.85	< 0.001
Urea (mg/dL)	62.32 ± 14.96	39.54 ± 15.47	< 0.001
Creatinine (mg/dL)	2.18 ± 0.90	1.42 ± 0.79	< 0.001

Correlation analysis revealed that PSA had a moderate positive correlation with both serum urea ($r = 0.445$, $p < 0.001$) and serum creatinine ($r = 0.413$, $p < 0.001$), indicating a relationship between increasing tumor marker levels and deterioration in renal function. A strong positive correlation was also observed between urea and creatinine ($r = 0.779$, $p < 0.001$), consistent with their physiological linkage in renal impairment. However, no significant correlation was found between age and PSA levels, suggesting that biochemical severity in this cohort was independent of patient age distribution.

Independent Samples t-test Results Biomarkers by Treatment Group

Variable	t-statistic	Degrees of Freedom	p-value	Significance
PSA (ng/mL)	6.586	98	< 0.001	Significant
Urea (mg/dL)	6.325	98	< 0.001	Significant
Creatinine (mg/dL)	3.968	98	< 0.001	Significant

Chi-square analysis further demonstrated a significant association between surgical treatment status and elevated serum urea levels ($\chi^2 = 18.378$, $p < 0.001$). A notably higher proportion of surgical patients (81.8%) had elevated urea compared to non-surgical patients (28.2%), reinforcing the observation that patients requiring surgical management tend to present with more advanced disease and associated systemic complications. Overall, the results indicate that PSA levels and renal function parameters collectively reflect disease severity and may provide complementary clinical information in the assessment of prostatic cancer patients.

Discussion

The present study evaluated serum prostate-specific antigen (PSA) along with renal function test parameters, including serum urea and creatinine, in 100 confirmed prostatic cancer patients. The findings demonstrated that all three biomarkers were significantly elevated, particularly in patients with advanced disease and those managed surgically. PSA levels showed a markedly skewed distribution, reflecting heterogeneity in tumor burden, while urea and creatinine elevations suggested concurrent renal involvement in a substantial proportion of patients. The positive correlation between PSA and renal markers indicates that increasing tumor burden may be associated with progressive impairment of renal function. This relationship is clinically important because it suggests that prostate cancer severity is not limited to oncological progression but may also involve systemic complications affecting renal physiology and metabolic waste clearance.

The age distribution in this study revealed a predominance of older patients, with most cases occurring above 60 years, which aligns with global epidemiological trends reported in large cancer registries. Prostate cancer is well recognized as a disease of aging due to cumulative genetic mutations, hormonal changes, and prolonged exposure to environmental risk factors. The observed findings are consistent with established literature indicating that incidence rises sharply after the sixth decade of life. This similarity supports the external validity of the current study population and reinforces that prostate cancer in this setting follows a predictable age-related pattern. The lack of significant correlation between age and PSA further indicates that disease severity in diagnosed patients is more dependent on tumor progression than chronological age alone.

A significant observation of this study was the clear difference in biomarker levels between surgical and non-surgical patients. Individuals undergoing surgical intervention exhibited substantially higher PSA, urea, and creatinine levels compared to those managed conservatively. This suggests that surgical patients presented with more advanced or aggressive disease, often associated with obstructive uropathy and impaired renal function. The elevated renal markers in this group may be attributed to urinary tract obstruction caused by tumor mass effect or metastatic involvement. The findings are consistent with clinical evidence indicating that advanced prostate cancer can lead to hydronephrosis and renal dysfunction, emphasizing the need for early detection and timely management to prevent irreversible renal damage and systemic complications.

Conclusion

Correlation and association analyses further strengthened the study findings by demonstrating meaningful relationships between biomarkers. PSA showed moderate positive correlations with both serum urea and creatinine, indicating that tumor burden may indirectly reflect renal impairment. The strongest correlation observed between urea and creatinine confirms their physiological interdependence in renal filtration processes. Additionally, chi-square analysis revealed a significant association between surgical status and elevated urea levels, reinforcing the link between advanced disease and renal dysfunction. Despite these significant findings, limitations such as cross-sectional design and single-center sampling restrict causal interpretation. Nevertheless, the study highlights the importance of integrating renal function assessment with PSA monitoring to achieve a more comprehensive evaluation of disease burden and patient prognosis.

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