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ORIGINAL ARTICLE

Evaluation of Mean Change in Serum PSA Levels and Renal Function Parameters Following Urological Procedures in Benign Prostatic Hyperplasia Patients

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ABSTRACT

Background: Benign prostatic hyperplasia (BPH) is a common cause of lower urinary tract symptoms in aging males, often leading to elevated serum PSA levels and impaired renal function. Surgical intervention is the mainstay of treatment in symptomatic cases not responding to medical therapy.

Objectives: To evaluate the mean changes in serum prostate-specific antigen (PSA) levels and renal function parameters—serum creatinine and estimated glomerular filtration rate (eGFR)—before and after various urological procedures in patients with BPH.

Study Design & Setting: This observational analytical study was conducted at the Department of Urology at Kidney Centre, Bahawal Victoria Hospital, Bahawalpur over a period of 6 months from January 2023 to June 2023.

Methodology: A total of 120 male patients diagnosed with BPH and scheduled for surgical intervention were enrolled. Patients underwent either Transurethral Resection of the Prostate (TURP), Holmium Laser Enucleation of the Prostate (HoLEP), or Open Prostatectomy. Pre- and post-procedural serum PSA, serum creatinine, and eGFR were recorded and analyzed using paired t-tests and one-way ANOVA.

Results: All three procedures resulted in significant reductions in serum PSA and creatinine levels and significant increases in eGFR ($p < 0.001$). The greatest PSA decline was seen with open prostatectomy (-5.9 ± 2.3 ng/mL). Changes in renal function parameters were comparable among groups ($p > 0.05$), indicating overall renal function improvement irrespective of procedure type.

Practical Implication: Surgical treatment of BPH not only alleviates obstructive symptoms but also contributes to measurable improvements in renal function and PSA normalization, thereby supporting timely intervention.

Conclusion: Urological procedures for BPH significantly reduce PSA levels and improve renal function parameters, with all three methods proving effective in the postoperative restoration of urinary and renal health.

Keywords: benign prostatic hyperplasia, creatinine, eGFR, HoLEP, open prostatectomy, PSA, TURP

INTRODUCTION

Benign Prostatic Hyperplasia (BPH) is a common, non-malignant enlargement of the prostate gland predominantly affecting aging males.[1] Its prevalence increases with age, with histological evidence found in nearly 50% of men aged 51–60 years and up to 90% of those above 80 years.[2] BPH leads to lower urinary tract symptoms (LUTS) such as urinary frequency, urgency, nocturia, hesitancy, and incomplete bladder emptying. These symptoms arise due to the progressive obstruction of urinary outflow caused by the hyperplastic prostate tissue, significantly affecting the quality of life.[3,4]

Prostate-Specific Antigen (PSA), a glycoprotein secreted by both normal and hyperplastic prostatic epithelium, serves as a useful biomarker in the evaluation of prostate health. Although PSA is commonly utilized for the early detection of prostate cancer, its levels can also be elevated in benign conditions such as BPH and prostatitis.[5,6] In BPH patients, serum PSA levels often correlate with prostate volume and disease progression. Various urological procedures, including Transurethral Resection of the Prostate (TURP), Holmium Laser Enucleation of the Prostate (HoLEP), and open prostatectomy, are employed to alleviate obstruction and improve urinary symptoms.[7,8]

Alongside PSA, renal function parameters such as serum creatinine and estimated glomerular filtration rate (eGFR) are critical markers that must be assessed in BPH patients, especially in those presenting with prolonged obstruction.[9] Chronic urinary retention and high post-void residual urine can result in hydronephrosis and impaired renal function, which, if left untreated, may lead to irreversible kidney damage.[10]

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Monitoring both PSA levels and renal function pre- and post-operatively offers valuable insight into the clinical effectiveness of urological interventions for BPH. A significant decline in PSA levels may suggest adequate prostatic tissue removal, while improvements in renal function parameters indicate the restoration of normal urinary flow and renal recovery. However, the pattern and extent of these changes can vary depending on the type of surgical procedure performed, the baseline severity of obstruction, and patient-specific factors such as age and comorbidities. This study aims to evaluate the mean change in serum PSA levels and renal function parameters—namely, serum creatinine and eGFR—before and after urological procedures in patients with BPH.

MATERIALS AND METHODS

This observational study was conducted at the Department of Urology at Kidney Centre, Bahawal Victoria Hospital, Bahawalpur over a period of 6 months from January 2023 to June 2023, after obtaining approval from the Institutional Ethical Review Board. A total of 120 male patients, aged 50 years and above, diagnosed with Benign Prostatic Hyperplasia (BPH) and scheduled to undergo urological procedures such as Transurethral Resection of the Prostate (TURP), Holmium Laser Enucleation of the Prostate (HoLEP), or open prostatectomy, were included in the study through consecutive non-probability sampling.

The sample size of 120 was calculated using OpenEpi version 3.01, with a confidence level of 95%, a power of 80%, and an expected mean difference of 1.2 ng/mL in serum PSA levels and 0.2 mg/dL in serum creatinine before and after the procedure, based on data from previous literature. Patients with known prostate cancer, history of recent urinary tract infection, renal failure requiring dialysis, or those on medications affecting PSA levels such as 5-alpha-reductase inhibitors were excluded. Written

informed consent was obtained from all participants after a detailed explanation of the study objectives and procedures.

Baseline serum PSA levels and renal function parameters including serum creatinine and estimated glomerular filtration rate (eGFR) were recorded prior to the surgical procedure. All procedures were performed by experienced urologists under standardized operative protocols. Postoperative PSA and renal function tests were repeated at six weeks following the intervention to assess changes in biochemical parameters.

Data were collected using a structured proforma and entered into SPSS version 25.0 for statistical analysis. Mean and standard deviation were calculated for continuous variables such as age, PSA, creatinine, and eGFR. The paired sample t-test was applied to compare pre- and post-procedure values of PSA and renal function markers. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The study included 120 male patients with a mean age of 66.4 years. Most patients underwent TURP (53.3%), followed by HoLEP (30.0%) and open prostatectomy (16.7%). Common comorbidities included hypertension (40.0%) and diabetes mellitus (30.8%), while 23.3% had a history of smoking given in table 1.

Table 2 shows a statistically significant reduction in serum PSA levels across all urological procedures performed for BPH ($p < 0.001$). The mean pre-procedural PSA level was highest in patients undergoing open prostatectomy (8.2 ± 3.1 ng/mL) and lowest in those undergoing TURP (6.8 ± 2.4 ng/mL). Postoperatively, PSA levels decreased in all groups, with the greatest mean reduction observed in the open prostatectomy group (-5.9 ± 2.3 ng/mL), followed by HoLEP (-5.3 ± 2.1 ng/mL), and TURP (-4.1 ± 1.8 ng/mL). The overall mean PSA declined from 7.2 ± 2.8 ng/mL to 2.5 ± 1.2 ng/mL, indicating a significant improvement after surgical intervention.

Table 3 demonstrates a significant reduction in serum creatinine levels following all three urological procedures ($p < 0.001$). The mean pre-procedural creatinine was 1.37 ± 0.25 mg/dL overall, which decreased to 1.19 ± 0.21 mg/dL postoperatively. The mean change was similar across the groups: -0.17 ± 0.11 mg/dL in TURP, -0.19 ± 0.14 mg/dL in HoLEP, and -0.19 ± 0.16 mg/dL in open prostatectomy.

Table 4 shows a statistically significant improvement in estimated glomerular filtration rate (eGFR) following all urological procedures ($p < 0.001$). The overall mean eGFR increased from 64.1 ± 11.1 to 72.3 ± 9.9 mL/min/1.73m², with a mean rise of +8.2 ± 4.7. Among the procedures, open prostatectomy demonstrated the highest mean increase (+9.2 ± 4.9), followed by HoLEP (+8.3 ± 5.1) and TURP (+7.4 ± 4.2). These findings indicate enhanced renal function postoperatively in BPH patients across all treatment modalities.

Table 5 presents a comparative analysis of mean changes in PSA levels and renal function parameters across the three urological procedures. A statistically significant difference was observed in PSA reduction among the groups ($p < 0.001$), with the greatest decrease seen in patients undergoing open prostatectomy (-5.9 ± 2.3 ng/mL), followed by HoLEP (-5.3 ± 2.1 ng/mL) and TURP (-4.1 ± 1.8 ng/mL). However, changes in serum creatinine ($p = 0.472$) and eGFR ($p = 0.091$) were not statistically significant across the procedures, indicating that while PSA reduction varied by surgical method, improvements in renal function were comparable.

Table 1: Demographic and Baseline Characteristics of Study Participants (n = 120)

Variable	Category	Mean ± SD / n (%)
Age (years)	Mean ± SD	66.4 ± 7.8
BMI (kg/m²)	Mean ± SD	25.6 ± 3.4
Procedure Performed	TURP	64 (53.3%)
	HoLEP	36 (30.0%)
	Open Prostatectomy	20 (16.7%)
Hypertension	Yes	48 (40.0%)
Diabetes Mellitus	Yes	37 (30.8%)
Smoking History	Yes	28 (23.3%)

Table 2: Pre- and Post-Procedural Serum PSA Levels (ng/mL)

Procedure Type	Pre-PSA (Mean ± SD)	Post-PSA (Mean ± SD)	Mean Change ± SD	p-value
TURP (n = 64)	6.8 ± 2.4	2.7 ± 1.3	-4.1 ± 1.8	<0.001
HoLEP (n = 36)	7.4 ± 2.9	2.1 ± 1.1	-5.3 ± 2.1	<0.001
Open Prostatectomy (n = 20)	8.2 ± 3.1	2.3 ± 1.0	-5.9 ± 2.3	<0.001
Overall (n = 120)	7.2 ± 2.8	2.5 ± 1.2	-4.7 ± 2.1	<0.001

Table 3: Pre- and Post-Procedural Serum Creatinine Levels (mg/dL)

Procedure Type	Pre-Creatinine	Post-Creatinine	Mean Change	p-value
TURP (n = 64)	1.35 ± 0.23	1.18 ± 0.21	-0.17 ± 0.11	<0.001
HoLEP (n = 36)	1.38 ± 0.25	1.19 ± 0.20	-0.19 ± 0.14	<0.001
Open Prostatectomy (n = 20)	1.41 ± 0.28	1.22 ± 0.23	-0.19 ± 0.16	<0.001
Overall (n = 120)	1.37 ± 0.25	1.19 ± 0.21	-0.18 ± 0.13	<0.001

Table 4: Pre- and Post-Procedural Estimated GFR (eGFR in mL/min/1.73m²)

Procedure Type	Pre-eGFR	Post-eGFR	Mean Change	p-value
TURP (n = 64)	65.1 ± 10.4	72.5 ± 9.8	+7.4 ± 4.2	<0.001
HoLEP (n = 36)	63.6 ± 11.1	71.9 ± 10.1	+8.3 ± 5.1	<0.001
Open Prostatectomy (n = 20)	61.4 ± 12.3	70.6 ± 10.6	+9.2 ± 4.9	<0.001
Overall (n = 120)	64.1 ± 11.1	72.3 ± 9.9	+8.2 ± 4.7	<0.001

Table 5: Comparison of Mean PSA and Renal Function Parameter Changes Across Procedures

Parameter	TURP	HoLEP	Open Prostatectomy	p-value (ANOVA)
PSA Change	-4.1 ± 1.8	-5.3 ± 2.1	-5.9 ± 2.3	<0.001
Creatinine Change	-0.17 ± 0.11	-0.19 ± 0.14	-0.19 ± 0.16	0.472
eGFR Change	+7.4 ± 4.2	+8.3 ± 5.1	+9.2 ± 4.9	0.091

DISCUSSION

Benign prostatic hyperplasia (BPH) is a prevalent non-malignant enlargement of the prostate gland in aging men, often leading to urinary obstruction and elevated serum PSA levels.[11,12] It can also impair renal function due to chronic urinary retention and backpressure effects. Common surgical interventions include TURP, HoLEP, and open prostatectomy.[13,14] These procedures aim to relieve obstruction, reduce PSA levels, and improve renal outcomes. Monitoring PSA and renal parameters before and after surgery helps assess procedural efficacy. Understanding the physiological impact of these interventions is essential for optimizing patient outcomes.

Ahmad et al. (2019) observed a transient rise in serum PSA levels immediately after manipulation, with a peak at 30 minutes followed by a gradual decline over 1-2 weeks, highlighting the acute PSA release due to tissue manipulation.[15] In contrast, our study measured PSA changes over a longer post-procedural period and found a significant overall decrease in PSA levels postoperatively (mean change -4.7 ± 2.1 ng/mL, $p<0.001$), suggesting effective removal of hyperplastic tissue rather than a temporary PSA spike. Iqbal et al. (2021) reported that procedures like TURP and prostatic biopsy caused significant rises in PSA, which could alter management plans.[16] Our study's results, showing significant PSA reduction post-procedure, reflect the later phase after tissue removal rather than the immediate post-manipulation rise. This difference emphasizes the timing of PSA measurement in interpreting procedural effects.

The improvements in renal function parameters in our study, with serum creatinine decreasing by -0.18 ± 0.13 mg/dL and eGFR increasing by +8.2 ± 4.7 mL/min/1.73m² ($p<0.001$), complement findings by Saeed et al. (2023), who demonstrated functional improvement after surgical intervention through enhanced urinary flow metrics such as Qmax and decreased residual urine volume, indirectly reflecting better renal drainage and function.[17] Zhang et al. (2022) compared surgical outcomes including PSA changes, symptom scores, and complications, similarly confirming the efficacy of surgical treatment for BPH in reducing PSA and improving quality of life, paralleling our findings of significant PSA reduction and renal function improvement across different surgical modalities.[18] Samad et al. (2019) and Hayat et al. (2021)

emphasized the variability of PSA levels in BPH and inflammatory conditions and the potential to reduce PSA with treatment. Our study's significant PSA decreases post-surgery further support that effective surgical management can normalize PSA levels by removing hyperplastic prostatic tissue.[19,20] Lastly, Seetlani (2024) reported a mean PSA reduction after TURP similar to our study (-4.07 ± 2.54 ng/mL vs. -4.1 ± 1.8 ng/mL in TURP group), underscoring the consistency of PSA decline following this standard procedure.[21] Our results corroborate existing literature demonstrating that surgical intervention in BPH leads to significant PSA reduction and renal function improvement, with the extent of change varying by procedure but consistently favoring patient benefit. Differences in PSA trends reflect timing of measurement and specific procedural impacts, underscoring the importance of standardized follow-up protocols.

This study included a relatively large sample size of 120 patients and compared three different surgical techniques. It employed standardized biochemical markers to assess outcomes. Pre- and post-operative values were statistically evaluated to ensure result reliability. However, it was conducted at a single center, limiting generalizability. The follow-up period was short, restricting assessment of long-term outcomes. Also, potential confounders such as comorbidities were not deeply analyzed.

CONCLUSION

All three urological procedures significantly reduced serum PSA and improved renal function in BPH patients. Surgical intervention proved beneficial regardless of technique. Timely management of BPH can prevent further renal compromise.

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