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Original Article

Improvement in Uroflowmetry Parameters After Transurethral Resection of Prostate for Bladder Outlet Obstruction in Benign Prostatic Hyperplasia

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ABSTRACT

Benign prostatic hyperplasia (BPH) commonly causes bladder outlet obstruction and lower urinary tract symptoms in older men. Transurethral resection of the prostate (TURP) is a standard surgical option, but the outcome should be assessed objectively. **Objectives:** To determine changes in uroflowmetry parameters and International Prostate Symptom Score (IPSS) after TURP in BPH. **Methods:** This prospective before-and-after interventional study was conducted at the Multan Institute of Kidney Diseases, Multan, from February to April 2026. Forty-five consecutive men undergoing TURP for BPH were enrolled. Qmax, Qavg, voided volume, voiding time, time to maximum flow, post-void residual urine (PVR), and IPSS were recorded before surgery and four weeks postoperatively. Paired t-test and McNemar test were applied. **Results:** Mean age was 67.98 ± 7.18 years, and mean prostate volume was 65.87 ± 17.16 mL. After TURP, Qmax increased from 8.08 ± 1.58 to 19.87 ± 2.35 mL/s and Qavg from 4.32 ± 0.84 to 10.64 ± 1.57 mL/s. PVR decreased from 157.69 ± 41.90 to 37.16 ± 16.10 mL, and IPSS from 24.13 ± 3.96 to 8.20 ± 2.35. All changes were significant ($p<0.001$). Severe IPSS category decreased from 36 (80.0%) cases to 0, and all patients converted from obstructed to normal flow patterns. **Conclusions:** TURP significantly improved flow parameters, residual urine, symptom severity, and flow pattern. Uroflowmetry with IPSS is useful for postoperative assessment.

INTRODUCTION

Benign prostatic hyperplasia (BPH) is a frequent non-malignant enlargement of the prostate in ageing men. Progressive enlargement may narrow the bladder outlet and produce lower urinary tract symptoms (LUTS), including poor stream, urgency, hesitancy, and nocturia. Untreated obstruction can impair quality of life and may progress to retention or recurrent urinary infection. [1, 2] The burden of symptomatic BPH rises with advancing age, and more than half of men above 60 years may show clinical or urodynamic evidence of obstruction [3, 4]. Uroflowmetry is a simple, non-invasive test of voiding that measures maximum flow rate (Qmax), average flow rate (Qavg), voided volume, and voiding time. The most frequently interpreted measure is Qmax, which also tends to correlate with symptom load, and decreased values are suggestive of outlet obstruction. For this reason, uroflowmetry is useful in conjunction with the International Prostate Symptom Score (IPSS) and post-void residual urine (PVR) estimation in the evaluation of LUTS in the context of suspected bladder outlet obstruction (BOO) from BPH. The current guidance also recommends that uroflowmetry should be used in the assessment of these patients [5-8]. Surgical treatment is indicated if drug therapy fails, symptoms are still bothersome, or complications develop. TURP is still a reference surgical procedure for the appropriate patient with BPH as it

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removes obstructing prostatic tissue, lowers urethral resistance, and improves voiding mechanics [9, 10]. Contemporary evidence indicates that TURP is associated with significant improvements in urinary flow, symptom scores, and post-void residual urine following surgery [11, 12].

Although there is evidence of the efficacy of TURP, there is a lack of locally generated prospective data describing the extent of uroflowmetric recovery in Pakistani patients. Further, many of the reports available only consider one or two outcomes and do not combine multiple uroflowmetry metrics with a standardized symptom score. The aim of the study was designed to evaluate the difference between the uroflowmetry parameters and IPSS of the patients who underwent TURP at a tertiary urology center in Pakistan before and after four weeks of surgery to document functional and symptomatic improvement.

METHODS

The study was conducted as a prospective before-and-after interventional study in the Department of Urology, Multan Institute of Kidney Diseases, Multan, Pakistan, from February to April 2026. It compared the change in urinary flow parameters and symptom scores following TURP in patients with BPH. The study was approved by the (CPSP: Ref No. CPSP/REU/URO-2024-346-10044, dated August 26, 2025). All enrolled patients provided written informed consent before participation. Male patients ≥50 years old with clinically diagnosed BPH and moderate to severe LUTS who were to undergo TURP were included in the study. Patients were excluded if they had suspected or confirmed prostate malignancy, prior surgery on the prostate or urethra, neurogenic bladder, urethral stricture, active UTI, were not fit for surgery, or failed to attend follow-up. Sample size estimation was based on the expected change in IPSS following TURP, using effect estimates (preoperative 18 ± 8, postoperative 12.1 ± 8.1) derived from a comprehensive meta-analysis of TURP randomized controlled trials [13]. At a two-sided α of 0.05, 90% power, and 10% allowance for attrition, the required sample size was 45 patients. Baseline assessment included demographic and clinical information. Age was recorded in years, and prostate volume was measured by transabdominal ultrasonography. Before TURP, each participant underwent uroflowmetry and completed the IPSS form. Uroflowmetry was undertaken under standardized conditions using a conventional device. Qmax, Qavg, voided volume, voiding time, and time to maximum flow were documented. The flow curve morphology was qualitatively categorized by two independent urologists: a curve was classified as 'normal' when it exhibited a smooth, bell-shaped contour with a rapid rise to peak flow; and 'obstructed' when it demonstrated a flattened, prolonged, or irregular contour, consistent with standard uroflowmetry interpretation guidelines. Immediately after voiding, PVR was assessed by bladder ultrasonography. IPSS was scored from 0 to 35 and categorised as mild (0-7), moderate (8-19), or severe (20-35). The same measurements were repeated four weeks after surgery. TURP was performed according to routine institutional practice by experienced urologists, and postoperative care and follow-up were provided according to departmental protocol.

Data analysis was performed in SPSS version 26.0. Frequencies and percentages were used for categorical variables, while quantitative variables were summarised as mean ± standard deviation or median (interquartile range) according to distribution. The Shapiro-Wilk test was applied to paired differences for continuous outcomes. All paired differences were normally distributed (Shapiro-Wilk p-values ranged from 0.124 to 0.783, all >0.05). Therefore, preoperative and postoperative values were compared by paired t-test; the Wilcoxon signed-rank test was therefore not used. Change in flow pattern was assessed by the McNemar test. All analyses were two-tailed, and p≤0.05 was considered statistically significant.

RESULTS

Forty-five patients completed the study. Mean age was 67.98 ± 7.18 years (55-80 years). Most participants were in the 60-79-year age range, with 37 (82.2%) patients in this group. Mean prostate volume was 65.87 ± 17.16 mL (41-90 mL), and 16 (35.6%) patients had prostate volume ≥80 mL (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics of the Study Population (n=45)

Characteristics	Value, n (%), Mean ± SD
Age (years), Mean ± SD	67.98 ± 7.18
Age Range (Years)	55–80
50–59 Years	7 (15.6%)
60–69 Years	18 (40.0%)
70–79 Years	19 (42.2%)
≥80 Years	1 (2.2%)
Prostate Volume (mL), Mean ± SD	65.87 ± 17.16
Prostate Volume Range (mL)	41–90
<50 mL	13 (28.9%)
50–79 mL	16 (35.6%)
≥80 mL	16 (35.6%)

After TURP, all uroflowmetric measures moved in the expected direction. Qmax rose from 8.08 ± 1.58 to 19.87 ± 2.35 mL/s and Qavg from 4.32 ± 0.84 to 10.64 ± 1.57 mL/s. Voided volume increased, whereas voiding time, time to maximum flow, and PVR declined. The mean IPSS also fell from 24.13 ± 3.96 to 8.20 ± 2.35. Each pre-post comparison was statistically significant (p<0.001) (Table 2).

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Table 2: Comparison of Preoperative and Postoperative Uroflowmetry Parameters and IPSS in Patients Undergoing TURP (n=45)

Variables	Preoperative Mean ± SD	Postoperative Mean ± SD	Mean Difference (Pre–Post)	t-value	p-value
Maximum Flow Rate (Qmax), Ml/S	8.08 ± 1.58	19.87 ± 2.35	−11.78	−28.85	<0.001
Average Flow Rate (Qavg), Ml/S	4.32 ± 0.84	10.64 ± 1.57	−6.32	−22.52	<0.001
Voided Volume, Ml	211.53 ± 41.94	352.93 ± 39.49	−141.40	−16.31	<0.001
Voiding Time, Sec	76.84 ± 13.36	37.73 ± 8.83	39.11	15.24	<0.001
Time To Maximum Flow, Sec	19.20 ± 4.48	8.64 ± 2.45	10.56	13.56	<0.001
Post-Void Residual Urine (PVR), Ml	157.69 ± 41.89	37.16 ± 16.10	120.53	16.93	<0.001
IPSS Score	24.13 ± 3.96	8.20 ± 2.35	15.93	22.87	<0.001

Abbreviations: SD=standard deviation; Qmax=maximum urinary flow rate; Qavg=average urinary flow rate; PVR=post-void residual urine; IPSS=International Prostate Symptom Score. Paired t-test was used for all comparisons. On categorical assessment of IPSS, 36 (80.0%) patients were severe, and 9 (20.0%) were moderate before surgery. At follow-up, severe symptoms were not observed in any patient; 20 (44.4%) patients were in the mild category, and 25 (55.6%) were in the moderate category (Table 3).

Table 3: Preoperative and Postoperative IPSS Severity Categories (n=45)

IPSS Categories	Preoperative, n (%)	Postoperative, n (%)
Mild (0–7)	0 (0.0%)	20 (44.4%)
Moderate (8–19)	9 (20.0%)	25 (55.6%)
Severe (20–35)	36 (80.0%)	0 (0.0%)

The flow pattern analysis also showed complete postoperative conversion. All patients had an obstructed pattern before surgery, whereas all had a normal pattern at four weeks. This paired categorical change was significant on the McNemar test (χ^2=43.02, df =1, p<0.001) (Table 4).

Table 4: Pre- and Postoperative Uroflowmetry Flow Pattern Analysis (McNemar Test, n=45)

Preoperative Flow Patterns	Postoperative Normal, n (%)	Postoperative Obstructed, n (%)	Row Total, n (%)
Normal	0 (0.0%)	0 (0.0%)	0 (0.0%)
Obstructed	45 (100.0%)	0 (0.0%)	45 (100.0%)
Column Total	45 (100.0%)	0 (0.0%)	45 (100.0%)

McNemar test: χ^2=43.02, df =1, p<0.001

DISCUSSION

In this prospective before-and-after study, substantial improvements were observed in urinary flow parameters and patient-reported symptoms four weeks after TURP. However, because the study lacked a control group, these pre-post changes cannot establish a causal effect of TURP and may be influenced by spontaneous recovery, placebo effects, regression to the mean, or other perioperative factors. Song *et al.* observed a mean Qmax gain of 7.2 mL/s and a 4.7-point decrease in IPSS after TURP. The larger change in the patients may reflect more pronounced baseline obstruction and the use of standard office-based uroflowmetry [14]. Recent Pakistani data have similarly demonstrated significant short-term improvements in IPSS, Qmax, Qavg, and PVR following transurethral prostate surgery. Nadeem *et al.* reported significant postoperative improvements in these functional and symptom-based measures among patients undergoing monopolar TURP or monopolar transurethral enucleation, supporting the short-term functional improvements observed in the present study [12]. Sharma *et al.* reported postoperative Qmax values of 15.9 mL/s and 17.0 mL/s at 1 and 3 months, with Qavg increasing from 3.22 to 10.22 mL/s. The slightly higher Qmax in the current cohort may be related to differences in baseline obstruction, prostate characteristics, or timing of follow-up [15]. In the study by Ngalle *et al.* Qmax increased from 11.09 to 18.00 mL/s, and 71.6% of patients achieved IPSS ≤7 after TURP, indicating that functional gains after this procedure can be reproduced across different healthcare settings [16]. Acharya *et al.* documented postoperative Qmax of 16.89 mL/s and Qavg of 11.01 mL/s, together with reduced PVR. The greater absolute decline in PVR, from 157.69 to 37.16 mL, may be explained by a higher preoperative residual volume in the included patients [17]. The parallel improvement in uroflowmetry and IPSS in the present study shows concordance between objective and subjective outcomes. This pattern is comparable with the findings of Bansal and Adiga, who also reported better uroflowmetric status after TURP [18]. Khalil *et al.* also reported favorable therapeutic outcomes following monopolar TURP for bladder outlet obstruction, with postoperative improvement accompanied by an acceptable complication profile, supporting the effectiveness of TURP in relieving obstructive symptoms [19]. Sahu *et al.* demonstrated significant postoperative improvements in urodynamic parameters following TURP in patients with benign prostatic enlargement, further supporting the functional improvements observed in the present study [20]. Combined with the increase in Qmax, Qavg, PVR, IPSS category, and flow pattern, this suggests that post-TURP follow-up should be performed using both uroflowmetry and IPSS. This will give quantitative and symptom-based evidence of recovery [4, 5].

There are some limitations to this study. The follow-up was only 4 weeks, so late functional results and late

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complications were not available. The sample size was sufficient for the pre-post analysis of the paired data, but was too small for detailed subgroup comparisons. The study was carried out at a single center, and there was no comparator group, so the results should be extrapolated with caution. Detailed information regarding comorbidities, baseline pharmacological treatment, including α1-blockers and 5α-reductase inhibitors, and perioperative complications was not systematically recorded in the study dataset. These factors may have influenced postoperative symptoms and functional outcomes and could not be adequately controlled for. Fluid intake before uroflowmetry was not formally standardized and this may have introduced variability in voided volume and flow measurements. Standardized complication reporting and quality of life instruments should be incorporated into future multicenter studies with longer follow-up periods and compared to newer minimally invasive procedures like HoLEP and photo-selective vaporization.

CONCLUSIONS

Significant postoperative improvements were observed in Qmax, Qavg, voiding time, PVR, and IPSS four weeks after TURP in patients with BPH. Although no patients remained in the severe IPSS category, 25 (55.6%) patients remained in the moderate category, indicating incomplete symptom resolution in a substantial proportion of participants. A shift from abnormal to bell-shaped uroflowmetry curve patterns was also observed; however, curve morphology alone should not be interpreted as definitive evidence of resolution of bladder outlet obstruction. Given the prospective before-and-after design without a comparator group, the observed improvements cannot be attributed solely to TURP and should be interpreted as short-term postoperative changes.

Authors' Contribution

Conceptualization: SNA
Methodology: SNA
Formal analysis: AUR
Writing and Drafting: SAIZ
Review and Editing: SNA, SAIZ, ZF, AUR, WA

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflict of Interest

All the authors declare no conflict of interest.

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