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Role of Transurethral Resection of the Prostate (TURP) in Chronic Kidney Disease Patients With Obstructive Uropathy

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Abstract

Obstructive uropathy secondary to benign prostatic hyperplasia (BPH) is an important and potentially reversible cause of chronic kidney disease (CKD) in elderly men. Transurethral resection of the prostate (TURP) is the standard surgical treatment for bladder outlet obstruction; however, its safety and the extent of renal recovery offered by this procedure in patients with established CKD remain insufficiently described. Therefore, we evaluated renal functional outcomes and complications of TURP in men with CKD and obstructive uropathy. In this prospective observational study conducted in the Department of Urology of a tertiary teaching hospital in Jammu, India, we followed 50 consecutive men with CKD, according to the estimated glomerular filtration rate (eGFR) staging distribution method and Exclusion Criteria for other causes of CKD, who underwent bipolar TURP for three months. Serum creatinine, eGFR and post-void residual (PVR) urine volume were compared before and after surgery using the paired samples t-test, with mean paired differences, 95% confidence intervals (CIs) and effect sizes reported. All 50 patients completed follow-up with no missing outcome data. Mean serum creatinine fell from 2.40 ± 0.78 to 1.92 ± 0.67 mg/dL (mean change -0.48 mg/dL, 95% CI-0.58 to -0.38; Cohen's dz = 1.43), mean eGFR rose from 41.1 ± 12.1 to 52.1 ± 16.4 mL/min/1.73 m² (+11.0, 95% CI 6.9 to 15.1; dz = 0.76) and mean PVR fell from 241.0 ± 111.0 to 90.0 ± 69.0 mL (-151.0 mL, 95% CI -179.5 to -122.5; dz = 1.51) ($p < 0.001$ for each). Renal function improved in 43 patients (86%, 95% CI 73.8-93.0%), remained stable in six (12%) and did not recover in one (2%). Complications occurred in 19 patients (38%, 95% CI 25.9-51.8%), all Clavien-Dindo grades I-II, with no mortality. TURP relieved bladder outlet obstruction and was associated with significant improvement in renal function in men with CKD stages 2-4, with an acceptable, predominantly minor complication profile. Timely intervention, before irreversible nephron loss, appears to be important for renal recovery.

Categories: Urology, Medical Education, Nephrology
Keywords: benign prostatic hyperplasia (bph), chronic kidney disease (ckd), incidental adenocarcinoma, obstructive uropathy, post-void residual urine, prostatic carcinoma/prostate cancer, prostatic intraepithelial neoplasia (pin), prostatic pathology, serum creatinine, trans urethral resection of prostate (turp)

Introduction

Benign prostatic hyperplasia (BPH) is the most prevalent urological condition in ageing men, with histological prevalence rising steeply from the fifth decade to more than three-quarters of men by the eighth decade of life [1]. Progressive bladder outlet obstruction (BOO) resulting from BPH is a well-recognised cause of obstructive uropathy and, if left untreated, can culminate in chronic kidney disease (CKD). About 11% of men presenting for evaluation of lower urinary tract symptoms (LUTS) attributed to BPH have an elevated serum creatinine [2].

Obstructive uropathy initiates a cascade of pathophysiological events (including increased intraluminal pressure, tubular ischaemia, interstitial inflammation and tubulointerstitial fibrosis) that collectively impair renal function [3,4]. The renin-angiotensin-aldosterone system (RAAS) is activated early, contributing to vasoconstriction and a decline in the glomerular filtration rate (GFR). Prolonged obstruction results in nephron loss that is often only partially reversible even after decompression [3].

Transurethral resection of the prostate (TURP) has been the reference-standard endoscopic treatment for BPH for more than three decades [5,6]. However, TURP in patients with CKD presents particular perioperative challenges, including haemodynamic instability, electrolyte imbalance, post-obstructive diuresis and an increased risk of surgical complications [7]. The extent of renal recovery after TURP in these patients is closely linked to the duration and severity of obstruction, making timely surgical intervention an important determinant of renal outcome.

Men with large residual urine volumes, urinary retention and concurrent urinary tract infection (UTI) are at higher risk of renal failure. Comorbid illnesses, such as diabetes mellitus and hypertension, may exacerbate

the renal damage caused by BPH and may also limit recovery of renal function after the obstruction is relieved [8].

Despite the high burden of coexistent BPH and CKD in elderly men, evidence specifically addressing renal functional outcomes of TURP in this group remains limited. This study was undertaken to evaluate the safety and efficacy of TURP in improving renal function, reducing residual urine volume and minimising morbidity in patients with CKD stages 2-4 presenting with obstructive uropathy.

Materials And Methods

Study design, setting and duration

This retrospective and prospective observational study was conducted in the Departments of Urology and General Surgery at Acharya Shri Chander College of Medical Sciences and Hospital (ASCOMS), Sidhra, Jammu, India. Fifty consecutive patients with CKD stages 2-4 (estimated glomerular filtration rate (eGFR) 15-89 mL/min/1.73 m^2) and obstructive uropathy secondary to BPH who underwent TURP were enrolled. Patient recruitment was carried out from 01/04/26 to 30/06/26, and the final three-month follow-up visit was completed on 30/09/26. The overall study duration was therefore six months. The study protocol was approved by the Institutional Ethics Committee of ASCOMS on 26/06/26 (approval number ASCOMS/IEC/2026/Meeting-2/FM/08). Written informed consent was obtained from every participant before enrolment.

Sample size and sampling

All eligible patients presenting during the study period were enrolled consecutively until the target sample size of 50 patients was reached. No formal a priori sample size calculation was performed. The sample size was based on convenience and determined by the number of eligible patients presenting during the study period. All eligible patients with CKD stages 2-4 and BPH-related obstructive uropathy who underwent TURP were consecutively enrolled.

Inclusion and exclusion criteria

Patients aged ⩾ 50 years with BPH-related BOO, documented CKD stages 2-4 and symptomatic LUTS were included. Patients with prostatic malignancy, neurogenic bladder, a history of prior pelvic surgery, CKD stage 5 (eGFR < 15 mL/min/1.73 m^2), hydronephrosis, active urosepsis at the time of surgery, or comorbidities such as uncontrolled diabetes mellitus or decompensated cardiac failure were excluded.

Preoperative assessment

All patients underwent a comprehensive haematological and biochemical evaluation, including serum creatinine and blood urea nitrogen. eGFR was calculated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) creatinine equation [9]. Renal ultrasonography was performed to assess hydronephrosis, cortical thickness and post-void residual (PVR) urine volume. LUTS were scored with the International Prostate Symptom Score (IPSS) [10], and uroflowmetry was performed according to the International Continence Society standards of good urodynamic practice [11]. Patients with clinically significant BOO received preoperative urethral catheterisation to decompress the bladder.

Operative technique

All patients underwent standard bipolar TURP under spinal anaesthesia. Bipolar resection with isotonic saline irrigation was used to minimise the risk of transurethral resection (TUR) syndrome and electrolyte disturbance [12]. The resection was continued until satisfactory visualisation of the verumontanum and adequate bladder outlet drainage was achieved. A three-way urethral catheter was placed postoperatively for continuous saline irrigation and removed at 48-72 hours after the surgery, provided the urine was clear.

Postoperative monitoring and follow-up

Serum creatinine, eGFR and PVR were reassessed at one week, one month and three months after surgery; the three-month values were used for the pre- versus post-operative comparison. Fluid balance, urine output and electrolytes were closely monitored during hospitalisation to detect post-obstructive diuresis. Complications were graded with the Clavien-Dindo classification [13].

Outcome definitions

Renal outcome at three months was classified as improved, stable or no recovery. Renal outcomes were assessed three months after TURP by comparing postoperative serum creatinine and eGFR with the corresponding preoperative values. Renal outcomes were classified as improved renal function, stable renal function or no recovery, based on the observed changes in these parameters. The three-month assessment was used for the final classification of renal outcomes.

Statistical analysis

Continuous variables are expressed as mean ± standard deviation (SD) and categorical variables as numbers and percentages. The three primary outcomes were serum creatinine, eGFR and PVR, each compared between the preoperative visit and the three-month postoperative visit within the same patient.

Paired Analysis

For each patient and each primary outcome, the within-patient change was calculated as the three-month value minus the preoperative value. The mean of these paired differences, the SD of the differences and the two-sided 95% confidence interval (CI) of the mean difference were derived, and pre- and postoperative values were compared with the two-tailed paired samples t-test (n = 50 pairs, degrees of freedom = 49). Percentage change from the preoperative mean was also reported. With 50 pairs, the sampling distribution of the mean paired difference was considered approximately normal, so the paired t-test was used for all three outcomes.

Effect Sizes

The magnitude of each pre-post change was expressed as Cohen's dz, calculated as the mean paired difference divided by the SD of the paired differences, and interpreted using conventional thresholds of 0.2 (small), 0.5 (medium) and 0.8 (large).

Confidence Intervals

Ninety-five percent CIs for mean paired differences were based on the t distribution with 49 degrees of freedom; 95% CIs for proportions (CKD stage distribution, renal outcome categories and complications) were calculated with the Wilson score method.

Multiplicity

Statistical significance was set at a two-sided $p < 0.05$. Because three primary outcomes were tested, the results were also checked against a Bonferroni-adjusted threshold of $p < 0.017$ (0.05/3).

Missing Data

All 50 enrolled patients attended the three-month follow-up and had complete preoperative and postoperative measurements of serum creatinine, eGFR and PVR. No patient was lost to follow-up, withdrew or was excluded after enrolment, so all analyses were performed on the complete dataset of 50 patients and no imputation was required. The baseline characteristics reported in Table *1* were available for all 50 patients.

All analyses were performed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY).

Use of assessment tools and permissions

The CKD-EPI equation [9] is published in the public domain. The IPSS [10] is freely available for clinical and research use under its applicable terms of use. Uroflowmetry [11] is a standard clinical investigation, rather than a proprietary instrument. Accordingly, no licence or permission was therefore required for any tool used in this study.

Results

Participant flow, missing data and baseline characteristics

Fifty consecutive eligible men with BPH-related obstructive uropathy and CKD stages 2-4 who underwent TURP during the study period were enrolled. All 50 completed the three-month follow-up, and there were no missing values for the primary outcomes, so every analysis is based on 50 patients.

The mean age was 68.0 ± 5.5 years. CKD stage 2 was present in 19 (38%) patients, stage 3 in 23 (46%) and stage 4 in eight (16%). The mean preoperative serum creatinine was 2.40 ± 0.78 mg/dL, eGFR 41.1 ± 12.1 mL/min/1.73 m^2 and PVR 241.0 ± 111.0 mL. These baseline characteristics are summarised in Table *1*.

Characteristic	Value (n = 50)
Demographics	
Age, years, mean ± SD	68.0 ± 5.5
CKD stage (CKD-EPI eGFR)	
Stage 2 (eGFR 60-89 mL/min/1.73 m²), n (%) (95% CI)	19 (38%) (25.9-51.8%)
Stage 3 (eGFR 30-59 mL/min/1.73 m²), n (%) (95% CI)	23 (46%) (33.0-59.6%)
Stage 4 (eGFR 15-29 mL/min/1.73 m²), n (%) (95% CI)	8 (16%) (8.3-28.5%)
Baseline renal and urinary parameters	
Serum creatinine, mg/dL, mean ± SD	2.40 ± 0.78
eGFR, mL/min/1.73 m², mean ± SD	41.1 ± 12.1
Post-void residual urine volume, mL, mean ± SD	241.0 ± 111.0

TABLE 1: Baseline demographic and clinical characteristics of the study cohort (n = 50).

Data are presented as mean ± SD or n (%); 95% CIs for proportions by the Wilson score method. No baseline data were missing.

CKD: chronic kidney disease; CKD-EPI: Chronic Kidney Disease Epidemiology Collaboration; eGFR: estimated glomerular filtration rate

Renal functional parameters

All three primary renal parameters improved significantly after TURP, with complete paired data for all 50 patients (Table 2). Mean serum creatinine fell from 2.40 ± 0.78 mg/dL to 1.92 ± 0.67 mg/dL, a mean paired reduction of 0.48 mg/dL (SD of change 0.34; 95% CI 0.38 to 0.58; -20.0%; t = 10.10, df = 49, p < 0.001), corresponding to a large effect (Cohen's dz = 1.43). Mean eGFR rose from 41.1 ± 12.1 to 52.1 ± 16.4 mL/min/1.73 m², a mean paired increase of 11.0 mL/min/1.73 m² (SD of change 14.5; 95% CI 6.9 to 15.1; +26.8%; t = 5.37, df = 49, p < 0.001; dz = 0.76, medium-to-large effect). Mean PVR fell from 241.0 ± 111.0 mL to 90.0 ± 69.0 mL, a mean paired reduction CI 122.5 to 179.5; -62.7%; t = 10.66, df = 49, p < 0.001; dz = 1.51, large effect). of 151.0 mL (SD of change 100.2; 95%

Parameter	Pre-TURP, mean ± SD	Post-TURP, mean ± SD	Mean paired change (95% CI)	SD of change	t (df = 49)	p-value	Cohen's dz
Serum creatinine (mg/dL)	2.40 ± 0.78	1.92 ± 0.67	-0.48 (-0.58 to -0.38)	0.34	10.10	< 0.001	1.43
eGFR (mL/min/1.73 m²)	41.1 ± 12.1	52.1 ± 16.4	+11.0 (6.9 to 15.1)	14.5	5.37	< 0.001	0.76
Post-void residual urine volume (mL)	241.0 ± 111.0	90.0 ± 69.0	-151.0 (-179.5 to -122.5)	100.2	10.66	< 0.001	1.51

TABLE 2: Paired comparison of renal parameters before and after TURP (n = 50 complete pairs).

Post-TURP values are those at three-month follow-up. Change = post-TURP minus pre-TURP value for each patient; 95% CI of the mean paired change based on the t-distribution (df = 49). Statistical test: two-tailed paired samples t-test; all p-values remain significant after Bonferroni correction (p < 0.017). Effect size: Cohen's dz = mean paired change/SD of change (0.2 small, 0.5 medium, ≥ 0.8 large). No missing data.

eGFR: estimated glomerular filtration rate; TURP: transurethral resection of the prostate

For each outcome, the 95% CI of the mean change excluded zero, and all three comparisons remained significant after Bonferroni adjustment for three primary outcomes (threshold p < 0.017).

Figure 1 shows the distribution of postoperative renal outcomes: improved renal function in 43 (86%; 95% CI 73.8-93.0%), stable renal function in six (12%; 95% CI 5.6-23.8%) and no recovery in one (2%; 95% CI 0.4-10.5%) patient.

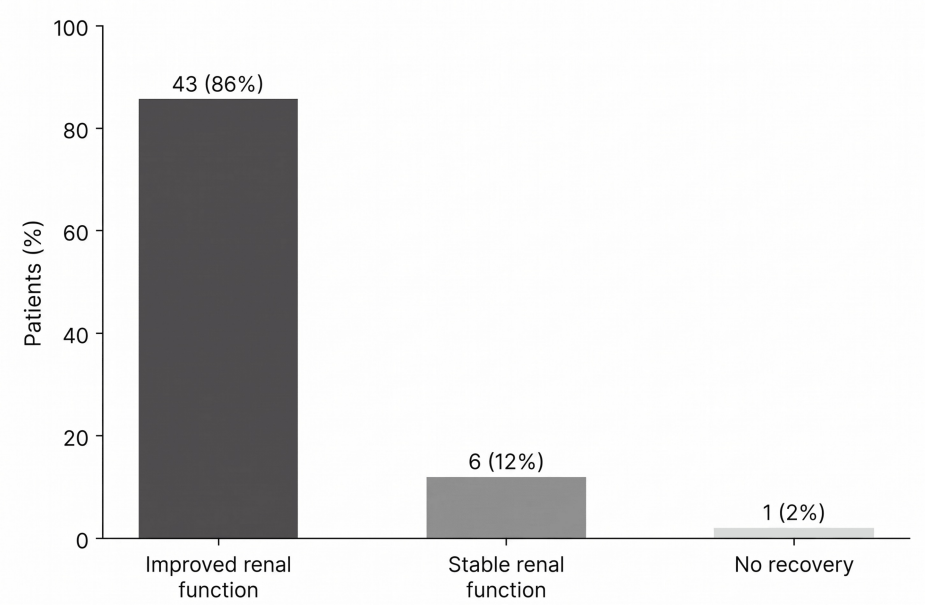


FIGURE 1: Distribution of postoperative renal outcomes following transurethral resection of the prostate (TURP) in chronic kidney disease (CKD) patients (n = 50).

Bars show the percentage of patients in each outcome category; descriptive data, no statistical test applied.

Figure 2 compares mean serum creatinine before and after TURP. The mean paired reduction was 0.48 mg/dL (95% CI 0.38 to 0.58; dz = 1.43), a modest absolute change that represents a 20% fall from baseline and is clinically relevant in patients with limited nephron reserve.

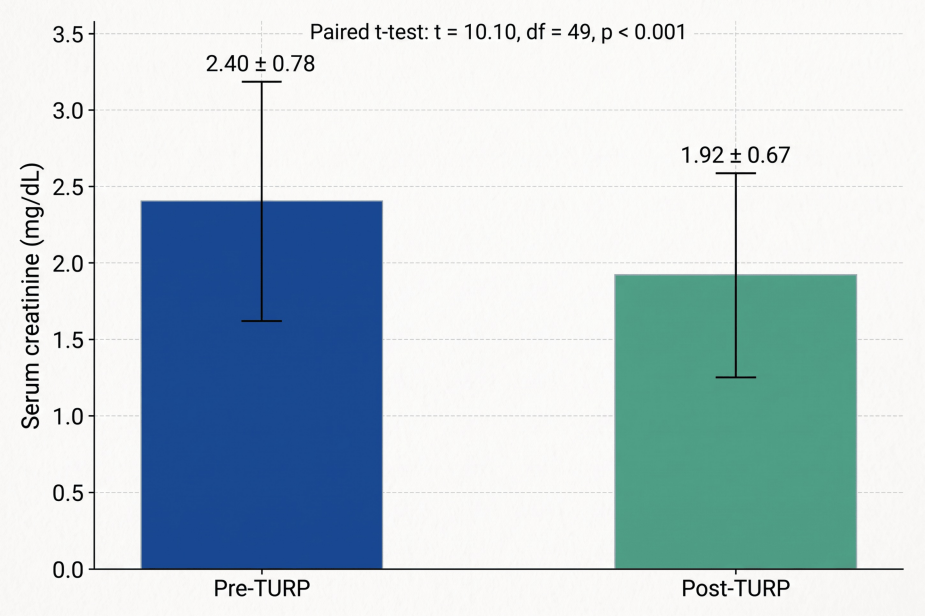


FIGURE 2: Mean serum creatinine (mg/dL) before and after transurethral resection of the prostate (TURP) (n = 50).

Bars show means; error bars show ± 1 SD. Mean paired change: -0.48 mg/dL (95% CI -0.58 to -0.38); two-tailed paired samples t-test: t = 10.10, df = 49, p < 0.001; Cohen's dz = 1.43.

Postoperative outcomes and complications

Thirty-one patients (62%; 95% CI 48.2-74.1%) had no complications. Among the 19 patients (38%; 95% CI 25.9-51.8%) who had an adverse event, transient haematuria occurred in 10 (20%; 95% CI 11.2-33.0%), urinary retention requiring recatheterisation in five (10%; 95% CI 4.3-21.4%) and UTI in four (8%; 95% CI 3.2-18.8%). All complications were Clavien-Dindo grades I-II and resolved with conservative management. No patient required return to theatre or postoperative haemodialysis, and there was no mortality (Table 3, Figure 3).

Outcome/complication	Patients, n (%)	95% CI (%)
Renal outcome at three months		
Improved renal function	43 (86%)	73.8-93.0
Stable renal function	6 (12%)	5.6-23.8
No recovery	1 (2%)	0.4-10.5
Complications (Clavien-Dindo grades I-II)		
No complications	31 (62%)	48.2-74.1
Any complication	19 (38%)	25.9-51.8
Transient haematuria	10 (20%)	11.2-33.0
Retention requiring recatheterisation	5 (10%)	4.3-21.4
Urinary tract infection	4 (8%)	3.2-18.8

TABLE 3: Postoperative outcomes and complication profile following TURP in CKD patients (n = 50).

Data are presented as n (%) with 95% confidence intervals calculated by the Wilson score method; no missing data. Complications were graded by the Clavien-Dindo classification; all were grades I-II.

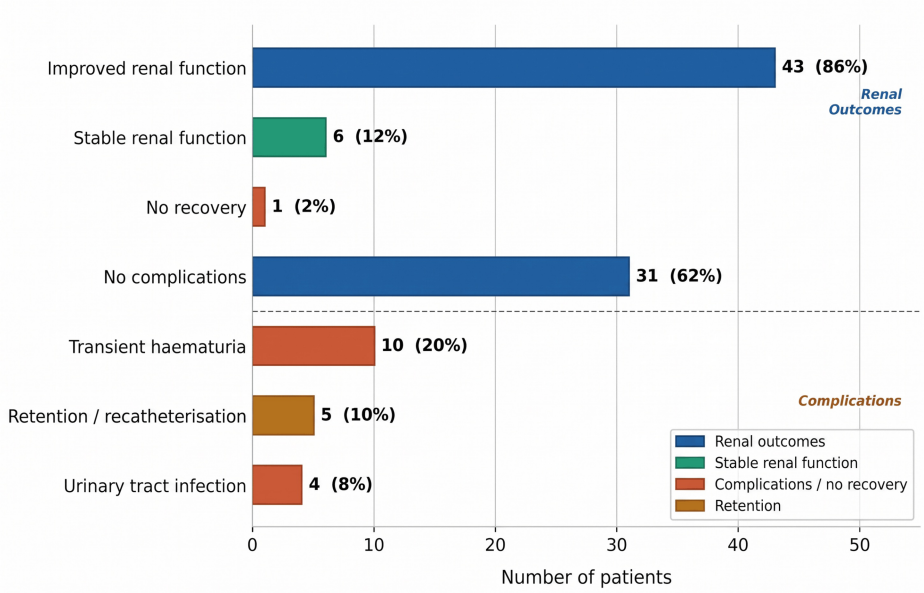


FIGURE 3: Postoperative renal outcomes and complications following transurethral resection of the prostate (TURP) (n = 50).

Bars show the number of patients in each category; descriptive data, no statistical test applied.

Discussion

This study shows that TURP was associated with statistically and clinically significant improvement in renal function in men with CKD and obstructive uropathy. The fall in serum creatinine and rise in eGFR are consistent with Zamzami et al., who found significant reductions in blood urea and creatinine after TURP in patients with kidney dysfunction [14], and with Volpe et al., who reported early and sustained improvement in renal graft function after TURP in kidney transplant recipients [15].

The pathophysiological basis for this recovery lies in reversal of obstructive nephropathy. Prolonged BOO raises intraluminal pressure, reduces renal blood flow and activates the intrarenal RAAS, all of which contribute to tubulointerstitial damage and fibrosis [3,4]. Decompression by TURP relieves this pressure gradient and allows surviving nephrons to recover filtration capacity. The wider literature indicates that recovery is greatest when obstruction is shorter and baseline renal impairment less advanced [7,8]; we did not analyse outcomes by obstruction duration or CKD stage, so this could not be confirmed in our cohort.

The use of bipolar TURP in this series is an important technical consideration. Bipolar resection uses isotonic saline as the irrigant rather than the hypotonic glycine used in conventional monopolar systems, which reduces the risk of TUR syndrome and dilutional hyponatraemia. This is particularly relevant in CKD, where impaired renal handling of free water and solutes increases susceptibility to electrolyte disturbance. Ho et al. found bipolar TURP in saline to be as effective as monopolar TURP with a better safety profile [16], and a Cochrane review of 59 randomised trials concluded that bipolar TURP probably reduces TUR syndrome and blood transfusion compared with monopolar TURP [17].

The overall complication rate of 38% is higher than the 11.1% short-term morbidity reported in a prospective multicentre series of 10,654 unselected TURP patients [18]. Two factors may explain this. First, we recorded every adverse event, including transient haematuria, which accounted for more than half of all complications. Second, all our patients had established CKD. Akdemir et al., however, found no excess morbidity after TURP in men with mild, non-dialysis-requiring renal insufficiency [19], so our rate should be interpreted with caution. Importantly, every complication in this study was Clavien-Dindo grades I-II [13]; none required return to theatre, and no patient needed postoperative haemodialysis. Thomas et al. reported that patients presenting with renal failure may continue to recover renal function for up to a year after prostatic surgery [7]. The single patient in our series without recovery had the most advanced CKD stage preoperatively, consistent with a threshold effect of irreversible nephron loss.

Post-obstructive diuresis is a recognised complication after relief of chronic obstruction and requires vigilant perioperative fluid management. Its mechanism involves aquaporin downregulation, loss of medullary tonicity and tubular transporter dysfunction after sustained high-pressure obstruction [4]. Careful hourly urine output monitoring and targeted fluid replacement, avoiding over-replacement that might perpetuate the diuresis, are essential. Luna and Pe found that post-obstructive diuresis was more likely in patients with baseline acute kidney injury and longer obstruction, and that relief of obstruction was followed by improvement in renal function [20].

Holmium laser enucleation of the prostate (HoLEP) and photoselective vaporisation achieve comparable functional outcomes in selected patients [21]. Nevertheless, TURP remains the most widely available and validated procedure, particularly in resource-limited settings [1,5]. Our data support its continued use in men with CKD, especially with modern bipolar instrumentation.

Limitations

This was a single-centre study with a modest sample of 50 patients and no control group, so improvement cannot be attributed to TURP alone. Follow-up was limited to three months, which does not capture longer-term renal trajectory or late complications such as urethral stricture. Outcomes were not stratified by CKD stage, obstruction duration or comorbidity, and IPSS and uroflowmetry results were recorded but not analysed as outcomes. Larger, longer-term studies with subgroup analysis are needed.

Conclusions

TURP is a safe and effective intervention for BOO secondary to BPH in patients with CKD stages 2-4. It was followed by significant improvement in serum creatinine, eGFR and PVR urine volume, with a complication profile limited to Clavien-Dindo grades I-II events. Early surgical intervention, before irreversible nephron loss occurs, is likely to maximise renal recovery. A multidisciplinary approach integrating urology and nephrology is essential for perioperative care, fluid balance monitoring and long-term renal surveillance in this high-risk population.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Manvir Singh, Ravinder S. Ghai, Tushar Raina, Lovish Mahajan, Kanav Gupta, Aman Ved

Acquisition, analysis, or interpretation of data: Manvir Singh, Tushar Raina, Lovish Mahajan, Kanav Gupta, Aman Ved

Drafting of the manuscript: Manvir Singh, Tushar Raina, Lovish Mahajan, Kanav Gupta, Aman Ved

Critical review of the manuscript for important intellectual content: Manvir Singh, Ravinder S. Ghai, Tushar Raina, Lovish Mahajan, Kanav Gupta, Aman Ved

Supervision: Manvir Singh, Ravinder S. Ghai, Tushar Raina, Lovish Mahajan, Kanav Gupta, Aman Ved

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Institutional Ethics Committee Acharya Shri Chander College of Medical Sciences and Hospital, Sidhra, Jammu issued approval ASCOMS/IEC/2026/Meeting-2/FM/08. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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Manvir Singh, Ravinder S. Ghai and Kanav Gupta have contributed equally to the work and should be considered co-first authors.

References

1. Chughtai B, Forde JC, Thomas DD, et al.: Benign prostatic hyperplasia. Nat Rev Dis Primers. 2016, 2:16031. 10.1038/nrdp.2016.31
2. Gerber GS, Goldfischer ER, Karrison TG, Bales GT: Serum creatinine measurements in men with lower urinary tract symptoms secondary to benign prostatic hyperplasia. Urology. 1997, 49:697-702. 10.1016/S0090-4295(97)00069-1
3. Deriugina LA, Popyhova EB, Rostovskaya VV, Krasnova EI: Pathophysiological mechanisms of renal damage in obstructive uropathies as potential therapeutic targets: a literature review. J Clin Trials Exp Investig. 2023, 2:209-19.
4. Yaxley J, Yaxley W: Obstructive uropathy - acute and chronic medical management . World J Nephrol. 2023, 12:1-9. 10.5527/wjn.v12.i1.1
5. Oelke M, Bachmann A, Descazeaud A, et al.: EAU guidelines on the treatment and follow-up of non-neurogenic male lower urinary tract symptoms including benign prostatic obstruction. Eur Urol. 2013, 64:118-40. 10.1016/j.eururo.2013.03.004
6. Elterman D, Aubé-Peterkin M, Evans H, Elmansy H, Meskawi M, Zorn KC, Bhojani N: UPDATE - Canadian Urological Association guideline: male lower urinary tract symptoms/benign prostatic hyperplasia. Can Urol Assoc J. 2022, 16:245-56. 10.5489/cuaj.7906
7. Thomas AZ, Thomas AA, Conlon P, Hickey D, Little DM: Benign prostatic hyperplasia presenting with renal failure--what is the role for transurethral resection of the prostate (TURP)?. Ir Med J. 2009, 102:43-4.
8. Chilumula R, Devaraj R, Sriramoju V, Dondapati T, Prakash A: Analysis of risk factors and outcome of renal failure in benign prostatic hyperplasia. J Clin Diagn Res. 2018, 12:PC01-3.
9. Levey AS, Stevens LA, Schmid CH, et al.: A new equation to estimate glomerular filtration rate . Ann Intern Med. 2009, 150:604-12. 10.7326/0003-4819-150-9-200905050-00006
10. Barry MJ, Fowler FJ Jr, O'Leary MP, Bruskewitz RC, Holtgrewe HL, Mebust WK, Cockett AT: The American Urological Association symptom index for benign prostatic hyperplasia. J Urol. 1992, 148:1549-57. 10.1016/s0022-5347(17)36966-5
11. Schäfer W, Abrams P, Liao L, et al.: Good urodynamic practices: uroflowmetry, filling cystometry, and pressure-flow studies. Neurourol Urodyn. 2002, 21:261-74. 10.1002/nau.10066
12. Rassweiler J, Teber D, Kuntz R, Hofmann R: Complications of transurethral resection of the prostate (TURP)—incidence, management, and prevention. Eur Urol. 2006, 50:969-79. 10.1016/j.eururo.2005.12.042
13. Dindo D, Demartines N, Clavien PA: Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg. 2004, 240:205-13. 10.1097/01.sla.0000133083.54934.ae
14. Zamzami Z, Rayendra H, Az-Zahra N: Associations between kidney dysfunction and risk factors in patients with transurethral resection of the prostate. Res Rep Urol. 2021, 13:665-72. 10.2147/RRU.S326836
15. Volpe A, Billia M, Quaglia M, et al.: Transurethral resection of the prostate in kidney transplant recipients: urological and renal functional outcomes at long-term follow-up. BJU Int. 2013, 112:386-93. 10.1111/bju.12030
16. Ho HS, Yip SK, Lim KB, Fook S, Foo KT, Cheng CW: A prospective randomized study comparing monopolar and bipolar transurethral resection of prostate using transurethral resection in saline (TURIS) system. Eur

Urol. 2007, 52:517-22. 10.1016/j.eururo.2007.03.038

17. Alexander CE, Scullion MM, Omar MI, et al.: Bipolar versus monopolar transurethral resection of the prostate for lower urinary tract symptoms secondary to benign prostatic obstruction. Cochrane Database Syst Rev. 2019, 12:CD009629. 10.1002/14651858.CD009629.pub4
18. Reich O, Gratzke C, Bachmann A, et al.: Morbidity, mortality and early outcome of transurethral resection of the prostate: a prospective multicenter evaluation of 10,654 patients. J Urol. 2008, 180:246-9. 10.1016/j.juro.2008.03.058
19. Akdemir AO, Oztekin CV, Doluoglu OG, Karabakan M, Ugurlu O, Cetinkaya M: The effects of transurethral resection of the prostate on morbidity and mortality in patients with nondialysis-requiring renal insufficiency. Ther Adv Urol. 2012, 4:51-6. 10.1177/1756287211435088
20. Luna NA, Pe DC: Renal profile and outcome of patients with post-obstructive diuresis at the UST hospital: a retrospective study. J Med Univ Santo Tomas. 2025, 9:1703-17.
21. Das AK, Teplitsky S, Humphreys MR: Holmium laser enucleation of the prostate (HoLEP): a review and update. Can J Urol. 2019, 26:13-9.