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Original Article

Comparative outcomes of transurethral resection of the prostate and prostate kinetic resection in treating benign prostatic hyperplasia with prostatic stones

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Abstract: Aims: To compare the clinical outcomes of transurethral bipolar plasma enucleation (TBPE) and transurethral resection of the prostate (TURP) in patients with benign prostatic hyperplasia (BPH) complicated by prostatic stones. Methods: This retrospective study included 150 patients divided into TBPE (n = 74) and TURP (n = 76) groups. Perioperative data, urodynamic parameters, symptom scores, complications, and sexual function were evaluated up to 6 months postoperatively. Results: TBPE was associated with shorter catheterization and hospital stay, greater improvements in maximum urinary flow rate, post-void residual volume, and International Prostate Symptom Score, fewer complications, less intraoperative bleeding, and better postoperative sexual function (all P < 0.001). Multivariate analysis confirmed TBPE as an independent predictor of favorable outcomes (OR = 12.074, 95% CI: 6.513-22.386, P < 0.001). Conclusion: TBPE demonstrates superior clinical effectiveness and safety over TURP for managing BPH with prostatic stones.

Keywords: Transurethral bipolar plasma enucleation, transurethral resection, benign prostatic hyperplasia, prostatic stones, minimally invasive surgery

Introduction

Benign prostatic hyperplasia (BPH) is a non-malignant enlargement of the prostate commonly seen in aging men. It often leads to lower urinary tract symptoms (LUTS) such as urinary retention, increased frequency and urgency, and incomplete bladder emptying, significantly affecting patients' quality of life and often requiring medical or surgical intervention [1, 2]. Among the complicating factors in BPH management, the presence of prostatic stones is of particular concern. Prostatic stones not only exacerbate urinary symptoms but also increase the technical difficulty of surgical treatment [3].

Surgical intervention remains the mainstay for symptomatic BPH, and over the years, several techniques have been developed to improve patient outcomes. One of the most established procedures is transurethral resection of the prostate (TURP), which has demonstrated consistent efficacy in symptom relief and acceptable long-term results [4]. However, TURP is associated with complications such as bleeding, prolonged catheterization, and delayed recovery - particularly in patients with complex cases involving prostatic stones [5].

With advancements in minimally invasive surgery, TBPE has emerged as a promising alternative to conventional transurethral resection of the prostate (TURP) [6]. TBPE utilizes bipolar energy to enucleate prostatic tissue, potentially reducing intraoperative bleeding, shortening hospital stays, and accelerating postoperative recovery. Despite these theoretical advantages, the effectiveness of TBPE specifically in BPH patients with prostatic stones has not been comprehensively evaluated [7].

While previous studies have compared TBPE with other minimally invasive techniques such

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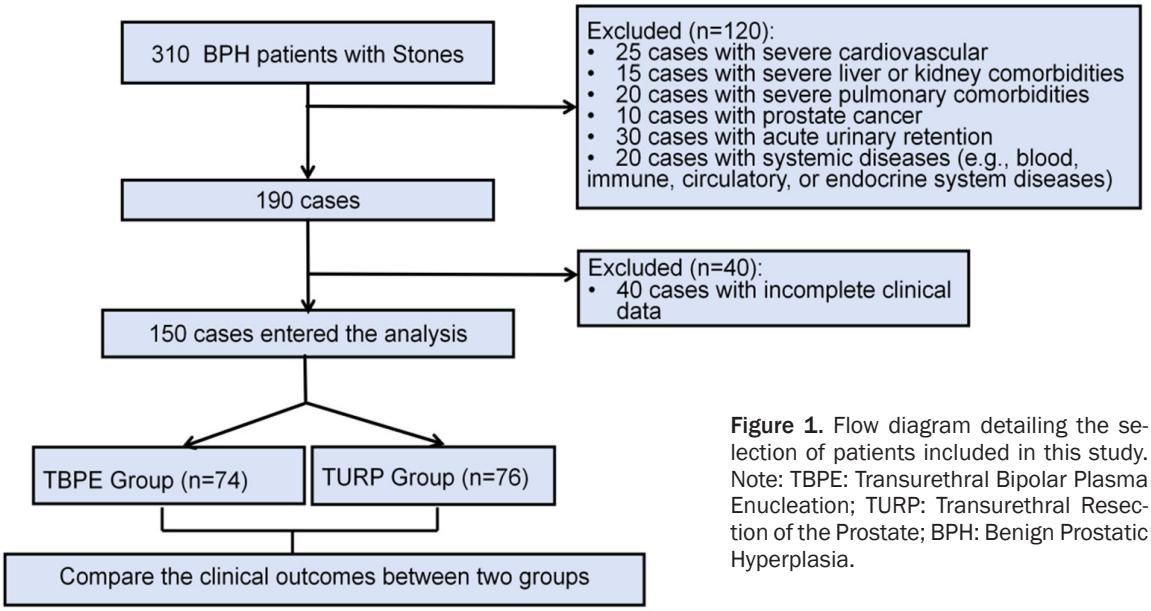

Figure 1. Flow diagram detailing the selection of patients included in this study. Note: TBPE: Transurethral Bipolar Plasma Enucleation; TURP: Transurethral Resection of the Prostate; BPH: Benign Prostatic Hyperplasia.

as laser enucleation, direct comparisons between TURP and TBPE in patients with coexisting prostatic stones remain scarce. The presence of prostatic stones can alter surgical characteristics - making dissection more difficult and increasing the risk of prolonged operative time, intraoperative hemorrhage, and postoperative complications. Given the limited data, a comparative evaluation of TBPE and TURP in this patient population is necessary to assess their relative efficacy and safety [8, 9].

This study aims to address this gap by directly comparing TBPE and TURP in the surgical management of BPH complicated by prostatic stones. Although both procedures involve the removal of hyperplastic prostatic tissue, TBPE employs bipolar energy, which may reduce collateral thermal damage and minimize bleeding - especially relevant in the presence of prostatic stones. By providing robust evidence, this research seeks to determine whether TBPE offers clinical advantages over TURP in terms of operative efficiency, complication rates, recovery speed, and long-term symptom relief in this challenging subset of patients. The findings may also contribute to the broader field of minimally invasive urologic surgery and assist clinicians in selecting the most appropriate technique for managing BPH with concomitant prostatic stones.

Materials and methods

Case section

This retrospective study was conducted using clinical data from the Sixth People's Hospital affiliated with Shanghai Jiao Tong University School of Medicine. It included patients diagnosed with BPH complicated by prostatic stones between January 2021 and January 2025. Retrospective analyses are a well-established method in clinical research, especially in surgical studies where randomized controlled trials may not always be feasible due to ethical or logistical constraints.

A total of 310 male patients were initially identified. After excluding 120 patients based on predefined exclusion criteria (e.g., severe cardiovascular disease, severe pulmonary comorbidities, etc.), 190 patients remained eligible for further assessment. An additional 40 patients were excluded due to incomplete clinical data, resulting in 150 patients being included in the final analysis. Patients were divided into two groups based on the surgical intervention received: the TBPE group (n = 74) and the TURP group (n = 76) (**Figure 1**).

Inclusion criteria were as follows: (1) male patients aged 50-80 years; (2) diagnosis of BPH with concomitant prostatic stones con-

firmed by imaging (e.g., transrectal ultrasound or CT scan) [10]; (3) moderate to severe LUTS defined by an International Prostate Symptom Score (IPSS) ≥ 12; (4) failure of conservative treatment, such as pharmacotherapy or lifestyle modification; (5) completion of surgical treatment and postoperative follow-up; (6) availability of complete clinical data, including baseline demographics, imaging findings, treatment records, and follow-up outcomes.

Exclusion criteria included: (1) severe cardiovascular or pulmonary disease increasing surgical risk; (2) diagnosis or suspicion of prostate cancer based on clinical or biopsy findings; (3) acute urinary retention unmanageable by catheterization or medication; (4) active urinary tract infection, bladder cancer, or significant bladder dysfunction; (5) history of prior prostate surgery.

Clinical efficacy was defined as an improvement in LUTS, as measured by the IPSS [11]. An IPSS < 8 at the 6-month postoperative follow-up was considered effective treatment, indicating mild or absent symptoms. For multivariate logistic regression, clinical efficacy was analyzed as a binary outcome variable ("effective" vs. "ineffective") to identify independent predictors of favorable postoperative outcomes.

Surgical intervention

The TBPE procedure was performed using a bipolar plasma enucleation system, first introduced at the Sixth People's Hospital in 2002. Patients underwent either general or spinal anesthesia. A resectoscope was inserted transurethrally to access the prostate, and enucleation of both adenomatous tissue and prostatic stones was performed using bipolar energy. The enucleated tissue and stones were removed through the resectoscope. This technique offers advantages such as reduced thermal damage to surrounding tissue, superior hemostasis, and minimized bleeding. All TBPE procedures were performed by Dr. Zuowei Li, an experienced surgeon with extensive expertise in bipolar enucleation techniques.

In the TURP group, a traditional method of TURP was used, which has been practiced at Sixth People's Hospital since 2000. After induction of anesthesia, a resectoscope was introduced into the urethra to access the prostate. The surgeon used an electrosurgical loop to resect prostatic tissue and stones. Continuous irrigation and careful dissection were maintained throughout the procedure, and hemostasis was achieved using standard electrosurgical techniques. All TURP surgeries were performed by Dr. Dongliang Yan, a skilled urologist with extensive experience in TURP.

Patients were informed of both surgical options, including associated risks and benefits. The choice of procedure was made collaboratively, based on patient preference, clinical characteristics, and the surgeon's clinical judgment. The nearly equal distribution of patients in the two groups reflects a balanced selection process.

All patients received standardized perioperative care, including prophylactic antibiotics, urinary catheterization, and postoperative complication management. Clinical parameters, including recovery time, complication rates, urodynamic outcomes, and symptom relief were monitored at scheduled follow-up visits.

Data collection and outcome measurement

Clinical efficacy was primarily assessed through changes in urodynamic parameters, including maximum urinary flow rate (Qmax) and postvoid residual volume (PVR), measured at baseline and at follow-up visits conducted 1 week, 3 months, and 6 months postoperatively. Qmax was evaluated using uroflowmetry, which provides an objective measurement of urine flow during micturition. PVR was assessed via ultrasound to determine the volume of residual urine in the bladder following voiding [12].

Symptom severity was evaluated using the IPSS and the National Institutes of Health (NIH) Chronic Prostatitis Symptom Index. Quality of life (QoL) was also measured at each follow-up point. The IPSS includes subscores for both storage and voiding symptoms and was administered as a standardized questionnaire during each follow-up visit [13].

Additional postoperative recovery indicators, such as time to first bowel movement, duration of catheterization, and total length of hospital stay were recorded as secondary outcomes. These variables were monitored daily during

hospitalization and compared between the two groups.

Surgical efficacy was evaluated by comparing preoperative and postoperative stone burden (as determined by imaging modalities such as CT or ultrasound), stone clearance rate, and operative time (from incision to completion). Postoperative complications were monitored through daily clinical assessments and follow-up visits, and included acute urinary retention, transient renal impairment, continuous hematuria, bladder neck contracture (BNC), capsular perforation, and urinary tract obstruction. Complication rates were calculated based on events occurring during hospitalization and follow-up.

Intraoperative blood loss was assessed by estimated surgical bleeding and perioperative changes in hemoglobin concentration, with values recorded immediately postoperatively and at subsequent follow-ups.

Sexual function recovery was evaluated using the International Index of Erectile Function (IIEF), focusing on erectile function and sexual satisfaction domains. IIEF scores were obtained at baseline and at the 6-month follow-up [14].

Statistical methods

All statistical analyses were performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize baseline characteristics, presented as mean ± standard deviation (SD) for continuous variables and frequency (percentage) for categorical variables.

Normality of data distribution was tested using the Kolmogorov-Smirnov test. For continuous variables with normal distribution, between-group comparisons were conducted using independent samples t-tests. For non-normally distributed data, the Mann-Whitney U test was applied. Categorical variables were analyzed using the chi-square (χ^2) test or continuity correction test as appropriate.

To evaluate changes in clinical parameters over time (e.g., Qmax, PVR, IPSS), repeated-measures analysis of variance (ANOVA) was used, with Bonferroni correction applied for multiple post hoc comparisons. Multivariate logistic regression analyses were performed to identify independent predictors of clinical efficacy, including age, baseline symptom severity, and surgical method. Regression models were constructed using stepwise variable selection, and potential interactions between variables were assessed.

A two-sided *P*-value < 0.05 was considered statistically significant. Effect sizes were calculated for key outcome measures to assess clinical relevance.

Possible confounding variables were evaluated and adjusted for in the analysis. Where necessary, subgroup analyses were conducted based on factors such as age and baseline symptom severity.

A priori power calculations were performed to ensure sufficient sample size for detecting significant differences in the above outcomes. All statistical analyses were conducted by an experienced biostatistician to ensure methodological rigor and reliability of the results.

Results

Comparison of clinical characteristics

Baseline demographic and clinical characteristics, including age, duration of illness, body mass index (BMI), prevalence of hypertension and diabetes, systolic blood pressure, routine blood tests, coagulation profiles, prostate volume, and prostate-specific antigen levels, were comparable between the groups (all P > 0.05). Additionally, no significant differences were observed in baseline symptom severity measured by IPSS scores, including storage and voiding sub-scores, QOL, Qmax, and PVR, confirming the groups were well matched for subsequent outcome comparisons (all P > 0.05, **Table 1**).

Comparison of changes in urodynamic parameters

Qmax increased significantly in both groups after the intervention, with a more pronounced improvement observed in the TBPE group (P < 0.05). Intragroup comparisons demonstrated significant increases in Qmax at 1 week, 3 months, and 6 months postoperatively in the TBPE group (all P < 0.05). The TURP group also

Table 1. Comparison of clinical characteristics between the two groups

Parameter	TBPE Group (n = 74 cases)	TURP Group (n = 76 cases)	t/χ^2	*P*-value
Age (years)	59.19 ± 3.56	60.11 ± 3.27	1.642	0.103
Duration of illness (years)	3.35 ± 0.80	3.50 ± 0.35	1.473	0.143
BMI (kg/m^2)	24.87 ± 1.78	24.92 ± 1.66	0.183	0.855
Hypertension (%)	48.6%	47.2%	0.025	0.875
Diabetes (%)	32.1%	30.3%	0.056	0.813
Blood Pressure (mmHg)	117.89 ± 8.53	119.66 ± 8.40	1.284	0.201
Blood Routine (WBC × 10^9/L)	6.34 ± 0.67	6.24 ± 0.63	0.890	0.375
Coagulation (INR)	1.01 ± 0.05	1.02 ± 0.05	1.211	0.228
Prostate Size (cm^3)	36.47 ± 5.73	37.13 ± 4.89	0.757	0.450
IPSS (score)	22.34 ± 3.24	21.74 ± 2.98	1.170	0.244
Storage symptoms (score)	11.42 ± 1.77	11.13 ± 1.68	1.015	0.312
Voiding symptoms (score)	13.27 ± 2.13	13.48 ± 2.00	0.613	0.541
QOL (score)	4.93 ± 0.93	5.12 ± 0.17	1.760	0.081
Qmax (ml/s)	8.71 ± 1.61	9.21 ± 1.80	1.816	0.071
PVR (ml)	74.74 ± 6.32	75.31 ± 8.80	0.459	0.647
PSA (ng/ml)	3.72 ± 0.66	3.67 ± 0.03	0.794	0.428

Note: TBPE: Transurethral Bipolar Plasma Enucleation; TURP: Transurethral Resection of the Prostate; BMI: Body Mass Index; IPSS: International Prostate Symptom Score; QOL: Quality of Life; PVR: Post-Void Residual; PSA: Prostate-Specific Antigen.

exhibited significant improvements ($P < 0.001$), though the magnitude of change was smaller. Between-group comparisons revealed statistically significant differences at all follow-up intervals, favoring the TBPE group (all $P < 0.05$).

Regarding PVR, the TBPE group showed significant reductions at 1 week and 3 months post-intervention, with continued improvement observed over time (both $P < 0.05$). In contrast, the TURP group showed only slight reductions in PVR ($P < 0.05$), and no significant intragroup changes were detected over time ($P > 0.05$).

At six months post-intervention, no significant between-group difference in PVR was detected ($P > 0.05$) (**Figure 2**). Overall, both groups showed improvement in Qmax and PVR, but the TBPE group experienced greater and more consistent improvements across the time points (both $P < 0.05$).

Comparison of changes in symptom assessment parameters

IPSS scores significantly decreased in both groups after the intervention. In the TBPE group, symptom scores were significantly reduced at 1 week, 3 months, and 6 months postoperatively, with the greatest improvement observed at six months (all $P < 0.05$). The TURP group also showed significant reductions over time, though the magnitude of improvement was less than in the TBPE group ($P < 0.05$). Between-group differences were significant at all follow-up time points, consistently favoring TBPE (all $P < 0.05$).

Similarly, QOL scores improved significantly in both groups. In the TBPE group, QOL scores showed sustained and significant improvement across all time points (all $P < 0.05$). The TURP group also experienced significant improvement (all $P < 0.05$), though to a lesser extent. Between-group comparisons confirmed that the TBPE group had significantly greater QOL improvements at all follow-up intervals (all $P < 0.05$) (**Figure 3**).

Comparison of changes in LUTS scores

Both groups showed significant improvements in storage symptom scores following the intervention. However, the TBPE group exhibited significantly greater reductions at all follow-up time points compared to the TURP group (all $P < 0.05$). Within-group comparisons also revealed significant improvements across all time points in both groups, with the TBPE group demonstrating more pronounced improvement (all $P < 0.05$).

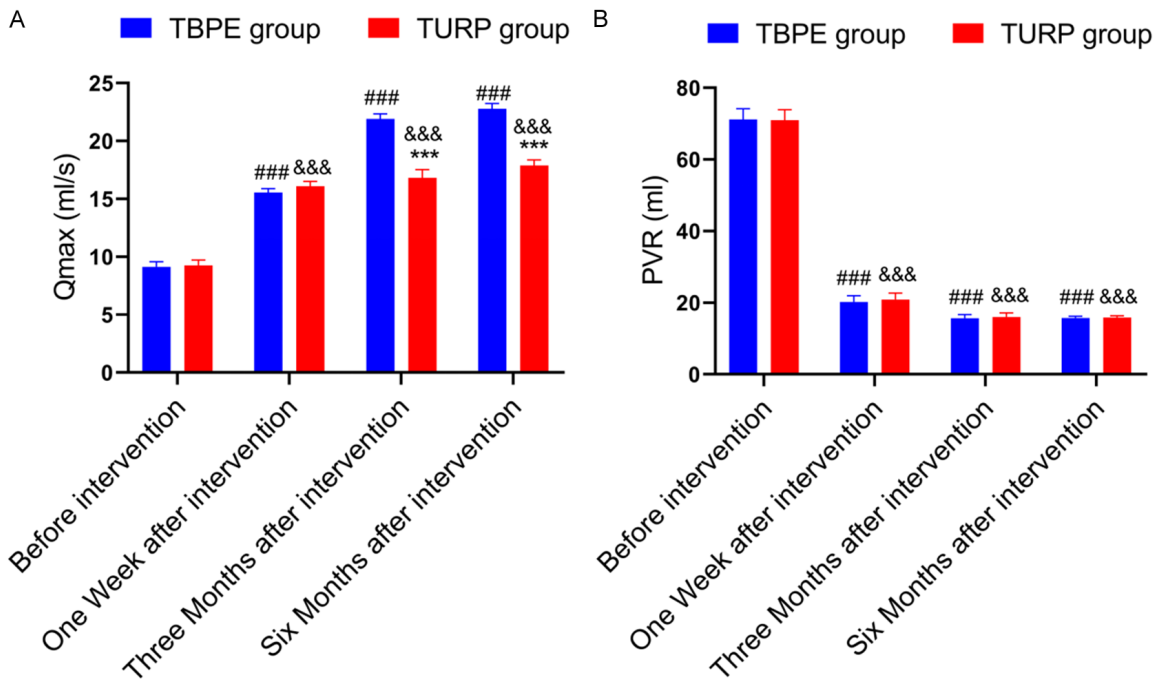

Figure 2. Comparison of the changes in urodynamic parameters between the two groups. A. Qmax; B. PVR. Note: Qmax: Maximum Urinary Flow Rate; PVR: Post-Void Residual; TBPE: Transurethral Bipolar Plasma Enucleation; TURP: Transurethral Resection of the Prostate. Compare to the TBPE group, ***P < 0.001, Compare to the TBPE group before intervention, ###P < 0.001, Compare to the TURP group before intervention, &&&P < 0.001.

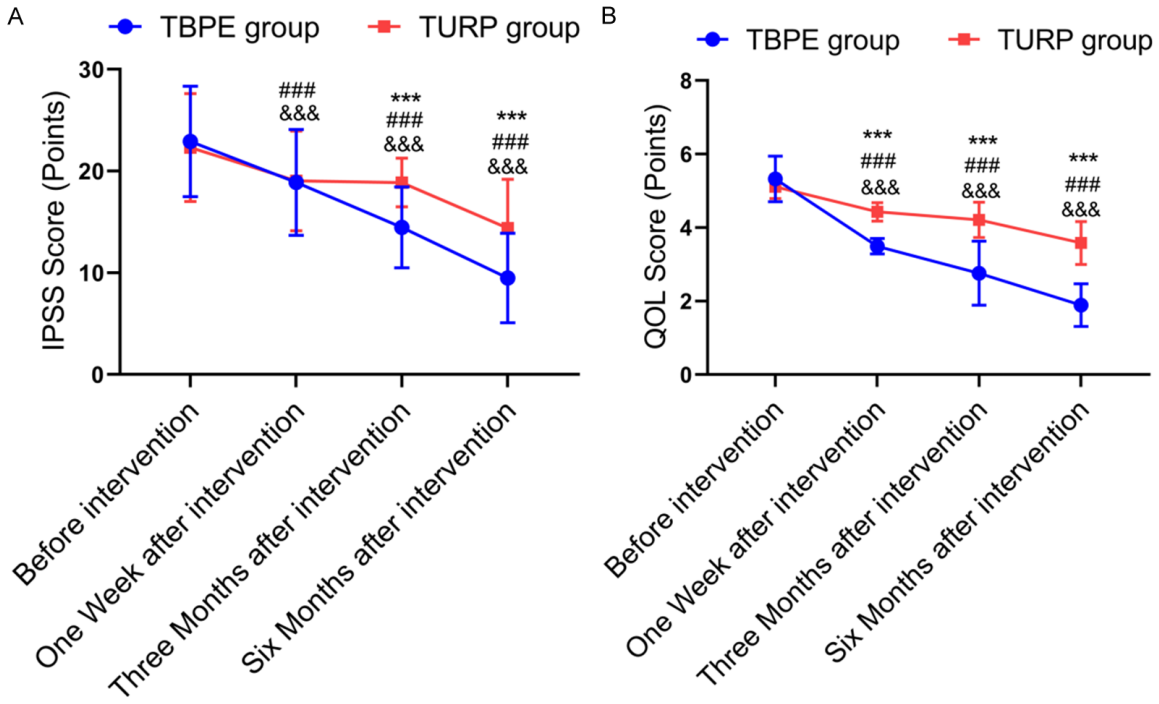

Figure 3. Comparison of the changes in symptom assessment parameters between the two groups. A. IPSS scores; B. QOL scores. Note: IPSS: International Prostate Symptom Score; QOL: Quality of Life Score; TBPE: Transurethral Bipolar Plasma Enucleation; TURP: Transurethral Resection of the Prostate. Compare to the TBPE group, ***P < 0.001, Compare to the TBPE group before intervention, ###P < 0.001, Compare to the TURP group before intervention, &&&P < 0.001.

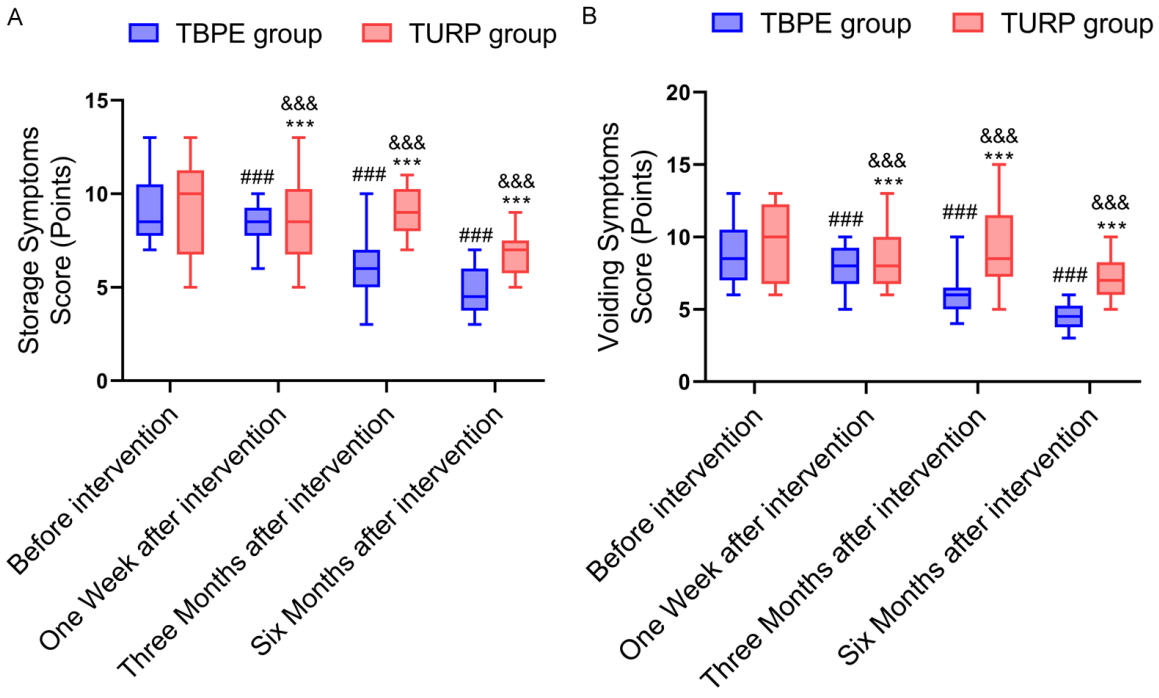

Figure 4. Comparison of the changes in lower urinary tract symptoms scores between the two groups. A. Storage Symptoms Score; B. Voiding Symptoms Score. Note: TBPE: Transurethral Bipolar Plasma Enucleation; TURP: Transurethral Resection of the Prostate. Compare to the TBPE group, ***P < 0.001, Compare to the TBPE group before intervention, ###P < 0.001, Compare to the TURP group before intervention, &&&P < 0.001.

Table 2. Comparison of postoperative recovery between the two groups

Parameter	TBPE Group (n = 74 cases)	TURP Group (n = 76 cases)	t	P
Time to Bowel Movement (hours)	19.44 ± 2.67	25.62 ± 3.99	11.126	< 0.001
Time to Urinary Catheter Removal (hours)	50.29 ± 6.03	72.59 ± 15.12	11.801	< 0.001
Postoperative Hospital Stay (days)	4.48 ± 0.81	6.50 ± 0.98	13.709	< 0.001

Note: TBPE: Transurethral Bipolar Plasma Enucleation; TURP: Transurethral Resection of the Prostate.

Similarly, voiding symptom scores improved significantly in both groups, with the TBPE group showing a markedly greater reduction at each time point (all P < 0.05, **Figure 4**).

Comparison of postoperative recovery

The TBPE group had a significantly shorter time to first bowel movement (19.44 ± 2.67 hours) compared to the TURP group (25.62 ± 3.99 hours, t = 11.126, P < 0.05). Similarly, time to urinary catheter removal was significantly shorter in the TBPE group (50.29 ± 6.03 hours) than in the TURP group (72.59 ± 15.12 hours, t = 11.801, P < 0.05). The postoperative hospital stay was also shorter in the TBPE group (4.48 ± 0.81 days vs. 6.50 ± 0.98 days, t = 13.709, P < 0.05) (**Table 2**).

Comparison of surgical efficiency

The preoperative prostate volume was significantly larger in the TBPE group (33.60 ± 1.85 mL) than in the TURP group (28.87 ± 2.96 mL, t = 11.694, P < 0.05). Likewise, the prostate tissue removal rate was higher in the TBPE group (74.58 ± 0.79%) compared to the TURP group (63.57 ± 1.47%, t = 57.057, P < 0.05). However, surgical duration did not differ significantly between groups (46.63 ± 4.40 minutes for TBPE vs. 46.18 ± 4.54 minutes for TURP, t = 0.609, P = 0.543) (**Table 3**).

Comparison of postoperative complications

Temporary renal failure occurred in 9 patients in the TBPE group and 12 in the TURP group (χ^2

Table 3. Comparison of surgical efficiency between the two groups

Parameter	TBPE Group (n = 74 cases)	TURP Group (n = 76 cases)	t/χ^2	P
Preoperative Kidney Stone Volume (ml)	33.60 ± 1.85	28.87 ± 2.96	11.694	< 0.001
Preoperative Stone Removal Rate (%)	74.58 ± 0.79	63.57 ± 1.47	57.057	< 0.001
Surgical Time (min)	46.63 ± 4.40	46.18 ± 4.54	0.609	0.543

Note: TBPE: Transurethral Bipolar Plasma Enucleation; TURP: Transurethral Resection of the Prostate.

Table 4. Comparison of postoperative complications between the two groups

Indicator	TBPE Group (n = 74 cases)	TURP Group (n = 76 cases)	χ^2 (Yates)	*P* Value
Temporary Renal Failure	9	12	0.410 (Yates)	0.522
Acute Renal Retention	3	4	0.123	0.726
Persistent Hemorrhage	1	2	0.314	0.576
BNC	2	10	5.569 (Yates)	0.018
Capsule Perforation	0	1	0.980	0.322
Ureteral Obstruction	2	4	0.640	0.424
Total	17	33	7.055 (Yates)	0.008

Note: BNC: Bladder neck contracture; TBPE: Transurethral Bipolar Plasma Enucleation; TURP: Transurethral Resection of the Prostate.

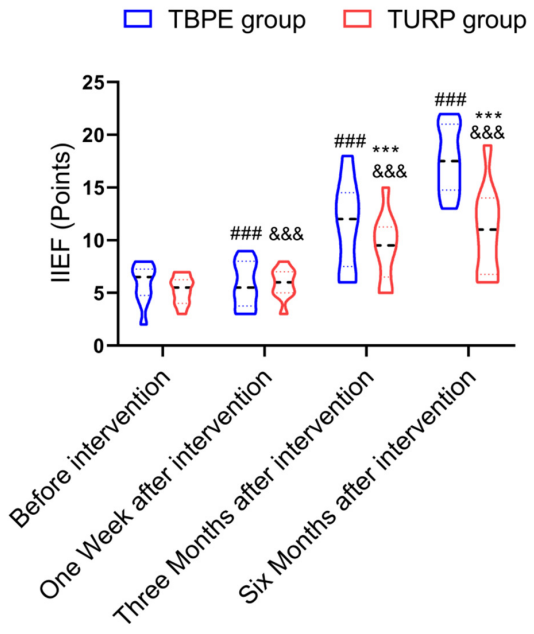

Figure 5. Comparison of sexual function recovery between the two groups. Note: IIEF: International Index of Erectile Function; TBPE: Transurethral Bipolar Plasma Enucleation; TURP: Transurethral Resection of the Prostate. Compare to the TBPE group, ***P < 0.001, Compare to the TBPE group before intervention, ###P < 0.001, Compare to the TURP group before intervention, &&&P < 0.001.

= 0.410, P = 0.522). Persistent hemorrhage was similarly rare in both groups (1 vs. 2 cases, χ^2 = 0.314, P = 0.576). However, BNC was significantly more frequent in the TURP group (10 cases) than in the TBPE group (2 cases) (χ^2 = 5.569, P = 0.018). Ureteral obstruction occurred in 2 TBPE patients and 4 TURP patients (χ^2 = 0.640, P = 0.424). The total number of complications was higher in the TURP group (33 vs. 17 cases, χ^2 = 7.055, P = 0.008) (**Table 4**).

Comparison of sexual function recovery

Sexual function recovery, assessed by the IIEF, showed improvement in both groups postoperatively. The TBPE group demonstrated significantly higher IIEF scores at six months compared to the TURP group (P < 0.05) (**Figure 5**). Within-group comparisons confirmed significant improvements at all follow-up periods in both groups, with the TBPE group showing greater gains at each time point (all P < 0.001).

Comparison of intraoperative blood loss and hemoglobin changes

Intraoperative blood loss was significantly lower in the TBPE group (121.17 ± 25.66 mL) than in the TURP group (214.24 ± 29.10 mL, t = 20.757, P < 0.001). Correspondingly, the postoperative hemoglobin drop was less pronounced in the TBPE group (from 14.32 ± 0.74 to 12.28 ± 0.79 g/dL) compared to the TURP

Table 5. Comparison of intraoperative blood loss and hemoglobin changes

Parameter	TBPE Group (n = 74 cases)	TURP Group (n = 76 cases)	t	*P* Value
Intraoperative Blood Loss (mL)	121.17 ± 25.66	214.24 ± 29.10	20.757	< 0.001
Preoperative Hemoglobin (g/dL)	14.32 ± 0.74	14.47 ± 0.62	1.309	0.193
Postoperative Hemoglobin (g/dL)	12.28 ± 0.79	11.35 ± 0.93	6.619	< 0.001

Note: TBPE: Transurethral Bipolar Plasma Enucleation; TURP: Transurethral Resection of the Prostate.

Table 6. Analysis of influencing factors for clinical efficacy (IPSS scores < 8 scores)

Variable	B	SE	Wald	P	OR	95% CI
TBPE surgery	2.491	0.315	62.545	< 0.001	12.074	6.513-22.386
Postoperative Complications	0.131	0.219	0.357	0.550	1.140	0.742-1.750
Constant	4.215	0.587	51.619	< 0.001	0.015	-

Note: TBPE: Transurethral Bipolar Plasma Enucleation; IPSS: International Prostate Symptom Score.

group (from 14.47 ± 0.62 to 11.35 ± 0.93 g/dL) (t = 6.619, P < 0.001) (**Table 5**).

Multivariate regression analysis of factors influencing clinical efficacy (IPSS Score < 8)

Multivariate logistic regression identified TBPE surgery as an independent predictor of clinical efficacy (OR: 12.074; 95% CI: 6.513-22.386; P < 0.001) (**Table 6**). This suggests that patients undergoing TBPE were significantly more likely to achieve an IPSS score < 8, indicating better symptom control compared to those undergoing TURP.

Discussion

The present study directly compares two of the most widely used surgical techniques for treating BPH complicated by prostatic stones: TBPE and TURP. Our findings indicate that TBPE offers considerable advantages over TURP, particularly in terms of postoperative recovery, surgical efficacy, and complication rates. These differences may be attributed to the technical characteristics of each procedure, the type of energy utilized, and how each technique interacts with the pathological features of BPH in the presence of prostatic stones.

One of the key findings of this study is that postoperative recovery was significantly better in the TBPE group. This is consistent with previous reports highlighting the benefits of bipolar plasma enucleation in reducing bleeding and shortening recovery time. The likely explanation lies in the use of bipolar energy in TBPE, which enables more precise hemostasis and minimizes thermal injury to surrounding tissues. Unlike TURP, TBPE's energy source allows for targeted tissue dissection, minimizing damage to healthy tissue and facilitating quicker healing [15]. This precision is especially critical in patients with prostatic stones, where accurate dissection is essential. Enhanced hemostasis with TBPE results in reduced intraoperative blood loss, less postoperative discomfort and pain, and a significantly shorter duration of catheterization - reported to be approximately half that of the TURP group.

Regarding clinical outcomes, the TBPE group showed superior improvements in urodynamic parameters, particularly in Qmax and PVR. These findings support the conclusion that TBPE more effectively relieves obstruction caused by prostatic enlargement and stones [16-19]. The enhanced tissue removal enabled by bipolar energy likely contributes to more complete resection of both hyperplastic prostate tissue and calculi, thereby improving urinary flow and bladder emptying. Additionally, the lower thermal injury and more precise excision of obstructive tissue may explain the more pronounced improvements in LUTS, with both storage and voiding symptoms showing greater reductions in the TBPE group. These results suggest that TBPE may provide more effective and longer-lasting symptom relief in patients with BPH complicated by prostatic stones compared to TURP [20].

Furthermore, the TBPE group experienced significantly fewer postoperative complications. Notably, the incidence of BNC was markedly higher in the TURP group. This finding aligns

with existing literature, which consistently reports higher BNC rates associated with traditional TBPE procedures (upon which TURP is based), especially in patients with prostatic calculi. This may be due to the mechanical resection method of TBPE, which is more likely to cause trauma and scarring at the bladder neck. In contrast, the enucleation technique used in TBPE - employing bipolar energy - minimizes tissue trauma and allows for more accurate removal of pathological tissue, reducing the risk of BNC and other complications such as hemorrhage and ureteral obstruction [21-23]. These findings reinforce the favorable safety profile of TBPE in the surgical management of complex BPH cases involving prostatic stones.

Another important observation in this study was the comparison of intraoperative blood loss and postoperative changes in hemoglobin levels. Significantly reduced blood loss was observed in the TBPE group, which can be attributed to the superior hemostatic capability of bipolar energy. This reduction not only lowers the risk of anemia and the need for blood transfusion but also promotes more rapid postoperative healing. These findings are consistent with previous studies that have emphasized the hemorrhage-reducing benefits of bipolar plasma enucleation, particularly in BPH surgery, where bleeding is a major concern [24, 25].

Another notable finding is the recovery of sexual function. Patients in the TBPE group demonstrated significantly greater improvements in sexual function, as evidenced by increased IIEF scores at six months postoperatively. This can be explained by the reduced collateral damage to the neurovascular bundles surrounding the prostate, a common risk associated with conventional TBPE techniques [26-28]. TBPE, through its more precise enucleation technique, likely spares these vital structures, contributing to better preservation of sexual function [29, 30]. This is especially important for patients who place a high value on postoperative sexual health, underscoring one of the key advantages of TBPE.

The novelty of this study lies not only in the direct comparison between TBPE and TURP for treating BPH complicated by prostatic stones, but also in its comprehensive evaluation of clinical outcomes, recovery profiles, and complication rates. While the individual efficacy of TBPE and TURP has been reported in prior research, few studies have conducted a head-to-head comparison in this specific patient population. A key finding of this study is that TBPE yields superior clinical outcomes - fewer complications, greater symptom relief, faster recovery, and better preservation of sexual function - without increasing operative time. These results position TBPE as a safer, more effective, and minimally invasive alternative for patients with BPH and prostatic stones.

Despite these promising findings, this study has several limitations. First, its retrospective design may introduce selection bias. Although we attempted to adjust for potential confounders, prospective randomized controlled trials are necessary to more definitively establish the superiority of TBPE over TURP. Second, the follow-up period was limited to six months, which may not be sufficient to assess long-term outcomes. Longer-term studies are needed to evaluate the durability of the observed benefits.

In conclusion, our findings suggest that TBPE offers several clear advantages over TURP in the management of BPH complicated by prostatic stones. These include better postoperative recovery, lower complication rates, improved surgical efficiency, and greater symptom relief. This study provides valuable evidence supporting TBPE as a preferred surgical option for this complex condition.

Disclosure of conflict of interest

None.

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References

[1] Abt D, Müllhaupt G, Hechelhammer L, Markart S, Güsewell S, Schmid HP, Mordasini L and Engeler DS. Prostatic artery embolisation versus transurethral resection of the prostate for benign prostatic hyperplasia: 2-yr outcomes of a randomised, open-label, single-centre trial. Eur Urol 2021; 80: 34-42.

[2] Del Giudice F, Belladelli F, Glover F, Basran S, Li S, Mulloy E, Pradere B, Soria F, Krajewski W, Nair R, Muncey W, Seranio N and Eisenberg ML. 5-alpha reductase inhibitors (5-ARi) with or without alpha-blockers (α-B) for Benign Prostatic Hyperplasia do NOT lower the risk of incident Bladder Cancer: United States insurance claims data. World J Urol 2023; 41: 2783-2791.

[3] Hashim H, Worthington J, Abrams P, Young G, Taylor H, Noble SM, Brookes ST, Cotterill N, Page T, Swami KS and Lane JA; UNBLOCS Trial Group. Thulium laser transurethral vaporesection of the prostate versus transurethral resection of the prostate for men with lower urinary tract symptoms or urinary retention (UNBLOCS): a randomised controlled trial. Lancet 2020; 396: 50-61.

[4] Cornu JN, Zantek P, Burtt G, Martin C, Martin A, Springate C and Chughtai B. Minimally invasive treatments for benign prostatic obstruction: a systematic review and network meta-analysis. Eur Urol 2023; 83: 534-547.

[5] Gelmis M, Bulut B, Kose MG, Gonultas S, Ayten A and Arslan B. Evaluating postoperative complications in standard percutaneous nephrolithotomy for renal stones larger than 2 cm: a retrospective study utilizing the E-PASS scoring system. Urolithiasis 2025; 53: 20.

[6] Mallikarjuna C, Nayak P, Ghouse SM, Reddy PC, Ragoori D, Bendigeri MT and Reddy S. Transurethral enucleation with bipolar energy for surgical management of benign prostatic hyperplasia: our initial experience. Indian J Urol 2018; 34: 219-222.

[7] Togo Y, Yoshioka S, Kaizuka Y and Nagasawa S. Effectiveness of transurethral enucleation with bipolar for benign prostatic hyperplasia patients with chronic prostatitis/chronic pelvic pain syndrome - Single center retrospective study. J Infect Chemother 2025; 31: 102647.

[8] Moris L, Heesakkers J, Nitti V, O'Connell HE, Peyronnet B, Serati M, Omar MI and Harding C. Prevalence, diagnosis, and management of stress urinary incontinence in women: a collaborative review. Eur Urol 2025; 87: 292-301.

[9] Tsuei A, Nezhat F, Amirlatifi N, Najmi Z, Nezhat A and Nezhat C. Comprehensive management of bowel endometriosis: surgical techniques, outcomes, and best practices. J Clin Med 2025; 14: 977.

[10] Ruetten H, Wehber M, Murphy M, Cole C, Sandhu S, Oakes S, Bjorling D, Waller K 3rd, Viviano K and Vezina C. A retrospective review of canine benign prostatic hyperplasia with and without prostatitis. Clin Theriogenology 2021; 13: 360-366.

[11] Gewanter RM, Sandhu JS, Tin AL, Gross JP, Mazzarella K, Urban J, Elsebai N, Hopkins MF, Vickers AJ and Zelefsky MJ. Assessment of patients with prostate cancer and their understanding of the international prostate symptom score questionnaire. Adv Radiat Oncol 2023; 8: 101200.

[12] Kaynar M, Kucur M, Kiliç O, Akand M, Gul M and Goktas S. The effect of bladder sensation on uroflowmetry parameters in healthy young men. Neurourol Urodyn 2016; 35: 622-624.

[13] Lin YT, Pereira H, Pellerin O, Déan C, Thiounn N and Sapoval M. Four-year impact of voiding and storage symptoms in patients with benign prostatic hyperplasia treated with prostatic artery embolization. J Vasc Interv Radiol 2020; 31: 1460-1466.

[14] Salonia A, Adaikan G, Buvat J, Carrier S, El-Meliegy A, Hatzimouratidis K, McCullough A, Morgentaler A, Torres LO and Khera M. Sexual rehabilitation after treatment for prostate cancer-part 2: recommendations from the fourth International Consultation for Sexual Medicine (ICSM 2015). J Sex Med 2017; 14: 297-315.

[15] Cetin T, Bolat D, Cesur G, Erdemoglu O and Nart MB. Comparison of monopolar versus bipolar repeat transurethral resection of bladder tumours. J Coll Physicians Surg Pak 2024; 34: 230-234.

[16] Malde S, Lam W, Adwin Z and Hashim H. Pharmacological and interventional treatment of benign prostatic obstruction: an evidence-based comparative review. BJUI Compass 2021; 2: 238-259.

[17] Gupta NK, Gange SN and McVary KT. New and emerging technologies in treatment of lower urinary tract symptoms from benign prostatic hyperplasia. Sex Med Rev 2019; 7: 491-498.

[18] Rieken M and Bachmann A. Laser treatment of benign prostate enlargement--which laser for which prostate? Nat Rev Urol 2014; 11: 142-152.

[19] Milicevic S. The impact of benign prostatic hyperplasia surgical treatment with turp method on the quality of life. Acta Inform Med 2011; 19: 142-145.

[20] Elshal AM, Elmansy HM and Elhilali MM. Feasibility of holmium laser enucleation of the prostate (HoLEP) for recurrent/residual benign prostatic hyperplasia (BPH). BJU Int 2012; 110: E845-50.

[21] Chen YY, Hua WX, Huang YH, Shen XY, You JN and Ding X. The safety and efficacy of five surgical treatments in prostate enucleation: a network meta-analysis. BMC Urol 2024; 24: 128.

[22] Ryang SH, Ly TH, Tran AV, Oh SJ and Cho SY. Bipolar enucleation of the prostate-step by step. Andrologia 2020; 52: e13631.

[23] Pirola GM, Maggi M, Castellani D, Sciarra A, Rubilotta E and Gubbiotti M. A cost-benefit analysis of bipolar TURP for the treatment of

bladder outflow obstruction. Res Rep Urol 2021; 13: 487-494.
[24] Hsu TS, Weng SC, Lin YH, Chen CL, Tsao SH, Tsai HY, Juang HH, Chang PL and Hou CP. Surgical outcomes of endoscopic enucleation of the prostate in community aging males with or without preoperative urinary retention. Int Urol Nephrol 2024; 56: 2513-2519.
[25] El-Shaer W, Alhefnawy M, Ebrahim Y, Elshazly A and Abdel-Lateef S. Bipolar needlescopic enucleation vs bipolar vapoenucleation of the prostate: a prospective, single-center randomized study. J Endourol 2022; 36: 1452-1459.
[26] Luethy S, Tulman DB and Brown JQ. Automated gigapixel circumferential surface microscopy of the prostate. Sci Rep 2020; 10: 131.
[27] Trivedi J, Sutherland T and Page M. Incidental findings in and around the prostate on prostate MRI: a pictorial review. Insights Imaging 2021; 12: 37.
[28] Sasser L. Segmental (central) maxillectomy using a piezoelectric surgery unit in a dog. J Vet Dent 2023; 40: 258-263.
[29] Tunc L, Bozzini G, Scoffone CM, Guven S, Hermann T, Porreca A, Misrai V, Ahyai S, Zor M, Aksoy E and Gozen AS. Determination of face and content validity of cadaveric model for holmium anatomic endoscopic enucleation of the prostate training: an ESUT AEEP group study. Eur Urol Open Sci 2021; 32: 28-34.
[30] Behr A, Salleron J, Mazeaud C, Larose C, Dagry A, Balkau B, Hubert J and Eschwège P. Comparison of surgical procedures for benign prostatic hyperplasia of medium-volume prostates: evaluation of the causes of rehospitalization from the French National Hospital Database (PMSI-MCO). World J Urol 2023; 41: 2481-2488.