# Transurethral Cylindrical Water Sac Prostate Enlargement Surgery for the Treatment of Small-Volume Benign Prostatic Hyperplasia: A Retrospective Analysis

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AIM: To investigate the clinical efficacy of transurethral columnar balloon dilation of prostate (TUCBDP) in the treatment of small-volume benign prostatic hyperplasia (BPH) and provide the optimal treatment for the surgical treatment of small volume benign prostatic hyperplasia.

METHODS: This retrospective study analyzed 106 patients with small-volume BPH who underwent surgical treatment at the Department of Urology, Xiangya Changde Hospital from December 2023 to January 2024. The patients were divided into two groups based on the type of surgery received: TUCBDP group ($n$ = 53) and transurethral resection of prostate (TURP) group ($n$ = 53), which serves as the control group. We observed and measured the primary outcome indexes of the two groups, including international prostate symptom score (IPSS), maximum urinary flow rate (Qmax), postvoid residual (PVR), and quality of life (QoL) score, as well as the secondary outcome indicators, such as operation time, hospital stay, indwelling catheter time, the frequency of night urination and daytime urination, and the total incidence of long-term and short-term complications.

RESULTS: Preoperative IPSS, Qmax, PVR, and QoL scores showed no significant differences between the TUCBDP and TURP groups ($p > 0.05$). Postoperatively, the TUCBDP group showed superior results in terms of shortened operation time (–15.96 minutes, 95% confidence interval (CI) [–20.06, –11.86], $p < 0.001$), hospitalization time (–1.73 days, 95% confidence interval (CI) [–2.26, –1.20], $p < 0.001$), and indwelling catheter time (–1.17 days, 95% CI [–1.55, –0.79], $p < 0.001$), reduced night urination frequency (–0.71 times, 95% CI [–0.89, –0.53], $p < 0.001$) and daytime urination frequency (–1.80 times, 95% CI [–2.25, –1.35], $p < 0.001$). For patients receiving TUCBDP, improvements were also noted in IPSS (–2.27, 95% CI [–3.58, –0.96], $p < 0.001$), Qmax (4.50 mL/s, 95% CI [3.30, 5.70], $p < 0.001$), PVR (–6.89 mL, 95% CI [–9.48, –4.30], $p < 0.001$), and QoL (–0.87, 95% CI [–1.57, –0.17], $p = 0.026$). The TUCBDP group also had lower rates of near-term (15.09% vs. 35.85%, $\chi^2 = 6.013$, $p = 0.014$) and long-term complications (11.32% vs. 37.74%, $\chi^2 = 9.988$, $p = 0.002$).

CONCLUSIONS: TUCBDP demonstrates significant clinical efficacy in the treatment of small-volume BPH, causing a low incidence of postoperative complications.

**Keywords:** transurethral columnar balloon dilation of prostate; small-volume benign prostatic hyperplasia; clinical efficacy; complications

## Introduction

Benign prostatic hyperplasia (BPH) is a common benign prostatic disease in men, characterized by hyperplasia of prostate tissue leading to urethral compression. Early BPH clinical symptoms are not distinctive, but some patients may experience frequent urination, urgency, and incomplete voiding. As the disease progresses, complications such as difficulty in urination, hematuria, recurrent urinary tract infections, bladder stones, and renal function impairment may occur. In extreme cases, it can lead to renal failure, which is life-threatening [1]. The occurrence of BPH is multifactorial, with etiologies ranging from age-related hormonal changes and genetic factors to lifestyle-related factors. According to related statistics, BPH affects more than 50% of men aged 60 and above, and this proportion is projected to increase annually due to the rapidly aging population [2]. Unlike other typical forms of BPH, small-volume BPH features a relatively small enlargement of the prostate but the general symptoms and signs associated with BPH are present. Patients with small-volume BPH have difficulty urinating in early stage and experience severe clinical symptoms; if treatments are not implemented in a timely manner, complications are likely to occur.

Previous studies have found that patients with small-volume BPH treated with transurethral resection of prostate

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(TURP) faced a significantly increased risk of bladder neck contracture [3, 4, 5, 6]. Recently, transurethral columnar balloon dilation of prostate (TUCBDP) has emerged as a new treatment method for small-volume BPH [4]. TUCBDP can improve urethral obstruction symptoms without requiring the removal of glandular tissue, offering advantages such as minimal tissue damage, quick recovery, and fewer postoperative complications [7]. Currently, there is relatively little research on TUCBDP, especially regarding its clinical efficacy and postoperative complications in small-volume BPH patients. Existing studies indicate that TUCBDP is effective in improving BPH symptoms, but the incidence of short- and long-term complications arising from the application of this method needs further evaluation. It has been reported that TUCBDP has promising potential in alleviating urinary symptoms, improving quality of life, and reducing postoperative complications [8], while featuring optimal levels of safety and efficacy [9]. However, more clinical trials and long-term follow-up data are still needed to further verify its safety and effectiveness. To address this research gap, this study retrospectively analyzed 53 patients with small-volume BPH treated with TUCBDP at Xiangya Changde Hospital, with the purpose of systematically evaluating the clinical efficacy of TUCBDP and the incidence of complications following the treatment procedure. The findings of the current study will provide invaluable insights into positioning TUCBDP as a new treatment option in clinical practice.

## Materials and Methods

*Study Subjects*

In this retrospective study, a total of 106 patients with small-volume BPH admitted to Xiangya Changde Hospital from December 2023 to January 2024 were included. Based on the type of surgery they received, the patients were divided into TUCBDP group ($n$ = 53) and TURP group ($n$ = 53), which acts as the control group. The clinical data of these patients were retrospectively reviewed and analyzed.

Only the patients meeting the inclusion criteria below were included: (1) patients aged 18–85 years; (2) patients with a prostate volume (PV) of less than 30 mL as shown on the color Doppler ultrasound; (3) patients with urinary symptoms such as frequency, pain, and urgency that affect daily quality of life, accompanied by ineffective or compromised tolerance to oral medications, that necessitate surgical indications; and (4) patients undergoing TUCBDP or TURP surgery.

The exclusion criteria defined for this study are as follows: (1) patients with prostatic lesions; (2) patients with severe systemic diseases such as acute coronary syndrome, stroke, and liver or renal insufficiency; (3) patients who had previously undergone prostate surgery or other treatments for prostatic diseases; (4) patients with urological diseases such as bladder tumors or prostatic stones; and (5) patients with incomplete clinical data.

This study was approved by the Medical Ethics Committee of Xiangya Changde Hospital, and the ethical approval number was (2024) Scientific Research Review No. 10. The study was conducted in accordance with the principles outlined in the Declaration of Helsinki. All study participants gave their informed consent prior to participation, and all the patient data were preserved anonymously.

*Methods*

Observation Group

Prior to the operation, the patients in the TUCBDP group were evaluated for surgical indications and contraindications by using urinary color Doppler (Brand: urinary color Doppler; Model: DC-35Pro; Manufacturer: Shenzhen Mindray Biomedical Electronics Co., Ltd.; Country of manufacture: Shenzhen, China) ultrasound. The appropriate type of cylindrical balloon catheter (Brand: cylindrical balloon catheter; Model: FHG39B; Manufacturer: Beijing Unikangtong Medical Technology Co., Ltd.; Country of manufacture: Beijing, China) was selected for the patients based on their PV. The operation was performed under spinal anesthesia or general anesthesia by the same surgeon with relevant skills and experience. After determining the site for lithotomy, the condition of the urethra, prostate, and bladder was first observed using a cystoscope (Brand: KARL STORZ; Model: 27002L; Manufacturer: Beijing Yudris Technology Co., Ltd.; Country of manufacture: Beijing, China). If bladder stones were detected, lithotripsy was performed before any operations. After exiting the cystoscope, a balloon dilatation catheter was placed through the external orifice of the urethra, and slowly, the guide ring of the dilatation catheter was pulled out to the location of the external sphincter. Subsequently, the dilatation catheter was tightened to prevent retraction after 22 mL of water was injected at 2 atm of pressure through the inner balloon catheter, before touching the tail of the balloon. The prostate surgical capsule was fully dilated in the 12 o'clock direction by injecting 70 mL of water at 0.3–0.35 MPa of atmospheric pressure and retained for 3–5 minutes. After abdominal compression, urination would become unobstructed due to more spacious urethra in the prostatic part, as observed via cystoscopy, and extracapsular fat could be seen in the 12 o'clock direction of the urethra. After full electrocoagulation and hemostasis, and indwelling an F22 three-chamber balloon catheter water bag water injection 60 mL compression hemostasis and traction, continuous bladder irrigation by irrigation tube was conducted to end the operation.

Control Group

TURP: After the success of general anesthesia, the patients took lithotomy position, routinely sterilized and laid towels, and a transurethral electroreception endoscope was placed to observe the urinary spray of the urethra, prostate, bladder, and bilateral ureter. With the bladder neck as the sign,

the annular fiber of the bladder neck was electrocute to the bladder neck, and the distal end was marked by the seminal caruncle. The glands of both sides of the prostate and the central lobe of the prostate were resected sequentially, and bleeding was stopped by electric cutting, and the hyperplastic prostate tissue on both sides of the prostatic tip and seminal caruncle and the joint of the prostate and the external urethral sphincter was cut off. Pay attention to protect the external sphincter of the urethra and double ureteral orifice. The irrigator rinses out the cut prostate tissue. After the wound was completely stopped and there was no obvious bleeding, the urethra was observed to be unobstructed, the sheath of the electroreception lens was removed, the bladder was pressed, and there was no obvious urinary incontinence in urine flow. An F22 three-chamber balloon catheter was indwelled, water was injected into the sac about 30 mL, and traction was done at the end of the operation.

### Case-Control Matching

The study employed a case-control matching method to minimize the impact of confounding factors on the evaluation of surgical outcomes in patients with small-volume BPH. The study involved 106 patients, divided into two groups based on type of surgical treatments received, with 53 subjects in each. Matching was done by considering the key clinical variables such as age, PV, hypertension, and diabetes status. A one-to-one nearest neighbor matching algorithm was used, with an appropriately set caliper width to ensure precise matching on these variables. After matching, a statistical analysis of baseline characteristics was conducted.

### *Observation Index*

### Clinical Data

The average age, education level, smoking history, high blood pressure (HBP), diabetes mellitus (DM), coronary heart disease (CHD), total cholesterol (TC), low-density lipoprotein (LDL), random blood glucose (RBG), white blood cell (WBC) count, platelet (PLT) count, serum creatinine (Scr), serum D-dimer, prothrombin time (PT), international normalized ratio (INR), activated partial thromboplastin time (APTT), mean arterial pressure (MAP), mean heart rate (MHR), and PV were compared between the TUCBDP and TURP groups before treatment.

### Primary Outcome Indicators

The international prostate symptom score (IPSS), which interrogates the frequency of urination, urinary retention, and difficulty in urination all evaluated in seven indexes, was compared between the TUCBDP and TURP groups before and after treatment. Each index of the IPSS was assigned a score from 0 to 5 according to the severity of symptoms, with a total score of 35; a higher total score indicates a higher severity of the urinary tract symptoms. The maximum urinary flow rate (Qmax) of the two groups before and after treatment was measured by urinary flow rate examination instrument. In normal male adults, the Qmax ranges from 15 to 30 mL/s, with a larger Qmax indicating a less impeded urination. Postvoid residual (PVR) was detected by means of ultrasound before and after operation. A more severe prostate obstruction is generally indicated by a greater PVR, but patients with a PVR $<$50 mL generally do not need special treatments. The quality of life (QoL) scale assesses the patients' health, emotional, social, economic and other aspects of QoL before and after the surgery. The total score of QoL scale is 6 points, and the lower the score, the better the quality of life.

### Secondary Outcome Indicators

The operation time (min), hospital stay (days), indwelling catheter time (days) and the frequency of night urination and daytime urination were calculated for the two groups.

### Incidence of Postoperative Complications

The study retrospectively reviewed the incidence of postoperative complications such as acute urinary retention, bleeding, urinary tract infection, transient urinary incontinence, dysuria, and bladder neck contracture within one month after operation. Additionally, the incidence of long-term complications, including urinary incontinence, urethral stricture, bladder neck contracture, erectile dysfunction, ejaculation dysfunction, and the need for reoperation, were reviewed over a six-month follow-up period. The total incidence of short-term and long-term postoperative complications was calculated for both groups.

### *Statistical Analysis*

The data were analyzed using SPSS 25.0 software (IBM, Chicago, IL, USA). The continuous data were tested for normality prior to any comparisons. The Shapiro–Wilk test or Kolmogorov–Smirnov test was used to assess whether the data conformed to a normal distribution. Normally distributed data are expressed as mean $\pm$ standard deviation (SD) and were compared between groups using the independent samples *t*-test (independent *t*-test). On the other hand, data not conforming to the normal distribution are expressed as median and interquartile range (IQR) and were compared using Mann–Whitney *U* test, which is a nonparametric test. Based on the normality tests, both the preoperative PVR and postoperative PVR data significantly deviate from normal distribution, while the variables Pre-operative IPSS, Postoperative IPSS, Qmax preoperative, Qmax postoperative, QoL preoperative, and Post QoL are all consistent with normal distribution, as shown in Table 1.

Categorical data are expressed as counts or percentages. Comparisons between groups for categorical data were performed using the Chi-square test.

The significance level for all statistical tests was set at $p < 0.05$, which indicates statistically significant difference between groups.

**Table 1. Results of normality tests for the key variables investigated in this study.**

| Variables | Normality test | Test statistic | *p*-value | Results |
|---|---|---|---|---|
| Preoperative IPSS | Shapiro–Wilk test | 0.962 | 0.092 | Consistent with normal distribution |
| Postoperative IPSS | Shapiro–Wilk test | 0.977 | 0.423 | Consistent with normal distribution |
| Preoperative Qmax | Kolmogorov–Smirnov test | 0.843 | 0.367 | Consistent with normal distribution |
| Postoperative Qmax | Kolmogorov–Smirnov test | 0.854 | 0.281 | Consistent with normal distribution |
| Preoperative PVR | Shapiro–Wilk test | 0.943 | 0.038 | Not normally distributed |
| Postoperative PVR | Shapiro–Wilk test | 0.951 | 0.061 | Not normally distributed |
| Preoperative QoL score | Kolmogorov–Smirnov test | 0.981 | 0.670 | Consistent with normal distribution |
| Postoperative QoL score | Kolmogorov–Smirnov test | 0.985 | 0.823 | Consistent with normal distribution |

**Notes**: IPSS, international prostate symptom score; Qmax, maximum urinary flow rate; PVR, postvoid residual; QoL, quality of life.

**Table 2. Clinical data comparison.**

| Parameters | TUCBDP ($n = 53$) | TURP ($n = 53$) | $t/\chi^2$ value | *p*-value |
|---|---|---|---|---|
| Average age (years) | 62.02 ± 7.95 | 62.72 ± 6.36 | –0.499 | 0.618 |
| Education level (years) | 10.87 ± 2.72 | 10.43 ± 3.01 | 0.778 | 0.438 |
| Smoking history | 36 (67.92) | 38 (71.70) | 0.197 | 0.657 |
| HBP | 32 (60.38) | 30 (56.60) | 0.155 | 0.693 |
| DM | 22 (41.51) | 23 (43.40) | 0.039 | 0.844 |
| CHD | 14 (26.42) | 12 (22.64) | 0.204 | 0.652 |
| TC (mmol/L) | 5.07 ± 0.87 | 5.34 ± 0.67 | –1.798 | 0.075 |
| LDL (mmol/L) | 3.01 ± 0.75 | 3.17 ± 0.66 | –1.184 | 0.239 |
| RBG (μmol/L) | 6.21 ± 2.10 | 6.72 ± 1.65 | –1.401 | 0.164 |
| WBC count ($\times 10^9$/L) | 9.88 ± 4.57 | 9.61 ± 3.92 | 0.323 | 0.748 |
| PLT count ($\times 10^9$/L) | 208.26 ± 29.16 | 216.94 ± 33.45 | –1.424 | 0.158 |
| Scr (μmol/L) | 72.04 ± 18.2 | 79.21 ± 16.88 | –2.102 | 0.038 |
| D-dimer (ng/mL) | 326.13 ± 86.69 | 312.23 ± 66.5 | 0.927 | 0.356 |
| PT (s) | 10.34 ± 1.18 | 10.96 ± 1.04 | –2.891 | 0.005 |
| INR | 2.16 ± 0.79 | 2.2 ± 0.65 | –0.323 | 0.748 |
| APTT (s) | 26.79 ± 5.46 | 28.08 ± 4.86 | –1.278 | 0.204 |
| MAP (mmHg) | 95.51 ± 17.8 | 99.94 ± 13.15 | –1.459 | 0.148 |
| MHR (bpm) | 84.23 ± 11.39 | 84.25 ± 11.39 | –0.009 | 0.993 |
| PV ($cm^3$) | 27.08 ± 2.6 | 27.19 ± 3.11 | –0.203 | 0.839 |

Notes: Normally distributed data are expressed as mean ± standard deviation, whereas categorical data are presented as count (percentage).

Abbreviations: HBP, high blood pressure; DM, diabetes mellitus; CHD, coronary heart disease; TC, total cholesterol; LDL, low-density lipoprotein; RBG, random blood glucose; WBC, white blood cell; PLT, platelet; Scr, serum creatinine; PT, prothrombin time; INR, international normalized ratio; APTT, activated partial thromboplastin time; MAP, mean arterial pressure; MHR, mean heart rate; PV, prostate volume; TUCBDP, transurethral columnar balloon dilation of prostate; TURP, transurethral resection of prostate.

## Results

*Comparison of Clinical Data*

The flowchart in Fig. 1 illustrates the process of case-control matching for the current study. Starting with the initial sample pool creation, the patients were screened based on small-volume BPH criteria, as shown in Fig. 1. Data organization and cleaning was conducted to ensure data completeness and compliance with inclusion and exclusion criteria. Key clinical variables were selected for matching, including age, PV, and comorbidities. The nearest neighbor algorithm was used to perform one-to-one matching, resulting in two groups with equivalent number of patients ($n = 53$ each). Validation analysis confirmed that there were no significant differences in the key characteristics post-matching.

There were no significant differences in the average age, education level, smoking history, HBP, DM, CHD, TC, LDL, RBG, WBC, PLT, D-dimer, INR, APTT, MAP, MHR, and PV between the TUCBDP and TURP groups ($p > 0.05$); however, significant differences were noted in serum creatinine (Scr) and prothrombin time (PT) ($p < 0.05$), as shown in Table 2.

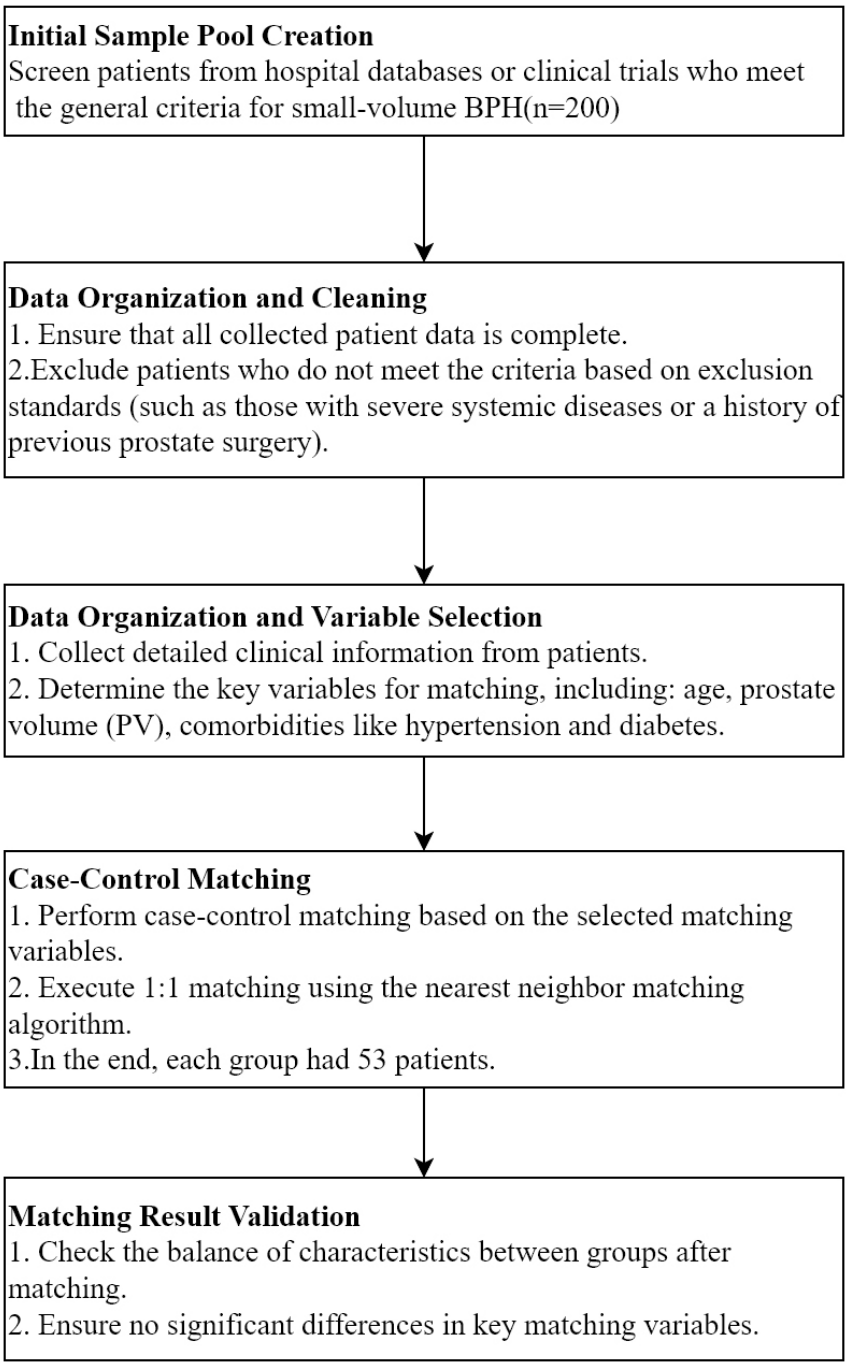


**Fig. 1. Flowchart depicting the case-control matching for this study.** BPH, benign prostatic hyperplasia.

*Comparison of Primary Outcome Indexes before and after Operation*

There were no significant differences in the scores of IPSS, Qmax, PVR, and QoL between the TUCBDP and TURP groups before operation ($p > 0.05$). Compared with the control group after the operation and the same group before the operation, the IPSS and PVR in the TUCBDP group decreased significantly, while the scores of QoL decrease significantly and Qmax increased significantly ($p < 0.05$), as shown in Table 3.

*Comparison of Postoperative Secondary Outcome Indexes*

Compared with the control group, the TUCBDP group had significantly shorter operation time, hospital stay and indwelling catheter time, as well as lower frequency of night urination and daytime urination ($p < 0.001$), as shown in Table 4.

*Comparison of Postoperative Complication Incidence*

After 1 month of follow-up, the total incidence of short-term complications in the TUCBDP group was 15.09%, which was significantly lower than 35.85% in the TURP

**Table 3. Comparison of main outcome between the two groups before and after operation ($\bar{x} \pm s$).**

| Group | *n* | IPSS | | Qmax (mL/s) | | PVR (mL) | | QoL | |
|---|---|---|---|---|---|---|---|---|---|
| | | Preoperative | Postoperative | Preoperative | Postoperative | Preoperative | Postoperative | Preoperative | Postoperative |
| TUCBDP | 53 | 28.21 ± 4.17 | 14.58 ± 3.36*# | 10.87 ± 2.65 | 19.72 ± 3.48*# | 80.52 ± 9.91 | 38.56 ± 5.34*# | 5.26 ± 1.16 | 2.72 ± 1.23*# |
| TURP | 53 | 29.58 ± 3.85 | 16.85 ± 2.86* | 9.96 ± 2.94 | 15.22 ± 2.66* | 81.67 ± 9.54 | 45.45 ± 6.64* | 5.22 ± 1.87 | 3.59 ± 2.51* |
| Difference | - | –1.37 | –2.27 | 0.91 | 4.50 | –1.15 | –6.89 | 0.04 | –0.87 |
| 95% CI | - | [–2.92, 0.18] | [–3.58, –0.96] | [–0.17, 1.99] | [3.30, 5.70] | [–4.90, 2.60] | [–9.48, –4.30] | [–0.56, 0.64] | [–1.57, –0.17] |
| *t* | - | 1.757 | 3.745 | 1.674 | 7.479 | 0.609 | 5.887 | 0.132 | 2.267 |
| *p*-value | - | 0.082 | <0.001 | 0.097 | <0.001 | 0.544 | <0.001 | 0.895 | 0.026 |

Notes: * As compared with the same group preoperative, $p < 0.05$; # as compared with the control group postoperative, $p < 0.05$.

**Table 4. Comparison of postoperative secondary outcome between the two groups ($\bar{x} \pm s$).**

| Group | *n* | Operative time (min) | Hospital stay (days) | Indwelling catheter time (days) | Night urination (frequency) | Daytime urination (frequency) |
|---|---|---|---|---|---|---|
| TUCBDP | 53 | 74.58 ± 10.16 | 5.32 ± 1.17 | 3.32 ± 0.78 | 1.55 ± 0.44 | 4.74 ± 1.09 |
| TURP | 53 | 90.54 ± 12.68 | 7.05 ± 1.44 | 4.49 ± 1.05 | 2.26 ± 0.51 | 6.54 ± 1.26 |
| Difference | - | –15.96 | –1.73 | –1.17 | –0.71 | –1.80 |
| 95% CI | - | [–20.06, –11.86] | [–2.26, –1.20] | [–1.55, –0.79] | [–0.89, –0.53] | [–2.25, –1.35] |
| *t* | - | 7.151 | 6.788 | 6.512 | 7.674 | 7.866 |
| *p*-value | - | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

Note: Data are expressed as mean ± standard deviation.

group ($p < 0.05$), as shown in Table 5. Table 6 shows that after 6 months of follow-up, the total incidence of long-term complications was 11.32% in the TUCBDP group, which was significantly lower than the incidence rate of 37.74% in the TURP group ($p < 0.05$).

## Discussion

BPH is a chronic urinary disease that has an adverse impact on the quality of life in men owing to the increased frequency of urination, difficulty urinating and other clinical symptoms. Patients with small-volume BPH have relatively small PV, usually lower than 30 mL; the PV in cases of small-volume BPH is not an appropriate guide for gauging the disease symptoms, which are not usually manifested in a proportionate manner to PV. In fact, the symptoms may be more severe with smaller PV, making the diagnosis and treatment of small-volume BPH more complicated compared with large-volume and moderate-volume BPH [10]. Study has reported that the combination of oral alpha 1-adrenergic receptor blockers and 5-alpha reductase inhibitors can be used for the treatment of small-volume BPH, but pharmacologic treatment for small-volume BPH increases the risk of Alzheimer's disease and does not result in significant improvement in lower urinary tract symptoms [8]. Although the traditional TURP procedure is the gold-standard method for treating small-volume BPH, it predisposes the patients to electrodesiccation syndrome due to the long duration of the procedure, intraoperative blood loss, and a higher risk for postoperative bladder neck contracture. This method is also associated with many disadvantages such as high incidence of postoperative retrograde ejaculation and adverse impact on sexual function, which limit its adoption in clinical settings [11, 12]. Compared with TURP, TUCBDP is a new procedure that utilizes a cylindrical water sac to expand the prostate envelope and relieve obstruction, facilitating urinary flow through the urethra, thus reducing the discomfort associated with urinary obstruction and improving urinary symptoms. Moreover, this procedure is advocated for advantages such as shorter operation time, lower risk of bleeding, prostate preservation, minimal to no effect on sexual function, and fewer complications [13, 14, 15].

The results of this study showed that the differences between the preoperative IPSS, Qmax, PVR and QoL scores between the two groups of patients were not statistically significant. However, TUCBDP significantly lowered the IPSS, PVR, and QoL scores, while increasing the Qmax. when compared to before any intervention was implemented, regardless of the type of methods (i.e., TURP or TUCBDP). Compared with the control group, the operation time, hospitalization time, indwelling catheter time, frequency of night urination and daytime urination were significantly shortened in the TUCBDP group. At 1 and 6 months postoperatively, the rates of short- and long-term complications were significantly lower in the TUCBDP group than in the TURP group.

These findings are consistent with those reported by Dong *et al*. [16], who also demonstrated that TUCBDP was effective in improving urinary symptoms in terms of frequency and difficulty, as well as elevating the quality of life in patients with small-volume BPH [17]. A study by Jiang *et al*. [18] further supported the superiority of TUCBDP, pointing out the advantages of rapid postoperative recovery, minimal injury triggered, and shorter retention time of

**Table 5. Comparison of short-term postoperative complications between TUCBDP and TURP groups.**

| Group | *n* | Acute urinary retention | Hemorrhage | Urinary infection | Transient urinary incontinence | Difficulty urinating | Cytoplasm | Total incidence |
|---|---|---|---|---|---|---|---|---|
| TUCBDP | 53 | 2 (3.77) | 0 (0.00) | 1 (1.89) | 3 (5.66) | 2 (3.77) | 0 (0.00) | 8 (15.09) |
| TURP | 53 | 3 (5.66) | 2 (3.77) | 3 (5.66) | 5 (9.43) | 4 (7.55) | 2 (3.77) | 19 (35.85) |
| $\chi^2$ value | - | | | | | | | 6.013 |
| *p*-value | - | | | | | | | 0.014 |

Note: Data are expressed ascount (percentage).

**Table 6. Comparison of long-term postoperative complications between TUCBDP and TURP groups.**

| Group | *n* | Incontinence | Urethrostenosis | Bladder neck contracture | Erectile dysfunction | Ejaculation dysfunction | Reoperation | Total incidence |
|---|---|---|---|---|---|---|---|---|
| TUCBDP | 53 | 2 (3.77) | 1 (1.89) | 1 (1.89) | 0 (0.00) | 0 (0.00) | 2 (3.77) | 6 (11.32) |
| TURP | 53 | 3 (5.66) | 1 (1.89) | 3 (5.66) | 6 (11.32) | 7 (13.21) | 0 (0.00) | 20 (37.74) |
| $\chi^2$ value | - | | | | | | | 9.988 |
| *p*-value | - | | | | | | | 0.002 |

Note: Data are expressed as count (percentage).

the urinary catheter [19]. Compared with TURP, TUCBDP is a relatively simple surgical operation, which mainly involves inserting a cylindrical water sac through the urethra and fixing it in the posterior urethral prostate, followed by the prostate and posterior urethra dilatation induced by injecting water into the internal and external sacs. Moreover, this method does not require extensive electrodesiccation and tissue resection, constituting a lower risk for bleeding, prostatic trauma, and postoperative bladder neck contracture, while shortening the operation time and postoperative recovery period [20].

However, this study is not without limitations. First, the study used a relatively small sample size, and the 6-month follow-up conducted in the investigation did not sufficiently allow for a comprehensive assessment of long-term postoperative outcomes. Second, given the retrospective nature of this research, the study might be fraught with evaluation bias since sample collection was not conducted in a blinded fashion. Taken together, these limitations may influence the generalizability of the study results. Thus, to improve the reliability of the findings, future studies should adopt larger sample size and investigate the subjects with an extended follow-up period. In addition, further investigations should consider comparing TUCBDP with other emerging treatments, such as laser therapy, prostate microwave therapy, and other related treatments, to offer a more complete picture about their advantages and indications.

## Conclusions

In conclusion, this study analyzed the clinical efficacy of TUCBDP and TURP in the treatment of small-volume BPH, as well as their impacts on postoperative recovery period. Comparatively, aside from a shorter period of time required for operation, TUCBDP boasts significant benefits for the treatment of small-volume BPH, in terms of shorter hospital stay, shorter indwelling catheter time, lesser night and daytime urination, and reduced adverse impact on sexual function, while improving urinary symptoms and reducing the incidence of postoperative complications. These findings highlight the superior clinical efficacy of TUCBDP over TURP, providing a promising therapeutic option for the surgical treatment of small-volume BPH.

## Availability of Data and Materials

The data used to support the findings of this study are available from the corresponding author upon request.

## Author Contributions

TF, JM, and XJ designed the research study. TF and XJ performed the research. GL, LL, and YC analyzed the data. TF wrote the manuscript. All authors have been involved in revising it critically for important intellectual content. All authors gave final approval of the version to be published. All authors have participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to its accuracy or integrity.

## Ethics Approval and Consent to Participate

This study was approved by the Medical Ethics Committee of Xiangya Changde Hospital, and the ethical approval number was (2024) Scientific Research Review No. 10. The study was conducted in accordance with the principles outlined in the Declaration of Helsinki. All study participants gave their informed consent prior to participation, and all the patient data were preserved anonymously.

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## Conflict of Interest

The authors declare no conflict of interest.

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