

Risk Factors for Urethral Stricture Following Transurethral Resection of the Prostate in Patients with Benign Prostatic Hyperplasia and Preventive Nursing Strategies

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Abstract: *Objective:* To analyze risk factors for urethral stricture and preventive nursing strategies following transurethral resection of the prostate (TURP) in patients with benign prostatic hyperplasia (BPH). *Methods:* Clinical data of 266 BPH patients undergoing TURP in our hospital's Department of Urology from June 2020 to May 2023 were retrospectively analyzed. Postoperative urethral stricture incidence was observed and recorded, with multivariate logistic regression analysis applied to identify risk factors. *Results:* Among 266 BPH patients undergoing TURP, 21 developed urethral strictures (incidence rate: 7.89%). Multivariate logistic regression analysis revealed that a history of diabetes mellitus, preoperative urethral infection, Grade III prostate volume, operative time ≥ 70 min, urinary catheterization duration ≥ 5 days, and intraoperative urethral dilation and reconstruction were independent risk factors for urethral stricture following TURP in BPH patients. *Conclusion:* Multiple risk factors contribute to urethral stricture following transurethral resection of the prostate in patients with benign prostatic hyperplasia. Implementing safe and effective preventive measures is essential to control these risks and improve patient outcomes.

Keywords: Benign prostatic hyperplasia; Urethral stricture; Transurethral resection of the prostate; Risk factors

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1. Introduction

Benign prostatic hyperplasia (BPH) is a common condition among middle-aged and elderly men, with its incidence increasing with age. It significantly impacts patients' daily lives and may lead to a series of complications^[1]. In the clinical management of BPH, transurethral resection of the prostate (TURP) is a widely adopted surgical approach. TURP is widely adopted clinically due to its advantages of simplicity and minimal trauma, playing a crucial role in alleviating symptoms and facilitating patients' return to normal life. However, patients often face the risk of

urethral stricture following TURP, which not only delays recovery of urinary function but may also lead to urinary retention and sexual dysfunction. Therefore, this complication warrants significant attention ^[2]. This clinical study analyzes risk factors for urethral stricture development and preventive nursing strategies in BPH patients following TURP. It aims to provide clinicians with valuable insights to better understand and prevent this complication, thereby enhancing treatment outcomes and patient quality of life.

2. Subjects and methods

2.1. Study population

Clinical data of 266 patients undergoing TURP admitted to the Department of Urology between June 2020 and May 2023 were collected, with postoperative urethral stricture complications recorded.

2.1.1. Inclusion criteria

- (1) Diagnosis of BPH meeting criteria in the 9th Edition of Surgical Procedures ^[3]
- (2) Undergone TURP
- (3) Mentally competent
- (4) No major organ dysfunction

2.1.2. Exclusion criteria

- (1) History of urethral stricture, bladder neck contracture, or other urological structural abnormalities
- (2) Previous prostate or urological surgery
- (3) Concurrent severe cardiac disease, renal failure, or other conditions significantly impacting surgical outcomes or increasing risks;
- (4) Incomplete medical records or inability to conduct effective follow-up.

2.2. Research methods

Relevant clinical data on patients, including demographic information (gender, age, disease duration), associated risk factors (hypertension, diabetes, hyperlipidemia, urinary tract infection), laboratory and related examinations (prostate volume), and surgical indicators (operative time, intraoperative blood loss, postoperative bladder irrigation time, urinary catheterization duration, intraoperative urethral dilation and reconstruction), as well as complication was collected. Univariate analysis on clinical data from both patient groups was performed. Subsequently, statistically significant variables from univariate analysis into multivariate analysis was incorporated. Multivariate logistic regression analysis was employed to identify risk factors for urethral stricture following TURP.

2.3. Disease definition

2.3.1. BPH definition

- (1) Prostate volume exceeding 30 mL confirmed by ultrasound or other imaging studies;
- (2) Symptoms including urinary frequency, urgency, nocturia, weak stream, or dysuria identified during medical history;
- (3) Prostate-specific antigen (PSA) level testing to exclude prostate cancer or other prostate diseases.

2.3.2. TURP implementation

- (1) Preoperative preparation

Comprehensive patient assessment via blood tests, ECG, renal function tests, and PSA level measurement. Inform patients and families about surgical procedures, associated risks, and postoperative recovery.

(2) Anesthesia

Combined spinal-epidural anesthesia administered.

(3) Surgical procedure

During surgery, an electrosurgical resectoscope is inserted transurethrally to precisely remove prostate tissue obstructing urine flow while minimizing damage to surrounding structures. Resected tissue is evacuated through the urethra. Mannitol solution or saline is used to clear blood and tissue debris from the surgical field, maintaining clear visualization.

(4) Postoperative recovery

Following surgery, a urinary catheter is placed to facilitate urination and flush residual blood clots or tissue fragments. Postoperative care instructions include activity restrictions, dietary adjustments, and medication use, with continuous monitoring of the patient's recovery and potential complications.

2.3.3. Urethral stricture definition

A narrowing of the urethral lumen due to various causes, obstructing normal urine flow. Primary symptoms include dysuria, weak urine stream, prolonged urination time, urinary urgency and frequency, and severe cases may lead to urinary retention. Urethral strictures can occur in any segment of the urethra, including the anterior urethra, posterior urethra, or both.

2.4. Statistical methods

Data analysis was performed using SPSS 23.00 statistical software. Count data are expressed as n (%). Intergroup comparisons were conducted using the chi-square χ^2 test or Fisher's exact probability test. For continuous data, normality was assessed. Normally distributed data are presented as mean \pm standard deviation ($\bar{x} \pm s$), with intergroup comparisons performed using the independent samples *t*-test. Non-normally distributed or unequal variance quantitative data were expressed as median (M) and interquartile range (IQR), with intergroup comparisons using the Mann-Whitney U test. Indicators with $p < 0.05$ in univariate comparisons were included in multivariate analysis. Multivariate logistic regression analysis was used to identify risk factors for AKI onset, with $p < 0.05$ indicating statistical significance.

3. Results

3.1. Incidence of urethral stricture

Among 266 BPH patients undergoing TURP, 21 developed urethral stricture (7.89%).

3.2. Univariate analysis

Univariate analysis revealed that urethral stricture after TURP in BPH patients was associated with a history of diabetes, preoperative urethral infection, intraoperative blood loss, surgical duration, urinary catheterization time, and intraoperative urethral dilation and reconstruction ($p < 0.05$). It was not associated with patient age, disease duration, preoperative prostate size, or postoperative bladder irrigation time ($p < 0.05$). See **Table 1**.

Table 1. Univariate analysis results for urethral stricture after TURP in BPH patients

Item	Urethral stricture		<i>t/χ²</i> Value	<i>p</i> Value
	Occurrence (n = 21)	No occurrence (n = 245)		
Age ($\bar{x} \pm s$) years	68.45 ± 3.75	67.78 ± 2.93	0.9822	0.3269
Duration of illness ($\bar{x} \pm s$) years	5.62 ± 0.35	5.73 ± 0.83	0.6019	0.5478
History of diabetes [Yes, n (%)]	14 (66.67)	73 (29.79)	11.9470	0.0005
Preoperative urinary tract infection [Yes, n (%)]	13 (61.90)	58 (23.67)	14.4481	0.0001
Intraoperative blood loss ($\bar{x} \pm s$) ml	64.31 ± 7.85	51.45 ± 6.24	8.8701	0.0000
Preoperative prostate size Grade I–II/Grade III [n (%)]	15/6	136/109	1.9971	0.1576
Surgical duration ($\bar{x} \pm s$) min	72.42 ± 3.55	64.39 ± 3.28	10.6977	0.0000
$\bar{x} \pm s$	8.28 ± 1.72	7.06 ± 1.08	4.7020	0.0000
Intraoperative urethral dilation and reconstruction [Yes, n (%)]	11 (52.38)	42 (17.14)	12.9259	0.0003
Postoperative bladder irrigation duration ($\bar{x} \pm s$) h	12.03 ± 1.12	12.35 ± 1.24	1.1430	0.2541

3.3. Multivariate logistic analysis of urethral stricture after TURP in BPH patients

Variables with $p < 0.05$ in univariate analysis were incorporated into a logistic regression model for further evaluation. Independent risk factors for urethral stricture development after TURR in BPH patients included prior diabetes, preoperative urethral infection, Grade III prostate volume, operative time ≥ 70 min, urinary catheterization duration ≥ 5 days, and intraoperative urethral dilation and reconstruction ($p < 0.05$). See **Table 2**.

Table 2. Multivariate logistic regression analysis for AKI in AMI patients

Variable	Value	β	SE	Wald χ^2	OR	95% CI	<i>p</i> -value
History of diabetes	Yes = 1; No = 0	1.475	0.293	25.591	4.363	1.463–18.602	< 0.01
Preoperative urinary tract infection	Present = 1; Absent = 0	1.162	0.266	20.712	3.197	1.942–25.225	< 0.01
Preoperative prostate size	Grade I–II = 0; Grade III = 1	1.304	0.392	11.103	3.685	1.812–25.912	< 0.05
Intraoperative blood loss	≥ 50 mL = 1; < 50 mL = 0	2.014	0.635	9.608	7.601	2.105–26.385	< 0.05
Surgical duration	≥ 70 min = 1; < 70 min = 0	1.457	0.373	15.294	4.287	1.688–30.223	< 0.01
Urinary catheterization duration	≥ 5 days = 1; < 5 days = 0	1.873	0.346	31.266	6.513	1.640–23.325	< 0.05
Intraoperative urethral dilation and reconstruction	Yes = 1; No = 0	1.654	0.461	12.723	5.213	1.938–24.637	< 0.01

4. Discussion

Benign prostatic hyperplasia (BPH) is a common disease affecting the health of middle-aged and elderly men, primarily manifesting as urinary dysfunction that significantly impacts patients' daily lives. For BPH treatment, transurethral resection of the prostate (TURP) is an effective surgical option. This procedure offers advantages such as minimal trauma and rapid recovery, making it the preferred treatment for BPH. However, it is suitable for many BPH patients. Nevertheless, following TURP, patients are susceptible to urethral stricture complications due to individual factors and surgical manipulation, manifesting as symptoms like urinary stream splitting and dysuria,

which severely disrupt normal life ^[4]. Therefore, actively exploring risk factors and preventive measures for post-TURP urethral stricture in BPH patients holds significant clinical value.

This study employed multivariate logistic regression analysis to investigate risk factors for postoperative urethral stricture complications in 266 BPH patients undergoing TURP at our hospital's urology department. Among these patients, 21 developed urethral strictures, yielding an incidence rate of 7.89%. Logistic regression analysis revealed that a history of diabetes, preoperative urethral infection, Grade III prostate volume, surgical duration ≥ 70 min, urinary catheterization ≥ 5 days, and intraoperative urethral dilation and reconstruction were independent risk factors for urethral stricture following TURP ($p < 0.05$). Further analysis identified the following primary contributing factors:

- (1) In patients with a history of diabetes, elevated blood glucose and urinary glucose levels create an environment conducive to bacterial proliferation. Concurrently, impaired leukocyte function and metabolic disorders severely compromise cellular immunity and serum complement function, creating gaps in the body's defense mechanisms. This facilitates pathogen invasion, increasing the risk of urinary tract infections leading to urethral mucosal edema and subsequent urethral stricture.
- (2) For patients with preoperative urethral infections, TURP surgery exacerbates urethral mucosal edema, prolonging wound healing and accelerating urethral stricture formation.
- (3) For patients with prostate volume exceeding Grade III (≥ 60 cm³), TURR procedures involve increased frequency of endoscope insertion/removal into the urethra, heightening the risk of urethral mucosal injury and predisposing to urethral stricture.
- (4) For BPH patients undergoing TURR, increased intraoperative bleeding and prolonged procedure duration necessitate repeated manipulation of the resectoscope. This inevitably exacerbates urethral mucosal injury, particularly in patients with a small urethral external orifice, potentially causing urethral lacerations and accelerating urethral stricture formation. Additionally, the elevated temperature of the cutting scope during surgery causes thermal injury alongside mechanical damage. This induces an inflammatory response in the urethral mucosa and surrounding tissues, heightening the risk of local infection and predisposing patients to urethral stricture.
- (5) For patients requiring indwelling catheterization beyond 5 days, prolonged urethral compression may impair drainage, inducing urethral mucosal scarring and exacerbating urethral stricture development.
- (6) In patients undergoing intraoperative urethral dilation and reconstruction, surgical manipulation damages the urethral mucosa, forming urethral scar tissue that triggers stricture formation.

To address these risk factors, the following preventive nursing measures are recommended, where:

- (1) For patients with a history of diabetes or preoperative urethral infection, prioritize glycemic control through medication and dietary management to stabilize blood sugar levels and enhance immune function. Concurrently, administer appropriate antibiotic therapy preoperatively and conduct regular blood and urine tests to monitor for infection signs, thereby minimizing the risk of urethral stricture complications.
- (2) For patients with enlarged prostates, prioritize minimizing intraoperative urethral injury by employing advanced surgical techniques and equipment to reduce mechanical and thermal damage to the urethral mucosa. Concurrently, minimize blood loss and surgical duration to lessen trauma to the urethral external orifice and mucosa.
- (3) For patients requiring long-term indwelling catheters, enhanced urinary management is essential. Regularly check catheter position for displacement to ensure it does not excessively compress the urethra,

and replace it periodically to reduce infection risk. Patients undergoing urethral dilation and reconstruction surgery require strict postoperative infection monitoring. Medication intervention and physical therapy should be employed as needed to promote urethral mucosal recovery^[5].

5. Conclusion

In summary, for patients undergoing transurethral resection of the prostate (TURP) to treat benign prostatic hyperplasia, preventing postoperative urethral stricture hinges on controlling and managing underlying risk factors, actively implementing appropriate preventive measures, and maintaining meticulous surgical technique and monitoring during the procedure. This approach maximizes the reduction of stricture risk and enhances patient quality of life.

Disclosure statement

The authors declare no conflict of interest.

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