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ORIGINAL RESEARCH

One-Year Outcomes of Transurethral Treatment of Bladder Neck Stenosis Following Transurethral Resection of the Prostate. Results from a Large, Multicenter Series

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Purpose: To assess management and outcomes of bladder neck stenosis (BNS) post-transurethral resection of the prostate (TURP) in 12 centers.

Patients and Methods: A retrospective analysis of patients who underwent transurethral BN incision for stenosis following TURP from January 2015 and January 2023 was performed. Inclusion criteria included endoscopic diagnosis of BNS associated with obstruction and/or lower urinary tract symptoms. Data are presented as median and interquartile range. Two distinct univariable logistic regression analyses were performed to identify factors associated with overall urinary incontinence and recurrent stenosis.

Results: Three hundred and seventy-two men were included. 95.2% of patients developed BNS following bipolar TURP. 21.0% of patients were on an indwelling catheter before BNS incision. Bipolar electrocautery was the most commonly employed energy for incision (66.5%). Collings knife was the most commonly employed (61.2%) instrument for incision, followed by end-firing holmium lasering (35.3%). Median operation time was 30 (25–45) minutes. The overall complication rate was 12.4%, with 19 (5.1%) patients suffering from acute urinary retention, 6 (1.6%) patients requiring prolonged irrigation due to persistent hematuria, and a surgical hemostasis was necessary in 8 cases (2.2%). Overall postoperative incontinence rate was 17.2%, with urge incontinence accounting for the most common type (45.3%). Incontinence lasted more than 3 months in 9/46 (14.3%) patients. Recurrent BNS occurred in 29 (7.8%) patients and was managed by re-endoscopic incision in 21 (5.6%) patients and dilatation only in 6 (1.6%) patients. Two (0.5%) patients underwent urethroplasty for recalcitrant stenosis. Logistic regression analysis showed that Collings knife was associated with higher odds of having postoperative incontinence (OR 3.93 95% CI 1.45–11.13, p=0.008) and BN recurrence (OR 3.589 95% CI 1.157–15.7, p=0.047).

Conclusion: Transurethral BN incision provides satisfactory short-term results with an acceptable rate of complications.

Keywords: bladder neck stenosis, transurethral resection of the prostate, postoperative complications, urinary incontinence

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Introduction

According to the European Association of Urology guidelines, transurethral resection of the prostate (TURP) is still considered the current standard/first choice in men with prostate size of 30–80 mL requiring surgery.[1]

Bladder neck stenosis (BNS) refers to the narrowing of the bladder neck typically post-surgical intervention and is among the most common late complications following TURP, with a pooled incidence of 1.3% (range from 0.5 to 15.4%) with no significant difference in the rate of incidence among randomized trials comparing TURP vs Ablation vs Enucleation.[2] BNS is undoubtedly a troublesome condition that can result in urinary retention and necessitate multiple procedures in case of recurrence. Yet, treatment of BNS can be associated with *de novo* urinary incontinence (UI) and this has a significant impact on patient quality of life and undermines the primary objective of the initial surgery.

Some patients suffer from recurrent stenosis and its exact causes are not fully understood, but it is thought to be related to the surgical procedure itself, tissue healing, and patient factors.[3] There are a few single-center, low-volume studies addressing the outcomes of endoscopic treatment of BNS following TURP[4,5] and only one multicentre cohort.[6]

This multicentre study aims to understand the nuances of management of BNS post-TURP in a real-world setting with regard to early and medium-term surgical outcomes and to analyze which are the common surgical approaches and energy mediums used to manage the same.

Materials and Methods

A retrospective analysis of all patients who underwent transurethral bladder neck incision for stenosis following monopolar or bipolar TURP from January 2015 and January 2023 was performed. Twelve centers from 8 Countries were involved. Inclusion criteria were endoscopic diagnosis of BNS associated with obstruction and/or lower urinary tract symptoms. Patients with primary bladder neck stenosis were excluded. Patients with associated bladder calculi were managed with same sitting cystolithotripsy. The following data were gathered: age, comorbidity, American Society of Anesthesiologists score, post-voiding residual of urine, previous dilatation, energy for incision, type of incision, and surgical time. Anticoagulants were stopped before surgery and switched to low-molecular-weight heparin according to a consultation with a local cardiologist. Single antiplatelets were continued. Early postoperative complications were considered up to 30 days following surgery and graded according to the modified Clavien-Dindo classification. Late complications were considered for up to 1 year. Urinary incontinence was defined as any self-reported complaint of urine leakage by patients and was categorized into three types: i) urge incontinence: involuntary loss of urine associated with urgency; ii) stress-urinary incontinence: involuntary loss of urine on effort or physical exertion; and iii) mixed urinary incontinence: association of both stress and urge urinary incontinence.[7] To assess the duration of incontinence, we divided it into three categories based on the period between catheter removal and the time when patients reported the cessation of incontinence: up to 1 month, from 1 to 3 months, and longer than 3 months. The primary center, the Asian Institute of Nephrology and Urology (Hyderabad, India), acquired institutional board review approval (AINU #08/2023), and the other participating centers also obtained approvals from their respective institutional boards. The study adhered to the principles outlined in the Helsinki Declaration. All patients provided informed consent for the collection of their anonymized data.

Statistical Analysis

Categorical data are presented as absolute numbers and percentages. Continuous data are reported as median and interquartile range. Two distinct univariable logistic regression analyses were performed to identify factors associated with overall urinary incontinence and recurrent stenosis. Variables that demonstrated significant prognostic potential in the univariable analysis were included in a multivariable model to determine their significance as independent predictors. Data are presented as odds ratio (OR), 95% confidence interval (CI), and p-value. All statistical tests were carried out in R Statistical language, version 4.3.0 (R Foundation for Statistical Computing, Vienna, Austria). A two-sided $p < 0.05$ was considered to indicate statistical significance.

Results

A total of 372 men were included in the analysis. Table 1 shows baseline characteristics. Median age was 67 (60–73) years. The majority of patients developed BNS following bipolar TURP (95.2%). Almost a quarter of patients had a positive preoperative urine culture and a course of antibiotics was given in 38% of patients. As a first-line approach, urologists performed an outpatient BN dilatation in 101 (27.2%) patients, and 78 (21.0%) patients were on an indwelling catheter before BNS treatment. Table 2 shows intraoperative outcomes. Concomitant bladder lithotripsy was performed in 29 (7.8%) patients. Bipolar electrocautery was the most commonly employed energy for BN incision (66.5%), followed by monopolar electrocautery (15.4%). Among instruments for incision, Collings knife was the most commonly employed (61.2%), followed by end-firing holmium lasering (35.3%). Bilateral BN incision was performed in roughly half of the cases and the incision was extended down to the veru montanum in 26.3% of cases. Median operation time was 30 (25–45) minutes. Table 3 depicts postoperative outcomes. In the majority of the cases indwelling catheter was kept less than 7 days after surgery. The overall complication rate was 12.4%, with 19 (5.1%) patients suffering from acute urinary retention, 6 (1.6%) patients requiring prolonged irrigation due to persistent haematuria, and a surgical hemostasis was necessary in 8 cases (2.2%). No patient had a blood transfusion. There was only 1 (0.3%) case of sepsis requiring intensive care unit admission. Overall postoperative incontinence rate was 17.2%, with urge incontinence accounting for the most common type among incontinent men (45.3%). Incontinence lasted more than 3 months in only 9 out of 46 (14.3%) patients. Regarding late complications, recurrent BNS occurred in 29 (7.8%) patients and was managed by re-endoscopic incision in 21 (5.6%) patients and dilatation only in 6 (1.6%) patients. Two (0.5%) patients underwent

Table 1 Baseline Characteristics of Patients

	N=372
Age, years, median [IQR]	67 [60, 73]
Type of previous TURP, n (%)	
Monopolar	18 (4.8)
Bipolar	354 (95.2)
Diabetes mellitus, n (%)	115 (31.0)
Hypertension, n (%)	221 (59.4)
Ischemic heart disease, n (%)	58 (15.6)
Cardiovascular disease, n (%)	20 (5.4)
ASA score, n (%)	
1	66 (17.8)
2	231 (62.3)
3	74 (19.9)
Anticoagulation stopped, n (%)	73 (38.2)
Urine culture positive, n (%)	55 (25.8)
Preoperative antibiotics, n (%)	105 (38.0)
Preoperative post-voiding residual of urine, median [IQR]	100 [55, 180]
Previous outpatient urethral dilation, n (%)	101 (27.2)
Preoperative indwelling catheter, n (%)	78 (21.0)

Abbreviations: TURP, transurethral resection of the prostate. IQR, interquartile range. ASA, American Society of Anesthesiologists.

Table 2 Intraoperative Characteristics

Concomitant bladder lithotripsy, n (%)	**29 (7.8)**
Incision modality, n (%)	N=224
End-firing laser	79 (35.3)
Collings knife	137 (61.2)
Cold knife	2 (0.8)
Loop	6 (2.7)
Main energy type, n (%)	N=372
Holmium laser <50W	27 (7.3)
Holmium laser ≥50W	24 (6.5)
Holmium with MOSES technology	10 (2.4)
Thulium fiber laser	8 (1.9)
Bipolar	246 (66.5)
Monopolar	57 (15.4)
Scope size (French), n (%)	N=367
21	2 (0.5)
22	5 (1.4)
24	104 (28.3)
26	256 (69.8)
Incision type, n (%)	N=245
1-side	34 (13.9)
2-side	115 (46.9)
Mercedes-Benz	96 (39.2)
Incision length ureteral orifice to veru montanum, n (%)	62 (26.3)
Additional haemostasis with loop, n (%)	60 (26.3)
Total operation time, minutes, median [IQR]	30 [25, 45]

Abbreviation: IQR, interquartile range.

Table 3 Postoperative Outcomes

	N=372
Removal of postoperative catheter, n (%)	
<7 days	317 (86.1)
7–14 days	41 (11.1)
15–30 days	6 (1.6)
>30 days	4 (1.1)
30-day complications, n (%)	46 (12.4)
Acute urinary retention (Clavien 2)	19 (5.1)
Continuous bladder washout for persistent haematuria (Clavien 2)	6 (1.6)
Blood transfusion (Clavien 2)	0
Bleeding requiring surgical control (Clavien 3)	8 (2.2)
Urinary tract infection (Clavien 2)	17 (4.6)
Sepsis requiring intensive care unit admission (Clavien 4)	1 (0.3)
Overall postoperative incontinence, n (%)	64 (17.2)
Incontinence type, n (%)	N=64
Urge	29 (45.3)
Stress	27 (42.2)
Mixed	8 (12.5)

(*Continued*)

Table 3 (Continued).

	N=372
Duration of incontinence, n (%)	N=64
<1 month	37 (58.7)
1–3 months	17 (27.0)
>3 months	9 (14.3)
Delayed complications (up to 1 year), n (%)	45 (12.1)
Urethral stricture, dilation only	8 (2.2)
Urethral stricture, urethrotomy	8 (2.2)
Bladder neck stenosis, dilation only	6 (1.6)
Bladder neck stenosis, repeat incision	21 (5.6)
Artificial urinary sphincter	1 (0.3)
Urethroplasty for recalcitrant bladder neck stenosis	2 (0.5)

urethroplasty for recalcitrant stenosis. At univariable logistic regression analysis, age, diabetes mellitus, previous urethral dilatation, and the use of Collings knife were associated with higher odds of having postoperative incontinence, while only the latter (OR 3.93 95% CI 1.45–11.13, p=0.008) was at multivariable analysis (Table 4). Again, the use of Collings knife (OR 3.589 95% CI 1.157–15.7, p=0.047) was the only factor associated with higher odds of BN recurrence at univariable logistic regression analysis (Table 5).

Table 4 Univariable and Multivariable Logistic Regression Analysis of Factors Associated with Overall Incontinence

	Univariable analysis		Multivariable analysis	
	OR (95% CI)	***p***	***OR (95% CI)***	***p***
Age	1.04 (1.01–1.072)	**0.01**	1.04 (0.97 – 1.11)	0.26
Diabetes mellitus	2.304 (1.324–4.001)	**0.003**	0.98 (0.31 – 2.88)	0.975
Preoperative post-voiding residual of urine	0.999 (0.996–1.002)	0.726	- - -	- - -
Previous outpatient urethral dilation	3.757 (2.149–6.601)	**<0.001**	0.87 (0.29 – 2.48)	0.794
Incision modality (ref. end-firing laser)				**0.008**
Collings knife	2.828 (1.401–6.129)	**0.005**	3.93 (1.45 – 11.13)	
Cold knife	6.182 (0.233–164.28)	0.209		
Main energy type (ref. Holmium <50W)				
Holmium HP ≥50W	0.408 (0.079–1.692)	0.237		
Holmium with MOSES	0 (0–731.38)	0.985		
Thulium fiber laser	0.476 (0.023–3.53)	0.525		
Bipolar	0.427 (0.173–1.161)	0.075		
Monopolar	1.544 (0.574–4.5)	0.403		
Incision type (ref. 1-side)				
2-side	1.502 (0.594–4.342)	0.416		
Mercedes-Benz	1.47 (0.568–4.317)	0.449		
Monopolar TURP (versus bipolar TURP)	0.961 (0.218–3.02)	0.951	- - -	- - -

Abbreviation: TURP, transurethral resection of the prostate. Bold value stands for significant p value.

Table 5 Univariable Logistic Regression Analysis of Factors Associated with Re-Stenosis

	OR (95% CI)	p
Age	0.988 (0.95–1.029)	0.556
Diabetes mellitus	2.014 (0.887–4.511)	0.088
Urine culture positive	0.512 (0.116–1.615)	0.303
Previous outpatient urethral dilation	0.935 (0.357–2.187)	0.882
Incision modality (ref. end-firing laser)		
Collings knife	3.589 (1.157–15.7)	**0.047**
Cold knife	0.855 (0.567–1.347)	0.12
Incision type (ref. 1-side)		
2-side	3.49 (0.642–64.99)	0.24
Mercedes-Benz	3.414 (0.606–64.18)	0.253

Note: Bold value stands for significant p value.

Discussion

A small prostate volume, a larger resecting loop, a larger instrument sheath, extensive resection of the bladder neck, a low resection speed, diabetes, smoking habits, cardiovascular disease, repeat catheterization, traction of the balloon, and postoperative urinary infections have all been demonstrated to be factors associated with an elevated risk of post-TURP BNS.[2,3] Nevertheless, there is a paucity of data regarding the outcomes following treatments of BNS and our study provides an insightful view from a large and multicentre series and pointed out two important findings.

Firstly, the use of both monopolar and bipolar electrocautery is still the most commonly used energy source to incise BN using the Collings knife. However, the latter was associated with three-and-A-half-fold higher odds of developing a re-stenosis in our series. This finding confirms the results of a study of 15 men where an incision was done using the Collings knife and the recurrence rate was 28%.[8] In Ramirez et al's study, a bilateral and deep incision was made into the perivesical fat.[8] In our series, some patients were instead treated using a cold knife or laser which could be associated with better wound healing due to tissue remodeling and lower scar formation. The recurrence rate was even higher at 41.7% in another single-center series of 60 patients[4] and at 52% in another multicentre series from Germany.[6] In the latter, most of the patients had a resection of BN instead of an incision. The use of the resection technique with a loop could also be associated, as for Collings knife, with the delivery of higher energy that can contribute to the development of BNS recurrence. Indeed, loop resection was only employed in 2.7% of cases in our series and 39.2% of patients had a Mercedes-Benz or the 3-point incision technique deployed. The latter was akin to the technique deployed by Rosenbaum et al, where an incision was made at the 4, 8, and 12 o'clock position and had a reported 45% success rate.[6]

Some authors proposed the injection of antiproliferative agents at the time of BN incision in patients with refractory stenosis. Vanni et al reported a success rate of 89% in 18 patients after two procedures involving deep cold-knife radial incisions (tri or quadrant) followed by the injection of 0.3–0.4 mg of mitomycin C to prevent contracture recurrence.[9] Therefore, this is an option that could be employed in the future for the first presentation of BNS too.

The occurrence of stress urinary incontinence following BNS endoscopic treatments is uncommon with incidence rates ranging from 1.7%[4] up to 9%.[8] Our rate of overall incontinence was somewhat higher probably because we were able to capture urge and mixed incontinence too. The hypothesis of more energy delivered during BNS treatment might be also supported by the fact that Collings knife was associated with almost fourfold higher odds of developing post-operative incontinence in our cohort. This could partially explain why urge incontinence was the most common type among incontinent men and lasted up to 3 months in 85.7% of cases. In fact, stress incontinence is less common and this is likely attributable to the typical location of the stricture. Since only a small number of strictures extend near the sphincter, this could clarify the low risk of sphincter involvement. We do admit that we are unable to delve further into

understanding the reason for incontinence, as the retrospective nature of this study, a lack of standardized reporting with questionnaires, and a pre-intervention history of any detrusor abnormality remains unknown.

The present study is not devoid of limitations starting with its retrospective nature that could have limited the individuation of minor complications. Secondly, we were not able to assess the time between TURP and BNS occurrence being not available in most of the patients. Thirdly, no patient in our series had concomitant injections of antiproliferative agents which showed some role in reducing the rate of recurrence. Fourthly, we were not able to provide data on primary TURP which may have an impact on BNS such as previous procedure prior to TURP, type and size of resectoscope sheath used, time of resection, experience of the operating surgeon, size of the median lobe and extent of bladder neck resection during TURP. Finally, we were also incapable of evaluating preoperative incontinence and its role in the rate of postoperative incontinence.

Despite these limitations, we also had a 1-year follow-up of patients in whom only 12.1% developed late complications of which expectedly recurrence of the BNS was the most common problem needing repeat incision. We also see that, in these patients, a urethral stricture was noted in 4.4% of cases adding to the morbidity. One striking observation in our series is that in 86.1% of cases, the indwelling catheter is removed post-operatively in less than 7 days. This is different from the reported classic practice of Ramirez et al who kept the indwelling catheter for 2 months after BN incision[8] but closer to the 4 days post recommendation by Cao et al.[10] It remains to be studied if keeping a longer catheter duration or self-intermittent catheterization can limit the recurrence akin to the post-internal urethrotomy practice for urethral strictures.[11]

Conclusion

BN incision by Collings knife or laser is safe enough to manage BNS but may not be enough to prevent the recurrence of the same. Additionally, urethral stenosis and UI from this surgery performed as a salvage to procedure for a complication of a previously performed surgery could potentially bring added morbidity in the long-term follow-up. Information from our study could be useful to plan a randomized study that compares BN incision with and without the use of intralesional agents. It also raises the opportunity to explore if we should move away from using Collings knife to other laser energy sources.

Disclosure

The authors report no conflicts of interest in this work.

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