Post-transurethral resection of prostate urethral strictures: Are they often underreported? A single-center retrospective observational cohort study

Hariharasudhan Sekar, Velmurugan Palaniyandi, Sriram Krishnamoorthy, Natarajan Kumaresan

Department of Urology, Sri Ramachandra Institute of Higher Education and Research, Chennai, Tamil Nadu, India

Abstract

Objectives: Post-transurethral resection of prostate urethral stricture (PTS) is a well-documented delayed complication following transurethral resection of the prostate (TURP). The aim is to analyze various risk factors of PTS and see if the overall incidence is underreported.

Materials and Methods: A retrospective study was conducted in our institution between January 2017 and December 2018 in men who underwent TURP. Data obtained from the medical records department were analyzed. Statistical analysis was done using Fisher's exact test. A two-tailed $P < 0.05$ is considered statistically significant.

Results: Of the 447 men who underwent TURP, 57 developed PTS. Fifteen of 334 patients who underwent calibration before the procedure developed stricture compared to 42 of 137 without calibration ($P < 0.01$). There was a significantly lesser incidence of stricture with 24 Fr resectoscope compared with 26 Fr sheath ($P < 0.04$). Two patients with 24 Fr Foley and 30 of 35 (86%) patients with 22 Fr Foley catheter developed stricture of urethra. Distal bulbar urethra was the most common site of narrowing following TURP. Eighteen patients had Salvaris swab placed for traction and 12 patients required full-thigh traction, of which majority developed meatal stenosis.

Conclusions: TURP is one of the common surgical procedures performed by urologists. Meatitis and meatal stenosis, if included as complications of TURP, would increase the overall incidence of PTS. Factors such as the size of resectoscope sheath used, size of catheter inserted, placement of Salvaris swab traction, and preoperative calibration of urethra have a significant impact on the ultimate outcome.

Keywords: Meatitis, Salvaris, stricture, transurethral resection of the prostate, urethra

Address for correspondence: Prof. Sriram Krishnamoorthy, Department of Urology and Renal Transplantation, Sri Ramachandra Institute of Higher Education and Research, Porur, Chennai - 600 116, Tamil Nadu, India.
E-mail: sriramuro@gmail.com

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INTRODUCTION

Transurethral resection of the prostate (TURP) is considered the gold standard treatment for benign hyperplasia of prostate gland (BPH). Despite recent innovations in technology and energy sources, TURP using monopolar diathermy has stood the test of time for more than five decades.[1-4] Post-TURP urethral stricture (PTS) is one of the well-documented delayed complications

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following TURP.[5,6] It usually presents in a delayed manner with recurrent lower urinary tract symptoms. The exact reason for PTS is still not clearly understood and continues to baffle all treating urologists. Various reasons proposed include improper urethral instrumentation, mucosal perforation related to the penoscrotal angle, and monopolar current leakage due to insufficient resectoscope insulation.[7] The size of the resectoscope, type and diameter of catheter used, duration of catheterization, degree of traction applied on the catheter, resection time, and patient age are various other factors that decide the incidence of PTS. The overall incidence of PTS in various studies following monopolar diathermy TURP ranges between 2.2% and 9.8%.[8] In our study, the overall incidence of PTS appeared to be much higher than what is generally reported in literature. The purpose of this study is to identify the risk factors that predispose to PTS and also to see if the data on PTS are underreported in the literature. In our study, data from perioperative parameters of TURP are studied to analyze the various potential risk factors of PTS and bladder neck contracture.

MATERIALS AND METHODS

This is a retrospective observational study conducted in Sri Ramachandra Institute of Higher Education and Research, Chennai, India, on a cohort of patients who underwent TURP. After obtaining the approval of the ethical committee, about 471 men who underwent TURP by consultant urologists with more than 3 years of experience, between January 2017 and December 2018, were evaluated. All patients over 50 years of age with a clinical diagnosis of benign hyperplasia of prostate gland (BPH), prostate gland volume (PV) ≤100 mL, International Prostate Symptom Score (IPSS) ≥18, quality of life (QoL) ≥3, maximal urinary flow rates (Qmax) <10 mL/s, and failed conservative medical management with normal urinary bladder function were included in our study.

Patients with postvoid residual urine volume >200 mL, presence of urethral stricture prior to TURP, indwelling urethral catheter prior to surgery, and history of previous prostate surgery; patients needing re-TURP; and patients with the presence of balanitis xerotica obliterans, bladder stones, neurogenic bladder dysfunction, elevated serum prostate-specific antigen (PSA) levels, urine culture documented infections, and presence of prostate malignancy in histopathology were excluded from our study. Patients who underwent bipolar TURP or holmium laser enucleation of the prostate were also excluded. Patients with prostatic abscesses, capsular perforation, or undermining of trigone during the procedure and who had the necessity to retain catheter for more than 48 h were also excluded from our study. TURP done by junior consultants with < 3 year's experience were excluded.

All patients were evaluated with general and urological examination including digital rectal examination (DRE), urine analysis and culture, transrectal ultrasound volume measurement of the prostate, serum PSA level, maximum urinary flow (Qmax), postvoid residual urine volume (PVR) assessment, QoL assessment, and self-assessment by IPSS. Intraoperative events such as resection time, weight of resected tissue, average blood loss, duration of traction, and type of traction used were studied. Perioperative complications including urinary retention and symptomatic culture-confirmed bacterial urinary tract infection and patients with prolonged catheterization time were also noted. DRE assessment of prostate size was done based on fingerprint graphical schema where a scaled standardization of clinical impression of the weight of prostate gland was done. The time of onset of post-TURP stricture was also noted.

All procedures were performed by qualified urologists with a minimum of 3 years of experience. TURP was performed using a standard technique, using either 24 Fr intermittent or 26 Fr continuous flow resectoscope with monopolar loop electrode. In most cases, the size of the resectoscope was chosen based on preoperative calibration of the urethra. TURP was performed with a monopolar electrocautery system, with the settings for cutting and coagulation being 120 W and 80 W, respectively. Resection was performed using 1.5% glycine solution as the irrigation fluid. Postoperatively, 20 Fr or 22 Fr three-way latex Foley catheters were used in all patients and catheters were taken out 48 h after the procedure. In those patients who had hematuria, the catheter was removed on the 3rd postoperative day. Patients who had persistent hematuria and needing prolonged catheterization or re-exploration TURP were excluded from our study.

The patients were reassessed at 2 weeks, 6 weeks postoperatively, and then, at every 3-month intervals in the outpatient clinic for 1 year. Urinalysis and ultrasonographic measurement of postvoid residual urine volume was performed. Uroflowmetry was done at 2 weeks, 6 weeks, and at 3 monthly intervals for 1 year. In patients with a typical flow pattern of a stricture or peak flow <10 mL/s, a retrograde urethrogram was performed to exclude urethral stricture. Statistical analysis was done using Fisher's exact test. A two-tailed $P < 0.05$ is considered statistically significant.

RESULTS

A total of 471 men underwent TURP during our study period, of which 57 developed PTS. The follow-up period was 6 months to 3 years. Table 1 illustrates the demographic data of all patients with PTS. The average age was 69.12 ± 7.51 years. Uroflowmetry showed a mean peak velocity of 8.36 ± 1.76 ml/s. Average flow was 4.68 ± 1.15 ml/s. Estimated prostate volume was 36.23 ± 10.73 in DRE and 45.52 ± 15.95 gm by ultrasonogram of the abdomen. The average postvoid residual volume (PVR) was 75.50 ± 25.49 ml. The mean serum PSA was 3.24 ± 0.64.

Most of the patients developed stricture between 6 weeks and 3 months. Table 2 illustrates the details of the time of onset of PTS. Most of them developed stricture between 6 weeks and 3 months. Early-onset PTS, within 6 weeks, was found to be relatively very uncommon. Figure 1 illustrates the various sites of involvement of PTS.

Fifteen patients of 334 patients who underwent calibration before the procedure developed stricture compared to 42 of 137 without calibration. This difference was found to be statistically significant [Table 3]. These data further reinforce the need for a preoperative calibration of the urethra before TURP. Sheath size also was also observed to be a major determinant of the onset of PTS. There was a significantly lesser incidence of stricture with the usage of 24 Fr resectoscope compared to the larger 26 Fr sheath [Table 4]. Size of the Foley catheter also decided the final outcome. Table 5 shows the various catheters used and the incidence of strictures. A 24 Fr catheter is mainly used when a large gland is resected and if there is any postoperative bleed to facilitate a better irrigation. Using a relatively smaller 20 Fr Foley catheter is associated with a lesser incidence of strictures. It is not our practice to use 18 Fr three-way Foley catheter. Traction is not applied as a routine except in unusual circumstances of uncontrolled bleeding or capsular breach. Thirty patients needed traction postoperatively, of which 25 developed strictures. Eighteen patients had Salvaris swab placed for traction and 12 patients required full-thigh traction [Table 6]. Salvaris swab technique is a method wherein two gauze swabs are tied moderately tightly around the catheter and pushed up against the glans penis. These swabs are usually removed within an hour; otherwise, a pressure sore may develop over the meatus.[9]

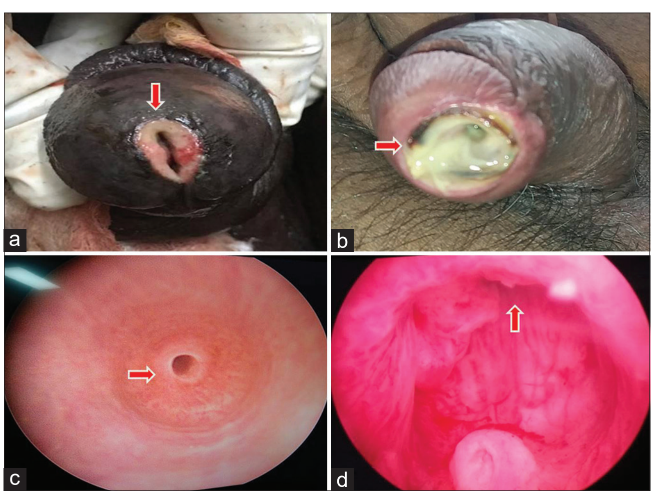

Figure 1: Various locations of involvement of posttransurethral resection of prostate urethral stricture. (a) Meatitis due to salwaris swab placement. (b) Meatal scab, as a sequel of overnight salwaris swab placement. (c) Bulbar urethral stricture. (d) Bladder neck contracturev

Table 7 illustrates the various parts of the urethra developing strictures following TURP. The distal bulbar urethra was the most common site of involvement. Nearly

Table 1: Demographic profile of the patients with posttransurethral resection of the prostate urethral stricture

Parameter	*n*=57
Age (years)	69.12±7.51
Maximum uroflow	8.36±1.76
Average uroflow	4.68±1.15
Prostate volume	45.52±15.95
DRE	36.23±10.73
PVR	75.50±25.49
PSA	3.24±0.64
Creatinine	1.12±0.26

DRE: Digital rectal examination, PVR: Postvoid residual, PSA: Prostate-specific antigen

Table 2: Time to presentation after transurethral resection of the prostate

Time to presentation post-TURP	*n*=57
<6 weeks	5
6 weeks-3 months	40
>3 months	12

TURP: Transurethral resection of the prostate

Table 3: Preoperative urethral calibration

Calibratrion	Stricture urethra	*P*
Done (*n*=334)	15	<0.001
Not done (*n*=137)	42	

Table 4: Incidence of urethral stricture with different sheath sizes

Size of sheath (*n*=471)	Stricture urethra (*n*=57)	*P*
24 Fr (*n*=151)	11	0.04
26 Fr (*n*=320)	46	

Table 5: Catheter size and stricture urethra

Size of catheter used	Stricture urethra (*n*=57)	*P*
24 Fr (*n*=2)	2	0.0008
22 Fr (*n*=198)	35	
20 Fr (*n*=271)	20	

one-half of strictures were found in this site (*n* = 27). Twelve patients had meatal involvement. Of these, 11 patients had Salvaris swab traction placed at the meatus [Table 8]. The other patient had a full Foley thigh traction placed. These data show that placement of Salvaris swab traction has to be done with the utmost caution, ensuring that the gauze swabs are loosened as early as possible following the procedure. Figure 2 illustrates the radiological delineation of various sites of involvement of PTS.

The size of the Foley catheter directly correlates with stricture urethra. Such iatrogenic strictures are not very uncommon. Table 9 illustrates the correlation between the size of the Foley catheter and urethral strictures. If we divide the 57 PTS patients into two groups, with Group 1 including those who had a smaller (20 Fr) catheter placed and the Group 2 who had larger (22 Fr or 24 Fr) catheter placed, we observe that only 2 of the 20 stricture patients who had a smaller catheter (20 Fr) placed developed stricture of the distal bulb or penoscrotal region. On the other hand, of the 37 stricture patients who had a larger catheter (22 Fr and 24 Fr) placed both patients with 24 Fr Foley and 30 out of 35 (86%) patients with 22 Fr Foley catheter, developed stricture of penoscrotal region or distal bulbar urethra. The difference between the two groups is statistically significant ($P < 0.0001$). This further reinforces the fact that size of the catheter is directly associated with the development of strictures. When the size of the catheter used was compared with location of the stricture, of 37 patients with a larger catheter (22 of 24 Fr), 32 had a penoscrotal and distal bulbar stricture, 2 had bladder neck contracture, one patient had a full length narrowing, and two patients had meatitis. On cross tabulation of size of Foley catheter used with the traction applied, it was observed that 19 of the 37 patients with a larger catheter had traction applied. Of these, 11 had a full traction and the remaining 8 had a Salvaris swab traction applied.

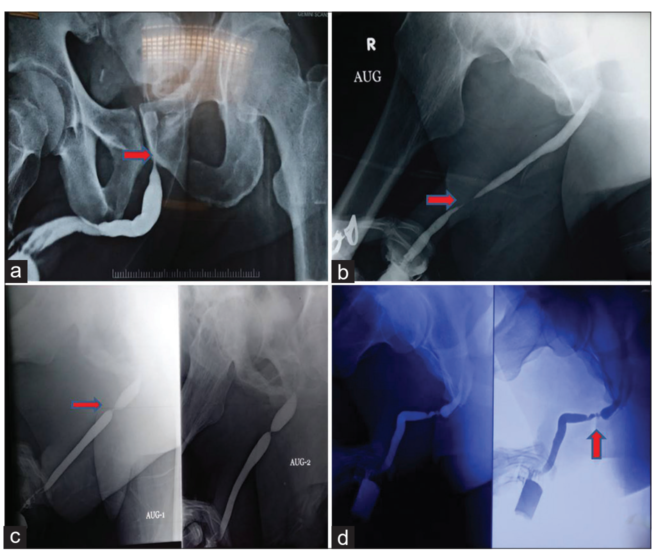

Figure 2: Ascending urethrogram images showing different sites of involvement of posttransurethral resection of prostate urethral stricture. (a) Pan posterior urethral stricture (Pansadaro type III). (b) Penoscrotal junction narrowing. (c) Short segment bulbar urethral stricture. (d) Long segment bulbar urethral stricture

DISCUSSION

BPH is one of the commonest conditions that affect elderly males. Despite various innovations and recent advances in the treatment modalities, TURP still continues to be one of the gold standard treatments of choice.[10,11] Although TURP is an effective and a well-established minimally invasive procedure, it still has a considerable morbidity. PTS is one such complication that continues to daunt the urologists who perform TURP. The introduction of resectoscope without prior calibration, mucosal damage at penoscrotal angle, and monopolar current leakage from the working element due to defective resectoscope insulation are the various reasons for PTS.[12] Figure 3 gives a detailed illustration of the vicious cycle involved in the pathogenesis of PTS.

Pansadaro in 1999 had classified post-TURP strictures as those involving prostatic fossa and the bladder neck.[13] Data related to such strictures would largely downsize the overall incidence of PTS. However, in reality, PTS would

Table 6: Postoperative traction applied

Postoperative traction (*n*=30)	Stricture urethra (*n*=25)	*P*
Salvaris swab technique (*n*=18)	14	0.6221
Full thigh traction (*n*=12)	11	

Table 7: Location of stricture

Stricture site	*n*=57
Meatitis/meatal stenosis	12
Fossa navicularis narrowing	6
Penile urethra	1
Distal bulbar	27
Proximal bulbar	8
Bladder neck	2
Full-length prostatic fossa	1

Table 8: Traction and meatitis/meatal stenosis

Traction	Meatal stenosis (*n*=12)
Salvaris swab technique (*n*=18)	11
Full thigh (*n*=12)	1

Table 9: Catheter size and Penoscotal and distal bulbar strictures

Catheter size	Penoscrotal and distal bulbar stricture (*n*=34)	*P*
24 Fr (*n*=2)	2	<0.0001
22 Fr (*n*=35)	30	
20 Fr (*n*=20)	2	

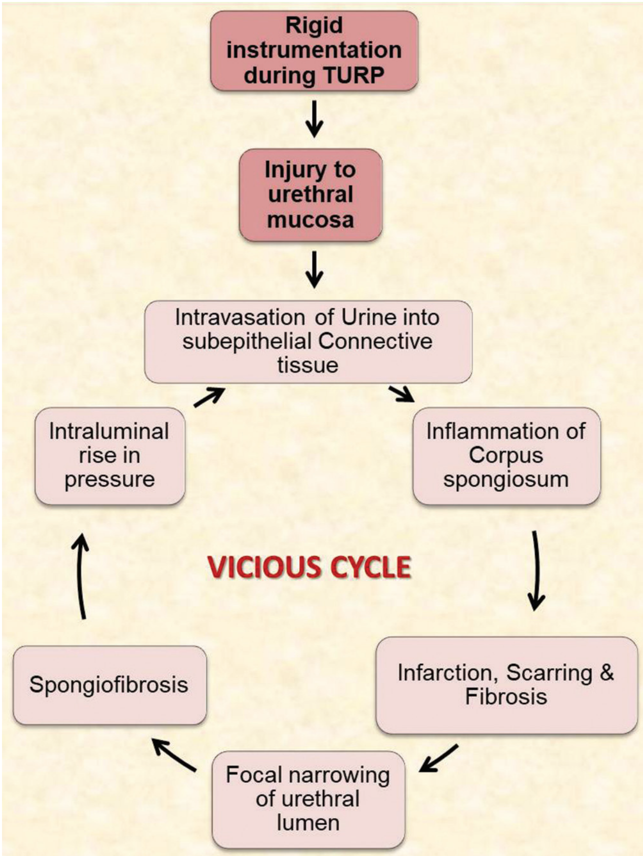

Figure 3: Pathogenesis of posttransurethral resection of prostate urethral stricture (concept adopted from Lentz *et al*., 1977)

also include various other strictures such as meatal stenosis, penobulbar narrowing, bulbar strictures in addition to bladder neck contractures and prostatic urethral synechiae. In such instances, when anterior urethral involvement is also included, the overall incidence of PTS would be far in excess to what is actually reported in the literature. The purpose of this manuscript is to bring to light the overall incidence of such underreported TURP-related strictures of the urethra.

The incidence of PTS is a common problem after TURP surgery. This generally occurs due to fibrosis of connective tissue rich in collagen type I, resulting in scar formation. PTS usually results from various urological procedures. Manipulation of the urethra using a larger resectoscope sheath size, catheter-related trauma, and prolonged endoscopic surgeries causing obliteration of the bend of the urethra at the penoscrotal junction can cause PTS. Various preclinical studies are being carried out using animal models to understand the mechanism and prevention of PTS. A higher degree of mechanical stress to the urethra, operating skill of the surgeon, inappropriate rotary movements of the resectoscope and disproportion between the sheath size and urethral diameter, inadequate lubrication of urethra, prolonged operating time, and electrothermal injury to urethral mucosa may be the various factors that can cause urethral stricture.[14,15]

The overall incidence of PTS varies between 2.2% and 9.8%.[16-18] The overall incidence of PTS in our study is 12.1%. Lentz *et al.* in their TURP audit, which is the largest study, had reported an overall incidence of 6.3%.[19] Rassweiler *et al.* in their study had an incidence of up to 9.8%.[12] Varkarakis *et al.* in their study reported an incidence of 1.7%.[20]

The common factors that cause PTS include resection of large volume prostate glands, presence of prostate cancer, surgeon's experience, failure to calibrate, inappropriate sheath size, and insufficient lubrication.[21,22] Prostate gland assessment was done clinically by DRE. The prostate weight assessment was clinically done in grams as suggested by Reis *et al.* where they made a scaled standardization of clinical impression of the weight of prostate gland, based on the fingerprints graphical schema.[23] Meatal stenosis and submeatal stenosis occur due to inappropriate use of instruments. Fossa navicularis strictures occur due to failure of calibration before TURP. A penile urethral stricture occurs due to the friction and rotating movements of the resectoscope, S bend, electrothermal leakage, and longer operating time.[24,25] Bulbar urethral strictures occur commonly due to inappropriate resectoscope sheath use.[26] Meatal involvement continues to be the most common site of involvement of PTS.[27,28] However, in our study, 35 of 57 (61%) developed bulbar urethral strictures.

Meatal strictures usually occur because of an inappropriate relationship between the size of the instrument and the diameter of the urethral meatus. Bulbar strictures occur because insufficient isolation by the lubricant causes monopolar current to leak. The lubricant should be applied carefully in the urethra and along the shaft of the resectoscope. The lubricant must be reapplied in cases of longer resection time. Moreover, Faul P suggested that a high cutting current should be avoided and internal urethrotomy must be performed before TURP if there are preexisting meatal or urethral strictures.[29] Bladder neck contractures occur commonly in smaller glands and patients presenting with higher storage symptoms. Ensuring proper indication in these patients before TURP is a must along with a prophylactic bladder neck incision at the end of the procedure to reduce the incidence of bladder neck contractures.[30,31]

The size of the resectoscope sheath is a major determinant of the ultimate outcome. The use of small-diameter resectoscope shafts resulted in a significant reduction in the incidence of PTS in our study. Günes *et al*. described a higher incidence of PTS in those patients who underwent TURP using a larger resectoscope sheath.[32] In their study on 71 patients, they observed an overall stricture rate of 11% and a higher rate of strictures in those with a larger sheath being used. However, it may be necessary to have a properly randomized study comparing different sheath sizes with the incidence of PTS.

Catheter size also plays an important role in urethral stricture development along with traction applied which can lead to bulbar urethral stricture.[33,34] Catheter-induced strictures are more commonly seen in the distal bulb, penoscrotal junction, and fossa navicularis. Traore, in his study on acquired urethral strictures, observed that 30 of 46 strictures were located at the distal bulb or penile urethra or fossa navicularis.[35] Altough not much of literature evidence is available to support our data, in our series, we could observe that there was a statistically significant stricture rate observed in patients who needed a larger sized catheter. Only 10% of patients (2 of 20) who had a smaller catheter developed stricture, which underlines the need for use of a smaller catheter after TURP. Most of the strictures presented after 6 weeks of resection. Most of them had voided well initially with a good uroflow, but the flow decreased after 6 weeks. There is a need for a periodic follow-up at regular intervals.

Limitations of our study

The major limitation of our study was the difficulty in maintaining uniformity in the protocol in choosing resectoscope size and the preoperative calibration. As ours was a retrospective observational study over a study period of 2 years, TURP done by senior consultants with different practising methodologies were included in our study.

CONCLUSIONS

TURP is one of the common surgical procedures performed by urologists. Various factors decide the incidence of PTS. Factors such as the size of resectoscope sheath used, the caliber of catheters used, placement of Salvaris swab traction, and preoperative calibration of the urethra have a significant impact on the ultimate outcome. Most studies indicate an overall incidence of <10%. Inclusion of strictures involving the anterior urethra and meatus would significantly increase the overall stricture rates. Most strictures develop after a period of 6 weeks, while the initial postoperative uroflowmetry may be normal. Such patients need to be on a regular follow-up, which would enable us to identify more of post-TURP strictures.

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Conflicts of interest

There are no conflicts of interest.

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