Original Article

Incidence of urethral stricture and urinary incontinence after transurethral resection of the prostate

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Background: Transurethral resection of the prostate (TURP) is the standard treatment for benign prostatic hyperplasia (BPH). The incidence of postoperative urethral stricture (US) and urinary incontinence remains clinically important, and their predictors are not fully established. This study aimed to determine the incidence of these complications and identify associated risk factors. **Materials and Methods:** This retrospective cohort study was conducted at Al-Zahra Hospital, Isfahan, Iran, between 2020 and 2023. A total of 110 male patients with BPH who underwent TURP and completed 6 months of postoperative follow-up were included. Baseline variables (age, prostate volume, and operative duration) were extracted from medical records. Complications were assessed at 6 months, specifically the occurrence of US, urinary incontinence, and the composite outcome defined as either stricture or incontinence. An independent samples *t*-test compared mean values between groups, and logistic regression was used to identify predictors. **Results:** The mean age of patients was 68.2 ± 11.6 years, the mean prostate volume was 38.9 ± 10.3 mL, and the mean operative duration was 96.8 ± 17.4 min. The incidence of US was 9.1% (18.2 cases per 100 person-years), urinary incontinence 6.4% (12.7 cases per 100 person-years), and the composite outcome 15.5% (30.9 cases per 100 person-years). Patients with US had slightly lower age and smaller prostate volume but longer operative duration; none of these differences were statistically significant. Patients with urinary incontinence were significantly older (78.1 ± 9.4 vs. 67.5 ± 11.4 years, $P = 0.018$). Logistic regression confirmed age as an independent predictor of incontinence (odds ratio = 1.095, 95% confidence interval: 1.011–1.186, $P = 0.025$). No significant predictors were identified for stricture or the composite outcome. **Conclusion:** The incidence of US and urinary incontinence after TURP was modest, with age emerging as a significant predictor of incontinence. Elderly patients undergoing TURP should be counseled about the increased risk of postoperative incontinence, and perioperative strategies may be needed to mitigate this risk.

Key words: Incontinence, transurethral resection of the prostate, transurethral resection of the prostate, urethral stricture

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INTRODUCTION

Urethral stricture (US) is a known and somewhat frequent complication following transurethral resection of the prostate (TURP), a principal surgical technique for addressing benign prostatic hyperplasia (BPH), and lower urinary tract symptoms indicative of benign prostatic obstruction.[1] TURP is regarded as the "gold standard" for its shown efficacy and lasting effects; yet, problems such as US continue to occur despite improvements in surgical expertise and endoscopic technology.[2]

The documented incidence of US formation following TURP ranges in the literature, ranging from 4% to 29%.[3] Strictures predominantly occur in the membranous urethra; however, the bulbar urethra is also commonly involved.[3] The US can profoundly affect a patient's quality of life by inducing dysuria, resulting in recurrent infravesical obstruction and frequently requiring many surgical procedures.[4] The primary etiology of US is frequently ascribed to excessive scar tissue development due to intraoperative damage to the urethral mucosa and persistent inflammation.

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The emergence of US s following TURP is affected by various factors, such as postoperative urinary infections, patient age, length of postoperative catheterization, disease histology, resection characteristics, patient comorbidities, preexisting conditions, recurrent bladder drainage, and prostate volume.[5]

TURP is the principal surgical technique and is widely regarded as the gold standard for addressing BPH and associated lower urinary tract symptoms due to its demonstrated efficacy and lasting effects. However, the US remains a known and somewhat frequent complication of TURP, persisting despite continuous improvements in surgical expertise and endoscopic technology. The US can significantly impact a patient's quality of life, leading to dysuria, recurrent infravesical obstruction, and often necessitating multiple surgical procedures. The development of USs is influenced by various factors, including mechanical trauma, infection, patient age, resection characteristics, and the length of postoperative catheterization. Therefore, the present study aimed to determine the incidence of US and urinary incontinence following TURP and to identify potential risk factors associated with these complications in a cohort of patients treated in Iran.

METHODS

Study design and setting

This retrospective cohort study was conducted at Al-Zahra Hospital, Isfahan, Iran, between 2020 and 2023 (1399-1402). The study population consisted of male patients diagnosed with BPH who underwent TURP. During the study period, 110 patients who met the inclusion criteria and had complete medical records and follow-up data were enrolled and analyzed. All patients were followed for 6 months after surgery to evaluate postoperative complications.

Eligibility criteria

Inclusion criteria were adult men with BPH who underwent TURP during the study period and completed 6 months of postoperative follow-up. Exclusion criteria included preexisting US, previous urological surgery, long-term urinary catheterization before TURP, seminal vesicle stones, and lichen sclerosus of the penis. Patients with prolonged catheterization after TURP or insufficient cooperation during follow-up were also excluded.

Outcome assessment

The US was diagnosed and confirmed by a urologist using patient history, physical examination, uroflowmetry, postvoid residual measurement, endoscopy, and urethrography, in accordance with international guidelines. Urinary incontinence was assessed through patient – reported outcomes and clinical evaluation, following established recommendations for male lower urinary tract dysfunction.[6]

In addition to analyzing each complication separately, a composite outcome variable was defined: Composite outcome 1 (either complication), representing the occurrence of US or urinary incontinence during follow-up. This composite measure was designed to capture the overall burden of complications after TURP.

Variables

The variables analyzed included patient age, prostate volume measured by ultrasound, operative duration, US, urinary incontinence, and the composite complication variable.

Statistical analysis

Descriptive statistics (mean ± standard deviation for continuous variables; frequency and percentage for categorical outcomes) were used to summarize baseline characteristics and complication rates. Incidence proportions were calculated for the US, urinary incontinence, and the composite outcome. Independent samples *t*-tests were applied to compare mean values of age, prostate volume, and operative duration between patients with and without each complication. Logistic regression analyses were performed to identify predictors of US, urinary incontinence, and the composite outcome. Odds ratios (ORs) with 95% confidence intervals (CIs) were reported, and $P < 0.05$ was considered statistically significant. All analyses were conducted using IBM SPSS Statistics for Windows, Version 27.0 (IBM Corp., Armonk, NY, USA).

RESULTS

A total of 110 patients were included in the study. The mean age was 68.2 ± 11.6 years (range 35–92). The mean prostate volume was 38.9 ± 10.3 mL (range 21–76), and the mean operative duration was 96.8 ± 17.4 min (range 55–120). During 6 months of follow-up, US occurred in 10 patients (9.1%), urinary incontinence in seven patients (6.4%), and the composite outcome in 17 patients (15.5%). When expressed as incidence rates per person-time, these corresponded to 18.2 cases per 100 person-years for the US, 12.7 cases per 100 person-years for urinary incontinence, and 30.9 cases per 100 person-years for the composite outcome.

To examine the relationship between baseline variables and postoperative complications, comparisons were made between patients with and without US, urinary incontinence, and the composite outcome (either stricture or incontinence). Table 1 summarizes the mean values of age, prostate volume, and operative duration across these groups.

Table 1: Mean values of age, prostate volume, and operative duration by complication status

Variable	Stricture		*P*	Incontinence		*P*	Composite		*P*
	Yes	No		Yes	No		Yes	No	
Age (years)	65.9±8.7	68.4±11.8	0.518	78.1±9.4	67.5±11.4	0.018*	70.9±10.7	67.7±11.7	0.286
Prostate volume (mL)	35.8±6.3	39.3±10.6	0.313	40.0±8.1	38.9±10.4	0.778	37.5±7.2	39.2±10.8	0.541
Operative duration (min)	103.0±16.4	96.2±17.4	0.240	95.0±16.8	96.9±17.5	0.776	99.7±16.5	96.3±17.6	0.459

*Significant at $P<0.05$. Composite=Eexpreiencing either one; *P*=Resulted from independent samples *t*-test

Patients with US had slightly lower age and smaller prostate volume but longer operative duration; none of these differences were statistically significant. Patients with urinary incontinence were significantly older (78.1 vs. 67.5 years, $P = 0.018$), while prostate volume and operative duration did not differ. For the composite outcome, affected patients tended to be older, with somewhat smaller prostate volumes and longer operative times, but differences were not statistically significant.

Logistic regression analysis was performed separately for the US, urinary incontinence, and the composite outcome. For the US, none of the predictors were statistically significant (age $P = 0.917$; prostate volume $P = 0.182$; operative duration $P = 0.118$). For urinary incontinence, age was a significant predictor (OR = 1.095; 95% CI: 1.011–1.186; $P = 0.025$), indicating that each additional year of age increased the odds of incontinence by approximately 9.5%. Prostate volume ($P = 0.871$) and operative duration ($P = 0.951$) were not significant. For the composite outcome, none of the predictors reached statistical significance (age, $P = 0.139$; prostate volume, $P = 0.188$; operative duration, $P = 0.215$).

DISCUSSION

This study provides valuable insights into the incidence of US and urinary incontinence following TURP, and how various clinical parameters relate to these complications.

The study found a US incidence of 9.09% (10/110) after TURP, which falls within the range reported in the literature, which varies from 4% to 29%.[7] This is consistent with many other studies, such as one study reporting an incidence of 11.65% (12 out of 103 patients).[3] More recent studies observed rates such as 7.92% in the TURP arm of a comparative study,[8] 3.5% for bipolar Plasmakinetic TURP (PK-TURP),[9] 7.8% in a Chinese center,[10] and 6.97% in another retrospective analysis.[4]

Our results indicated no statistically significant differences in age, prostate volume, or resection time between patients who developed US and those who did not. Although stricture patients had a slightly younger age, smaller prostate volume, and longer resection time, these nonsignificant numerical differences confirm that US occurrence post-TURP was not strongly associated with these specific clinical parameters in this cohort.

This finding contrasts with external literature, where age has been identified as a risk factor, with some studies suggesting a higher risk of stricture development in younger age groups. Similarly, prostate volume was not found to be a statistically significant direct factor for stricture. While our study found resection time to be nonsignificant ($P = 0.193$), external literature consistently suggests that longer resection time is associated with a higher risk of US/bladder neck contracture.

Resection time was strongly supported and found to be statistically significant by numerous sources. Durmus *et al*.[11] reported that resection time was significantly higher in patients with US (53.1 ± 10.8 min vs. 42.2 ± 9.7 min, $P < 0.001$). Gür *et al*.[12] also found prolonged operative time to be a significant risk factor, suggesting that prolonged resectoscope use can lead to urethral inflammation and ischemia, causing mucosal damage and increasing stricture risk. Elsaqa *et al*.[8] concluded that longer operative time was associated with a higher risk of US/bladder neck contracture.

Tao *et al*.[10] identified lower resection speed as an independent risk factor for US, linking it to unfavorable surgical processes such as hemorrhage, poor vision, and prolonged operative time. Tan *et al*.,[9] specifically for bipolar PK-TURP, found slow resection rate to be the only significant risk factor in their multivariate analysis.

Another systematic review and meta-analysis found a pooled incidence of bladder neck stenosis (BNS) at 1.3% after TURP, 1.4% after M-TURP, and 0.1% after B-TURP.[13] However, this meta-analysis concluded no statistically significant difference in BNS rates between TURP and Ablation or Enucleation procedures.

The data may not encompass postoperative urinary infections, duration of postoperative catheterization, disease histology, resectoscope size or instrument diameter, intraoperative urethral mucosa rupture, presence of chronic prostatitis, repeated bladder drainage, comorbidities, and the type of energy utilized (bipolar vs. monopolar TURP). The potential etiologies of US following TURP are often regarded as controversial and encompass mechanical trauma from the resectoscope, electrical injury due to stray current, infection, and the temperature of the irrigation solution.[14-17]

The size of the resectoscope, specifically the instrument diameter, was identified as a statistically significant factor in the development of scar-sclerotic changes, indicating that larger diameters are associated with a heightened risk.[4] However, Durmus *et al*.[11] reported no significant difference in resectoscope size between the groups.

Urethral mucosa rupture is recognized as an independent risk factor for US, resulting from the loss of urethral mucosal integrity, which leads to urine leakage, inflammation, and scar formation.[8,10] Chronic prostatitis is a significant factor in the development of US and bladder neck contracture, with histological examination indicating increased inflammatory processes in the complication group.[4] Frequent bladder drainage via a urethral catheter emerged as a statistically significant risk factor, likely attributable to the need for endoscopic surgery and bladder irrigation, which heightens the risk of trauma and infection.[4]

Diabetes mellitus and other comorbidities were identified as significant risk factors for early US.[12] Elsaqa *et al*.[8] noted a higher incidence of US with bipolar TURP (9.8%) compared to monopolar TURP (5%). In addition, Tan *et al*.[9] addressed this ongoing debate.

The study has several limitations: it employs a retrospective design, is conducted at a single center, has a limited sample size and statistical power, lacks specificity concerning the TURP technique, is subject to patient exclusion bias, does not define a primary outcome, has a limited follow-up duration for assessing long-term complications, and may be affected by documentation inaccuracies and recall bias. The findings of the study may lack generalizability to other patient populations, healthcare systems, or surgical practices across various regions or countries. The limitations of the study hinder the establishment of definitive cause-and-effect relationships and the broad application of findings across various clinical scenarios.

CONCLUSION

This retrospective cohort study of 110 patients undergoing TURP demonstrated that US and urinary incontinence occurred in 9.1% and 6.4% of patients, respectively, with a composite incidence of 15.5% at 6 months. No statistical association was observed between US and urinary incontinence, and baseline variables such as prostate volume and operative duration were not significant predictors. However, older age was identified as an independent risk factor for postoperative urinary incontinence.

These findings suggest that while US may arise independently of age and operative parameters, urinary incontinence is strongly age-related. Clinically, this highlights the importance of preoperative counseling and tailored perioperative management for elderly patients undergoing TURP. Future studies with larger sample sizes and longer follow-up are warranted to further clarify risk factors for US and to explore preventive strategies for postoperative incontinence.

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Conflicts of interest

There are no conflicts of interest.

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