Correlation Between Urethral Length and Urethral Stricture After Transurethral Resection of Prostate

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Abstract

Aim: To show the effects of urethral length, and surgical or patient related parameters on urethral strictures after Transurethral Prostate Resection (TURP).

Methods: The study included 127 patients who underwent TURP for benign prostate hyperplasia (BPH) unresponsive to medical treatment in our clinic between May 2019 and February 2020. The patients were separated into two subgroups as those who underwent second surgery because of urethral stricture and those who did not. These two groups were compared in respect of age, height, weight, total prostate specific antigen, fall in hemoglobin values, increase in urine peak flow rate, decrease in the post-micturition residual volume, prostate volume, operating time, tissue amounts, resection rate, and urethral length.

Results: Urethral stricture was determined in 13.4% of the patients. A statistically significant difference was determined between the two groups in respect of age and urethral length ($p<0.05$). At the postoperative 6-week follow-up, urine peak flow rates were seen to be statistically significantly lower in the stricture group ($p<0.05$).

Conclusions: Together with an increase in urethral length there could be an increased risk of damage to the urethral mucosa, and it should be kept in mind that this could contribute to the development of urethral stricture.

Keywords: *Benign prostate hyperplasia; urethral stricture; urethral length; transurethral prostate resection*

1. Introduction

Transurethral resection of the prostate (TURP) is the gold standard surgical treatment method for prostates of moderate volume (30-80 cc) and lower urinary system symptoms that have formed due to benign prostate hyperplasia (BPH). Although the high success rates of TURP have been proven with symptom scores, urine flow rates, and other functional parameters, this surgery has been associated with significant morbidities such as perioperative and postoperative bleeding, prolonged length of stay in hospital, recurrent urethral strictures, urinary incontinence, retrograde ejaculation, and erectile dysfunction.[1] Urethral stricture, which is one of the oldest and most difficult to treat diseases in urology, is known to be caused by scar formation in the urethral subepithelial tissue. Urethral strictures are seen in the late period in 2.7% of endourological interventions.[2] It has been reported in the range of 2.2%-9.8% following TURP.[3] Stricture is seen within the first 6 months in most patients.

The monopolar energy used in the traditional method has been replaced by bipolar energy based on a new radiofrequency system. Bipolar energy is a part of the electromagnetic spectrum, and requires completion of the bipolar current in the electrode used. Different techniques are used for this, and the current emerging from the end of the electrode can be converted to a second parallel electrode.[4] Isotonic physiological saline is used as fluid. In surgeries where this method is used, there has been shown to be a lower risk of urethral stricture as the electric current does not pass through the urethra.[5]

The etiology of urethral strictures is examined in four main groups of idiopathic, iatrogenic, inflammatory, and traumatic. Idiopathic and iatrogenic strictures are the most common strictures seen at the rate of 33%, followed by traumatic causes at 19% and inflammatory causes at 15%[6]. The leading iatrogenic cause, at the rate of 41%, is transurethral resections (TUR). Other causes include prolonged urethral catheterization, hypospadias repair, and prostatectomy procedures (open, laparoscopic or robotic prostatectomy).[7]

Patients with urethral stricture after prostate surgery usually present with weak urine flow, urinary infection, and sometimes acute retention.[5] Just as the length of the stricture may be very short, panurethral strictures may also be seen. It has been shown that urethral stricture may be associated with resection duration, catheter type, catheterization duration, catheter diameter, pathology result, and urinary infection, either singly or as a combination of several of these.[8] However, no study comparing urethral length and stricture development could be found in the literature, so this research was

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planned based on the thought that urethral length may contribute to the development of stricture after surgical procedures.

In this study, patients who underwent bipolar TURP in our clinic as surgical treatment for BPH were evaluated. The patients were grouped according to the development or not of postoperative urethral stricture. These two groups were compared in respect of patient characteristics, total prostate specific antigen (tPSA), prostate volume, resection amount, resection amounts per minute, changes in hemoglobin values after the procedure, the pre-post procedure change in the amount of post-micturition residual urine (PMR), the pre-post procedure change in urine peak flow (Qmax), and urethral length.

2. Materials and methods

The study was a retrospective, that included patients who underwent bipolar TURP because of BPH unresponsive to medical treatment in the Urology Department of Baskent University between May 2019 and February 2020. All the patient information was obtained from the hospital records. The absence of previous urethral stricture in all patients was confirmed by cystoscopy before TURP. Each patient underwent urethra calibration with 30f bougie dilators during TURP. The patients with available data were separated into two groups as those who developed and did not develop urethral stricture. The diagnosis of urethral stricture was made during cystoscopy performed on those who had difficulty urinating after the TURP. A record was made for each patient of the patient characteristics, tPSA, operating time, prostate volume, resection amount, resection amounts per minute, changes in hemoglobin values after the procedure, the pre-post procedure change in the amount of PMR, the pre-post procedure change in Qmax, and urethral length. The first postoperative evaluations were made at 6 weeks postoperatively.

The surgical procedure was performed using an Olympus® bipolar resection device (Olympus Europa SE & Co., Hamburg, Germany). It was ensured that the temperature of the irrigation fluid used in the surgical procedure was equal to room temperature. Postoperatively, a 22F 3-way Rusch® Gold Foley catheter (Teleflex Medical, Republic of Ireland) was placed as standard. Urethral length was measured as shown in Figure 1, by placing the catheter and holding the penis stretched with the patient in the lithotomy position immediately before starting surgery, and this measurement was recorded [|CD| = |AB| - (|AC| + |BD|)].

2.1. Statistical Analysis

Data obtained in the study were analyzed statistically using SPSS vn. 25.0 software (SPSS Inc., Chicago, IL, USA). Descriptive statistics for continuous variables were stated as mean±standard deviation (SD) values depending on normality assumptions, and categorical variables as number (n) and percentage (%). Conformity of the variables to normal distribution was examined with the Shapiro-Wilk test. As the data were not normally distributed, differences between the groups were examined with the Mann Whitney U-test. Risk factors affecting the development of urethral stricture were evaluated with Stepwise Binary Logistic Regression analysis. Type I error probability was defined as 0.05 in all the analyses

3. Results

Evaluation was made of 127 patients, comprising 17 (13,4%) who developed urethral stricture and 110 (86,6%) who did not develop urethral stricture. The descriptive characteristics and postoperative values of the patients are shown in Table 1. With the exception of age, no significant difference was determined between the groups in respect of height, weight, body mass index, preoperative tPSA values, prostate volume, operating time, amount of tissue resected, resection rate, change in hemoglobin, and changes in PMR urine.

The mean follow-up period was 11.8±8.01 months. At the 6-week postoperative examination, the change in Qmax values was observed to be statistically significantly lower in the group that developed urethral stricture [respectively 15 (-1 - 29) ml/sec, 11 ml/sec (-5 - 19) ml/sec; p=0.027]. A difference of 1ml/sec in the Qmax change was seen to increase the risk of urethral stricture development 1.1-fold (96% confidence interval (CI): 1.017-1.200). Urethral length was determined to be median 23 cm (19 - 28.9 cm) in the group that developed stricture, and median 21.4 cm (16.7 - 27.3 cm) in the group that did not develop stricture, and the difference between the groups was statistically significant (p=0.002). An increase of 1cm in urethral length was determined to increase the risk of developing urethral stricture 1.44-fold (96% CI: 1.108-1.872).

Table 1

Comparison of patients with and without urethral stricture after TURP

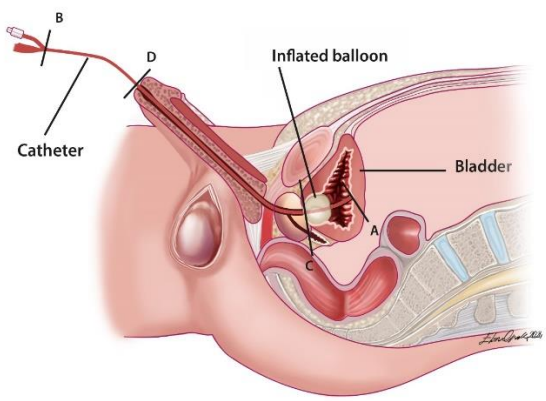
	Developing Urethra Stricture (n=17)	Not Developing Urethra Stricture (n=127)	p
Age	67 (54-75)	68 (52-93)	0,045*
Height (mt)	1.77 (1.65 - 1.92)	1.73 (1.55 - 1.86)	0.311
Weight (kg)	81 (66 - 123)	78 (50 - 120)	0.191
BMI (kg/m^2)	27.68 (21.68 - 37.87)	26.55 (19.53 - 41.52)	0.376
tPSA (ng/dl)	2.94 (0.5 - 13.71)	2.89 (0.45 - 176)	0.715
Duration of operation (min)	50 (30 - 155)	58.5 (20 - 178)	0.339
Prostat Volume (ml)	72 (23-140)	65 (24-180)	0,676
Tissue Amount (gr)	18.3 (4.3 - 60)	17.4 (3.2 - 118.7)	0.804
Resection Rate (gr/min)	0.28 (0.1 – 0.57)	0.27 (0.09 - 0.74)	0.463
Qmax change (ml/sn)	11 (-5 - 19)	15 (-1 - 29)	0.027*
Hemoglobin Change (gr/dL)	-0.6 (-3.4 – 0.4)	-1.1 (-6.6 – 2.1)	0.316
PMR change (ml)	-65 (-470 - 50)	-140 (-1485 - 25)	0.097
Urethra Length (cm)	23 (19 - 28.9)	21.4 (16.7 - 27.3)	0.002*

mt: meter, kg: kilogram, ng: nanogram, dl: deciliter, min: minute, ml: mililiter, gr: gram, sn: second, cm: centimeter
**p<0.05*

4. Discussion

Benign prostate hyperplasia (BPH), which is one of the most common causes of lower urinary tract symptoms (LUTS), is a frequently seen condition. TURP is the gold standard surgical treatment method for patients with LUTS unresponsive to medical treatment and for those with predominantly evacuation symptoms. In a 1962 study by Holtgreve et al. of a series of 2105 cases in the period when

Figure 1
Measurement of urethra length



TURP first came into use, it is striking that the mortality rate associated with TURP was reported to be 2.5%[9]. In subsequent years, this rate reduced dramatically, reaching 0.25% in recent series[9].

The main reason for this decrease is the developments in anaesthesia and surgical procedures.[10] Although TURP-related complications have gradually decreased, technical complications are still seen such as bleeding, capsule perforation, TUR syndrome, clot retention, urinary system infection, hydronephrosis, urosepsis, and incontinence. In addition to these complications, cardiac arrhythmia, myocardial infarctus, pulmonary embolism, pneumonia, chronic obstructive pulmonary disease, and postoperative deep vein thrombosis have been documented in 0.5%-11% of patients.[10]

To the best of our knowledge, there is no direct formula providing the actual urethral length in adults. However, Sreekanth et al. demonstrated a formula for urethral length according to age, height, and weight in children aged 1-15 years[11]. The urethral length was first measured with the help of a Foley catheter, then formulised according to height and weight. However, when compared according to the results of the current study, this formulation was not seen to provide an accurate result in adults. As seen in the current study, the real urethral length could be obtained with direct measurements using a urethral catheter.

Another important long-term complication of TURP is generally a difficulty in urinating because of urethral strictures or narrowness of the bladder neck. Urethral stricture is usually due to injury to the urethral mucosa and surrounding tissues. Urethral strictures can be classified as anterior and posterior, with anterior comprising 92.2%. Most occur in the bulbar urethra alone (46.9%), followed by in the penile urethra alone (30.5%), or bulbar and penile strictures (9.9%), and finally, pan-urethral strictures (4.9%).[12] In literature, the rate of urethral stricture has been reported to vary between 2.2% and 9.8%, and the rate of bladder neck stricture as 0.3%-9.2%.[13] In the current study, these rates were higher at 13.2%. Meatal strictures are generally due to incompatibility between the urethral meatus diameter and the device diameter, and bulbar strictures form because of monopolar current leakage as a result of insufficient isolation by lubrication gel. To prevent the development of urethral stricture, sufficient lubricant must be applied to the urethra and along the outer sheath of the resectoscope, and lubricant must be re-applied when the resection time is long.

Instead of the use of monopolar energy, bipolar energy is currently used. Tefekli et al. suggested that bipolar TURP caused a higher incidence of stricture than monopolar TURP[14]. Hueber et al. compared the results of 43 males at 6 months postoperatively and reported no significant difference between the two techniques.[15] In another study with a short follow-up period, Mamoulakis et al. reported that another intervention was necessary because of urethral stricture in 12 (9.9%) of the 121 patients in the monopolar TURP arm and in 20 (14.8%) of the 135 patients in the bipolar TURP arm (p=0.32).[16] In a review comparing bipolar and monopolar TURP results, Sinha et al. reported that from 9 studies that mentioned postoperative urethral stricture and bladder neck stricture, a significant increase in urethral stricture was only determined in the bipolar TURP group of a study by Stucki et al. (p=0.002).[17,18] Although the current does not pass through the urethra in bipolar TURP, there has been no significant decrease in the number of patients presenting with stricture. Urethral stricture can cause repeated urethral interventions or more costly urethroplasty operations for these patients. Therefore, it is recommended that a high current should be avoided during resection and urethra calibration with meatal or urethral dilatation should be performed before TURP.[19]

Despite standard surgical procedures performed with the same device and the same method, urethral strictures continue to be seen in patients. Tao et al. reported the development of urethral stricture in 29 (7.8%) of 373 patients.[20] A slow resection rate is seen as another risk factor as it is associated with poor surgical outcomes such as bleeding, prolonged operating time, more fluid leakage/absorption, and urethral mucosal damage, which are potential causes of urethral stricture[21]. However, in the current study, no significant difference was found between the two groups in respect of resection rates.

In the study by Tao et al., urethral length was not investigated as a cause. Although urethral mucosa rupture seems to be a plausible cause, it would not be wrong to think that urethral length could increase the probability of mucosal rupture. The presence of urethral mucosa rupture has been found to be an independent risk factor. When the integrity of the urethral mucosa is disrupted, it has been reported that there will be urine leakage below the epithelium, and consequently, there will be inflammation and scar formation.[20] However, there is also a study showing that the development of urethral stricture can be prevented with the suppression of inflammation with colchicine treatment.[22] In that study, the authors showed that stricture could be prevented by colchicine blocking the arachidonic acid lipoxygenase pathway, reducing inflammation and chemotaxia, preventing leukotriene formation and intervening in procollagen transcellular migration.

It has been reported that generally age is not a significant factor in urethral strictures developing after TURP.[23] In contrast, there is also a study reporting that patient age is a significant factor.[24] Balbay et al. determined the median age of patients to be 61.7 years (49-75 years) in those who developed urethral stricture after TURP, and 66.8 years (45-96 years) in those who did not develop stricture.[24] Similarly, our study concluded that age is an important factor for urethral stricture. The median age of the patients who developed stricture was determined to be younger, similar to the above-mentioned study.

To the best of our knowledge, there is no previous study in literature that has shown that urethral length contributes to urethral stricture developing after TURP. The relationship between an increase in urethral length and the development of urethral stricture can be considered a reason for the greater risk of urethral mucosal damage in patients with a long urethra. That the urethral length was greater in the group that developed stricture after surgery was an expected result in this study.

4.1. Limitation

The main limiting factor of this study seems to be that the surgical treatments were performed by different surgeons. In addition, there were very few subjects with urethral stricture. Therefore, there is a need for further studies with greater numbers of patients and a high level of evidence to confirm these findings.

5. Conclusion

The results of this study demonstrated that it would be beneficial to take more care in respect of the development of urethral stricture following TURP in cases where the resectoscope sheath is in contact with the urethral meatus, in other words in cases where urethral length is greater. To prevent the development of urethral stricture in these cases, attention must be paid to the frequent use of lubricating gel to the urethra, and urethra calibration before the procedure would also be useful in preventing stricture development.

Statement of ethics

The present study protocol was reviewed and approved by Baskent University Institutional Review Board and Ethics Committee (Project no: KA 19/93).

Conflict of interest statement

The authors declare that they have no financial conflict of interest with regard to the content of this report.

Availability of data and materials

The data supporting this study's findings are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Author contributions

Eray Hasirci: Substantial contributions to the conception and design of the work; and the acquisition, analysis, and interpretation of data for the work. Drafting the work. Final approval of the version to be published. Responsibility for all aspects of ensuring questions regarding the accuracy of the work.

Enis Kervancioglu: Acquisition, reviewing the work critically for important intellectual content. Final approval of the version to be published. Responsibility for all aspects of ensuring questions regarding the accuracy of the work.

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