Risk factors for developing urethral stricture in patients that underwent transurethral resection of the prostate

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Original Article

KEYWORDS
Stricture; Urethra; Transurethral resection of the prostate; Mexico.

Abstract

Background: Transurethral resection of the prostate (TURP) is currently one of the most widely used treatments for managing prostatic hyperplasia. One of the risks of this procedure is the formation of urethral stricture, defined as a narrowing of the urethral lumen secondary to cicatrization. Different factors intervene in the formation of urethral narrowings in patients that undergo TURP.

Aims: To determine the risk factors for post-TURP urethral stricture.

Results: In accordance with the established criteria, a total of 63 patients were included in the study; 30 belonged to the group that developed stricture (group A) and 33 belonged to the group that did not (group B). The International Prostate Symptom Score (IPSS) was applied prior to the TURP; group A had a mean score of 19.03 ± 3.78 points and group B of 19.48 ± 5.42. The mean postoperative IPSS for group A was 16.27 ± 5.12 points and for group B was 8.88 ± 4.20 points. A total of 36.7% of the patients that developed stricture had preoperative Foley catheter placement, whereas 69.7% of the patients that did not develop stricture had a catheter at some point prior to surgery (p<0.005).

Mean surgery duration for group A was 57.17 ± 17.74 minutes vs. 57.12 ± 20.04 minutes for group B. In group A, surgery lasted more than 60 minutes in 60% of the patients (n=18) and was under 60 minutes in 40% (n=12). In group B, surgery duration was over 60 minutes in 42.4% (n=14) of the patients and under 60 minutes in 57.6% (n=19). In the patients presenting with stricture, the transurethral Foley catheter remained in place after TURP for 8.90 ± 3.91 days vs. 5.15 ± 3.0 days in the patients with no stricture (p<0.05).

Conclusions: The principal risk factors for urethral stricture formation in patients that underwent TURP were a prostate volume greater than 80 g determined through transabdominal or transrectal ultrasound prior to surgery, urethral dilatation immediately prior to the procedure, resection duration greater than 60 minutes, and the prolonged use of a transurethral catheter following surgery (8.9 ± 3.91 days).
Introduction

Benign prostatic hyperplasia (BPH) is currently one of the most frequent health problems affecting the adult male population. It is estimated that 10% of men present with BPH at 30 years of age, 20% at 40 years, 50-60% at 60 years and 80% to 90% at 70 and 80 years of age.1

BPH is the result of the proliferation of fibroblasts, myofibroblasts, and glandular epithelial elements near the urethra in the transitional zone of the prostate.2-5

An enlarged prostate is found in only some of the men presenting with urinary symptoms. Taking into account that the normal size of the prostate is from 20 to 30 mL in the young adult, it has been established that a volume greater than 30 mL represents clinical prostatic hyperplasia.6 Currently, the International Prostate Symptom Score (IPSS) is used for clinical management in patients with lower urinary tract symptoms. Some of the other instruments that are employed are the hyperactive bladder symptom scale, the urinary perception score, and the lower urinary tract symptom result score (table 1).7,8

The clinical diagnosis of BPH is made through obtaining the clinical history from the patient and carrying out the complete medical interview and physical examination. Studies such as ultrasound imaging enable a more precise prostatic volume to be established. Cystourethroscopy has been shown to be less precise in determining the size of the prostate gland. Nevertheless, the shape of the prostate gland can be determined through this type of procedure, and its macroscopic aspect, in accordance with studies carried out by Randall in 1931, can be established.9,10

Treatment for prostatic hyperplasia is medical or surgical. Recurrent urinary tract infections, bladder lithiasis, acute urinary retention, symptomatology that is not resolved through medical management, bladder diverticula secondary to chronic prostatic obstruction, hematuria of prostatic origin, and elevated serum creatinine and urea due to prostatic obstruction are some of the indications for surgical management.

Transurethral resection of the prostate (TURP) is one of the most widely used surgical treatments worldwide and is considered to be the treatment of choice when drug therapy has not resolved the symptoms. Despite its being performed routinely, this procedure is not free from complications and they can be divided into intraoperative and postoperative ones. The intraoperative complications are blood loss, post-TURP syndrome, extravasation, and ureteral meatus injury.

There are early and late postoperative complications. An early complication is bladder tamponade due to heavy clot formation. Infection is rare, although one study reported its presence in 21.6% of the patients.11 Urinary retention,
### Table 1 The International Prostate Symptom Scale (IPSS)

<table>
<thead>
<tr>
<th></th>
<th>During the last 30 days...</th>
<th>During the last 30 days...</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not at all</td>
<td>Less than 1 in 5 times</td>
</tr>
<tr>
<td>1. Over the past month, how often have you had a sensation of not emptying your bladder completely after you finish urinating?</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2. How often have you to urinate again less than 2 hours after urinating?</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3. How often have you found you stopped and started again several times when you urinate?</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4. How often have you found it difficult to postpone urination?</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>5. How often have you had a weak urinary stream?</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>6. How often have you had to push or strain to begin urination?</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>7. How many times did you most typically get up to urinate from the time you went to bed at night until you got up in the morning?</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total Score**

- **0-7** Mild symptoms
- **8-19** Moderate symptoms
- **20-35** Severe symptoms

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incontinence, retrograde ejaculation, and erectile dysfunction are late complications. In the instant it is sufficiently reduced to obstruct the exit flow of urine, urinary symptoms, particularly emptying ones, appear and the patient seeks medical attention. Urethral strictures or narrowings can be divided into anterior and posterior ones. Those located in the posterior urethra are invariably the consequence of trauma or radical prostatectomy. It is necessary to recall the anatomy of the urethra to adequately understand the following pathologic description. The bulbous urethra is eccentrically placed in relation to the corpus spongiosum in the bulbus portion of the urethra and is much closer to the dorsum of the penile structures. As it gets closer to the urethral lumen. In the instant it is sufficiently reduced to obstruct the exit flow of urine, urinary symptoms, particularly emptying ones, appear and the patient seeks medical attention. Urethral strictures or narrowings can be divided into anterior and posterior ones. Those located in the posterior urethra are invariably the consequence of trauma or radical prostatectomy. It is necessary to recall the anatomy of the urethra to adequately understand the following pathologic description. The bulbous urethra is eccentrically placed in relation to the corpus spongiosum in the bulbus portion of the urethra and is much closer to the dorsum of the penile structures. As it gets closer to
the glans penis, the urethra is located more centrally within the corpus spongiosum (fig. 1). The corpus spongiosum receives its irrigation from the penile artery that, in turn, is a branch of the internal pudendal artery.

Any situation causing the formation of a scar inside the urethra is considered to be able to produce stricture. However, the main cause of urethral stricture is trauma. Unfortunately, iatrogenic trauma can be caused during any urethral manipulation, such as the placement of a catheter or diagnostic and/or therapeutic instrumentation in treating a urinary tract pathology. Some years ago, the frequency of urethral narrowings secondary to *Neisseria gonorrhoeae* and *Chlamydia* infection was higher. Today these infections are rare, thanks to the available treatments. A very strong relation has been found principally between lichen sclerosus, or balanitis xerotica obliterans, and meatal stricture, as a consequence of the very severe inflammatory process produced.

In general, patients present with obstructive and irritative urinary symptoms that are secondary to urinary infections. On occasion the patient complains of bifurcation and progressive weakening of the urinary stream that can lead to urinary retention. The introduction of a catheter can determine the presence and location of the narrowing. Before deciding on management, it is important to precisely determine the location, length, depth, and density of the stricture. This can be done through well-validated imaging studies such as urethrography and cystourethrography for establishing the location and length. Urethral ultrasound imaging identifies the density and depth of the stricture. Stricture can also be diagnosed through urethroscopy, but it is an invasive procedure and does not provide complete information about the stenosis. Once diagnosed, the stricture can be identified according to the classification established by Jordan in 1987 (fig. 2).

The main causes of post-TURP urethral stricture are associated with location. Meatal strictures are related to a proctoscope size that is greater than the size of the urethra, whereas bulbous strictures are related to the passage of monopolar current through the sheath of the proctoscope due to an insufficient amount of lubricant. It has been proposed that the lubricant should be applied to the meatus and all along the length of the proctoscope and application should be abundant and repeated in longer procedures. Likewise, the monopolar current used should not be very high so that urethral tissue damage is prevented. To preserve the urethra’s normal physiology, there should be a minimum of urethral manipulation, a small caliber proctoscope should be employed, there should be adequate blood circulation, and the postoperative Foley catheter should be used for the least amount of time possible.

The most frequent late TURP complications are urethral stricture and sclerosis of the bladder neck, which can present in up to 9.2% of patients. Despite the technologic advances in the instrumentation, lubricants, and energy used,
these complication rates have not varied. Supposedly, the use of new technologies such as laser and bipolar energy reduces the risk for stricture.²⁵,²⁶ However, recent publications have compared the use of bipolar energy for resection with monopolar energy and reported a higher rate of urethral stricture (6.1 vs. 2.1); this was mainly attributed to having to use a wider resection sheath.²⁷ Kuntz et al. reported similar urethral stricture rates upon comparing the holmium laser for resection and TURP, when a proctoscope was used for prostate tissue morcellation.²⁸,²⁹ These results show a multifactorial risk for the development of post-TURP urethral stricture that is dependent on factors such as technique, surgery duration, antibiotic regimen used, the use of a catheter, its material, and the length of time it is indwelling, etc.¹¹

**Methods**

A retrospective study was conducted after receiving authorization from the Research and Ethics Committee of the Hospital Regional Lic. Adolfo López Mateos. All male patients over the age of 18 years that underwent TURP at the Urology Service of the Hospital Regional Lic. Adolfo López Mateos of the ISSSTE, and that had a preoperative diagnosis of prostatic hyperplasia, were included in the study.

All patients with a past history of urethral trauma and/or pelvic fracture, a history of lithuria, patients previously treated with a modality other than TURP, not having studies confirming urethral stricture, or presenting with a previous urethral pathology were excluded. Those patients with no case records were eliminated from the study.

Voiding cystourethrogram and/or cystoscopy study were reviewed to confirm urethral stricture diagnosis in those patients with suggestive symptoms.

The patients were divided into 2 groups: group A: those patients with post-TURP urethral stricture diagnosis and group B: those patients that did not present with post-TURP urethral stricture diagnosis.

The following variables were recorded and analyzed: age, past history of pathology, diabetes mellitus diagnosis, high blood pressure diagnosis, recurrent urinary tract infections, prostate size obtained through ultrasound, prostate-specific antigen (PSA) prior to surgery, IPSS, catheter use prior to surgery, length of time of catheter use prior to surgery, urethral dilation prior to surgery, urethral stricture at the time of surgery, type of prostatic growth, duration of resection in minutes, volume of intraoperative blood loss, volume of resected prostate tissue, caliber of postoperative transurethral catheter, material of postoperative transurethral catheter, length of time the postoperative transurethral catheter was indwelling, the length of time between TURP and stricture diagnosis, stricture location, and the method employed for stricture diagnosis.

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**Figure 2** Jordan classification for urethral strictures. A) Mucosal fold. B) Iris constriction. C) Full-thickness involvement with minimal spongiosis. D) Full-thickness spongiosis. E) Inflammation and fibrosis affecting tissues outside the corpus spongiosum. F) Complex stricture complicated by a fistula.
After the data were collected, both groups were compared. The continuous variables were compared using the Student’s t test. Means, standard deviation, frequencies, and percentages of the collected data were obtained. Thirty patients for each group were analyzed.

**Results**

In accordance with the established criteria, a total of 63 patients were included in the study; 30 belonged to the group that developed stricture (group A) and 33 to the group that did not develop stricture (group B).

The demographic data are included in table 3. Of the group A patients, 33.3% (n=10) had a history of urinary tract infection prior to the TURP, whereas that figure was 27.3% for the group B patients.

The prostate volume calculated by ultrasound prior to surgery was significantly different in the 2 groups, with 62.93 ± 27.58 g for group A and 87.30 ± 60.83 g for group B (p<0.005).

The PSA results were very similar in the 2 groups, with 6.31± 4.73 ng/ml for group A and 6.15 ± 3.3 ng/ml for group B. The iPSS prior to the TURP for group A was 19.03 ± 3.78 points and for group B was 19.48 ± 5.42. The postoperative iPSS for group A was 16.27 ± 5.12 points and for group B was 8.88 ± 4.20 points (table 3).

A Foley catheter prior to prostate surgery was used by 36.7% (n=11) of the patients that developed urethral stricture, and 69.7% (n=23) of the patients that did not develop stricture used a catheter at some point before surgery (p<0.005).

The length of time that the group A patients used a catheter at some time prior to TURP was 38.67 ± 76.87 days vs. 82.61 ± 78.97 days for group B, with a p<0.005.

Urethral dilation was performed in a total of 32 patients prior to TURP; in 16 group A patients (53.3%) and in 16 group B patients (48.5%).

It is important to mention that the transurethral resection equipment used on all patients of both groups had a 25.6Fr caliber sheath.

In accordance with the cystoscopic findings and the modified Randall classification for the macroscopic description of the prostate gland, group A had one patient with type A, 13 patients with type B, 7 patients with type C, and 9 patients with type D. Group B had one patient with type A, 7 patients with type B, 11 patients with type C, and 14 patients with type D.

Surgery duration for group A was 57.17 ± 17.74 minutes vs 57.17 ± 20.04 minutes for group B. 60% (n=18) of the patients had a duration longer than 60 minutes and 40% (n=12) had a duration under 60 minutes, whereas in group B, 42.4% (n=14) had a duration longer than 60 minutes and 57.6% (n=19) had a duration under 60 minutes.

The intraoperative blood loss for group A was 333.33 ± 188.15 ml vs. 313.64 ± 136.51 ml for group B. The quantity of resected tissue was 28.87 ± 12.42 g for group A and 32.0 ± 16.0 g for group B.

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**Table 2** Demographic characteristics of group A and group B

<table>
<thead>
<tr>
<th></th>
<th>Group a (n = 30) with stricture</th>
<th>Group b (n = 33) without stricture</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>64.0 ± 8.35</td>
<td>68.48 ± 8.76</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>16.7% (5)</td>
<td>18.2% (6)</td>
<td>NS</td>
</tr>
<tr>
<td>High blood pressure</td>
<td>36.7% (11)</td>
<td>27.3% (9)</td>
<td>NS</td>
</tr>
<tr>
<td>Previous UTI</td>
<td>33.3% (10)</td>
<td>27.3% (9)</td>
<td>NS</td>
</tr>
<tr>
<td>Prostate volume (g)</td>
<td>62.93 ± 27.58</td>
<td>87.30 ± 60.83</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>PSA (ng/mL)</td>
<td>6.31± 4.73</td>
<td>6.15 ± 3.3</td>
<td>NS</td>
</tr>
<tr>
<td>Previous catheter</td>
<td>36.7% (11)</td>
<td>69.7% (23)</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>Days with catheter</td>
<td>38.67 ± 76.87</td>
<td>82.61 ± 78.97</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>Pre-TURP dilation</td>
<td>16 (53.3%)</td>
<td>16 (48.5%)</td>
<td>NS</td>
</tr>
<tr>
<td>Surgery duration</td>
<td>57.17 ± 17.74</td>
<td>57.12 ± 20.04</td>
<td>NS</td>
</tr>
<tr>
<td>Time over 60 minutes</td>
<td>60% (18)</td>
<td>42.4% (14)</td>
<td>NS</td>
</tr>
<tr>
<td>Time under 60 minutes</td>
<td>40% (12)</td>
<td>57.6% (19)</td>
<td>NS</td>
</tr>
<tr>
<td>Approximate blood loss (mL)</td>
<td>333.33 ± 188.15</td>
<td>313.64 ± 136.51</td>
<td>NS</td>
</tr>
<tr>
<td>Resected volume (g)</td>
<td>28.87 ± 12.42</td>
<td>32.0 ± 16.0</td>
<td>NS</td>
</tr>
<tr>
<td>Days with post-TURP catheter</td>
<td>8.90 ± 3.91</td>
<td>5.15 ± 3.0</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

UTI: urinary tract infection; PSA: prostate-specific antigen; NS: not significant; TURP: transurethral resection of the prostate

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**Table 3** Pre and Post-TURP International Prostate Symptom Scale (iPSS) in group A and group B

<table>
<thead>
<tr>
<th>IPSS</th>
<th>Preoperative</th>
<th>Postoperative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>19.03 ± 3.78</td>
<td>16.27 ± 5.12</td>
</tr>
<tr>
<td>Group B</td>
<td>19.48 ± 5.42</td>
<td>8.88 ± 4.20</td>
</tr>
</tbody>
</table>

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A 22Fr caliber catheter was used post-TURP in 28 group A and in 28 group B patients. In all patients, the postoperative catheter used was made of latex.

The post-TURP Foley catheter remained indwelling for 8.90 ± 3.91 days in the group with stricture vs. 5.15 ± 3.0 days in the group without stricture (p<0.05).

The mean presentation time of urethral stricture in the post-TURP patients was 40 months.

Stricture location in the study group was distributed as follows: meatal stricture 3.3% (n=1), penile stricture 33.33% (n=10), bulbous stricture 73.3% (n=22), and bladder neck sclerosis 10% (n=3). It is important to mention that some patients presented with more than one stricture in different locations.

Cystoscopy was carried out in 43.3% (n=13) of the patients with stricture, whereas 63.3% (n=19) underwent voiding cys-tourethrography. Some patients had both of the diagnostic studies done.

According to the Jordan classification for urethral strictures, they were distributed as shown in figure 3.

Discussion

Urethral stricture frequency as reported in the medical literature varies from 2.2% to 9.8%.14-19

The World Health Organization (WHO) defines urethral stricture as a narrowing of the urethral lumen that is secondary to a scarring process, affecting the erectile tissue of the corpus spongiosum that results in spongiosfibrosis. Scar contraction reduces the urethral lumen.

The study population was made up of 2 groups of patients: group A were those with urethral stricture following a TURP and group B were those that underwent TURP but did not develop urethral stricture.

In relation to the demographic characteristics of both groups, it should be stressed that there was a significant age difference between the 2 groups; the mean age in group A was 64.0 ± 8.35 years and it was 68.48 ± 8.76 years in group B (p<0.005). The age in the group of patients with stricture was significantly lower than that of the control group without stricture. This finding can perhaps be explained by the fact that there is better cicatrization and tissue repair after an injury or trauma in younger patients. Studies such as those by DuNuoy and Carrell found that cicatrization was better in younger patients.30 This leads to the idea that advanced age could become a protective factor for the development of urethral stricture because repair would be less intense at the site of the urethral damage, reducing the amount of fibrosis and the consequential urethral narrowing.

Diabetes mellitus has been shown to substantially interfere with cicatrization processes in the entire organism. One of the contributing factors is the reduced inflammatory reaction that is associated with hyperglycemia. Diabetes diminishes granulocyte chemotaxis, phagocyte function, and cellular and humoral immunity. In addition, associated microangiopathy decreases the blood supply to the cicatrization site.31,32

The number of patients with diabetes mellitus was very similar in the 2 groups (5 and 6 in group A and group B, respectively), representing a percentage lower than 20%. Our study results suggest that diabetes mellitus is not a risk factor for the development of urethral stricture. The same holds true for high blood pressure and a history of urinary tract infections, given that the figures did not show a tendency toward any specific group that could be interpreted as a factor intervening in the development of urethral stricture.

With respect to prostate gland characteristics prior to TURP, the volumes measured by transabdominal or transrectal ultrasound showed mean values that were lower for the urethral stricture group, with 62.93 g vs. 87.3 g for the group that did not develop stricture and a p<0.05. Those patients with higher prostate volumes had a lesser tendency to develop urethral stricture. This is quite striking, given that a higher prostate volume implies a longer resection time. This result could be attributed to the fact that prostate volume measurement was indistinctly carried out, either transabdominally or transrectally, resulting in volume variability, depending on the method employed. Further studies could corroborate whether these same findings are present in larger populations.

In relation to the high prostate volumes, it is not surprising that the PSA figures were above normal values in the 2 groups, and there was no difference between them.

In both groups the IPSS scale showed a decrease after TURP. The mean initial IPSS in the 2 groups was found to be in the moderate symptom range, with 19 points for each group. After TURP, the group without stricture showed a descent of 10 points on the scale vs. a descent of 3 points in the patients that developed urethral stricture. It was not possible to precisely know the postoperative IPSS at a determined point in time due to the fact that the measurements were taken in the patients at different post-TURP moments. Nevertheless, it is clear that the patients who presented with stricture developed symptoms with greater frequency and intensity than those that did not present with stricture after TURP.

There were patients that had indwelling transurethral catheters as temporary treatment at some point prior to TURP in the 2 groups. Of those patients that did not develop
urethral stricture, 69.7% (n=23) had used a catheter at some moment vs. 36.7% (n=11) of those patients that developed stricture (p<0.05). Likewise, those that did not develop stricture and that used a catheter prior to TURP had a mean indwelling time of 82.6 days vs. 36.7 days in those patients that developed stricture. This suggests that the prolonged use of a transurethral catheter before TURP creates a urethral inflammation episode that protects the patient or is conducive to making the second inflammatory episode from the placement of a catheter after TURP less intense and shorter. In other words, the inflammatory process is not so severe in those patients that have had previous contact with the material of the catheter (latex, in the majority of the cases), thus reducing the possibility of developing urethral stricture.

As was to be expected, of those patients that developed urethral stricture, 53% had received dilation prior to TURP vs. 48% of the patients that did not develop stricture. Urethral dilation is undeniably a risk factor for urethral trauma with injury to the mucosa that can condition the formation of spongiofibrosis and urethral stricture. Therefore, gentle dilation is recommended, using the adequate amount of lubricant so as not to injure the urethra at any point along its course.

The anatomic configuration of the prostate according to the modified Randall classification showed that type B (n=11) was the most frequent in the patients that developed stricture (group A) followed by types D (n=9) and C (n=7). In group B the most frequent type was the Randall D (n=14), followed by types B (n=11) and C (n=7).

The mean surgery duration for both groups was 57.17 ± 17.74 minutes for group A and 57.12 ± 20.04 minutes for group B. However, as established in the hypothesis, 60% (n=18) of the patients that developed stricture (group A) had a resection time above 60 minutes vs. 42.4% (n=14) of the patients that did not develop stricture (group B). According to reports in the medical literature, resection time is one of the most important factors for developing urethral stricture. The results of our study showed a coinciding tendency for a TURP duration greater than 60 minutes to be a risk factor for the later development of urethral stricture, although there was no statistically significant difference.

The intraoperative blood loss for both groups was very similar, with a mean 333 mL for group A and 313 mL for group B. The quantity of resected tissue was also similar in the 2 groups, with a mean 28 g for group A and 32 g for group B.

In this aspect, it is worth mentioning that time, blood loss, and resected volume were correlated, taking into account that resection time was intended to be no greater than 60 minutes, and blood loss was calculated based on the quantity of resected tissue, multiplying the resected volume by 10 mL.

After TURP, a difference in the indwelling time of the transurethral catheter was observed between the 2 groups. Those patients that had the indwelling catheter for a longer period of time after the TURP had a higher percentage of probability of developing stricture. In group A the mean length of time with catheter after TURP was 8.90 ± 3.91 days and in group B it was 5.15 ± 3.0 days with a p<0.05.

This is due to the fact that the postoperative inflammatory process disappears within the first 48 to 72 hours. The inflammatory process in those patients that have a catheter for more time is more intense and prolonged as a consequence of the presence of a foreign body at the surgical site and along the course of the urethra.

A descriptive analysis was done on the Group A patients. In those patients the length of time from the TURP to the appearance of stricture was a mean 40.7 months (range: 4 to 70 months).

In regard to stricture location the distribution was as follows: bulbous urethra 73% (n=22), penile urethra 33.3% (n=10), bladder neck 10% (n=3), and meatus 3.3% (n=1). Two strictures in 2 different locations were found in 6 patients. These results are in contrast to those of another study in which stricture incidence was greater in the meatus (18.3%) than in the bulbous urethra (9.1%).

The difference could be due to the fact that the aim of that study was to show a decrease in stricture using an irrigation solution at a temperature of 36 °C, which reduced the incidence of bulbous and penile strictures, but not meatal strictures.

Taking into account the Jordan classification described in 1987 based on spongiofibrosis configuration and extension, the strictures were divided into type B 56.7% (n=17), type C 26.7% (n=8), type A 20% (n=6), and type D 3.3% (n=1). There was no type E stricture, albeit that this type was difficult to determine, given that none of these patients had a urethral ultrasound study to establish the extension of the fibrosis into the corpora cavernosa (type E stricture). There was no type F stricture (associated with fistula).

Of the 30 patients, 19 had voiding cystourethrography, whereas 13 had cystoscopy in order to diagnose urethral stricture. Both studies were carried out on 2 patients due to inconclusive voiding cystourethrography. Urethral ultrasound was not done on any of these patients because it is not a routine study in our service. Urethral ultrasound imaging is an important study because it determines stricture depth, enabling appropriate classification, which in turn results in more adequate treatment for these patients.

Conclusions

Based on the results of our study, the main risk factors for the formation of urethral stricture in patients that have undergone TURP are a preoperative prostate volume greater than 80 g that is determined through transabdominal or transrectal ultrasound imaging, dilation of the urethra immediately prior to the procedure, a resection time greater than 60 minutes, and the prolonged use (8.9 ± 3.91 days) of a postoperative transurethral catheter.

According to the medical literature, there may be other additional factors in the development of urethral narrowing, such as an insufficient quantity of intraurethral lubricant before and after the surgery, the use of a high level of energy for cutting and coagulating that causes the sheath to heat up during the procedure, the use of a sheath with a diameter greater than that of the urethra, the material from which the catheter is made, and the temperature of the irrigation solution during the procedure.

All these factors should continue to be analyzed, because each one of them can have an effect on the process of epithelial damage and the local inflammation that are later produced, with the probability of causing scarring that results in a urethral stricture.
Conflict of interest
The authors declare that there is no conflict of interest.

Financial disclosure
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References