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Urethral and Bladder Changes and Stricture Recurrence Rates Following Internal Urethrotomy for Short Urethral Strictures

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ABSTRACT

INTRODUCTION: We analyzed: (1) the effect of internal urethrotomy on objective and subjective measures of bladder function and bladder wall thickness, (2) the stricture recurrence rate, and (3) the effects of urethral and bladder changes on recurrent stricture formation.

METHODS: Between October 2008 and May 2009, 22 male patients with primary urethral strictures (14 membranous, 4 penile, 4 bulbous) were prospectively studied. Strictures were posttraumatic (68.2%), iatrogenic (27.3%), or idiopathic (4.5%). Urethral stricture was incised at the 12 o'clock position with a 21F internal urethrotome, which included a cold knife under direct monitoring. Patients were evaluated 6 and 12 months postoperatively. Statistical analyses included paired-sample *t* tests with a Bonferonni adjustment (significance at $P < .004$) and Pearson correlations.

RESULTS: The mean age of the patients was 59.1 (13.7) years. The length of stricture was 6.1 (1.7) mm. The stricture was most prevalent in the membranous urethra (63.6%). Significant improvements were detected in mean International Prostate Symptom Score and peak flow at 6-months and 12-months postoperatively, when compared with baseline (all with $P < .001$). Mean urethral width and the wall thickness of the empty bladder significantly decreased 6 and 12 months after surgery (all with $P < .001$). The mean bladder wall thickness of the filled bladder significantly decreased from baseline at 6 months ($P < .001$) but not at 12 months following surgery ($P > .004$). Stricture recurrence rates were 13.6% at 6 months and 27.3% at 12 months. All patients were instructed to perform intermittent self dilatation; at the postoperative 6-month and 12-month follow-up, 16 patients (72.7%) and 11 patients (50%), respectively, were using it. There was no significant correlation between stricture recurrence and wall thickness of the empty or filled bladder, bladder capacity, urethral stricture location, stricture length, or the length of the widest segment of the urethra.

CONCLUSIONS: Internal urethrotomy is a successful procedure with rapid effect for management of primary short-segment urethral strictures. Significant changes in the urethra and bladder occur after surgery. However, these changes do not appear to be correlated with stricture recurrence.

Abbreviations and Acronyms

EF, erectile function
ISD, intermittent self-dilatation
IU, internal urethrotomy
IPSS, International Prostate Symptom Score
Qmax, peak urine flow rate
RU, retrograde urethrography

KEYWORDS: Urethral stricture; Internal urethrotomy; Urethral and Bladder Changes; Recurrence; Intermittent self-dilatation

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original study

Urethral and Bladder Changes and Stricture Recurrence Rates Following Internal Urethrotomy for Short Urethral Strictures

INTRODUCTION

Endoscopic urethrotomy was first used by Sasche, who incised the urethral stricture via a cold-knife technique [1,2]. This method is now widely used due to advantages such as minimal invasiveness, easy applicability, shorter hospital stay, and quicker return to daily life when compared with open surgery. Unfortunately, there are some negative aspects of this procedure, including development of recurrent strictures that may require additional surgery [3,4]. The recurrence rate has been reported at between 25% and 89% following the first internal urethrotomy (IU), depending on the duration, location, length, and number of strictures [4-6]. However, another study showed a success rate of only 8% following the initial urethrotomy [7].

Previous research has reported on the effects of etiology, location, and length of stricture on stricture recurrence [5,6]; however, to the best of our knowledge no study has evaluated urethral and bladder changes due to stricture and their effect on recurrence. Therefore, in this study we analyzed: (1) the effect of the IU procedure on objective and subjective measures of bladder function and bladder wall thickness, (2) the stricture recurrence rate, and (3) the effects of urethral and bladder changes on recurrent stricture formation.

METHODS

This was a prospective study of patients with primary urethral stricture, conducted between October 2008 and May 2009. The protocol was approved by the ethics committee of the authors' institution. All patients provided informed consent.

Participants

The participants were 22 male patients who were diagnosed with primary urethral stricture. Urethral stricture diagnosis was made using clinical history, International Prostate Symptom Score (IPSS), peak urine flow rate (Qmax), and retrograde urethrography (RU). Exclusion criteria were: (1) patients with high creatinine levels (> 2.5 mg/dL), (2) patients with a history of bladder surgery, urinary system infections, or recurrent urethral stricture, and (3) patients using anticholinergic, alpha-adrenergic, or diuretic drugs.

Surgical Technique

All internal urethrotomies were performed by the same surgeon, with the patient under general or regional anesthesia. All patients received perioperative antibiotic prophylaxis. Initially, the urethra was examined with a 17F cystoscope and the location of stricture was detected with patients in the lithotomy position. Then, the urethral stricture was incised at the 12 o'clock position under direct monitoring with a 21F internal urethrotome that included a cold knife. After the stricture was fully incised, healthy mucosa was seen and the bladder was accessed easily. An 18F silicone urethral catheter was inserted; it was removed on the 7th postoperative day.

Data Recording and Analysis

For each participant, we recorded International Index of Erectile Function 15 (IIEF-15) erectile function (EF) domain scores, IPSS, uroflowmetry, and postvoid residual volume (PVR) values. The measures were recorded during the diagnosis (baseline) and at follow-up examinations 6- and 12-months after surgery. Additionally, wall thickness of the empty and filled bladder and bladder capacity were measured by ultrasonography. RU was performed in all patients to determine the location and length of the stricture preoperatively (see example in Figure 1). Postoperative RU was performed at the 6-month or 12-month follow-up examination if the patient developed obstructive voiding problems or the peak flow was < 15 mL/sec.

All results were expressed as the mean and standard deviation (SD). The Kolmogorov-Smirnov test was used to standardize the data so that they had a normal distribution. Statistical analyses were performed using paired-sample *t* tests. A Bonferonni adjustment was applied to account for 14 paired comparisons; a probability value < .004 was considered significant. Pearson correlation analysis was used to evaluate the impact of wall thickness of the empty and filled bladder, bladder capacity,

Figure 1. Retrograde urethrography showing measurement of the widest urethral segment (A) and stricture segment length (B).

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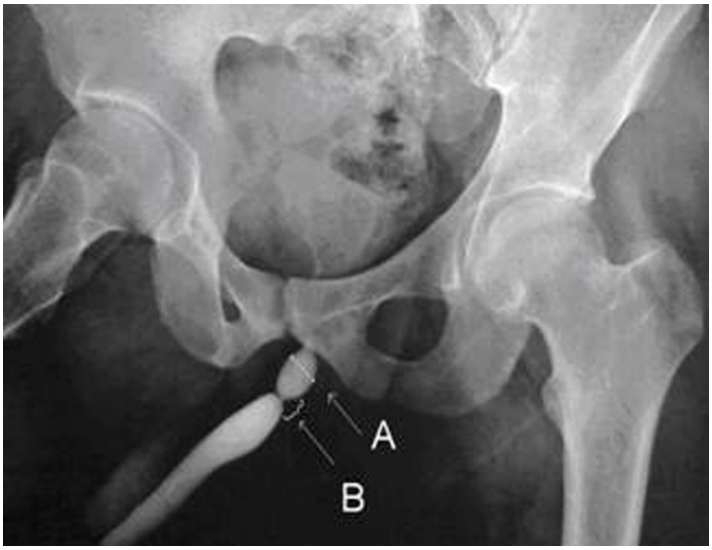

urethral stricture location, stricture length, and the length of the widest segment of the urethra on recurrent stricture formation. Correlations with P < .05 were considered statistically significant. All data were collected in a database and analyzed using the SPSS for Windows version 11.5 (IBM Corp; Somers, NY, USA).

RESULTS

The mean age of the 22 patients with urethral stricture was 59.1 years (SD = 13.7; range, 28-79 years). The mean length of the stricture was 6.1 mm (SD = 1.7; range, 4-9 mm). Other characteristics of the patients are contained in Table 1. The stricture was most commonly located in the membranous urethra (n = 14; 63.6%). The most common etiology was posttraumatic stricture (n = 15; 68.2%).

The mean duration of the operation 21 minutes (range, 5-45 minutes). No intraoperative complications occurred. The postoperative period was uneventful without infection or bleeding.

In the postoperative period, 6 patients underwent RU (3 patients at the 6-month and 3 patients at the 12-month follow-up examinations). Recurrent stricture was detected in these patients; therefore, stricture recurrence rates were 13.6% at 6 months and 27.3% at 12 months.

Table 1. Presurgical Characteristics of Patients With Urethral Stricture (N = 22).
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Characteristic	n	(% N)
Marital status		
Married	18	81.8
Not married	4	18.2
Comorbid disease		
Hypertension	6	27.3
Diabetes	4	18.2
Athlerosclerotic vascular disease	4	18.2
Location of stricture		
Membranous urethra	14	63.6
Penile urethra	4	18.2
Bulbous urethra	4	18.2
Cystofix catheter fixed	2	9.1
Etiology		
Posttraumatic	15	68.2
Iatrogenic	6	27.3
Idiopathic	1	4.5
Postvoid residual urine > 100 mL	6	27.3

Table 2 contains the means and standard deviations of the outcome measures at baseline and at the 6-month and 12-month postsurgical evaluations and the probability of significant differences. Significant improvements were detected in mean IPSS and Qmax at 6-months and 12-months postoperatively, when compared with the baseline values (all with $P < .001$). Mean IPSS decreased and mean Qmax increased significantly following surgery. There were no significant differences in mean EF scores at either of the follow-up evaluations. The mean bladder wall thickness of the empty bladder significantly decreased from baseline at both postoperative evaluations (both with $P < .001$). The mean bladder wall thickness of the filled bladder significantly decreased from baseline at 6 months following surgery ($P < .001$), but there was no significant difference from baseline at 12 months following surgery ($P > .004$). A power analysis was not completed, so it is possible that this was a type II error based on the sample size. There were no significant changes in mean bladder capacity following surgery. Urethral width decreased significantly from baseline at the 6-month and 12-month evaluations (both with $P < .001$).

All patients were instructed to perform intermittent self dilatation (ISD); however, not all of the patients complied. At the postoperative 6-month and 12-month follow-up, 16 patients (72.7%) and 11 patients (50%), respectively, were performing ISD.

There was no significant correlation between stricture recurrence and wall thickness of the empty or filled bladder, bladder capacity, urethral stricture location, stricture length, or the length of the widest segment of the urethra.

DISCUSSION

Expansion and ingravescence emerge in the bladder following partial obstruction of the urethra. Hypertrophy can then develop in the detrusor muscle, leading to an increase in muscle thickness. This increase does not occur via mitotic division of muscle cells (hyperplasia); rather, it occurs as a massive increase in the dimension of muscle cells (hypertrophy) [8]. Similarly, urethral expansion can occur proximal to the stricture. This expansion can vary according to the length of the narrow segment or to the severity, number, localization, and duration of the stricture [8].

It is recommended that IU should be performed at the 12-o'clock position between the corpora cavernosa to avoid hemorrhage [9,10]. We used this technique without any complications. EF scores were similar before and after IU (Table 2).

Table 2. Means and Standard Deviations of Outcome Measures Before Urethral Stricture Surgery and at 6- and 12-Month Follow-up Evaluations; Probability of Significant Differences (N = 22).
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Outcome Measure	Presurgery		Postsurgery 6 Months		*P*[a]	Postsurgery 12 Months		*P*[b]
	Mean	SD	Mean	SD		Mean	SD	
IPSS	22.9	3.8	12.8	2.7	<.001	13.6	2.6	<.001
Erectile function score	19.2	6.7	19	6.3	.162	19	6.3	.162
Qmax, mL/s	12.2	6.6	18.3	2.4	<.001	17.4	2.3	<.001
Wall thickness, mm								
Empty bladder	4.5	0.8	4.1	0.6	<.001	3.9	0.3	<.003
Filled bladder	3.8	0.8	3.4	0.7	<.001	3.3	0.5	.018
Bladder capacity, mL	393	86.4	381.9	69	.323	389.5	66	.767
Urethral width, mm	11.1	1.3	8.8	1.4	<.001	9	1.3	<.001

[a]Comparison of baseline and postoperative outcomes at 6 months.
[b]Comparison of baseline and postoperative outcomes at 12 months.
Significance at $P < .004$.
Abbreviations: IPSS, International Prostate Symptom Score; Qmax, peak urine flow rate.

Following surgery, the duration of urethral catheterization is still controversial [6,11,12]. Kamp et al [12] stated that no relationship exists between urethral catheter duration and recurrent stricture. On the other hand, Albers et al [6] reported that catheter duration, especially longer than 7 days, increases recurrent stricture formation. We used a silicone urethral catheter and removed it on the 7th postoperative day in order to avoid contributing to stricture formation.

Recurrent strictures following IU usually develop within 3 to 12 months [9]. Therefore, we evaluated our patients at 6- and 12-months following surgery. In our study, we observed a significant decrease from baseline in the empty-bladder wall thickness at both 6 and 12 months and in the full-bladder wall thickness at 6 months after surgery. These results suggest a decrease in bladder output pressure. Similarly, prestricture urethral width decreased after the IU procedure; however, bladder capacity did not change significantly. Changes in bladder capacity are known to be a long-term consequence of diminished urine output. Therefore, bladder capacity may have changed in our patients if they had been followed for more than 12 months.

Albers et al [6] showed that the recurrence rate following IU was 27.8% for urethral strictures shorter than 1 cm in length; the recurrence rate increased to 50.5% for patients with longer or multiple strictures. They also reported that localization of stricture did not affect recurrence rate. Ishigooka et al [10] found that the recurrence rate was 4.4% in cases with stricture length < 10 mm and 42.9% in strictures > 10 mm. These authors indicated that the age of the patient, etiological factors, stricture location, and duration of urethral catheter use did not have an effect on the development of recurrent strictures. In our study, all patients had a stricture length of < 10 mm. Our recurrence rates were 13.6% and 27.3% at 6 months and 12 months, respectively. These results are similar to those reported by Albers et al but higher than those reported by Ishigooka et al. However, it should be noted that Albers et al had 937 patients, Ishigooka et al had 66 patients, and we had 22 patients. These differences in total numbers make it difficult to draw conclusions from percentage rates.

It is reported that using ISD after IU decreases the recurrence rate of urethral strictures. Lauritzen et al [11] found a recurrence rate of 9% in 55 patients who performed ISD in the postoperative period and a recurrence rate of 31% in 162 patients who did not perform ISD; their follow-up period was 3-6 years [11]. In our study, the recurrence rate was 13.6% at 6 months and 27.3% at 12 months following surgery. These rates are higher than their reported 9%, even though 72.7% of our patients were using ISD at the 6-month evaluation and 50% were using ISD at the 12-month evaluation. Our study population is smaller and the follow-up period is shorter. However, in our clinical practice we agree with Lauritzen et al that ISD decreases the recurrence rate of stricture and recommend this preventive approach postoperatively.

There are known risk factors for stricture recurrence: a previous

IU, penile and membranous strictures, long (20 > mm) and multiple strictures, untreated perioperative urinary infection, and extensive periurethral spongiofibrosis [9]. In our study, we noted significant changes in the urethra and bladder following surgery to correct urethral strictures; however, we were unable to find any correlation between these changes and recurrence of urethral strictures. Further studies with larger numbers of patients and longer follow-up examinations are needed in order to confirm our results.

CONCLUSION

In conclusion, IU is a rapid, effective, and reliable procedure for the treatment of primary short-segment urethral stricture. Significant functional changes occur in the bladder and urethra following IU. However, these changes do not appear to be correlated with stricture recurrence.

Conflict of Interest: none declared.

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