

Voiding Dysfunction/Female Urology

Surgical Outcome of Excision and End-to-End Anastomosis for Bulbar Urethral Stricture

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Purpose: Although direct-vision internal urethrotomy can be performed for the management of short, bulbar urethral strictures, excision and end-to-end anastomosis remains the best procedure to guarantee a high success rate. We performed a retrospective evaluation of patients who underwent bulbar end-to-end anastomosis to assess the factors affecting surgical outcome.

Materials and Methods: We reviewed 33 patients with an average age of 55 years who underwent bulbar end-to-end anastomosis. Stricture etiology was blunt perineal trauma (54.6%), iatrogenic (24.2%), idiopathic (12.1%), and infection (9.1%). A total of 21 patients (63.6%) underwent urethrotomy, dilation, or multiple treatments before referral to our center. Clinical outcome was considered a treatment failure when any post-operative instrumentation was needed.

Results: Mean operation time was 151 minutes (range, 100 to 215 minutes) and mean excised stricture length was 1.5 cm (range, 0.8 to 2.3 cm). At a mean follow-up of 42.6 months (range, 8 to 96 months), 29 patients (87.9%) were symptom-free and required no further procedure. Strictures recurred in 4 patients (12.1%) within 5 months after surgery. Of four recurrences, one patient was managed successfully by urethrotomy, whereas the remaining three did not respond to urethrotomy or dilation and required additional urethroplasty. The recurrence rate was significantly higher in the patients with nontraumatic causes (iatrogenic in three, infection in one patient) than in the patients with traumatic etiology.

Conclusions: Excision and end-to-end anastomosis for short, bulbar urethral stricture has an acceptable success rate of 87.9%. However, careful consideration is needed to decide on the surgical procedure if the stricture etiology is nontraumatic.

Keywords: Surgical anastomosis; Treatment outcome; Urethral stricture

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Article History:

received 24 January, 2013

accepted 15 May, 2013

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INTRODUCTION

According to the results of a nationwide survey, direct-vision internal urethrotomy (DVIU) is used for most urethral strictures in the United States [1] and the situation should be similar in Korea. According to the high recurrence rate of strictures after DVIU, the most cost-effective strategy for the management of short, bulbar urethral strictures is to reserve urethroplasty for patients in whom a single DVIU procedure fails [2]. Repeated DVIU can increase the length and density of spongiositis, thus making defini-

tive surgical intervention more difficult [3]. Thus, it might be more cost-effective to go straight to primary urethroplasty because most patients want a cure [4].

For bulbar urethral strictures of 2 cm or less, excision and end-to-end anastomosis remains the ideal procedure with excellent long-term results reported [5-7]. Unfortunately, there have been few studies on the surgical outcomes of end-to-end anastomosis for bulbar urethral stricture in Korean patients [8]. We therefore performed a retrospective evaluation of patients who underwent bulbar end-to-end anastomosis to report our experience with the

surgery and to assess the factors affecting surgical outcome.

MATERIALS AND METHODS

We reviewed the medical charts of 33 patients who underwent excision and end-to-end anastomosis for bulbar urethral strictures by a single surgeon and who completed at least 6 months of follow-up. Patients who underwent combined procedures or augmented anastomotic urethroplasty were excluded. The patients' records were reviewed with respect to etiology of stricture, previous treatment, preoperative evaluation, surgical findings, follow-up results, and early and late complications. Preoperative evaluation included history, physical exam, urinalysis, urine culture, uroflowmetry, and retrograde and voiding cystourethrography. Urethrocystoscopy was performed preoperatively to determine the length of the stricture. Stricture length was measured intraoperatively by the excised length of urethra.

Patient age ranged from 22 to 80 years (mean, 55.1 years). The most common cause of stricture was blunt perineal trauma (straddle injury) in 18 patients (54.6%), followed by iatrogenic causes in 8 patients, idiopathic causes in 4 patients, and infection in 3 patients (Table 1). About two-thirds of the patients (63.6%) underwent DVIU, dilation, or multiple treatments before referral to our center (Table 2). At presentation, 20 patients (60.6%) had a suprapubic cystostomy. In the remaining 13 patients with slow stream, the mean maximal flow rate (MFR) was 5.4 mL/s (range, 2.4 to 8 mL/s).

The standard surgical technique of anastomotic urethroplasty was applied while the patient was positioned in a slightly hyperextended lithotomy position [9]. After mobilization of the bulbar urethra, the area of fibrosis was completely excised and the healthy ends of the urethra were spatulated. Urethral mobilization was required, extending in some cases to the penoscrotal junction distally and perineal body proximally. Dorsal anastomosis was performed with interrupted 4-0 or 5-0 polyglactin sutures and ventral anastomosis was performed in two layers with the urethral mucosa first and then the corpus spongiosum. At the end of the procedure, a 14-Fr silastic Foley urethral

catheter was exclusively placed and a small drain was left under the bulbospongiosus muscle for 2 to 3 days.

Patients were discharged with oral antibiotics until the catheter was removed, usually after 14 days. The urethral catheter was removed when there was no extravasation on urethrography of the pericatheter. The catheter was left in place an additional 1 to 2 weeks when extravasation was present. Uroflowmetry was performed 3, 6, and 12 months after surgery in the first year and annually thereafter. Patients underwent retrograde urethrography or urethroscopy if they developed voiding symptoms, such as slow or splayed stream.

Treatment failure was defined as the need for any postoperative intervention including urethral dilation. Chi-square test or Fisher exact test was used to assess the significance of categorical risk factors for surgical failure, and Student t-test or Wilcoxon rank sum test was used to assess significance in continuous factors, e.g., age or operation time. Values were expressed as mean \pm standard deviations. Statistical significance was considered at $p < 0.05$. All statistical analyses were performed by using SAS ver. 9.2 (SAS Institute Inc., Cary, NC, USA).

RESULTS

Mean operation time was 151 minutes (range, 100 to 215 minutes). Six patients (18.2%) required corporal separation to achieve a tension-free anastomosis. Mean excised stricture length was 1.5 cm (range, 0.8 to 2.3 cm). Stricture length was less than 1 cm in 3 patients (9.1%), 1 to 2 cm in 26 patients (78.8%), and more than 2 cm in 4 patients (12.1%). Blood transfusion was needed in only one patient during the operation. The urethral catheter was removed a mean of 16.5 days (range, 13 to 24 days) postoperatively.

At a mean follow-up of 42.6 months (range, 8 to 96 months), 29 of the 33 patients (87.9%) had no evidence of recurrent stricture. In one case in the success group, meatal stenosis was successfully treated with a single urethral dilation. Because there was no evidence of recurrence of bulbar stricture by retrograde urethrography or urethroscopy, the surgical outcome of this patient was classified as successful. In the success group, the mean MFR after surgery was 21.65 mL/s. Patients aged less than 50 years

TABLE 1. Causes of urethral strictures in patients who underwent end-to-end anastomosis

Cause	No. of patients (%)
Trauma	18 (54.6)
Iatrogenic	8 (24.2)
Urethral catheterization	3
Transurethral resection of prostate	2
Laser prostatic surgery	2
Transurethral resection of bladder	1
Idiopathic	4 (12.1)
Infection	3 (9.1)

TABLE 2. History of previous surgery for urethral stricture in patients who underwent end-to-end anastomosis

Previous surgery	No. of patients (%)
DVIU(s)	7 (21.2)
DVIU(s), dilation(s)	6 (18.2)
Dilation(s)	3 (9.1)
Primary realignment, DVIU	3 (9.1)
Primary realignment	1 (3.0)
End-to-end anastomosis	1 (3.0)
Total	21 (63.6)

DVIU, direct-vision internal urethrotomy.

TABLE 3. Risk factors for stricture recurrence

Factor	Success (n=29)	Fail (n=4)	p-value
Age (y)	54.3±14.9	58.8±7.7	0.5664 ^a
Stricture length (cm)	1.4±0.4	1.6±0.4	0.4336 ^a
Operative time (min)	154.5±32.6	126.3±33.5	0.1150 ^a
Mean follow-up duration (mo)	44.5±27.3	29.0±18.6	0.2202 ^a
Etiology			0.0330 ^b
Traumatic	18	0	
Nontraumatic	11	4	
Previous surgery			0.2710 ^b
None	12	0	
≥ 1	17	4	
Preoperative voiding status			1.0000 ^b
Suprapubic cystostomy	18	2	
Slow stream	11	2	

Values are presented as mean±standard deviation.

^a:Student t-test. ^b:Fisher exact test.

(n=11) showed better MFR with mean of 27.4 mL/s (range, 18 to 48 mL/s) than did those aged 50 years or more (n=18), who had a mean MFR of 18.14 mL/s (range, 12 to 47 mL/s). Six patients who had benign prostatic hyperplasia preoperatively had an MFR less than 15 mL/s. Two of these patients were treated by laser prostate surgery and the other two patients were well controlled by medication.

Strictures recurred in four patients (12.1%) at a mean follow-up of 3.5 months (range, 2.5 to 4.7 months). Of the four recurrences, one patient was managed successfully by DVIU, whereas the remaining three patients did not respond to DVIU or dilation. These three patients underwent ventral onlay graft urethroplasty using buccal mucosa at 6, 13, and 14 months after end-to-end anastomosis, respectively. Although all patients had excellent outcomes, with good urinary stream and not requiring any intervention after the reoperation, further follow-up is needed because of the short follow-up time (range, 4 to 7 months).

Potential risk factors for the development of recurrence were analyzed (Table 3). The recurrence rate was significantly higher in the patients with nontraumatic causes than in the patients with traumatic etiology. The stricture etiology of the four recurrent cases was iatrogenic in three patients and infection in one patient. Previous treatment and preoperative voiding status did not affect surgical outcome. However, all recurrent cases had a history of one or more DVIUs. Other variables did not affect the surgical outcome of end-to-end urethroplasty.

Early complications were minor, including catheter-related infection and epididymitis that was easily treated with antibiotics in one patient each. With respect to late complications, intermittent perineal or scrotal pain bothered eight patients (24.2%) and was relieved by analgesics. Two patients complained of a decrease in ejaculatory force and volume. In the seven patients who had erectile dysfunction preoperatively, the condition persisted after the operation. All these cases had a traumatic etiology. However, no patient had new onset of erectile dysfunction

postoperatively. No patient complained of penile shortening or curvature.

DISCUSSION

In the bulbar urethra, many variables, such as length, severity, and location of stricture, can influence surgical outcome. The surgical technique should be selected mainly according to stricture length, but the stricture etiology and density of the spongiofibrosis tissue should also be taken into account [10]. For the treatment of a short segmental bulbar urethral stricture (< 2 cm), DVIU or end-to-end urethroplasty is commonly accepted as standard therapy [4]. When the stricture is limited in focal area, DVIU is recommended as the first choice of treatment. If the stricture is more than 1 cm in length, single DVIU followed by end-to-end urethroplasty is commonly used as a cost-effective strategy [2,4,11]. Dorsal or ventral onlay substitution urethroplasty using a buccal mucosa graft is currently suggested for a longer (> 2 cm) strictures, where the urethral lumen is relatively well preserved and the spongiofibrosis around the lumen is limited to 1 mm [12,13]. Augmented anastomotic urethroplasty, with complete excision of the worst stricture segment, is currently recommended for strictures that cover a particularly dense and narrow area of 1 to 2 cm in length [14-16]. Both ventral and dorsal onlay free grafts survive well with equal success rates [14-16].

Short bulbar strictures are generally amenable to complete excision with primary anastomosis via a perineal incision, affording a high success rate of 95%, as reported by Santucci et al. [5]. Eltahawy et al. [6] published their series of 260 patients with bulbar stricture who underwent end-to-end anastomosis with a mean follow-up of 50.2 months. The stricture length ranged from 0.5 to 4.5 cm (mean, 1.9 cm) and the authors reported a success rate of 98.8%. Recently, Barbagli et al. [7] described a success rate of 90.8% in 153 patients who underwent bulbar end-to-end anastomosis with a mean follow-up of 68 months. In 2002,

Jeziar and Schlossberg [17] summarized the surgical outcomes of excision and primary anastomosis for bulbar stricture on the basis of major series reported in the literature. These series showed a success rate of 93% in 443 patients with a range of 65% to 100% between series.

In our series of 33 patients with bulbar stricture, end-to-end anastomosis had a success rate of 87.9% with a mean follow-up of 42.6 months. We tried to identify potential risk factors for surgical failure. Many variables such as age, operation time, stricture length, previous operation history, preoperative voiding status, and etiology of stricture were evaluated as potential risk factors of recurrence. However, only etiology of stricture was a significant factor related to recurrence. There were no cases of surgical failure in the patients with traumatic etiology. No clear consensus exists on stricture etiology and the success rate with respect to excision and end-to-end anastomosis. It is believed, however, that inflammatory strictures are more extensive, generally involving more of the urethra and corpus spongiosum, and are less likely to yield a successful result [17]. Lindell et al. [18] reported the highest failure rate in patients with strictures, which was related to prolonged indwelling catheter drainage. In our series, the stricture etiology of the four failure cases was iatrogenic in three pa-

tients and infection in one patient. Therefore, the most common cause of stricture in the surgical failure group was iatrogenic, arising after previous endoscopic surgery (n=1) or following prolonged indwelling catheter placement (n=2).

Although initial postoperative retrograde urethrography findings were normal, stricture recurred in four patients at a mean follow-up of 3.5 months (range, 2.5 to 4.7 months). Popular wisdom dictates that early failure within 3 months represents a technical problem [5]. A typical case of recurrent stricture after excision and end-to-end anastomosis is illustrated in Fig. 1. To get the best results for end-to-end anastomosis, complete excision of unhealthy urethra and accompanying spongiofibrosis and tension-free anastomosis are essential. Failure to remove all abnormal urethra is thought to be the primary cause of surgical failure and stricture recurrence [17]. The main cause of surgical failure in our series was also assumed to be inadequate excision of the urethral stricture. Unfortunately, accurate identification of spongiofibrosis is not possible with the technology at hand. Retrograde urethrography often combined with voiding cystourethrography is a conventional preoperative tool for evaluation of the extent of urethral involvement. However, the static retrograde ure-



FIG. 1. Representative retrograde urethrography of a recurrent case. (A) Pre-operative retrograde urethrography in a patient with a tight 1-cm bulbar urethral stricture following prolonged indwelling urethral catheter. (B) Normal retrograde urography 2 weeks after excision and end-to-end anastomosis. (C) Retrograde urography 4 months after primary anastomosis showed a recurrent stricture at the previous anastomotic site. Single direct-vision internal urethrotomy was unsuccessful. (D) Retrograde urethrography 3 weeks after substitution urethroplasty with ventral buccal mucosa onlay graft.

thrography image can both underestimate (by as much as 50%) and overestimate the length of the stricture [19]. Intraoperative urethrocystoscopy can be used as an adjunct to retrograde urethrography to estimate the extent of stricture [6]. Some advocate urethral ultrasonography to accurately determine stricture length [5,19]. In one study, intraoperative ultrasonography of the anterior urethra directly influenced the operative approach in 45% of 232 patients [19]. Recurrence might have been prevented in our series by a wider excision of suspicious spongiofibrosis or augmented anastomotic urethroplasty. We have no clear explanation for why the patients with traumatic etiology had better surgical outcomes than did those with nontraumatic etiology. The most likely reason for the better results in the traumatic group is that spongiofibrosis developed from outside to inside, which makes it easier to identify the extent of stricture. On the contrary, spongiofibrosis propagated from inside to outside in urethral strictures of nontraumatic causes, especially those with iatrogenic or infectious causes.

In addition to complete excision of abnormal urethral mucosa and spongiofibrosis, tension-free anastomosis is important for achieving the best results. The ideal stricture length for excision and end-to-end anastomosis has been a contentious issue. Guralnick and Webster [14] insisted that this operation should be limited to strictures of 1 cm or less, because excision of a 1-cm urethral segment with opposing 1-cm proximal and distal spatulations results in a 2-cm urethral shortening. They emphasized that excision of a longer urethral segment risks penile shortening or chordee [14]. In general, the best stricture length manageable by excision and primary anastomosis is 2 cm or less [6,20]. However, strictures longer than 2 cm can be managed successfully in selected patients with end-to-end anastomosis [5-7]. Morey and Kizer [21] reported on a selected cohort of 22 patients with proximal bulbar urethral strictures longer than 2.5 cm that were treated with an extended anastomotic approach and suggested that the ability of the urethra to be reconstructed is proportional to the length and elasticity of the distal urethral segment. They reported a 91% success rate, concluding that defects up to 5 cm can be successfully excised and primarily reconstructed in select young men with proximal bulbar strictures [22]. In our series, the majority of patients (87.9%) had an excised urethral length of 2 cm or less; no cases had a stricture length more than 2.5 cm. We consider strictures up to 2 cm to be suitable for primary anastomosis.

The literature suggests that the influence of previous treatment on surgical outcome is controversial [2,5-7,22]. In the recent series reported by Santucci et al. [5] and Eltahawy et al. [6], 55% and 69.2% of the patients had failed attempts of urethroplasty or DVIU, respectively. Despite this fact, however, surgical outcomes were equally excellent. Furthermore, previously failed urethrotomy did not influence the long-term outcome of urethroplasty [2]. By contrast, in the study of Barbagli et al. [7], the only group of patients who had a lower success rate (78.6%) had under-

gone multiple treatments (dilation, DVIU, or urethroplasty), whereas the other groups (prior single or no treatment) showed similar success rates ranging from 92.1% to 100% without any statistical significance. It was also suggested that endoscopic or open urethral manipulation before anastomotic urethroplasty for posttraumatic urethral stricture has a significant impact on the outcome of urethral reconstruction [22]. In our study, 21 of 33 patients (63.6%) underwent prior single or multiple treatments, whereas 12 patients (36.4%) had no previous treatment. Although previous treatment did not affect surgical outcome, all recurrent cases had a history of one or more DVIUs.

Complications after anastomotic urethroplasty are few and self-limited [5,6]. Most patients feel satisfied with the surgical outcome despite some minor postoperative complications [7]. In our series, the most common complication was intermittent perineal or scrotal pain (24.2%). In addition, 2 patients complained of decreases in ejaculatory force and volume. Barbagli et al. [7] reported that 23.3% of patients had postoperative ejaculation disorder. The most frequent postoperative ejaculation disorder was decreased force of ejaculation (20%) or semen sequestration in the urethral bulb (3.3%) [7]. Yucel and Baskin [23] suggested that most likely surgical damage to the branches of the perineal nerves or bulbospongiosus muscles may have a role in determining the loss of efficient bulbar urethral contraction, thus causing difficulties in expelling semen and urine. Although the success rate of bulbar urethroplasty is high, some argued that this is the urologist's view and not necessarily the patient's view [24]. Whereas the urologist concentrates on voiding efficiency, the patient is much more concerned with cosmetic effects and adverse effects, especially on sexual performance [25]. We concur with this opinion. Recently, a patient-reported outcome measure for urethral stricture surgery was devised and validated [26].

A major limitation of this study was that the number of involved patients was not enough to obtain statistical significance in the multivariate analysis. For example, etiology of stricture was a significant factor that influenced recurrence after surgery, but an exact odds ratio could not be calculated because the recurrence rate of the traumatic group was 0%. Instead, we could calculate the estimated odd ratio, but the range of the confidence interval was so wide that the interpretation of the results was limited. Also, the study was retrospectively designed. Thus, additional prospective study with more cases might be warranted for conclusive results.

CONCLUSIONS

Excision and end-to-end anastomosis for short, bulbar urethral stricture has an acceptable success rate of 87.9% with minor complications. However, strictures recurred early (less than 5 months) in four patients (12.1%). Only the stricture etiology affected the surgical outcome. All recurrences occurred in the patients with nontraumatic causes (iatro-

genic in three, infection in one patient). Therefore, careful consideration is needed when choosing a surgical procedure if the stricture etiology is nontraumatic.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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