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European Association of Urology

Reconstructive Urology

One-Stage Bulbar Urethroplasty: Retrospective Analysis of the Results in 375 Patients

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Article info

Article history:
Accepted January 15, 2008
Published online ahead of print on January 22, 2008

Keywords:
Bulbar urethra
Free skin graft
Oral mucosa
Urethroplasty

Abstract

Objective: To review the outcome of bulbar urethroplasty using one-stage surgical techniques.
Methods: Of 375 patients, who underwent one-stage bulbar urethroplasties, 165 patients (44%) underwent anastomotic repair (AR), 40 (10.7%) underwent augmented anastomotic repair (AAR) using penile skin grafts (PSGs) or oral mucosal grafts (OMGs), and 170 (45.3%) underwent onlay grafting techniques (OGTs) using PSGs or OMGs. Clinical outcome was considered a failure when any postoperative instrumentation was needed. The χ^2 and Fisher's exact test for categorical data were used. The sample size of 375 patients provides a statistical power $(1-\beta)$ of 99% at $\alpha = 0.05$; $p < 0.05$ was set as significant.
Results: The average follow-up was 53 mo. Of 375 cases, 313 (83.5%) were successful and 62 (16.5%) failures. Of 165 ARs, 150 (90.9%) were successful and 15 (9.1%) failures. Of 40 AARs, 24 (60%) were successful and 16 (40%) failures. Of 170 OGTs, 139 (81.8%) were successful and 31 (18.2%) failures. The AR showed statistically significant higher success rate compared to OGT ($p = 0.023$) and AAR ($p = 0.0001$). Of 47 PSGs, 28 (59.6%) were successful and 19 (40.4%) failures. Of 163 OMGs, 135 (82.8%) were successful and 28 (17.2%) failures. This difference was statistically significant ($p = 0.002$).
Conclusions: One-stage bulbar urethroplasties showed an overall 83.5% success rate. The AR showed the higher success rate compared to the OGT or AAR. OMGs (82.8% success rate) perform statistically better than PSGs (59.6% success rate).

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0302-2838/$ – see back matter doi:10.1016/j.eururo.2008.01.041

1. Introduction

The treatment of urethral stricture diseases includes numerous reconstructive surgical techniques, and the urologist must be familiar with all of these different techniques to be able to deal with any condition of the urethra during surgery [1]. Basically, in the bulbar urethra, the surgical technique should be selected mainly according to stricture length, but the stricture aetiology and density of the spongiofibrosis tissue should be taken into account. Short, traumatic and nontraumatic, uncomplicated bulbar urethral strictures are universally treated by complete excision of the scar tissue and primary anastomotic repair (AR), with a reportedly high success rate and low postoperative morbidity [2–4]. Whereas the surgical approach to longer urethral strictures is more controversial, augmented anastomotic repair (AAR), with complete excision of the worst stricture segment, is currently recommended for strictures that cover a particularly dense and narrow area of 1–2 cm in length [5–7]. AAR may be arranged using a ventral or dorsal graft location [6,7]. Substitution onlay grafting techniques (OGTs) are currently suggested for longer strictures, and location of the graft on the urethra surface (ventral or dorsal) has become a contentious issue [8–10]. Finally, in patients with strictures associated with local adverse conditions (fistula, abscess, tumour, and other) two-stage urethroplasty should be considered [1,11].

This study reviews the outcome of one-stage bulbar urethroplasty, comparing the results of the different surgical techniques that are suggested worldwide for repairing simple and complex bulbar urethral strictures.

2. Patients and methods

2.1. Patient population

We reviewed retrospectively the charts of 375 patients (mean age: 39 yr; range: 14–80 yr; Table 1), who underwent bulbar urethroplasty using different one-stage techniques. Patients with lichen sclerosus or failed hypospadias repair were excluded. Preoperative evaluation included clinical history, physical examination, urine culture, residual urine measurement, uroflowmetry, and retrograde and voiding cystourethrography. Since 1998, urethral ultrasound has also been performed in all patients. The stricture aetiology was unknown in 245 (65.3%) cases, catheter was the cause in 52 (13.9%), trauma in 38 (10.1%), instrumentation in 29 (7.8%), infection in 7 (1.9%), radiotherapy in 2 (0.5%), and congenital causes in 2 (0.5%) (Table 2). Stricture length was: 1 to <2 cm in 104 patients (27.7%), 2 to <3 cm in 74 (19.7%), 3 to <4 cm in 65 (17.3%), 4 to <5 cm in 87 (23.2%), 5 to < 6 cm in 35 (9.4%), and >6 cm in 10 (2.7%) (Table 3). A total of 260 patients (69.3%) underwent dilation (3.2%), internal urethrotomy (36%), urethroplasty (2.4%), or multiple treatments (27.7%) before the urethroplasty (Table 4).

Table 1 – Success rate according the patient age

Age, yr	Patients		Success rate	
	No.	%	No.	%
14–49	285	76%	238	83.5%
50–69	65	17.3%	52	80%
>70	25	6.7%	23	92%

Table 2 – Success rate according the stricture's aetiology

Aetiology	Patients		Success rate	
	No.	%	No.	%
Unknown	245	65.3%	207	84.5%
Catheter	52	13.9%	39	75%
Trauma	38	10.1%	34	89.5%
Instrumentation	29	7.8%	25	86.2%
Infection	7	1.9%	7	100%
Radiotherapy	2	0.5%	1	50%
Congenital	2	0.5%	0	0

Table 3 – Success rate according the stricture length

Length	Patients		Success rate	
	No.	%	No.	%
1 to <2 cm	104	27.7%	96	92.3%
2 to- <3 cm	74	19.7%	65	87.8%
3 to <4 cm	65	17.3%	47	72.3%
4 to <5 cm	87	23.2%	70	80.5%
5 to <6 cm	35	9.4%	27	77.1%
>6 cm	10	2.7%	8	80%

2.2. Surgical techniques

One hundred-sixty-five patients (44%) underwent AR, 40 patients (10.7%) underwent AAR, and 170 patients (45.3%) underwent OGT (Table 5). Twenty-four patients (60%) underwent AAR using dorsal oral mucosal grafts (OMGs), 9 patients (22.5%) underwent AAR using dorsal penile skin grafts (PSGs), and 7 patients (17.5%) underwent AAR using ventral OMGs

Table 4 – Success rate according the previous treatments

Prior treatment	Patients		Success rate	
	No.	%	No.	%
Urethrotomy	135	36%	115	85.2%
Dilation	12	3.2%	9	75%
Urethroplasty	9	2.4%	8	88.9%
Multiple treatments	104	27.7%	79	76%
None	115	30.7%	102	88.7%

Table 5 – Success rate according the surgical techniques

Technique	No. of patients	Substitute material	Success rate	Mean follow-up, mo
Anastomotic repair	165		90.9%	64
Augmented anastomotic repair	40	Oral mucosa/skin	60.0%	46
Dorsal	24	Oral mucosa	79.2%	31
Dorsal	9	Skin	33.3%	102
	7	Oral mucosa	28.6%	32
Onlay graft techniques	170	Oral mucosa/skin	81.8%	56
Ventral	93	Oral mucosa	91.4%	36
Lateral	6	Oral mucosa	83.3%	77
Dorsal	22	Oral mucosa	77.3%	41
Dorsal	38	Skin	65.8%	111
Circumferential	11	Oral mucosa	63.6%	48
Total	375		83.5%	53

(Table 5). Ninety-three patients (54.7%) underwent ventral onlay OMGs, 22 patients (12.9%) underwent dorsal onlay OMGs, 6 patients (3.5%) underwent lateral onlay OMGs, 11 patients (6.5%) underwent circumferential OMGs, and 38 patients (22.4%) underwent dorsal onlay PSG_s (Table 5). All surgical procedures were performed by the same urologist (G.B.).

2.3. *Postoperative care and follow-up criteria*

Patients were usually discharged from the hospital 3 d after the surgery and voiding cystourethrography was performed 2 or 3 wk later. Clinical outcome was considered a failure when any postoperative instrumentation was needed, including dilation. Uroflowmetry and urine culture were repeated every 4 mo in the first year and annually thereafter. When symptoms of decreased force of stream were present and uroflowmetry was <14 ml/s, urethrography, urethral ultrasound, and urethroscopy were repeated. The average follow-up was 53 mo (range: 12–218 mo).

2.4. *Statistical analysis*

The groups were compared using the χ^2 and Fisher's exact tests for categorical data. Statistic significance was set at $p < 0.05$. All calculations were carried out with SPSS (Statistical Packages for Social Sciences, SPSS, Chicago, IL, USA).

3. Results

Of 375 cases, 313 (83.5%) were successful and 62 (16.5%) failures. Based on patient age, the success rate was 83.5% in 285 patients aged 14–49 yr, 80% in 65 patients aged 50–69 yr, and 92% in 25 patients older than 70 yr (Table 1). No statistically significant difference was detected among the groups ($p = 0.32$). Based on stricture aetiology, the success rate was 84.5% in 245 patients with strictures of unknown aetiology, 75% in 52 strictures caused by catheter, 89.5% in 38 traumatic strictures, 86.2% in 29 strictures following urethral instrumentation, 100% in 7 patients with strictures following infection, 50% in 2 strictures following radiotherapy, and 0% in congenital strictures (Table 2). No statistically significant difference was recorded when the first four groups were compared ($p = 0.87$). Based on stricture length, the success rate was 92.3% in 104 strictures ranging from 1 to <2 cm, 87.8% in 74 strictures ranging from 2 to <3 cm, 72.3% in 65 strictures ranging from 3 to <4 cm, 80.5% in 87 strictures ranging from 4 to <5 cm, 77.1% in 35 strictures ranging from 5 to < 6 cm, and 80 % in 10 strictures >6 cm (Table 3). Patients with strictures ranging from 3 to <4 cm had a statistically significant lower success rate compared with the other groups ($p = 0.007$). Based on having received treatment prior to surgery, the success rate was 88.7% in 115 patients who had not undergone previous treatment and 81.1% in 260 patients who had undergone prior treatment ($p = 0.89$). The success rate was 85.2% in 135 patients who had undergone urethrotomy, 75% in 12 patients who had undergone dilation, 88.9% in 9 patients who had undergone urethroplasty, and 76% in 104 patients who had undergone multiple treatments (Table 4). Based on substitute material, of 47 PSGs, 28 (59.6%) were successful and 19 (40.4%) failures. Of 163 OMGs, 135 (82.8%) were successful and 28 (17.2%) failures. This difference was statistically significant ($p = 0.002$).

Of 165 cases that underwent AR, 150 (90.9%) were successful and 15 (9.1%) failures (Table 5). Of 40 cases that underwent AAR, 24 (60%) were successful and 16 (40%) failures (Table 5). AAR using dorsal OMGs showed a 79.2% success rate, AAR using dorsal PSGs showed a 33.3% success rate, and AAR using ventral OMGs showed a 28.6% success rate (Table 5). AAR dorsal OMGs performed statistically better than ventral ($p = 0.001$). Of 170 cases that underwent OGT, 139 (81.8%) were successful and 31 (18.2%) failures (Table 5). Ventral onlay OMGs showed a

91.4% success rate, lateral onlay OMGs showed an 83.3% success rate, and dorsal onlay OMGs showed a 77.3% success rate. No statistically significant difference in success rate was recorded according to ventral versus lateral versus dorsal placement of an OMG ($p = 0.67$). Dorsal onlay PSGs showed a 65.8% success rate, and circumferential OMGs showed a 63.6% success rate (Table 5). Focusing on the different repairing techniques, AR showed a statistically significant higher success rate compared to OGT ($p = 0.023$) and AAR ($p = 0.0001$).

The multivariate analysis was not performed because of the small size of some groups, that is two strictures following radiotherapy and two congenital strictures.

4. Discussion

The exact incidence of urethral stricture diseases in Italy is unknown, and the aetiology of bulbar urethral strictures still remains unknown in the majority of patients (65.3%). Moreover, in our present study, we found that bulbar urethral stricture disease is prevalent (76%) in young men, aged 14–49 yr, carrying a potential impact on the patient's sexual activity and quality of life. A recent survey of stricture management in the United States showed that 57.8% of urologists do not perform urethroplasty, whereas 31–33% would continue to manage the stricture by minimally invasive means, despite predictable failure [12]. Furthermore, most urologists believed that the literature supports the use of urethroplasty only after repeated endoscopic failure [12]. Our study seems to confirm such a trend in Italy, because 69.3% of patients who were referred to our centre for urethroplasty had undergone minimally invasive procedures that repeatedly failed. In the present study, 178 (47.4%) strictures were <3 cm in length, and it might probably explain why the urologist selected the endoscopic procedure as a primary approach.

We have reviewed these results according to the factors reported as influencing the success rate of any kind of urethroplasty: patient age, stricture aetiology, stricture length, and prior treatments. Our results showed patient age has no effect on the success rate, suggesting that one-stage bulbar urethroplasty should not be withheld from patients on the basis of age (Table 1). The evaluation of the success rate of urethroplasty according to the stricture aetiology showed that the only strictures showing a low success rate (50%) were those developing following radiotherapy (Table 2). The success rate of urethroplasty according to the stricture length was controversial, because short strictures showed a 92.3% success rate, but strictures >6 cm showed an 80% success rate and strictures 3–4 cm showed a 72.3% success rate (Table 3). For the effects of previous treatment on outcome, the success rate was 88.7% in patients who had not undergone previous treatment, whereas in patients who underwent prior urethroplasty, the success rate was higher (88.9%) and in patients who underwent urethrotomy the success rate was not low (85.2%) as some could expect (Table 4).

Our study confirms that AR still represents an effective surgical option in patients with bulbar strictures [2–4]. Our overall success rate (90.9%) is, however, lower than 95% or 98% as reported by other authors using different follow-up criteria [3,4]. Surprisingly, OGT using ventral OMGs provided about the same success rate (91.4%) compared to AR (90.9%) (Table 5). This unexpected outcome is probably due to the fact that we used the ventral OMG technique mainly in patients with nontraumatic, nonobliterative, noncomplex urethral strictures, whereas AR was also used in traumatic or complex strictures showing dense fibrotic spongiosum tissue, which should represent a cause for urethroplasty failure. Further prospective studies on a large series of patients are necessary to clarify whether OGT could also represent a valid alternative to AR for short urethral strictures.

In our experience, the AAR showed a lower success rate (60%) compared to AR (90.9%) or to OGT (81.8%) (Table 5). Nevertheless, we selected this technique mainly for patients with complex strictures that recurred following a previous open urethroplasty or with stricture covering a 1- to 3-cm area that is particularly narrow and with extensive fibrosis widely involving the spongiosum tissue. Sometimes, this surgical approach was selected intraoperatively, when, following complete transection of the bulbar urethra and removal of all scar tissue, the stricture length was longer than that seen on urethrography and it was not possible to arrange an AR. Moreover, this series included nine patients who had undergone AAR using a PSG, performed at the beginning of our learning curve and showing poor results (33.3%) after a long mean follow-up (102 mo). Moreover, this series of subjects also included seven patients who had undergone AAR using ventral OMGs with poor results (28.6%). These two subjects negatively influenced the overall success rate of the AAR. As a matter of fact, AAR using a dorsal OMG, performed at the end of our learning curve, showed satisfactory results (79.2%) in 24 patients. Recently, Abouassaly and Angermeir reported a 90% success rate using AAR, with a

ventral or dorsal location of an OMG [6]. Previously, Guralnick and Webster reported a 93% success rate in patients who underwent AAR using dorsal OMG [5]. El-Kassaby et al reported the largest series of patients treated by AAR using ventral location of the OMG, with a 93% success rate [7].

For a long time, oral mucosa has been variously used as a free graft in reconstructive plastic surgery, and the success rate of OMGs in plastic surgery also enabled the initial use of this tissue in urethral surgery for hypospadias and urethral strictures [13].

In 1996, Morey and McAninch fully described the ventral onlay OMG urethroplasty and Barbagli et al described the dorsal free graft urethroplasty [14,15]. Over time, these two onlay graft procedures have become the preferred techniques for bulbar urethral stricture repair and an incredible number of reports have been published with short-, intermediate-, and long-term follow-ups of these techniques [8–10]. Location of the graft on the urethra surface has become a contentious issue, dating back to the time the ventral and dorsal onlay graft urethroplasty techniques were first described [8–10]. In 2005, we showed that the placement of the OMG on the ventral, dorsal, or lateral surface of the bulbar urethra showed the same success rates (83–85%), and the outcome was not affected by the surgical technique [16]. Moreover, stricture recurrences were uniformly distributed in all patients [16]. In the present study, we included the same patients who were included in the 2005 study [16]. With an extended follow-up, the success rate surprisingly changed. The ventral OMG placement showed an 83% success rate in 2005 (17 cases) [16] and a 91.4% in the present series (93 cases). This is probably due to the fact that we have notably increased the number of patients selected for this procedure and, consequently, we have notably improved our surgical technique (high-volume surgeon effects). Moreover, this technique was primarily selected for patients showing nonobliterative and noncomplex urethral strictures, basically ranging in length from 2 to 5 cm. The dorsal OMG placement showed an 85% success rate in 2005 [16] and 79.2% in the present series. This series included the same patients who were included in the 2005 study [16] and, with the extended follow-up, the success rate decreased slightly. Moreover, this technique was primarily selected for patients showing complex, long urethral strictures, also recurring after previous urethroplasty. In 2005, we reported that six patients underwent lateral OMG placement, showing an 83% success rate [16]. At present, the success rate in this series of patients is the same (83%) and has not shown any deterioration rate over time. In 2003, we described a new circumferential OMG bulbar urethroplasty, reporting a 100% success rate at short-term follow-up [17]. At present, the success rate in 11 patients is 63.6% at a long-term follow-up. Finally, OGT using a dorsal PSG showed a 65.8% success rate, but this technique has a longer mean follow-up (111 mo).

Prior to the use of oral mucosa, penile skin was the preferred tissue-transfer material for urethroplasty. In Europe, De Sy and Oosterlink pioneered in the use of penile free skin graft for urethral reconstruction [18]. The question remains: Is oral mucosa really superior to penile skin [19]? Undoubtedly, success of the oral mucosa for urethral surgery can be partially attributed to the particular biologic properties of the tissue [20]. The oral mucosa is architecturally similar to the stratified squamous epithelium of the penile and glanular urethra, making it exceptionally adaptable for urethral substitution [20]. In the present series of patients, it is evident that the OMG is superior to the PSG for one-stage bulbar urethroplasty, showing an overall success rate of 82.8% compared to 59.6%.

The main weakness of this study is that it is retrospective and not prospective. Even if we ruled out patients with lichen sclerosus and failed hypospadias repair, our population could not be considered homogeneous with regard to stricture aetiology, patient characteristics, and surgeon preferences. This could bias the statistical analysis we performed and on which we based our conclusions. Finally, the mean follow-up could be considered short-term and lacking in evidence to calculate long-term failures, because the general population is aging and life expectancy is increasing.

5. Conclusions

One-stage bulbar urethroplasty using three different surgical techniques, suggested worldwide for repair simple and complex bulbar urethral strictures, showed different success rates. Oral mucosa represents the best substitute material for one-stage bulbar urethroplasty.

Conflicts of interest

The authors have nothing to disclose.

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