



A retrospective analysis of urethral strictures and their management at a tertiary care center

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ABSTRACT

Background: Surgical treatment of urethral strictures includes numerous options such as dilation, internal urethrotomy, stenting and reconstructive surgical techniques. Short uncomplicated strictures are generally amenable to complete excision with primary anastomosis. We performed a retrospective evaluation and analysis of outcome in patients who underwent any kind of treatment for urethral strictures.

Objectives: To evaluate and analyze the outcome in patients who underwent treatment for urethral stricture disease over the last 15 years (May 1993 to June 2008), at a tertiary care centre, as well as to determine the treatment option to be utilized in different varieties of urethral strictures.

Patients and Methods: We reviewed 524 patients who underwent treatment for urethral strictures between May 1993 and June 2008. Mean follow-up was 68 months. Preoperative evaluation included clinical history, physical examination, urine culture, residual urine estimation, uroflowmetry, and retrograde and voiding cystourethrography. Since 2000 urethral ultrasound was also performed in all patients. Clinical outcome was assessed by comparing pre and post operative investigation and patient satisfaction.

Results: Stricture etiology was catheter induced (15.36%), blunt perineal trauma (59.2%), instrumentation (12%), spontaneous (3.52%) and infection (10%). Stricture length was 0 to 1cm (in 9.92%) 1 to 2 cm (in 32%), 2 to 3 cm (17.28%), 3 to 4 cm (24%) or 4 to 5 cm (8.8%) more than 5cm (16%). The success rates in these procedures were 93.6% (TAU-Tunica albuginea urethroplasty), 94.4% (USPBA-U shaped Prostatic-bulbar Anastomosis), 91.7% (BMSU-Buccal Mucosa urethroplasty), 90% (IOU-Internal optic urethrotomy), 90.35% (dilatation) and 81% (two staged urethroplasty). There were 129 patients (25.49%) who experienced ejaculatory dysfunction. Good and fair results were considered successful. Of 524 cases 480 (91.6%) were successful and 44 (8.4%) were treatment failures.

Conclusions: We conclude that the treatment of urethral strictures should be individualized, taking into account the location, length and extent of spongiosclerosis.

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► Implication for health policy/practice/research/medical education:

Clinical outcomes for one of the surgical treatments of urethral strictures are discussed in this article. We suggest reading this article for urologists and general practitioners.

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Background

Surgical treatment of urethral strictures includes numerous options such as dilation, internal urethrotomy, stenting

and reconstructive surgical techniques. Peterson and Webster suggested that no single technique is appropriate for all strictures and the urologist must be familiar with various surgical techniques to deal with any condition of the urethra during surgery. In the management of urethral strictures, the etiology, site, length and density of spongiosclerosis are taken into account (1). Short uncomplicated strictures are generally amenable to complete excision with primary anastomosis. Longer strictures are managed using augmented

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roof strip anastomosis or substitution on lay graft urethroplasty. Finally, for patients with strictures associated with local adverse conditions, 2-stage urethroplasty might be suggested. Strictures limited to epithelium can be managed by dilation with a metal bogies or balloon dilatation. Small strictures less than 1 cm are treated by optical urethrotomy (1, 2). Tunica albuginea urethroplasty [TAU] for anterior, and "U" shaped prostatobulbar end-to-end anastomoses [USPBA] for posterior urethral strictures have high success rate and low postoperative morbidity (2, 3). We performed a retrospective evaluation and analysis of outcome in patients who underwent any kind of treatment for urethral strictures.

Patients and Methods

From May 1993 to June 2008 a total of 524 patients with an average age of 39 years (range 14 to 78) who underwent treatment for urethral strictures, were included in our study. Preoperative evaluation included a thorough clinical history, physical examination, urine culture, residual urine estimation, uroflowmetry, and retrograde and voiding cystourethrography. Since 2000 urethral ultrasound was also performed in all patients. A total of 132 (26.08%) patients underwent dilation, internal urethrotomy, urethroplasty or multiple procedures before being referred to our center. These 132 patients were evaluated and subsequently treated according to our standard protocol. All surgical procedures were performed by the same surgical team, without significant changes in standard technique. After surgery, a per-urethral 22 French silicon catheter was kept for 3 weeks in simple strictures and for 6 weeks in complex strictures. A complex stricture is defined as a stricture length more than 3 cm or one with associated perineal fistulas, recto urethral fistulas, periurethral cavities, false passages, open bladder necks or previous failed repair. After catheter removal, patients were scheduled for postoperative assessment with contrast urethrogram, urethrosonogram, and uroflowmetry. Results were assessed by comparing pre and postoperative investigations and patient satisfaction (Table 1). Good and fair results were considered as successful. Fair results were considered successful as the patients were satisfied with the results and patient satisfaction has been given the maximum importance by us. Clinical outcome was considered failure for patients who were falling under group C (Table 1). Uroflowmetry and urine cultures were repeated every 4 months in the first year and annually thereafter. When symptoms of decreased force of stream were present and uroflowmetry was less than 15 ml per second, urethrography, urethral ultrasound were repeated.

Results

Total of 524 patients were included in the study. Age range was from 14 to 78 years with a mean age of 39 years. Majority of patients 293 (58%) presented with urinary retention and urine had to be diverted as emergency measure in these. Trauma caused stricture formation in 300 (59.2%). Previous catheterization was responsible for stricture formation. In 77 (15.21%) patients instrumentation was responsible in 61 (12%) and infection was responsible in 51 (10%) cases. In 17 (3.3%) patients no cause could be found (Table 2). Stricture length was 0 to 1cm (in 9.92%) 1 to 2 cm (in 32%), 2 to 3 cm (17.28%), 3 to 4 cm (24%) or 4 to 5 cm (8.8%) more than 5 cm (16%) (Table 3). The

114 patients who presented with signs and symptoms of urethral strictures were found to have only epithelial strictures without any spongiofibrosis, all of whom underwent regular dilation (once every three months) with metal bogies. Out of these 114 cases, 103 (90.3%) patients were successfully treated with a max flow rate of 20ml/sec, 11 (9.7%) patients showed poor results and were declared as failures. These 11 patients required a definitive surgical procedure, 3 patients underwent TAU and in rest 9 patients USPBA done.

Optical internal urethrotomy was the treatment of first choice in 30 cases. It was performed in 30 cases and it was successful in 27 (90%) patients. It failed in 3 (10%) cases and in these cases open surgery was performed. Anastomotic urethroplasty (USPBA) was performed in 2 patients and TAU was done in 1 patient. Out of these 30 cases, infection was the etiology in 25 (83.33%) patients, instrumentation in 4 (13.33%) and in 1 patient the cause was unknown. Twenty four patients underwent buccal mucosal urethroplasty for long segment anterior urethral stricture. The mean age of these men was 38.9 years (range 17-58 years), the mean maximum urinary flow rate (Q max) among the patients who were not on SPC was 8.3 ml/sec (range 6.4-10.1 ml/sec). The mean length of the stricture was 7.1 cm (range 3-11 cm). The mean follow up period was 14.2 months (range 2-26 months) and the procedure was successful with no indication for a secondary procedure in 22 (91.7%) cases. The mean maximum urinary flow rate (Qmax) in this group was 18.1 ml/sec (range 14.2-24.5 ml/sec). Two patients developed recurrence of stricture at proximal anastomotic site, requiring an internal urethrotomy. Eighteen patients underwent a two staged procedure, wherein, the mean stricture length was 8.2 cm (range 4-12 cm). The mean maximum flow rate (Qmax) among these patients was 16.2 ml/sec (range 12.2-21.5 ml/sec). 16 of the 18 results were successful, while the other two patients were lost to follow up, with a mean follow up period of 16 months.

A total of 206 patients underwent Tunica Albuginea urethroplasty (TAU). Most of the stricture patients (63%) were young and middle-aged (20-45) years. Length of stricture (measured intraoperatively ranged between 2.5 and 12.7 cm with median value 4.6 cm. Mean ranged between 2.5 and 12.7 cm with median value 4.6 cm. Mean stricture length was 5.8 cm, with a standard deviation of 1.6 cm and the mode was 4.0 cm. Preoperative uroflowmetry was possible only in 98 patients as more than half of patients had suprapubic catheter for complete urinary retention. Preoperative maximum flow rates (Qmax) analysis showed a range of 3.0 to 12.5 ml/s, mean 7.6 ml/s, mode 5.0 ml/s, median 6.8 ml/s and standard deviation of 1.9 cm. Good and fair results were assumed to be successful, while poor results were considered failures. Postoperative and half yearly evaluation showed 96.6% (199) [good 85.9% (177) + fair 10.7% (22)] success rate which decreased to 94.7% (195) [good 84.5% (174) + fair 10.2% (21)] at 1 year and 93.2% (192) [good 84% (173) + fair 9.2% (19)] at 2 years. At the end of 3 years, the success rate was over 90% (good 84% [173] + fair 6.8% [14]). Most of the stricture recurrence (14 = 6.8%) occurred within the first 2 years of surgery, followed by 2.4% (five patients) between the 2nd and 3rd years of follow-up. A total of 19 cases (9.2%) were considered failures, requiring repeat urethroplasty. In 111 patients "U" shaped prostatobulbar anastomosis was done, all were posterior urethral strictures. Results on immediate post operative evaluation were 96.2% (100 + 6), which remained same at 6 months. This decreased to 92% (103) at 12 months & 90.09% (100) at

24 months. Most patients were in age group 20-40 yrs- (68, 61.27%), most common cause was pelvic trauma due to road

traffic accident-74 (67.27%), previous catheterization was responsible in 25% (34) of cases.

Table 1. Postoperative result assessment criteria

	GOOD (A)	FAIR (B)	POOR (C)
Retrograde Urethrography	Good caliber	Partial narrowing at stricture site	Persistent stricture
Urethrosonogram	Patent and distensible lumen	Patent lumen with decreased distensibility	Stricture present
Uroflometry	Q max > 20 ml/sec	Qmax 15-20 ml/sec	Q max < 15 ml/sec
Patient satisfaction	Satisfactory voiding, no instrumentation required	Satisfactory voiding, but require < 1 dilatation per year	Not satisfactory; not voiding or voiding with thin stream needs multiple dilatation/surgery

Table 2. Various etiological factors

S.No.	Etiology	Number of cases	Percent of cases
1.	Pelvic trauma	300	59.2%
2.	Post instrumentation	61	12%
3.	Post catheterization	77	15.2%
4.	Infection	51	10%
5.	Spontaneous	17	3.3%

Discussion

Urethral stricture is a very troublesome disease of human male. It is very challenging to the treating urologists. Major causes of stricture in this study were trauma, previous catheterization, infections and iatrogenic causes such as other series comparable to other studies (4). Bladder-outflow obstruction is a common age-related clinical entity and a close differential to urethral strictures. Studies have shown that surgical treatment is not suitable for high-risk elderly patients and prostatic thermo-expandable metal stents are equally efficacious for treating bladder-outflow obstruction (5). One hundred and fourteen patients were treated with simple dilatation in our centre and a success rate of 90.3% was achieved. The aim of dilatation is to dynamically stretch the scar, and if the scar is limited to epithelium then this could cure the patient (6). Dilatation is not a procedure to be relegated to the inexperienced. It should be done with utmost gentleness and care. Internal optical urethrotomy was applied as treatment of choice in 30 cases. It was less time consuming and associated with less morbidity and shorter hospital stay and was successful in short strictures. In long strictures (> 1.5 cm) it had to be carried out for more than one time along with active and passive dilatations (6, 7). Open surgery had to be performed in 3 (10%) cases. Open surgery in failed internal urethrotomy cases was more difficult as compared to the cases in which open surgery was the primary treatment of urethral stricture. Urethrotomy is a full thickness incision through the scar performed at 12 o'clock position using an optical direct vision urethrotome. A 12 o'clock urethrotomy avoids damage to the cavernous nerves which are at 5 and 7 o'clock to the prostatic urethra, 3 and 9 o'clock to the membranous and 11 and 1 o'clock to the bulbar urethra (7, 8). The penile urethra is not related to cavernous nerves. A long segment stricture in the anterior urethra is a challenge for the urologist. The best approach in these cases is a substitution urethroplasty (9, 10). A number of techniques using various tissues have evolved to deal with these strictures. These include split skin and full thick-

ness grafts, bladder mucosa, buccal mucosa and tissue engineered substitutes (11, 12). Initially, scrotal skin was used but was disfavored because of high rate of complications. Buccal mucosa grafts (BMG) are emerging as new gold standard in the treatment of long segment stricture urethra. The BMG appears to be a versatile urethral substitute, as it can be successfully used for both one and two stage reconstruction (10). The dorsal placement of BMG results in better outcome than ventral patch as the corporeal bodies have an excellent blood supply and good mechanical support. Also the spreading of the graft, making use of the tensile strength in the corporeal bodies reduces the risk of graft shrinkage and chordee (9). The success rate for dorsal onlay buccal mucosa graft is reported to be 96-100% that is comparable to our study. The advantages of buccal mucosa include ease of harvesting, superior donor site cosmeses, resilience to infections and better long-term stability (10, 12). The only disadvantage is that it cannot be used in patients with bad oral hygiene and in tobacco chewers (13). Tunica albuginea urethroplasty is a single-stage procedure which was done in 206 patients in this study. In this procedure, anatomically similar tissues are used for approximation, as the fibers of the tunica albuginea of the corpora cavernosa and corpus spongiosum are histologically similar except that the tunica of the latter is a bit thinner in composition and has different fiber orientation. Both have a circular inner layer that supports and contains the respective cavernous and spongiosal tissues (3). From this inner layer radiates intercavernosal and spongiosal pillars, respectively that act as struts to augment the septum which provides essential support, thus facilitating healing without the danger of excessive fibrosis, which could lead to recurrence of the stricture. Tunica albuginea is locally available and highly distensible connective tissue; therefore the neourethra formed by tunica albuginea gives normal distensible lumen (3). Tunica albuginea present at the urethral plate has long been used to construct the neourethra in cases of hypospadias with time tested tabularized incised plate (TIP) urethroplasty (14). TIP (Snodgrass) urethroplasty for hypospadias provides good urethral reconstruction with cosmetically normal penis and its effectiveness has been proven over numerous studies (15). In TAU only the roof of the neourethra is formed by tunica as compared with the complete circumference formed with tunica in TIP. With the availability of tunica albuginea for the full length of the anterior urethra, it can effectively be used alone or in conjunction with other procedures for fairly long strictures (even pan urethral stricture). In the present study, failures were predominantly seen in cases with poor prognostic factors like in amatory etiology

Table 3. Length of urethral stricture

S.No.	Length of stricture (CMS)	Number of cases	Percent of cases	Mean	Standard Deviation	Variance
1.	0-1	50	9.92%	0.6386	0.18041	0.0319
2.	1.1-2.0	162	32%	1.64877	0.17605	0.0308
3.	2.1-3.0	87	17.3%	2.4516	0.1563	0.0307
4.	3.1-4.0	121	24%	3.65165	0.17521	0.03045
5.	4.1-5.0	45	8.8%	4.672	0.1672	0.02509
6.	> 5.0	41	8%	5.687	0.15417	0.02319

Table 4. Total number of patients treated, modality of treatment & success rate

S.No.	Number of cases	Treatment modality	Success rate
1.	30	Internal optical urethrotomy (IUO)	90%
2.	24	Buccal mucosal graft urethroplasty [BMG]	91.7%
3.	206	Tunica Albugenia Urethroplasty (TUA)	93.6%
4.	132	“U” shaped prostatic bulbar anastomosis. (USPBA)	94.4%
5.	114	Dilatations	90.3%
6.	18	Two staged urethroplasty	81%

and complete (anterior + posterior) urethral strictures. On the other hand, tunica albuginea urethroplasty worked very well for uncomplicated anterior urethra strictures. Tunica albuginea has advantages of being locally available and highly distensible tissue, which can be used for fairly long strictures (including pan urethral stricture) (3, 16). The procedure is easy to master and because it doesn't require any graft or flap, is feasible in patients not having a healthy oral mucosa due to tobacco chewing. Cosmetically, the penis looks normal because the procedure doesn't cause any chordee or curvature. With the mentioned advantages tunica albuginea urethroplasty can safely be recommended for selected patients as a useful tool by treating urologists. In anastomotic urethroplasty it is accepted that spatulation of both the proximal and distal urethral end results in wide anastomosis and spatulation has been recommended to reduce the disadvantages of ring anastomosis (17). In “U” shape urethroplasty, the slit opened edges of the urethra are sutured in such a manner that it provides wide anastomosis, hence reducing the chances of restenosis (2). Recurrence of stricture after urethroplasty was 3.8% immediately to 9.1% after 24 months the impotence rate was also significantly lower at 1.4% which is quite acceptable in comparison to other studies (2). None of the patients in our study were incontinent, as bladder neck function was adequate in keeping the patient continent in the absence of a distal sphincter function. Spatulation has been recommended over circular ring anastomosis so as to avoid constricting scar formation at the site of the anastomosis. Studies show that making too many stitches is an invitation for increased inflammation and scar formation ultimately leading to restructure (18, 19). USPBA is on the one hand an easy technique to learn and also avoids ring anastomosis. There are only three sutures taken at the 3, 6 and 9, o'clock positions,

hence minimal inflammation is caused by sutures. Therefore all the technical reasons for stricture to recur are avoided. USPBA is an easier technique master which restores basic fundamentals of urethroplasty and it is an effective treatment option for posterior urethral stricture. Near the apex of the prostate, the neurovascular bundle [internal pudendal vessels and nerve] divides into two parts: a larger anterior and a smaller posterior part. The anterior part [the deep dorsal vessels and nerve of penis] crosses the membranous urethra, at the 1 and 11 o'clock positions on either side respectively. The posterior part crosses the membranous urethra more posteriorly to enter the bulb of the penis. In our technique we avoided complete ring anastomosis which may be a cause in ring stenosis and lastly we avoided taking sutures from 2 to 10 o'clock positions which may have two advantages. By avoiding too many sutures the chances of restenosis is reduced and also by avoiding sutures from 2 to 10 o'clock positions there are reduced chances of injury to neurovascular bundles which enter the corpora cavernosa at 1 and 11 o'clock positions implying less chance of impotence and restenosis (2, 18-20).

However, when sufficient local tissue is not available for a skin flap procedure or the local tissues are not suitable for a free graft, a staged procedure may be required. The first stage in a staged procedure focuses on opening the underside of the urethra to expose the complete length of the stricture. A graft is secured to the edges of the opened urethra and allowed to heal and mature over a period of three months to a year. During that time, patients urinate through a new opening behind the stricture or a perineal urethrotomy, which in some cases will require the patient to sit down to urinate. The second stage is performed several months after the graft around the urethra has healed and is soft and flexible. At this stage, the graft is formed into a tube & the urethra is returned to normal. (Urology Health Organization-Urethral Stricture Disease). In our patients, who underwent the two staged repair, no graft was used, and results were excellent. Epithelial strictures without spongiofibrosis should be treated by dilation. Optical urethrotomy should be employed for epithelial stricture less than 1 cm, in long strictures (> 1.5 cm) it had to be carried out for more than one time along with active and passive dilatations. A single recurrence following urethrotomy should be treated with other procedures since a second urethrotomy is of limited value even for palliation and a third repeated urethrotomy of no value. End to end anastomosis of penile strictures or bulbar strictures of more than 3cm may lead to shortening of the urethra and penile curvature at erection. These strictures are treated by substitution urethroplasty using free grafts. Augmented anastomotic repair should be considered when a 2-3cm bulbar stricture excision is necessary. Our study showed that the results of

long anterior stricture treated by TAU have comparable results with substitution urethroplasties like buccal mucosa urethroplasty. Strictures in the bulbar urethra of 2cm or less should be treated by excision and spatulated end to end anastomosis in "U" shape. Most cases of posterior urethral injury should be managed acutely with suprapubic drainage, and then definitively treated after 3–6 months of recovery. This allows any hematoma to resolve, with descent of the prostate and shortening of the defect. Although this results in stricture formation in almost 100% patients which can usually be managed by end to end anastomosis in 'U' shape. This technique is advantageous over the others owing to the fact that "U" shaped end to end anastomosis markedly decreases the chances of restenosis in patients because of the wide anastomosis. Two staged procedures tend to have lower success rates due to the longer length of the stricture segments as well as the greater degree of spongiofibrosis. We conclude that procedure selection should be determined by stricture characteristic, including location, etiology, length and the presence of local adverse factors.

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Conflict of interest

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