Anterior Urethral Strictures: A Brief Review of the Current Surgical Treatment

Key Words
Urethra • Stricture • Urethroplasty • Anastomosis • Reconstruction

Abstract
A review of the recent literature on the surgical management of anterior urethral stricture was performed. The literature was searched via PubMed using the search terms ‘urethral stricture’ and ‘urethroplasty’ from 1996 to 2009. The management of anterior urethral strictures is changing rapidly in the sense that the reconstructive procedures have evolved greatly. Penile skin, because of its location and because it is hairless, has been popular and used for a long time. Since the early 1990s, buccal mucosa graft (BMG) was introduced in urethral reconstructive surgery and has become the first choice of most practicing urologists. Recently, there has been an increase in the use of lingual mucosa graft with various doctors reporting easy harvesting and lesser morbidity in comparison to BMG. Also, fibrin glue has recently been used to fix the graft with promising results. With the success of tissue-engineered materials that are still in the experimental phase, the urologist would no longer be limited by the quantity of the graft. These substitutes will also boost the appealing scarless endoscopic urethroplasty. This article provides a brief up-to-date review of the main surgical techniques in the management of anterior urethral stricture disease for the contemporary practicing urologists. Present controversies have been given special emphasis. The possible future techniques and the future of the anterior urethral stricture surgery are also discussed in brief.

Introduction

Urethral strictures are a common source of referrals to urologists. Anterior urethra classically is divided into bulbar and penile parts. Bulbar urethra is enclosed by the bulbospongious muscle. The penile urethra runs from the distal margin of the bulbospongious to the fossa navicularis and external meatus. Strictures of the bulbar urethra are commoner than those of the penile urethra [1]. Blunt perineal trauma, urethral catheterization or instrumentation, lichen sclerosus (LS) and sexually transmitted diseases are the most frequent causes of strictures. Surgical treatment of urethral stricture diseases is rapidly evolving. Currently there exist various means of reconstructing the urethra that are almost all comparable in terms of technical ease, associated morbidity and the outcome. But which one is the best technique has not yet been clearly defined [2]. In this period of rapid evolution of urethral reconstruction surgery, the contemporary urologists have to be up-to-date with the use of different surgical techniques and experimental advances. This article aims to provide an update on the reconstructive...
techniques currently used to repair anterior urethral strictures, and provides a brief discussion of the current controversies related to this topic, possible future advancements and techniques.

**Methods**

The literature search was made with the PubMed database using the search terms ‘urethral stricture’ and ‘urethroplasty’ from 1996 to 2009. Only English language original and review articles were included presenting data regarding all aspects of the surgical repair of anterior urethral strictures. Articles presenting opinions rather than evidence and those published in non-peer-reviewed journals were not included. The relevance of each search article to the subject matter was independently assessed by the authors. Meta-analyses or multivariate designs were not employed.

**Direct Visual Internal Urethrotomy/Optical Urethrotomy**

This is performed using cold knife or laser as a day-care procedure. The stricture ring is incised at 12 o’clock. At the end of the procedure the patient is catheterized and the catheter is removed within 24–48 h. Healing occurs by subsequent epithelialization of the constriction ring [4]. Self urethral calibration following direct visual internal urethrotomy (DVIU) has been shown to prolong the time to stricture recurrence [5]. Both of these procedures are ideal for short bulbar urethral strictures with no previous intervention. In such cases the success rate is up to 50% [4]. However, like dilatation, urethrotomy too has high recurrence rates. Moreover, repeated dilatation and DVIU render subsequent reconstructive surgery more difficult [3]. Further, surgical repair for patients with short urethral strictures is more cost-effective than repeated urethrotomy [6].

**Urethroplasty**

This is considered as the ideal treatment for anterior urethral strictures [7]. It can be offered to males of all age groups and can even be performed as a day procedure with costs comparable and even less than those of DVIU [8, 9]. Different types of surgical procedures under this heading are listed below.

**End-to-End Anastomosis**

In general, strictures in the bulbar urethra of 2 cm or less are treated by excision and spatulated end-to-end anastomosis. In non-inflammatory strictures, this procedure can provide success rates of up to 95% [10]. Mun- dy [11] has recently illustrated the surgical technique of end-to-end anastomosis in his excellent paper. Eltahawy et al. [12] published their series of 260 patients with bulbar stricture who underwent end-to-end anastomosis over 10 years with a mean follow-up of 50.2 months. The mean stricture length was 1.9 cm, and the authors described a success rate of 98.8%. On the other hand, Gupta et al. [13] published the results of 114 patients who underwent end-to-end anastomosis in their center with a mean follow-up of 26.7 months and an average stricture length of 2.2 cm. The success rate of the procedure was 82.6%. While analyzing the long-term results of end-to-end anastomosis for bulbar urethral stricture of varied etiologies in 153 patients, Barbagli et al. [14] found that the procedure had a success rate of 90.8%,
and most patients felt satisfied with the surgical outcome despite some minor postoperative complications.

Augmented Roof-Strip Anastomosis

For longer strictures (2–4 cm) excisional augmented anastomotic urethroplasty which involves the segmental excision of the worst section of the stricture (but only up to 2 cm) followed by reanastomosis of dorsally spatulated urethra and dorsal augmentation with a graft or flap is the most suitable [15]. This lowers the tension between the two mobilized ends of the urethra [11]. The half circumference of the urethra is then closed. Augmented roof strip anastomosis can also be performed with the graft or flap being placed on the ventral surface of urethra. Gur-alnick and Webster [15] have used this technique in 29 patients with bulbar urethral stricture. They use ventral onlay in 9 and dorsal onlay in 20 patients. The mean stricture length was 1.5 cm on retrograde urethrography and the mean excised length was 1.2 cm. They reported a success rate of 93% at a mean follow-up of 28 months. Complications include new erectile dysfunction in 1 patient, postvoid dribbling in 13, pseudodiverticulum formation in 2 and subjective penile shortening in 5. Recently, Abouassaly and Angermeyer [16] reported their experience of augmented anastomotic urethroplasty in 69 patients with a success rate of 90% at a mean follow-up of 34 months.

Substitution Urethroplasty

This is the most commonly practiced type of urethroplasty and it is the area of much progress in reconstructive urology. The primary indications for substitution urethroplasty, using local skin flaps or free grafts, are recurrent or long strictures of bulbar urethra (>2 cm) and those of penile urethra (>1 cm). The strictured urethral segment is either partly or wholly replaced with another tissue. An ideal replacement tissue is one that has a thick epithelial layer, minimal donor site complications, thin lamina propria, minimal shrinkage, is non-water absorbing, non-hair bearing and easy to procure [17]. Several autologous grafts or flaps from genital and extragenital skin or mucosa have been proposed for anterior urethral stricture repairs, but today substitution urethroplasty using BMG applied dorsally is the most popular and widespread method available to the urologists. [3, 18]. The main reason for this is that this procedure can be easily performed and mastered. On the other hand, flap procurement while keeping its vascularity undisturbed requires great precision and experience. Different techniques of placing the graft have been described. The urethra is mobilized and the strictured segment is replaced with a graft placed dorsally or ventrally, either partly or wholly. Recently, Asopa et al. [19] described a technique of dorsal placement of a free full-thickness preputial graft or BMG without mobilizing the urethra. They did it by laying open the stricture ventrally and then incising the urethra dorsally to expose the tunica albuginea for placement of graft/flap followed by retubularization of the urethra. After a follow-up of 8–40 months, of 12 patients, only 1 recurred and required dilatation [19]. Kulkarni et al. [20] have described one-sided urethroplasty for anterior strictures to preserve the lateral vascularity of the urethra, which may be a slight but significant step toward perfecting the surgical technique of urethral reconstruction.

Substitution Urethroplasty Using BMG

BMG was first described in 1886 by Suprechko, and has become the most popular substitute material in the treatment of urethral strictures. It is readily available and easily harvested from the cheek or lip, allowing for a concealed donor site scar with low morbidity (all the qualities to make it a good choice of tissue), and has a thick elastic-rich epithelium with natural resistance to infection and progression of other skin diseases such as LS [3, 21]. Buccal mucosa is hairless, and the tough epithelium makes it tough yet easy to handle. It also has a thin and highly vascular lamina propria, which facilitates inoculation and imbition and thus tissue harvesting. The donor site heals quickly with minimal morbidity and complications. Hence, since 1998 BMG has become the choice for urethral augmentation or reconstruction [3]. Furthermore, BMG grafts carried the highest success rate (96%) of all free graft tissues or pedicled flaps used in single-stage bulbar urethroplasty structure repair [17]. But it should be noted that almost all these series had a follow-up period of less than 10 years.

Flap versus Graft

This is an area of great controversy in this subject matter. Dubey et al. [22] performed a prospective randomized trial to compare outcomes of BMG dorsal onlay and penile skin flap dorsal onlay urethroplasty in patients with anterior urethral strictures, and found that on intermediate follow-up the success rate for BMG (89.9%) and penile skin flap (85.6%) was no different (p > 0.05). But they also described the flap procedure as technically more complex, associated with higher morbidity and less preferred by patients when compared to the BMG procedure [22]. Recently, Whitson et al. [23] used penile skin
Review

Mosites [29–32]. A portion of the stricture and perform dorsal reanastomosis and, if necessary, excise the mucosal edges, measure the size of the plate, and hence urethral caliber [28]. On the other hand, ventral placement of BMG is currently considered the technique of choice with plenty of evidence supporting it [3, 18]. In 2001, Andrich et al. [21] compared their results of ventral onlay to dorsal onlay BMG urethroplasty. They followed 29 patients for 48–60 months with a success rate of 86%. The rates of recurrent stricture were similar irrespective of the technique or graft material used. With both techniques, all patients had some postcoital pooling of semen or postmicturition urine dribbling, which was reported as significant in 21% of patients with ventral onlay grafts versus 17% of those with dorsal onlay grafts [21]. Kane et al. [35] reported a multicenter experience of 53 patients with complex bulbar urethral stricture treated by ventral onlay BMG urethroplasty, and followed for an average of 25 months with an overall success rate of 94.3%. Four patients (7.5%) had sacculation in the region of the graft but with good postoperative urine flow rates and minimal symptoms [35]. In 2003, Heinke et al. [31] published their results of 38 patients, of whom 30 had bulbar urethral disease treated by ventral onlay BMG urethroplasty. At a mean follow-up of 22.8 months, 7 of 38 patients had recurrence of their disease (18.4%). Elliott et al. [38] reported the long-term results of the same procedure in 60 patients with bulbar urethral stricture with a 90% success rate at a mean follow-up of 47 months. Dubey et al. [39] in a series of >100 patients treated with various urethroplasty techniques reported data on 18 patients, of whom 7 had received ventral onlay BMG. Over a follow-up of 45.7 months, they reported a success rate of 77.8%, but noted a significantly higher incidence of graft sacculation, diverticulum formation, urethrocutaneous fistula, and postmicturition dribbling than with dorsal onlay procedures. Stricture recurrence was equivalent among all groups [39]. Kellner et al. [32] in 2004 published the results of a long-term follow-up after ventral onlay BMG urethroplasty in 23 patients with anterior urethral strictures of varied etiologies. At mean follow-up of 50 months they reported a success (defined as normal voiding without any need for subsequent urethral manipulation) rate of 87% [32]. However, Berger et al. [40] reported their outcomes of management of posttraumatic urethral strictures. This included 7 patients undergoing ventral onlay BMG for bulbar urethral strictures. At a mean follow-up of 70.7 months, they noted a high failure rate of 57%, with 4 of 7 patients requiring revision surgery [40]. Barbagli et al.

Where Should the Graft/Flap Be Placed in Relation to the Urethra?

This has been another source of great controversy. Although Barbagli et al. [27] described 3 variations for BMG placement, ventral, dorsal and lateral, the first 2 are those which are most commonly done. Dorsal placement of the graft has the advantage of using the corporal bodies to provide a secure well-vascularized graft bed that helps to prevent the protrusion of the graft with resulting pseudodiverticulum formation. In addition, this spread BMG fixation preserves graft width and hence urethral caliber [28]. On the other hand, ventral location provides the advantages of ease of exposure and good vascular supply by avoiding circumferential rotation of the urethra. Ventral urethrotomy allows the urethra, and good vascular supply by avoiding circumferential rotation provides the advantages of ease of exposure and hence urethral caliber [28].

Early success rates of dorsal and ventral onlay with BMG were 96 and 85%, respectively. However, long-term follow-up revealed essentially no difference in success rates which in general have been high [16, 21, 27, 29, 31, 33–37]. Dorsal placement of BMG is currently considered the technique of choice with plenty of evidence supporting it [3, 18]. In 2001, Andrich et al. [21] compared their results of ventral onlay to dorsal onlay BMG urethroplasty. They followed 29 patients for 48–60 months with a success rate of 86%. The rates of recurrent stricture were similar irrespective of the technique or graft material used. With both techniques, all patients had some postcoital pooling of semen or postmicturition urine dribbling, which was reported as significant in 21% of patient with ventral onlay grafts versus 17% of those with dorsal onlay grafts [21]. Kane et al. [35] reported a multi-center experience of 53 patients with complex bulbar urethral stricture treated by ventral onlay BMG urethroplasty, and followed for an average of 25 months with an overall success rate of 94.3%. Four patients (7.5%) had sacculation in the region of the graft but with good postoperative urine flow rates and minimal symptoms [35]. In 2003, Heinke et al. [31] published their results of 38 patients, of whom 30 had bulbar urethral disease treated by ventral onlay BMG urethroplasty. At a mean follow-up of 22.8 months, 7 of 38 patients had recurrence of their disease (18.4%). Elliott et al. [38] reported the long-term results of the same procedure in 60 patients with bulbar urethral stricture with a 90% success rate at a mean follow-up of 47 months. Dubey et al. [39] in a series of >100 patients treated with various urethroplasty techniques reported data on 18 patients, of whom 7 had received ventral onlay BMG. Over a follow-up of 45.7 months, they reported a success rate of 77.8%, but noted a significantly higher incidence of graft sacculation, diverticulum formation, urethrocutaneous fistula, and postmicturition dribbling than with dorsal onlay procedures. Stricture recurrence was equivalent among all groups [39]. Kellner et al. [32] in 2004 published the results of a long-term follow-up after ventral onlay BMG urethroplasty in 23 patients with anterior urethral strictures of varied etiologies. At mean follow-up of 50 months they reported a success (defined as normal voiding without any need for subsequent urethral manipulation) rate of 87% [32]. However, Berger et al. [40] reported their outcomes of management of posttraumatic urethral strictures. This included 7 patients undergoing ventral onlay BMG for bulbar urethral strictures. At a mean follow-up of 70.7 months, they noted a high failure rate of 57%, with 4 of 7 patients requiring revision surgery [40]. Barbagli et al.
[27] also compared success rates of bulbar urethroplasty using BMG at different locations and found no significant difference. Singh et al. [41] used dorsal placement of lingual mucosal graft (LMG) through Asopa’s ventral sagittal urethrotomy approach, and showed the superiority of this technique over the classical Barbagli’s procedure in terms of success and complications. Recently, McLaughlin et al. [42] reported their results of ventral placement of BMG in 58 patients with anterior urethral stricture and previous history of multiple surgeries. At a mean follow-up of 29.6 months, in 48 patients the success rate was 94%. But Patterson and Chapple [43] reviewed the updated literature on the results of the use of BMG in dorsal onlay, ventral onlay, and tubularized grafts and the role of two-stage procedures, to find out which technique is most appropriate. Although they found that in experienced hands the results of the ventral and dorsal onlay BMG for bulbar urethroplasty were equivalent, the dorsal onlay BMG was more suitable for surgeons new to the practice of urethroplasty. Further, the complications associated with the ventral onlay technique in series with longer follow-up tend to be more prevalent [43]. Most recently, Wang et al. [44] performed a meta-analysis review of the literature on dorsal or ventral graft urethroplasty. The success rates of ventral onlay urethroplasty (750 cases) and dorsal onlay (513 cases) were 82.5 and 86.9% (p = 0.034). Dorsal and ventral placement of the patch can also be combined for severe stricture disease. In 2008, Palminteri et al. [45] described the combined use of dorsal and ventral inlay of BMG in the management of severe bulbar urethral structuring. Through a ventral incision BMG is inlaid and quilted to the underlying corpora, followed by inlaying of another patch ventrally, and further augmentation of the urethra with spongioplasty. They reported a success rate of 89.6% at a mean follow-up of 22 months, with 4 of 5 recurrences managed with DIVU alone with no further recurrence [45].

The Other Graft Materials

(1) Tunica vaginalis has been used to reconstruct bulbar urethral strictures with good success rates [46]. However, still more studies are needed to assess the suitability of this new graft. (2) Postauricular skin graft (PASG): Mundy and his group [47] in 1999 were the first to describe that it had results comparable to BMG owing to the presence of a dense subdermal plexus. PASG was used in patients with diseased genital skin or oral mucosa unsuitable for harvesting with a success rate of 89% [48]. But PASG is not popular. (3) LMG: This has recently emerged as a potential substitute for BMG. The site of graft harvesting is the lateral mucosal lining of the tongue starting from a posterior landmark, and can be continued across the tip of the tongue to the other side if a longer graft is required. The graft harvesting site is simultaneously closed with a continuous running suture using 4-0 poliglecapron suture for adequate homeostasis. Few studies exist in the literature which describe this procedure and the majority lack a long-term follow-up. Das et al. [49] achieved a success rate of 83.3% at 9 months’ follow-up. Barbagli et al. [50] used LMG in 10 patients with anterior stricture and concluded that it may be the best alternative to BMG. Song et al. [51] in a good review of studies on urethroplasty using LMG concluded that easy harvesting and low morbidity can make LMG a suitable replacement for BMG.

Urethral Strictures by Site

In the anterior urethra, bulbar urethral strictures are more common than other urethral strictures except in specialist units where penile strictures are becoming more common because of previous hypospadias surgery or LS [1]. On the whole, penile urethral surgery is technically more challenging than bulbar urethral surgery, and the results are less satisfactory [2]. Anastomotic urethroplasty provides best results for short (less than 2 cm long) congenital, traumatic or inflammatory strictures of the bulbar urethra. For longer strictures (2–4 cm) excisional augmented anastomotic urethroplasty is most suitable [15]. If a bulbar stricture is too long, which is often the case, circumferential urethral reconstruction with a patch (BMG or flap) is performed [21, 33, 52, 53]. It should be borne in mind that these stricture lengths are approximations and the choice of procedure is usually guided by intraoperative findings.

On the other hand, the use of BMG for one-stage reconstruction of meatal, penile and pan-urethral strictures has been limited [54]. The best management of the strictures of the penile urethra (not resulting from LS) appears to be with an onlay flap using penile skin [55]. A transverse flap of foreskin may be used in uncircumcised males to repair hypospadias. Flaps harvested from the prepuce and the shaft can be used to repair an up to 15-cm-long stricture. Excision of a tight segment before onlay is usually not recommended so as to avoid chordee [6, 47]. However, the recurrence rates have been similar with the use of both BMG and penile skin flap urethroplasty for anterior urethral strictures [23, 39, 56], but greater morbidity with the use of flaps was reported by Dubey et al. [39]. They further confirmed the versatility of BMG as urethral substitute by successfully using it for
the entire anterior urethra in both one- and two-stage reconstructions [54]. However, as penile skin flap urethroplasty is a relatively difficult procedure to perform when compared to BMG urethroplasty, the outcome of flap procedures done by lesser experienced surgeons may have higher morbidity and recurrence or both than those done by surgeons with more expertise. The surgeons’ experience is not generally taken into account while calculating the overall recurrence and morbidity rates, and this may lead to biased labelling of flap urethroplasty as a procedure with higher morbidity rate. It is actually a procedure that demands more expertise than BMG urethroplasty does. Further, Asopa et al. [19] and Gupta et al. [13] successfully used dorsal fixation of BMG for penile and combined bulbopenile and pan-urethral strictures, respectively. Levine et al. [57] evaluated 35 patients with bulb and 18 with penile urethral stricture who were treated with BMG (dorsal or ventral) urethroplasty, and found good success rates in both groups.

Single-Stage versus Staged Urethroplasty

Single-stage urethroplasty for bulbar strictures using BMG has been reported to carry a very high success rate (96%) [17]. Long-term (at least 5 years) success rates for single-stage BMG urethroplasty for repair of defects associated with hypospadias/epispadias and strictures were 84% [58] and 75% [59], respectively.

Staged urethroplasty has been recommended for more complex strictures requiring extensive tissue replacement or in cases with adverse local conditions including extensive scarring, fistulization or infection [60]. Early reports of staged BMG repair exhibited a 93% success rate [60], and long-term data showed virtually the same rate. Dubey et al. [54] used a procedure in which the first stage included complete excision of stricture and the placement of BMG to form the urethral plate, and the second stage used a penile skin flap to form the urethra. They reported favorable results.

In 2003, Heinke et al. [31] reported that even complex and extensive urethral defects can be repaired in a single stage. Markiewicz et al. [61] in an excellent review of the literature on the use of BMG in urethroplasty found that the success rate in 18 studies (529 cases) that assessed single-stage BMG urethroplasty for stricture repair was 81.1%. The success rate for 4 studies (165 cases) using two (or more)-stage BMG urethroplasty repair was 75.8% (p = 0.149) [61]. Palminteri et al. [60] used only two-stage BMG urethroplasty for bulbar urethral stricture with a success rate of 93%. While operating on a population with LS or with previously successful hypospadias/epispadias repair, Andrich et al. [62] reported a 50% success rate using two-stage procedures which necessitated multiple subsequent repairs. They found that two-stage urethroplasty has a significantly lower restricture rate than single-stage urethroplasty for complex strictures in the penile urethra, but it does so at the expense of a significantly higher revision rate [62]. Both Palminteri et al. [60] and Andrich et al. [62] advised a two-stage approach only when adverse conditions like the one mentioned above were present. Further, the penile urethral strictures should undergo a single-stage procedure whenever possible to avoid patient discomfort and disability. This is usually possible for strictures caused by trauma, infection, instrumentation or catheters, when the penile shaft is on the whole normal and the urethral plate, corpus spongiosum and darts fascia are suitable for single-stage reconstruction [18]. On the other hand, for strictures after hypospadias repair or where the penile skin, urethral plate and darts fascia are not suitable for single-stage reconstruction, two-stage urethroplasty is recommended [18, 63].

Strictures from LS

The changes from LS most commonly occur in the glans penis and prepuce, causing phimosis. With more extensive involvement it can affect the urethra as far back as the midbulb [1]. Most of the patients with urethral involvement require complex reconstructive surgery procedures that can have high complication and failure rates of up to 71% [64]. Surgical management of the urethral involvement by LS is difficult, and ranges from extended simple meatotomy for distal strictures to complex staged repairs for more extensive disease. These usually include excision of the entire affected urethra and the use of BMG for reconstruction, so as to prevent recurrence of disease in the repaired area [1].

Dubey et al. [65] reported the outcomes of 39 patients with LS-related anterior urethral strictures that were treated by either single-stage dorsal onlay BMG urethroplasty (25 patients with a salvageable urethral plate) or two-stage urethroplasty (14 patients with severely scarred urethral plate). They assessed the outcomes in terms of cosmesis, stricture recurrence and complications. At a mean follow-up of 32.5 months 3 patients (12%) treated in a single stage had recurrent strictures, which were treated with urethrosopic interventions. All patients had a normal meatus and none had chordee or erectile dysfunction. Among those treated in two stages, 4 (28.6%) required stomal revision and 2 had glans cleft narrowing after the first stage. Following stage two, 3 patients had
the obliterated segment is short and forms part of a long
BMG-augmented roof-top anastomosis is useful when
not be able to deal adequately with such strictures. The
less obliterative [2]. Standard patch urethroplasties may
ment of long anterior urethral strictures that are more or
ally lost [2]. Thus there is no gold standard for the treat -
ance of complete excision of the diseased urethra with
multistage repair, and reported a higher rate of stricture recurrence with single-stage repair. Kulkarni et al. [67] in
their multicenter international experience with 215 male
patients of LS of the genitalia and urethra found that the
use of one-stage oral graft urethroplasty has greater suc-
cess than the staged procedures. Furthermore, in an at-
tempt to decrease the morbidity, some workers prefer per-
ineal urethrostomy as an alternative to complex staged repairs, especially in the older patients [3, 68].

Further, Dubey et al. [54] advocated preferential use of several BMGs in single stage while managing longer stric-
tures particularly those related to LS. Harvesting BMG from several sites has not been found to cause significant
morbidity in the long term, and taking grafts from both cheeks and the lower lip, they were able to reconstruct
urethral lengths even up to 17 cm. However, whenever there is not enough BMG to substitute the entire length
of the stricture, they recommended the combined use of BMG and a penile skin flap [54].

Thus, it is clear that now the trends have moved to-
wards using single-stage repair for difficult strictures of
anterior urethra due to LS, and the substitute of choice is
BMG.

Obliterative Strictures

In the literature, little or no differentiation has been
made among urethroplasties for the strictures with the
lumen more or less completely obliterated, and those
where the lumen is significantly narrowed but not actu-
ally lost [2]. Thus there is no gold standard for the treat-
ment of long anterior urethral strictures that are more or
less obliterative [2]. Standard patch urethroplasties may
not be able to deal adequately with such strictures. The
BMG-augmented roof-top anastomosis is useful when
the obliterated segment is short and forms part of a long
stricture in which the lumen is otherwise okay [2]. But
when the whole stricture is more or less oblitative through-
out its length, long flap repair preferably using a
patch of penile shaft skin is a good option [69]. In cases
of strictures complicated by periurethral infection or ab-
cess, a two-stage repair is preferred. The first stage in-
volves marsupialization of the skin to the margins of a
full-length ventral urethrotomy followed by mobilization
and rolling-up of a neourethral strip (3 cm wide) into a
tube in the second stage [2].

Role of Fibrin Glue

Fibrin glue increases tissue plane adherence, acceler-
ates revascularization, reduces hemorrhage, prevents se-
roma formation and decreases inflammation [18]. In
2004, Hick and Morey [70] used fibrin in anterior ure-
thal reconstruction in 25 patients (mean stricture length
8.3 cm) and compared their outcome with that of 18 pa-
tients (mean stricture length 7.24 cm) in whom fibrin was
not used. All procedures were performed by same sur-
geon (Morey). They found that the use fibrin glue pro-
motes early catheter removal and enhances wound heal-
ing after penile urethral reconstruction. Barbagli et al.
[71] reported in 2006 their first series of 6 patients of dor-
sal onlay BMG urethroplasty with fibrin glue to support
the graft on the corporal bodies. Short-term results were
promising with no strictures at 12 months. However,
further comparative studies are required to confirm that
the use of fibrin glue is really beneficial and to evaluate
whether its use reduces restenosis rate following substitu-
tion urethroplasty [72].

Tissue-Engineering Urethroplasty

Every autologous tissue is associated with donor site
morbidity, time-consuming harvesting, and morpholog-
ic features that may cause complications or strictures.
Thus urethral tissue engineering is a new emerging field.
At present there is little data available for tissue-engi-
neered urethroplasty in humans. Various heterologous
materials have been used but with bad results in the long
term [73]. The main problem is the development of a suit-
able carrier for cells. Advancements in this field have
made it possible for scientists to be able to regenerate ure-
thral tissues using biodegradable organic matrices. Car-
sen [74] suggested that the use of tissue engineering to
optimize graft material may allow us to combine the most
refined surgical techniques with the best graft material,
to achieve even more reliable results. Palmiter et al. [75]
performed urethroplasty in 20 patients using collagen tis-
sue matrix manufactured from porcine small intestinal
submucosa. For anterior urethral strictures a success rate of 85% was found at 21 months. El Kassaby et al. [76] recently described an ‘off-the-shelf’ collagen matrix based on cultured human cadaveric bladder mucosa that showed promising results. Later, they performed a randomized comparative study between the use of this material and BMG in complex anterior urethral strictures, and found significant improvement in postoperative urine flow in both the groups [77]. Bhargava et al. [78] in 2008 reported the clinical outcome of the first human series (5 patients) in which autologous tissue-engineered buccal mucosa was used in substitution urethroplasty. All 5 patients had strictures related to LS. Two out of the 5 patients developed asymptomatic recurrence of stricture within 1 year that was detected on urethroscopy. This occurred as a result of graft fibrosis that as indicated by the authors might be in part attributed to the underlying disease.

Endoscopic Urethroplasty

This may be an option for complex or recurrent strictures where urethrotomy alone is inadequate. This procedure involves preparation of a free graft, endoscopic delivery and fixation in the stricture bed with the help of balloon catheters [79]. Endoscopic urethroplasty has not gained wide acceptance and the number of studies is limited. Recently, Farahat et al. [80] performed endoscopic urethroplasty using a small intestinal submucosa patch in 10 patients with short urethral stricture that was associated with mild spongiformis, and achieved 80% success at 12–18 months’ follow-up.

The Future of Anterior Urethral Stricture Surgery

There are two important fields that seem to guide the future trends in the management of anterior urethral stricture disease: tissue-engineering substitutes and endoscopic reconstruction. BMG, which is considered the best substitute for urethral tissue at present, can be cultured and seeded to a scaffold for urethral replacement [81]. This will avoid the need for tissue transfer in patients with long and complex strictures. Moreover, the quantity or quality of urethral substitutes available in any given patient will not be a problem. Progress in and acceptance of artificial tissue replacements, allografts and xenografts, thus obviating the need for graft harvesting, could be easily anticipated [82]. Also, refinement in endoscopic instrumentation and techniques may enlarge the area of endoscopic urethroplasty. This may shift today’s standard surgical management to scarless urethral reconstruction. Further, the findings of a pilot study on the use of tissue-engineered buccal mucosa in substitution urethroplasty for LS-related strictures indicate future strategies for the management of such complex urethral strictures; it is the underlying stricture pathophysiology that should be given more concern rather than the availability of the graft [44]. Thus, future research should target this concern too.

Conclusion

In view of the fact that the surgical treatment of urethral stricture diseases is continually evolving, and that at present the choice of a procedure for a particular patient depends mainly on the expertise of the surgeon and the available resources, contemporary urologists working in this field should keep themselves updated so as to obtain the best outcomes. Among various available reconstructive urethral procedures for urethral stricture disease, the superiority of one approach over another cannot be clearly stated. Still, single-stage dorsal BMG urethroplasty is currently considered the standard procedure. Unilateral urethroplasty represents a small but definitely significant step forward. Newer materials like engineered tissues that are expected to become the standard in future represent a platform for further studies. The technique of endoscopic urethroplasty combined with the use of engineered tissues also mandates further work.

References

Surgical Treatment of Anterior Urethral Strictures


