

# Mini-reviews

Urethral strictures demand careful surgical management, and the authors from North Carolina describe the developing art of urethral surgery in the first of the mini-reviews in this issue. The non-surgical oncologists' role in managing advanced and metastatic TCC is of great importance, and as urologists increasingly adopt a multi-disciplinary approach to cancer, the next two mini-reviews in this section should be of considerable interest. Finally, what is a prostatesome? The possible importance of its role in prostate disease is described in the fourth paper.

## Management of urethral stricture disease: developing options for surgical intervention

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### KEYWORDS

urethroplasty, bulbar, pendulous, stricture, posterior urethral stricture

### INTRODUCTION

Urethral strictures are documented in ancient literature dating from the Greek and Egyptian period [1]. Currently urethral stricture disease is relatively common, most strictures being acquired from injury or infection. Blunt perineal trauma causes injury to the bulbar urethra; pelvic fractures result in urethral distraction defects in the posterior urethra, but iatrogenic causes, including urological instrumentation and placing indwelling catheters, which result in strictures anywhere in the urethra, are probably the most common cause.

### DIAGNOSIS AND PREOPERATIVE EVALUATION

Obstructive voiding symptoms remain the typical reason for evaluating urethral stricture disease. UTIs, urethral bleeding, and now more rarely, urethrocutaneous fistula and peri-urethral abscess develop. Retrograde urethrography (RUG) remains the study of choice for diagnosis. Often an

antegrade voiding study through a previously placed suprapubic tube, combined with a RUG, provides important information. Some now advocate the use of ultrasonography to define the extent of spongiofibrosis and absolute length of the urethral stricture. Specially developed probes allow for operative intraurethral examination, increasing the accuracy of the evaluation [2].

Cysto-urethroscopy allows the true calibre of a urethral stricture to be evaluated (there is often a mismatch between radiographic and endoscopic findings) and if a small flexible endoscope (or ureteroscopy) is used the length of the stricture and the quality of the proximal urethra can be assessed. In the case of pelvic fracture urethral distraction defects (PFUDDs) it is important to examine the active sphincter area of the urethra for evidence of concomitant injury, and the bladder for calculi; this is usually done via the suprapubic tract.

MRI can be invaluable in some cases of posterior urethral strictures after pelvic fracture [3]. This is an important study to define the post-traumatic anatomy, allowing the surgeon to plan the reconstructive approach. MRI should always be used in conjunction with RUG and voiding cysto-urethrography, and not as a sole method of evaluation.

## MANAGEMENT

Treatment options for urethral strictures continue to include simple dilatation, urethrotomy, the UroLume™ stent, and a wide spectrum of reconstructive surgical techniques. The choice depends heavily upon stricture location, cause and length. For instance, the more abundant corpus spongiosum of the bulbar urethra than in the pendulous urethra makes optical urethrotomy more successful for strictures of the former. Also, penile elongation during erection necessitates that repairs in the penile urethra be elastic, making local flaps superior to grafts which are, nonetheless, still used with caution (it appears to us that buccal mucosa is more elastic than full-thickness penile skin when used as a graft). Likewise, while successful in the bulbar urethra, primary anastomotic repairs when used in the pendulous urethra may result in chordee with erections.

While no one procedure is appropriate for all strictures, dilatation and urethrotomy continue to be most commonly used, but have high recurrence rates and many patients eventually progress to surgical repair.

## DILATATION AND URETHROTOMY

Office/clinic dilatation of urethral stricture, often assisted by use of filiforms and followers under endoscopic control, continues to be the most common initial treatment. When the history and the RUG show the stricture to have no 'complex' features this is an appropriate initial choice. Afterwards, patients can be taught self-calibration with a 'soft' catheter for ongoing management; however, few accept this option in the long term.

Visual internal urethrotomy using local, spinal or general anaesthetic, and ideally aided by a guidewire placed through the stricture, remains an alternative to dilatation. The incision is made at either the 12 o'clock or at the 3 and 9 o'clock positions with a cold-knife urethrotome; the choice is personal. Urethrotomy is especially suited for short strictures in the bulbar urethra and has high failure rates when the stricture is long, is in the pendulous urethra or is associated with significant spongiofibrosis [4]. Reportedly, multiple endoscopic treatments predispose to a more difficult definitive open repair and a lower success rate [5]. Our experience, and that of others, suggests that patients with

previous endoscopic treatments and open surgical repairs do not have a significantly higher later failure rate, but the urethroplasty may be rendered more complex [6]. In 1997 Steenkamp *et al.* [7] showed both dilatation and urethrotomy to have equivalent long-term outcomes for treating short urethral strictures.

## UROLUME STENTS

The UroLume stent, enthusiastically introduced in 1988, is used for treating urethral strictures, prostatic B00 and detrusor-sphincter dyssynergia. Because of the common problems associated with its recommended use in the bulbar urethra we rarely use it, other than in unique circumstances. Problems with its use in bulbar stricture disease (its recommended location for use) include postvoid dribbling, perineal pain, erectile pain and recurrent stricture. We have found it useful, albeit accompanied by the need for an artificial urinary sphincter, to manage recalcitrant anastomotic bladder neck contracture after radical prostatectomy [8].

## SURGICAL INTERVENTION

Surgical options for urethral stricture disease are based primarily on the location and length of the stricture. The techniques used include excision with primary anastomosis, onlay repairs, stricture excision with augmented anastomosis, flap-based repairs and staged repairs. The tissue used to substitute for urethra includes local grafts or flaps from the penis or scrotum (now rarely used), and grafts from remote sources such as the mouth, thigh and pre-auricular areas. All can be applied dorsally or ventrally. The buccal mucosal graft applied dorsally currently enjoys the most support.

## MANAGEMENT OF STRICTURES IN THE PENDULOUS URETHRA

The optimum management of these strictures (other than those resulting from lichen sclerosus) continues to be by an onlay flap using penile skin, as described by several authors [9–13]. In the uncircumcised male a transverse flap of foreskin may be used, although this technique is more challenging. Even circumcised men invariably have ample penile skin for the longitudinal harvest of a flap 2 cm wide [9]. The inventive use of flaps harvested from the prepuce and the shaft

(J flaps) allow for repairs up to 15 cm long, a technique best reserved for the expert. Excision of a tight segment before onlay is rarely feasible, for fear of causing penile chordee.

## BULBAR STRICTURES

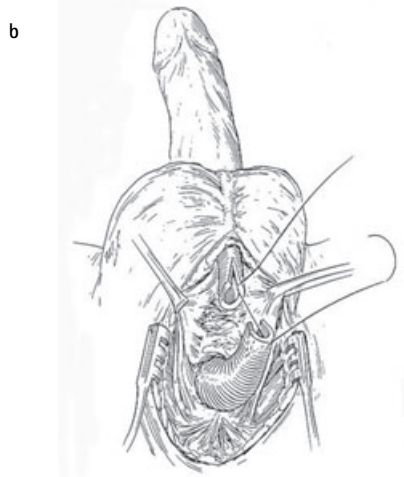
Ten to 20 years ago flap-based repairs (using pedicled islands of penile skin or even scrotal skin) and tubularized graft urethroplasties were often used to repair bulbar urethral strictures. These had a high failure rate, of up to 56% [14]. Currently the enthusiasm has shifted to excising tight segments where possible and using grafts (ideally buccal) as dorsal onlays to augment the anastomosis or to address the stricture in its entirety.

For strictures of <2 cm long (including adjacent spongiofibrosis), stricture excision and primary re-anastomosis remains the ideal procedure, with excellent long-term results reported (Fig. 1) [15]. For strictures of 2–4 cm (these lengths are approximations and intraoperative findings ideally dictate the choice of procedure), the latest development is the excisional augmented anastomotic urethroplasty [16]. In this procedure the worst section of the stricture is segmentally excised (but only up to 2 cm), and the dorsally spatulated urethra re-anastomosed and dorsally augmented with a buccal graft or other onlay (Fig. 2). Long strictures where segmental excision is not feasible are best managed with a dorsal onlay alone (Fig. 3) [17]. We find that the excisional augmented anastomotic urethroplasty provides favourable long-term results when compared with dorsal onlay alone (data presented at the 2003 AUA annual meeting). This hierarchical/progressive approach to bulbar stricture management anticipates that the surgeon has experience with the selection process and has the repertoire of procedures required.

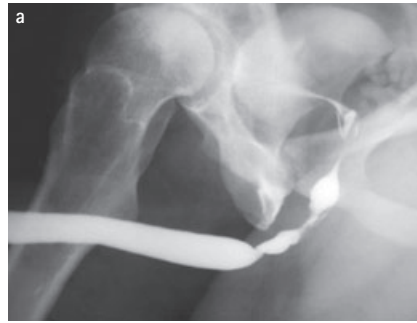
## CHOICE OF TISSUE

Penile and scrotal skin were used almost exclusively in the past but failure rates were 20–30%, prompting a search for better tissue [18,14]. Desirable qualities included a thick epithelial layer, a thin lamina propria, ease of harvesting with minimal donor-site problems, a large availability of tissue, and minimal shrinkage [18]. Early candidates, e.g. bladder mucosa, had a failure rate of 12% at 28 months and harvest required laparotomy, prolonging convalescence [19]. Buccal grafts

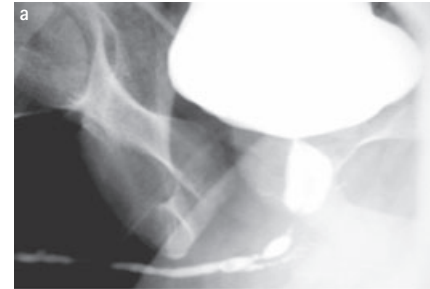
**FIG. 1.** Retrograde urethrograms: (a), showing a short, bulbar urethral stricture, amenable to excision with primary anastomosis (b). (b: with permission: Webster GD, Koefoot RB, Sihelnik SA. Urethroplasty management in 100 cases of urethral stricture: a rationale for procedure selection. *J Urol* 1985; **134**: 892–8).



**FIG. 2.** Retrograde urethrograms: (a) showing a longer, more complex, bulbar urethral stricture needing excision of the most significant area of stricture and onlay of the remaining stricture; the excisional, augmented anastomotic urethroplasty (b). (b: with permission: Iselin CE, Webster GD. Dorsal onlay urethroplasty for urethral stricture repair. *World J Urol* 1998; **16**: 181–5).



**FIG. 3.** Retrograde urethrograms: (a) showing a very long and complex stricture needing repair with dorsal onlay (b). (b: with permission: Iselin CE, Webster GD. Dorsal onlay urethroplasty for urethral stricture repair. *World J Urol* 1998; **16**: 181–5).



were first described in 1886 by Suprechko, and they have all the qualities to make them a good tissue choice, including a thick epithelium, natural resistance to infection and progression of other skin diseases such as lichen sclerosis [20]. The buccal donor site heals quickly with minimal morbidity and complications, and hence since 1998 buccal tissue has become enthusiastically the choice for urethral augmentation.

#### LOCATION OF THE GRAFT

The best location for placing grafts (ventral or dorsal) remains controversial. Following the report by Barbagli *et al.* [17] our preference has been to almost exclusively rely on dorsally placed grafts (Fig. 3). This technique has several theoretical advantages; the corporal bodies provide a secure well vascularized

graft bed, the inelastic graft bed prevents out-pouching of the graft with pseudo-diverticulum formation, and the spread fixation may preserve graft width and hence urethral calibre [21]. Conversely, advantages to the ventral onlay urethroplasty include ease of exposure, good vascular supply consisting of sponge tissue, while still maintaining the ability to excise the stricture if needed. Some authors report good long-term stricture-free outcomes equal to dorsal onlay using this technique [22–24], indicating that both techniques may be acceptable.

#### STRICTURES FROM LICHEN SCLEROSIS (BALANITIS XEROTICA OBLITERANS)

Balanitis xerotica obliterans, first described in 1928, is a form of lichen sclerosis and occurs in up to 1 in 300 men [25]. The cause is

unclear and changes from lichen sclerosis most commonly occur in the glans penis and prepuce, causing phimosis, with more extensive disease affecting the urethra as far back as the mid-bulb (Fig. 4a) [26].

Management includes medications and surgery; topical steroids, e.g. clobetasol 0.05% cream applied two to four times weekly, are used with variable results. Surgical therapy ranges from extended simple meatotomy for distal strictures to complex staged repairs for more extensive disease. The dictum for treatment often takes on major proportions, including excision of the entire affected urethra and the use of extragenital tissue (buccal mucosa) for reconstruction, so as to prevent recurrence of disease in the repaired area [26]. These can be morbid procedures fraught with complications and high failure rates of up to 71% [27].

In our experience many patients in this group are already accustomed to voiding while seated because of age and from chronic

disease, and so particularly in the older group we offer perineal urethrostomy as an alternative to a complex staged repair (Fig. 4b). Previous reports link lichen sclerosis with a risk of developing squamous cell carcinoma, leading some to recommend routine biopsy for tissue diagnosis and to exclude concomitant neoplasm [28].

#### POSTERIOR URETHROPLASTY

Traumatic injury to the prostatomembranous urethra has been reported to occur in  $\approx 10\%$  of pelvic fractures [29]. The magnitude of injury determines the length of the ultimate defect, ranging from elongation with no tearing of the urethra to complete transection, seen in most cases. Therefore, the resulting 'stricture' is technically a distraction defect, with no lumen present between the urethral ends.

With any suspicion of urethral injury in a pelvic trauma patient, RUG should be used. If no extravasation is seen a Foley catheter may be inserted and a cystogram or upper tract study taken as indicated. While CT is routinely used in evaluating trauma it is not useful for diagnosing urethral injuries [30].

Most cases of posterior urethral injury should be managed acutely with suprapubic drainage, then definitively treated after 3–6 months of recovery. This allows any haematoma to resolve, with descent of the prostate and shortening of the defect. Acute surgical intervention is indicated in the uncommon situation where there is an associated rectal injury. Concomitant bladder or bladder neck injury offer other indications for acute intervention but leave optional how to deal with the urethra (leave it alone for later repair or acutely realign).

*Immediate (primary) re-alignment* has been reported with none of the above indications, using a variety of techniques. All involve acutely placing a catheter across the urethral defect. This involves using magnetic guides, interlocking sounds or an open surgical procedure. Long-term re-stricturing in 50–100% of patients might necessitate additional future endoscopic procedures, intermittent catheterization or reconstruction [31,32]. The greatest deterrent to this approach is the morbidity associated with acute intervention.

*Delayed (primary) management* is an attractive alternative for selected cases whose

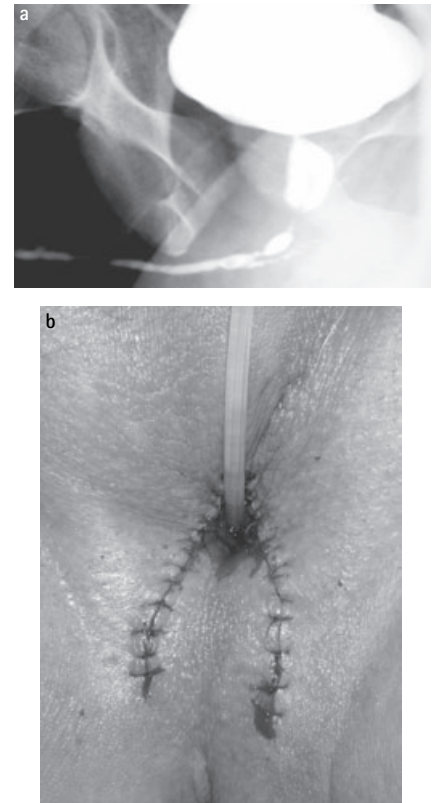
recovery allows for a return to the operating room 5–10 days after injury (a suprapubic tube having been placed acutely). Realignment is accomplished endoscopically by two endoscopists. The antegrade flexible endoscope negotiates the bladder neck and emerges in the injury haematoma. The retrograde endoscope (particularly if a 24 F resectoscope sheath is used) allows for haematoma irrigation, visualization of the defect and antegrade passage of a linking guidewire, over which a stenting catheter can be passed across the defect. Later a pericatheter RUG will precede stent removal and voiding trial.

*Delayed (secondary) repair* is delayed for  $\geq 3$  months after the injury, while in the interim the patient is managed by suprapubic catheter drainage. Before surgery, combined RUG and antegrade cystography ('up and down o-gram') is used to identify the length of the defect and any other associated pathology, e.g. bladder neck competence, fistula or bladder calculus. Most of these defects are reconstructed with a one-stage perineal anastomotic urethroplasty. This remarkably versatile procedure deals with long obliterative strictures well, with only uncommon, extremely complex strictures needing an abdominoperineal approach or substitution urethroplasty in  $<5\%$  of cases [33,34].

As we reported, the progressive perineal anastomotic repair involves mobilising the urethra as a distally based urethral 'flap', with the urethra being transected at the point of obliteration. The bulbar urethra is then anastomosed to the prostatomembranous urethra proximal to the obliteration, after cutting down onto the tip of a descending sound passed through the suprapubic tract into the proximal urethral 'stump'. Once this perineal access to the spatulated proximal urethra has been secured several sequential steps are used to accomplish a tension-free anastomosis.

- Circumferential mobilization of the distal urethra to the suspensory ligament of the penis provides 2–3 cm of length, sufficient for anastomosis in 8% of our cases.
- Separation of the proximal corporal bodies shortens the distance by 1–2 cm and is sufficient for anastomosis in 41% of cases.
- Inferior pubectomy is performed by resecting a 1.5–2 cm wide wedge of bone from the inferior surface of the pubis. This

FIG. 4. Retrograde urethrograms: (a) showing a pendulous urethral stricture from lichen sclerosis. These may be repaired with complex staged reconstruction but a simple perineal urethrostomy (b) may be appropriate for some patients.



further shortens the defect by 1–2 cm, facilitating anastomosis in 28% of cases.

- Re-routing the urethra around the lateral surface of a corporal body provides another 1–2 cm of length and is needed in 23% of cases.

We spatulate the bulbar urethra dorsally and the prostatic urethra ventrally, and make the anastomosis with interrupted 4–0 polyglycolic acid sutures over a supporting 12 F fenestrated Silastic catheter.

In expert hands the results are excellent, with success in  $>90\%$  of patients. Indeed, even failed repairs can generally be salvaged using the same procedure with further steps. The rate of de novo erectile dysfunction is low [35], and if the patient has a competent bladder neck continence is preserved [36]. The results are not as good in prepubertal boys, in whom this injury is fortunately uncommon [37].

## MANAGEMENT DURING AND AFTER SURGERY

Over the last 10 years we have progressively shortened our hospitalization for patients undergoing urethroplasty. Currently, we plan same-day surgery as the norm and only those undergoing posterior urethroplasty for PFUDD stay overnight. Outpatient surgery decreases costs and increases patient satisfaction, without risking the surgical care of the patient [38]. Likewise, we have also minimized the limitations placed on patients after urethroplasty, discarding suction drainage in most cases, and immobilization with bed rest after graft urethroplasty. Since omitting these aspects of management, convalescence is shortened, with no new complications.

## FUTURE TRENDS

We anticipate that the next development will be further progress in and acceptance of artificial tissue replacements, allografts and xenografts, obviating the need for graft harvesting [39]. These include Apligraf, a bioengineered product composed of a bovine-collagen, fibroblast-containing matrix integrated with a sheet of stratified human epithelium which is similar to human skin. El Kassaby *et al.* [40] recently described a promising 'off the shelf' collagen matrix based on cultured human cadaveric bladder mucosa.

## CONFLICT OF INTEREST

None declared.

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**Abbreviations:** PFUDD, pelvic fracture urethral distraction defect; RUG, retrograde urethrography.