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LOWER URINARY TRACT SYMPTOMS & VOIDING DYSFUNCTION (J SANDHU, SECTION EDITOR)

Female Urethral Strictures: Review of Diagnosis, Etiology, and Management

Nnenaya Agochukwu-Mmonu[1] · Sudarshan Srirangapatanam[1] · Andrew Cohen[1] · Benjamin Breyer[1,2]

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Abstract

Purpose of Review In this review, we describe the incidence, diagnosis, and management of urethral strictures in women.

Recent Findings Definitive repair of urethral strictures in women traditionally utilizes vaginal and labial flaps. Oral mucosal buccal graft urethroplasty also has high success rates, with larger series demonstrating feasibility and durability.

Summary Urethral strictures in women are very rare. When they do occur, they are often difficult to diagnose, requiring a high index of suspicion. Women with urethral strictures often present with symptoms of obstructed urinary flow, such as incomplete emptying, straining, and elevated postvoid residual. First line, minimally invasive treatment consists of urethral dilation and urethrotomy, though urethrotomy is rarely performed. Repeat urethral dilation has low success rates compared with urethroplasty, which is a more definitive treatment.

Keywords female urethral strictures · reconstruction · urethral strictures

Introduction

Urethral strictures in women are exceedingly rare, with a prevalence of 3–8% overall, 4–13% in women with bladder outlet obstruction (BOO) [1–4], and 0.1–1% in women with lower urinary tract voiding symptoms [5••]. Female urethral strictures are defined as a fixed, symptomatic, anatomical narrowing of the urethra that does not accommodate urethral instrumentation [6]. Given the rare occurrence of urethral strictures in women, there is no consensus on diagnosis and treatment and, hence, there are no standard guidelines. Women who present with urethral strictures present with non-specific lower urinary tract symptoms (LUTS) and are often treated for LUTS or BOO [7••]. Diagnosis requires meticulous and intentional investigations consisting of history, physical exam, and specific diagnostic tests.

Women with urethral stricture disease may present with a weak stream, dribbling, recurrent UTIs, pain localized to the urethra, urgency, frequency, dysuria, hesitancy, overflow urinary incontinence, urinary retention, and/or elevated postvoid residual (PVR) [6, 8]. This wide range of symptoms explains why diagnosis is often elusive.

In this review, we describe the current literature on the diagnosis, etiology, and treatment of urethral strictures in women.

Etiology

Anatomically, urethral strictures in women are often located at either the distal third of the urethra or the urethral meatus [9]. They can also be located in the mid urethra, mid-proximal urethra, or the entire urethra [10••]. Etiologies of urethral strictures in women include iatrogenic causes, chronic cystitis and urethritis, idiopathic, trauma, and inflammation. It is believed that many of these strictures are iatrogenic in nature, from prolonged catheterization, repeated instrumentation, urogynecological procedures (e.g., sling procedures, transvaginal urinary fistula repair, diverticulum repair), vaginal deliveries, pelvic radiation, and urethral dilation. Notably,

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✉ Benjamin Breyer
Benjamin.Breyer@ucsf.edu

[1] Department of Urology, University of California, San Francisco, San Francisco, CA, USA

[2] Departments of Urology and Epidemiology and Biostatistics, Zuckerberg San Francisco General Hospital and Trauma Center, San Francisco, CA, USA

though urethral dilation is a treatment for urethral strictures in women, it can cause urethral strictures.

In a recent contemporary series, the most common cause of urethral stricture in women was previous urethral instrumentation and traumatic catheterization, followed by traumatic vaginal delivery [7••]. In a more recent series, of those women with known etiologies, the most common etiology was iatrogenic followed by trauma [10••]. A different series evaluating urethral strictures in women demonstrated that 88% of urethral strictures were iatrogenic, originating from previous vaginal or urethral surgery [11]. Of urethral surgeries, urethral diverticulectomy is the most common cause of urethral stricture in women; this is likely due to tension when closing the defect in the urethra [12]. Incontinence procedures, such as a sling for stress urinary incontinence, can result in urethral erosion, which can cause ischemia, thereby leading to scar tissue (stricture) formation. It is possible that some of these iatrogenic injuries can be averted by meticulous surgical technique. For example, during urethral surgeries, keeping a safe distance from the urethra can avoid iatrogenic injury to the urethra and preserve blood supply, thereby avoiding ischemia. In addition, utilization of nonsynthetic slings may have a higher rate of erosion compared to synthetic slings [13].

Traumatic injury to the urethra can result from prolonged labor, which results in pressure necrosis of the urethra and decreased tissue perfusion, both of which can lead to urethral stricture, predominantly in the proximal urethra [14]. Straddle injuries can also lead to urethral stricture by a similar mechanism. Urethral strictures also estimated to occur in 5% of women with a pelvic fracture [15]. A series demonstrated that of patients with a pelvic fracture who sustained a urethral injury, common factors were severe pelvic fractures with pubic diastases as a result of rapid deceleration injury [15]. Etiologies of this disruption include upward displacement of the femur and hip joint, which leads to traction on the anterior and posterior urethral ligaments thereby leading to partial or complete disruption of the urethra. A second etiology is diastasis at the pubic symphysis which can result in rupture of the posterior pubourethral ligament thereby leading to laceration of the urethra. Finally, urethral disruption from a bony spicule originating from pelvic fractures can lead to urethral injury and subsequent urethral stricture development in women.

Other etiologies of urethral strictures in women, though rare include urethral tuberculosis, lichen sclerosis, urethral carcinoma, urethral fibroepithelial polyps, infection, and locally advanced cervical carcinoma [8, 16–18].

Diagnosis

Urethral strictures in women can pose a diagnostic challenge. This is due to the fact that the presenting LUTS are rather nonspecific and that urethral obstruction in women can be multifactorial, originating from a functional deficit or an anatomical deficit. Anatomical obstructions can result from stricture, prolapse, urethral diverticulum, or primary malignancy [12]. A high index of suspicion is required that can only be garnered from a meticulous history and physical exam, followed by appropriate diagnostic tests. Physical examination, including bimanual and pelvic exams, is key [5••].

Symptoms consistent with BOO resulting in obstructive voiding, such as a weak stream, incomplete emptying, straining, nocturia, and urinary retention, are often present in women with urethral strictures [19, 20]. In a recent series, the most common presenting symptom in women with urethral strictures was reduced flow/slow stream. Recurrent UTIs, urethral pain, and obstruction related to overactive bladder were also common presenting symptoms [7••]. It is important to have a high index of suspicion of urethral strictures in women who have sustained pelvic fracture, specifically those with rapid deceleration injury, severe pelvic fractures, and pubic diastases, as they are often overlooked [15]. In these individuals, careful examination with visualization of the vaginal vault is key, especially in those with blood at the introitus. Important clinical signs include anuria after catheterization and/or difficulty with placing a urethral catheter.

Adjuncts to the comprehensive history and physical examination include uroflowmetry and PVR measurement. While there are no specific cutoffs for uroflowmetry and PVR volumes, a curve which reaches a plateau, flow rates from 12 to 15 ml/s, and postvoid residuals > 100, suggests obstruction [2, 8, 21]. Cystourethroscopy and voiding cystourethrography (VCUG), can confirm the presence and location of urethral stricture and thereby lead to a definitive diagnosis. Cystourethroscopy provides very little information on stricture length but can diagnose a urethral stricture. In a recent series of 33 women with urethral strictures, urethral stricture was identified with cystourethroscopy in all cases. Uroflowmetry confirmed reduced flow in 26 patients, and 22 patients had videocystometrogram, which diagnosed BOO in all patients [7••]. In this series, videocystometrogram was done only in those considering urethroplasty. Importantly, cystourethroscopy may not be feasible in individuals with meatal stenosis, distal urethral strictures, and narrow strictures [6]. In these and many cases, VCUG is essential as it not only can definitively diagnose a urethral stricture but also provides key information on location and length of urethral stricture, which guides surgical planning. While urodynamics or videocystometrogram can be helpful in classifying if there is outlet obstruction [22] and may be a useful adjunct in diagnosis, VCUG and direct visualization with cystourethroscopy uniquely offer the opportunity for definitive diagnosis.

Three-dimensional imaging, such as magnetic resonance imaging (MRI), may also be useful in this setting, specifically in identifying other etiologies that may present with similar symptoms. For example, primary tumors of the urethra,

periurethral fibrosis, and other conditions may have similar presenting symptoms as urethral stricture and can be identified on MRI [23, 24]. Computed tomography (CT) urethrography may also be useful in 3D evaluation and has the added advantage of simulating urethroscopic evaluation with a technique called CT virtual urethroscopy (CTVU) [25].

Treatment

Important factors when determining management and surgical approach for urethral strictures in women include location, length of the stricture, length of healthy proximal urethra, bladder neck integrity, and surgeon experience. Anatomy of the urethra must be taken into account, especially to avoid iatrogenic urinary incontinence. The continence mechanism in women is controlled by the striated urethral sphincter muscle which lies external to the smooth muscle layer and spans across the entire urethra [6, 26]. In addition, the short urethral length (4 cm) [27], makes it especially prone to incontinence and neurosensory dysfunction [5••]. Key reconstruction techniques include careful dissection, wide mobilization, use of vascularized tissue flaps, and tension-free closure [28]. Importantly, if there is any suspected malignancy, patients should undergo biopsy and appropriate workup prior to reconstruction [11]. Table 1 describes the type of urethral reconstruction, outcomes, and sample size of original urethral reconstruction reports for urethral strictures in women over the last 5 years.

Urethral Dilation and Urethroplasty

Management of urethral strictures in women consists primarily of urethral dilation and urethroplasty. First-line treatment is often urethral dilation, which has a lower overall success rate of less than 50%. A study of 93 patients demonstrated a 51% success rate after one urethral dilation, and 10 of 46 patients who failed went on to have urethroplasty at a mean follow-up of 46 months. In addition, those who underwent repeat dilations had a decreased success rate, at 27% [29]. Urethrotomy is also a plausible first option, though there is a lack of data on this treatment modality. Definitive repair with urethroplasty is recommended for those with recurrences as repeat dilations are less successful than first attempts [30, 31]. Moreover, repeated dilations may make future repair more difficult due to the formation of a complex scar.

Urethroplasty is often performed in women who have failed urethral dilation and has a mean success rate of 80–94%, across all techniques [6]. In a retrospective study of 17 women with urethral stricture disease, all women who

Table 1 Female urethral stricture reports, 2014–2019*

Author	Year	Treatment type	Patients (*n*)	Follow-up	Outcome
Hampson et al.	2019	Dorsal buccal graft urethroplasty	39	33 months (mean)	• 23% stricture recurrence • 14 months: mean time to recurrence
Hajebrahimi et al.	2019	Anterior vaginal wall flap	14	16 months (mean)	• In all patients, voiding LUTS improved
Romero-Maroto et al.	2018	Lateral-based Anterior vaginal wall flap	9	81 months (mean)	• No stricture recurrence • No immediate or delayed complications
Mukhtar et al.	2017	Ventral-onlay buccal musical graft	22	22 months (median)	• 95% of women had no recurrence • Qmax increased and PVR decreased following repair
Spilotros et al.	2017	Buccal mucosal graft (14), vaginal flap (2), urethral dilation (8), urethrotomy (1), meatoplasty (1)	26	36 months (mean)	• All patients treated with urethroplasty had no stricture recurrence. • All patients treated with urethral dilation required further treatment.
Popat et al.	2016	Urethral dilation	30	59 months (mean)	• 17 patients had stricture recurrence, durable resolution in 43% of women
Kowalik et al.	2014	Vaginal flap (6), buccal mucosal graft (4)	10	34 months (mean)	• 2 patients undergoing vaginal flap urethroplasty had recurrence. • No patients undergoing buccal mucosa graft urethroplasty had a recurrent stricture.
Heidari et al.	2014	Urethral dilation	86	6 months (mean)	• On-demand urethral dilation is more effective than intermittent dilatation.
Goel et al.	2014	Buccal mucosa graft	8	14.8 months (mean)	• Two women had stricture recurrence at 12 months, one at 18 months.

underwent initial urethral dilation had a recurrence of the stricture. There was no recurrence, however, after urethroplasty at 5 years of follow-up [12]. There are several graft options for urethroplasty including vaginal flap, labial flap, vaginal wall flap, and buccal mucosal graft (Fig. 1). Vaginal flap urethroplasty is an advancement flap between the vaginal mucosa and periurethral fascia and has success rates as high as 91% with low complication rates (4%) [20, 32]. Vaginal flaps typically involve a U-shaped inlay, C-shaped inlay, or a vestibular flap. Labial flaps also have high success rates [33].

Buccal Mucosal Grafts

Oral mucosal grafts using buccal mucosa in a dorsal or ventral onlay technique have been described, with promising results. Like many of the female urethral stricture techniques, there are few series with small sample size. Until recently, the largest series consisted of 22 patients. This series evaluated ventral onlay buccal mucosal grafts. In this series, 96% of women did not have stricture recurrence, Qmax significantly improved and PVR was significantly reduced following repair. There was a low rate of complications with one woman developing mild stress urinary incontinence [34]. A more recent series, evaluated dorsal onlay buccal mucosal graft in 39 women with urethral strictures with mean follow-up of 33 months [10••]. In this series, there was a 23% recurrence rate, which occurred at 14 months. Notably, recurrence was identified by cystoscopy whereas in the prior discussed series, recurrence was defined by flow rate, PVR, and absence of symptoms. This likely explains the variation in the recurrence rate. Prior series has a combined success rate of 94%, which is likely due to a shorter follow-up period and variation in methods of determining stricture recurrence. Overall, buccal mucosal grafts are gaining traction as a graft type for urethral reconstruction of urethral strictures in women and have been associated with high success.

Conclusion

Urethral strictures in women are a rare occurrence, and hence, there are no standard guidelines for diagnosis or treatment. Women typically present with symptoms representative of bladder outlet obstruction. Diagnosis can be

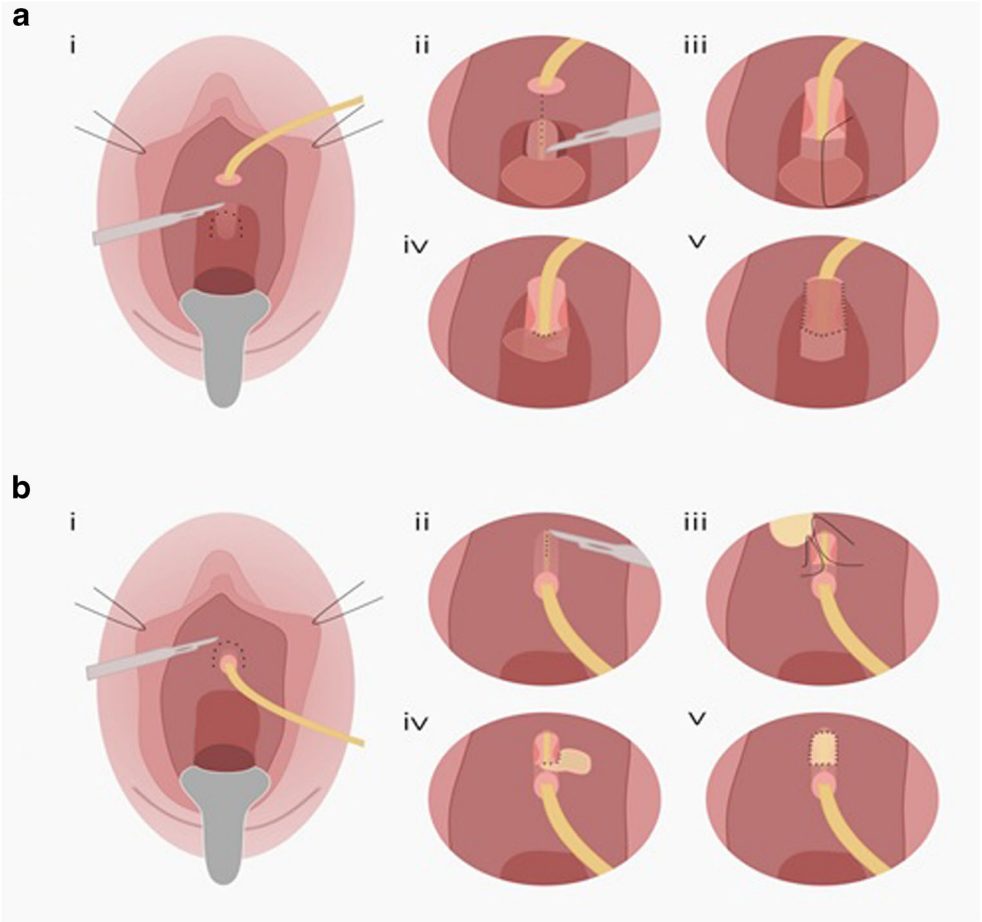

Fig. 1 Vaginal flap and dorsal buccal mucosa graft flap urethroplasty. **a** Vaginal wall flap: (i) vaginal wall incision, (ii) incision of urethral stricture, (iii) mobilization of vaginal wall flap, (iv) suturing of flap to urethral defect, (v) end result. **b** Dorsal buccal mucosal graft: (i) periurethral incision and mobilization of the urethra, (ii) dorsal incision of urethral stricture, (iii and iv) edges of graft sutured to the urethral border and placed over the defect, (v) end result

done by cystourethroscopy, which allows for direct visualization or VCUG. Urethral dilation or urethrotomy is often considered the first-line treatment in women with urethral strictures, though these treatment options do not offer a durable result in many cases. Urethroplasty can be done with vaginal flap, labial flap, vaginal wall, and buccal mucosal grafts, and is considered a definitive treatment option for those who have failed at least one urethral dilation. In addition, urethroplasty is a more durable option with higher success rates.

Compliance with Ethical Standards

Conflict of Interest Nnenaya Agochukwu-Mmonu, Sudarshan Srirangapatanam, Andrew Cohen, and Benjamin Breyer each declare no potential conflicts of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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