Urethral Stricture in Women: Etiology, Diagnosis, and Treatment

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Abstract

Urethral stricture in women is an uncommon cause of bladder outlet obstruction, an already unusual condition in women. Most cases are the result of urogenital surgical procedures; periurethral fibrosis is the mechanism implicated, regardless of cause. Diagnostic criteria are controversial, but it is clear that the condition consists of structural obstructions involving the middle and distal third of the urethra. There is no consensus regarding treatment; however, less aggressive maneuvers such as dilation and internal urethrotomy are the preferred techniques for primary strictures; the high degree of recurrence entailed by this treatment must be taken into consideration. Urethral reconstruction techniques with various kinds of grafts or flaps are indicated in recurrence cases or in those with a partial or total urethral defect.

Key words: Female urethra. Stricture. Treatment. Urethroplasty.

Bladder outlet obstruction in women is an uncommon condition that affects 3% to 8% of all women with low urinary tract symptomology. In 13% of these, urethral strictures can be demonstrated with urethrocystography and pressure-flow urodynamics. The incidence is clearly lower than in men because the urethra is shorter, more mobile, or because it is more protected by the pelvic bones.

There is little literature about the causes, diagnosis, and treatment of the condition; many articles focus on pediatric pathology. It seems that the treatment for primary strictures in adult women is urethral dilation or endoscopic urethrotomy; however, these treatments entail a high rate of recurrence, and there is controversy about which is the first-choice technique for recurrent strictures.

The objective of the present article is to describe the etiology, diagnosis, and treatment of female urethral strictures, with emphasis on the treatment of recurring or complex strictures.

Anatomical considerations

As we will see later, familiarity with the anatomy of the urethra and its relations is essential not only for the treatment of strictures, but also for avoiding potential urethral injuries during surgery in the pelvic area.

Karam et al. conducted a study with 3D reconstruction (after histochemical stain) of muscle and nerve fibers of the sphincter and the urethra in female human fetuses. This study confirms that the proximal third consists of a circular smooth muscle sphincter, the middle third consists of two circular layers of smooth and striated muscle fibers, and the distal third consists of a circular layer of smooth muscle fibers surrounded by an omega-shaped layer of striated muscle fibers that opens on the dorsal side. As for innervation of these structures, myelinated fibers were identified in the proximal third running with unmyelinated fibers from the pelvic plexus, closely related to the anterior and lateral walls of the vagina. Unmyelinated fibers entered the smooth muscle part of the sphincter at the 4 o’clock and 8 o’clock positions, while most myelinated fibers entered the sphincter at 3 o’clock and at 9 o’clock.

The urethral musculature’s thickness decreases as it becomes more distal, and incorporates connective tissue fibers until it disappears. From this point until the meatus, the urethra is no longer a muscular but a connective tissue structure with interposed elastic fibers. An excess of this collagen tissue would result in
stricture and reduction of the elasticity of the urethral segment; this histological finding seems to be the reason for stenotic urethral rings found in girls with repeated urinary infections.

The complex structure of the female urethra entails mixed innervation (autonomic for the smooth muscle, somatic for the striated muscle, and autonomic and sensory for the mucosa and submucosa). Smooth and striated muscle fibers are closely related; this makes it difficult to identify the nerve fibers innervating each muscle structure.

Another consideration to bear in mind is the anatomy and innervation of the urinary sphincter in order to avoid injuring it during surgical interventions nearby. Arango confirmed in fetal models the existence of intrapelvic somatic fibers that share the innervation of the striated sphincter with other autonomic fibers derived from the pelvic plexus. In turn, Stein found that the perineal membrane is composed of a dorsal and a ventral portion; the latter is a complex structure that encompasses the compressor urethrae and the urethrovaginal sphincter of the distal urethra and continues onto the inguinal falx. Therefore, the proximal dissection of the urethra, both on the ventral and dorsal aspects, entails a risk of injuring the sphincter complex.

Finally, before proposing a surgical approach, the relations of the urethra with the clitoral body must be explained. The erectile tissue of the clitoris envelopes the dorsal aspect of the urethra, creating the urethrovaginal complex, supporting the urethra. The bulbs of the clitoris progress toward the urethra until they coalesce ventrally.

Etiology of urethral stricture in women

In most cases, the etiology of the stricture of the urethra in women is unknown. In developing countries the most common cause is injury of the urinary tract during prolonged labor. In industrialized countries the most common causes are the following: post-traumatic, iatrogenic injuries (during urethral diverticulectomies, anti-incontinence surgery, endoscopic and gynecologic surgery...), pelvic radiotherapy, and acute and chronic urethritis. Other associated factors are vulvar atrophy in postmenopausal women.

Taking into consideration the high incidence of urethral instrumentation in the healthy population, it seems that even though this is not a direct cause, it may be a risk factor for the development of a stricture. Edwards et al. used an animal model to study the effects of various catheter materials and diameters on the urethral mucosa. These authors found that all materials induce inflammation of the mucosa, with silicone being the material producing the least inflammation; smaller caliber catheters also induce less inflammation because they allow the exit of urethral exudates; when the urethral catheter is maintained more days, a risk of bacterial colonization is added, along with an increased injury to the urethral mucosa. These authors recommend the use of smaller diameter silicone catheters and a careful insertion, as well as securing them proximally.

Whatever the origin of the stricture, it seems clear that the pathophysiologic mechanism of urethral stricture is periurethral fibrosis.

DIAGNOSIS

Even though voiding dysfunction in women is common, bladder outlet obstruction is relatively rare, affecting 3-8% of these patients; of these, only about 13% have urethral stricture. There is also some debate among authors about the diagnosis, as there is no clear definition of the criteria that should be used to diagnose the condition.

Bladder outlet obstruction in women can be classified as either functional or structural (anatomic); the structural causes may be intraluminal (lithiasis, tumor...) or urethral, such as: stricture of the meatus, carunculae, fibrosis, urethral diverticuli, and urethral stricture.

Some authors assert that only distal bladder outlet obstructions are structural in women, and proximal obstructions are predominantly functional, caused by inadequate relaxation of the musculature of the pelvic floor. Most proximal structural obstructions would be caused by extra-urethral processes, which are for the most part the result of prior anti-incontinence treatment processes.
In women, we define urethral stricture as a fixed anatomical stricture that does not permit the penetration of an instrument without disrupting the mucosa. It must be distinguished from functional or physiologic strictures seen in radiology exams, which do permit the penetration of instruments without disrupting the urethral lumen (for example, dysfunctional voiding or bladder sphincter dyssynergia). Sometimes the therapeutic failure of urethral dilation or urethrotomy for urethral and voiding syndromes is caused by a diagnostic error. There is no clinical evidence that the efficacy of those treatments for these syndromes increases the risk of developing anatomic stricture later on as a result of successive manipulations.

There is also no clear consensus about what is the diameter at which the female urethra should be considered stenotic. Brannan suggests that a urethral narrowing ≤20Fr is pathologic and should be treated. A literature review concludes that an adult female urethra that does not permit a 14Fr catheter is highly suggestive of being obstructive and will cause voiding dysfunction.

HISTORY

Urethral stricture in women was first described in 1824 by Lisfranc. Newman was the first to point out its importance and the need to treat the condition with electrolysis. In 1924, Scott reviewed what had been published so far, and added his own contributions supported with clinical cases. That article concludes that urethral stricture in women is a common pathology, the main etiology being gonococcal urethritis and labor trauma; the most common location is the distal urethra and the meatus. The diagnosis is reached with calibrated catheters and/or bougies, and treatment consists of progressive dilation, avoiding surgery as much as possible. To a large extent, classic literature is based on the reports of clinical cases. In 1951, Brannan conducted another review, reaching conclusions similar to Scott's; they agreed that the first choice treatment consisted of progressive dilation. Lyon correlates the urethral calibration-dilation treatment with an improvement in urinary parameters in women with middle and distal urethral stricture, and suggests urethral calibration with pre- and post flow urodynamics as tools to determine which cases will respond to treatment, and which would benefit from more studies to detect a possible proximal obstruction.

Treatment of primary stricture of the urethra in women

The objective of a urethral stricture treatment is to correct the anatomical and functional obstruction while preserving urinary continence.

Before surgery, the patient must be carefully assessed in order to rule out concomitant pathologies such as vesicovaginal fistulas, vesicourethral reflux, sphincter insufficiency, or overactive detrusor. Even if there is a preoperative overactive detrusor or low bladder accommodation, these conditions often disappear when the obstruction is corrected because they are a consequence of the obstruction.

Treatment for urethral stricture in women depends on:
- The location and length of the stricture.
- The length of the healthy proximal urethra.
- The integrity (or lack thereof) of the bladder neck.
- The coexistence of incontinence.

The most simple method of initial treatment of female urethral stricture is progressive urethral dilation. The efficacy of the maneuver for the treatment of urethral strictures has been proven with durable improvement in terms of urethral diameter (measured by calibration with catheters), of the mean flow, and decrease in the peak urethral pressure. While it is considered a simple maneuver, it is not exempt form risk, and the rate of recurrence is not insignificant. A careless urethral dilation entails a certain degree of urethrorrhagia and extravasation, which could lead to subsequent fibrosis and recurrence of the stricture.

The problem with assessing the real efficacy of dilations as treatment for urethral stricture is that up to 61% of urologists use urethral dilation as treatment for urethral syndrome, and do not confirm the presence of a stricture. This fact makes assessing the results of the technique difficult, and increases strictures due to
careless dilations of non-stenotic urethral syndromes. Recent studies show that over the past few years, fewer urologists use this technique, and find it less effective.

Smith published a series of 7 patients treated between 1999 and 2004 with self-catheterization after urethral dilation under sedation. The diagnosis was reached with video urodynamics. The researchers performed a urethral dilation up to 30Fr with progressive catheters and a subsequent urethroscopy in which a disruption of the mucosa was considered a sign highly suggestive of the presence of prior stricture. They obtained biopsies of the strictures to rule out malignity, and excluded patients with prior radiotherapy. A Foley catheter was left in place for 1-7 days; at the time of removal, the patients learned to catheterize themselves with a 18-20Fr catheter (at least once a day). If the stricture recurred during follow-up, the procedure was repeated. Three patients required repeat dilations, and one required cold urethrotomy with subsequent self-catheterization; this patient had initially not complied with the self-catheterization program.

Due to the risk of recurrence upon stopping self-catheterization, the patients kept performing them for long periods of time. All patients had objective improvement with urethral dilation, and none had incontinence or complications. Apparently, compliance with self-catheterization was the only factor associated with recurrence, for which reason the study concludes that non-compliant women or those with little manual skill should be treated initially with reconstructive surgery.

The global rate of success of this practice (patients who have been relieved with only one dilation and subsequent self-catheterization) id only 42%, which confirms the high recurrence of post-dilation stricture, already discussed.

For selected patients with short strictures, internal urethrotomy would be an appropriate option; however, in proximal strictures there is a risk of causing a sphincter injury with the resulting urinary incontinence. An indispensable requirement is that the lumen of the healthy urethra be sufficiently large to allow the insertion of the endoscopic instruments. The advantages of this technique are the low morbidity and the short hospital stay. Dogra suggests endoscopic realignment through a simultaneous retrograde and antegrade approach, maintaining the urethral catheter dorsally for 6 weeks in patients with traumatic urethral injuries; these patients must continue with self-catheterization after removal of the urethral catheter; therefore, an indispensable criterion is the patient's motivation to perform self-catheterization.

**Treatment of stricture recurrence in women**

If female urethral stricture is already an uncommon pathology, recurrence of the stricture is even more uncommon, and constitutes a therapeutic challenge for the urologist. There is no first choice technique with proven efficacy in the long term. What does seem to be proven is that patients with partial or total defects of the urethra or repeated failure of less invasive techniques such as dilation or urethrotomy would be candidates for urethral reconstruction. The best surgical treatment in these cases is still debatable; there is no consensus about which is the best surgical option in these cases.

Between July and December 2008, we conducted a literature review on the Medline (PubMed) database of articles published between 1995 and 2008 about the treatment of urethral stricture in women. The key terms used for the Medline search were the following: “female urethral stenosis,” “female urethral reconstruction” and “female urethral stenosis treatment.” The articles published in English and Spanish were reviewed, and the reviews of malformations and pediatric pathologies were discarded.

Palou et al. describe the first technique found in our review: the use of a vaginal flap in one patient with iatrogenic middle and distal stricture caused by the coagulation of condylomas. They describe the urethroplasty as an approximation of the anterior vaginal flap to the dorsal wall of the urethra which had been incised previously; the vaginal walls at either side cover it transversally. A 20Fr Foley catheter was left for three days, and a cystostomy for three weeks. At 10 months, flow time was normal.

In 2002, Tanello published a urethroplasty with pedicle flap from the labia minora in two patients with urethral stricture with failed prior treatment. The reasons why the skin of the labia minora was chosen were its elasticity, lack of hair, and it being a moist tissue easy to obtain. An incision was made on the anterior vaginal wall from the meatus, separating the wall from the urethra, and continuing the dissection in a circular manner through the periurethral connective tissue. The entire width of the urethra is sectioned ventrally from the meatus to the healthy tissue proximal to the stricture. The labia minora flap is mobilized from the vascular pedicle and approximated to the urethra by transposition through a tunnel under the vaginal wall. The epidermic aspect of the flap was placed on the lumen of the urethra, sutured to the
are presented. With normal physical examinations at 30 and 12 months of follow-up. No follow-up urodynamic parameters were done at the 6-week follow-up visit. One patient developed meatal stricture that required subsequent dilations; none had subsequent stress incontinence. The authors report that the patients are asymptomatic, were assessed not only anatomically, but also functionally with urodynamic parameters. The patients had obstructive stricture of the distal third of the urethra and the meatus; all the patients received the AUA symptom questionnaire. The technique was performed as microsurgery with optical magnification (4.5x). An inverted Y-shaped incision was made around the meatus, and the distal 3 centimeters of the urethra were dissected from the 3 to the 9 o’clock positions. The urethra was incised dorsally, and the strictured segment was excised and forwarded to the antatomopathology department. A 1 x 3 cm pedicle of the vaginal vestibule immediately above the meatus was sectioned and anastomosed with sutures from its distal end to the distal end of the urethra (next to the meatus) so that the margins of the pedicle were joined to the margins of the urethra to form the neourethral roof. The bladder catheter was removed 24 hours after surgery; one month later the patients were evaluated, and improvement was evident in 88% of them for all parameters analyzed: questionnaires, peak flow rate, detrusor pressure at peak flow, residual urine volume, and cystourethrogram.

Schwender\textsuperscript{23} published the first series from two institutions about treatment of strictures with ventral urethroplasty with vaginal flap. They present a series with eight patients in whom a U-shaped incision was made on the ventral vaginal wall with the apex of the U below the urethral meatus. The plane between the vaginal wall and the periurethral fascia is dissected until a 3 cm-long flap is obtained. A nasal speculum is inserted and the strictured area is incised at the 6 o’clock position. The vaginal flap is sutured over the defect and inverted onto itself, so that the apex of the U is sutured to the end of the urethral incision, and the margins of the vagina are sutured to the margins of the urethral mucosa. Permeability was verified by passing a 22Fr cystoscope; a Foley catheter was left in place for 7-10 days. The caliber of the urethras increased, and there was a decrease in post-voiding residues. After a 2.5-year follow up, only one patient has required subsequent dilations. The authors advocate this technique because it is easy to perform and reproduce, does not require tissue tunnelization, and they assure that the suprameatal incision is better tolerated. They do not present urodynamic results, and their diagnostic criteria are not clear.

One year before, Park presented a series with seven pediatric patients treated with urethroplasty with buccal mucosa graft. In only one patient the urethral pathology was iatrogenic stricture with urethrovaginal fistula (the other girls had uro-gynecologic malformations)\textsuperscript{24}. In this case, the fibrotic urethra was excised until healthy margins were found. A 2 x 4 cm-rectangle of the mucosa below Stensen’s (parotid) duct opening provided the graft. The ends of the graft were sutured and tubularized in situ over an 8-10Fr Foley catheter. Part of the vaginal mucosa was sectioned over the injured urethra to allow inlay of a buttock flap with its suture line away from the graft. A well vascularized buttock or labial flap long enough to reach the sphincter was used to cover the neourethra; care was taken to make the base of this flap wide and thick to ensure vascularization. The bladder catheter remained in place for 2 weeks. At the 12-month postoperative follow-up visit, the patient reported satisfactory voiding via the urethra, but she had recurrence of the urethral fistula. The authors conclude that there is some difficulty in the use of free grafts for female urethral reconstruction due to the lack of local tissues that permit adequate vascularization. They solved this inconvenience with buttock and perineal flaps.

In 2006, Berglund\textsuperscript{25} was the first to publish a ventral urethroplasty with buccal mucosa in two patients, based on Park’s experience. The author recommends this technique when it is not possible to use the vaginal wall to make a flap. The diagnosis in these patients was reached with pressure-flow urodynamics and urethrocystography. The urethra was exposed via a midline incision on the ventral vaginal wall; the urethra was opened at the 6 o’clock position through the meatus into the healthy urethral tissue; the graft was then sutured into the urethral defect and covered with healthy periurethral tissue or a Martius flap. An 18Fr Silastic catheter and a 22Fr suprapubic tube were left in place. A cystoscopy and cystourethrogram were done at the 6-week follow-up visit. One patient developed meatal stricture that required subsequent dilations; none had subsequent stress incontinence. The authors report that the patients are asymptomatic, with normal physical examinations at 30 and 12 months of follow-up. No follow-up urodynamic parameters are presented.
On the same year, Migliari published a similar procedure in three patients, but the graft was placed dorsally. Diagnosis was reached with pressure-flow urodynamics and urethrocytography. One patient had a prior urethroplasty. A reversed U-shaped incision over the meatus from the 3 o’clock to the 9 o’clock positions was made; a dorsal plane was developed overlying the clitoral body and underlying the urethra, as close as possible to the urethra in order to avoid injuring the clitoris; the urinary sphincter was identified. The full thickness of the dorsal part of the urethra was incised from the meatus to the bladder neck. A buccal mucosa graft of 3 x 5 cm is sutured over the defect. The urinary catheter was removed after 15 days. With a mean follow-up of 6 months, the patients had normal urodynamic tests and an unobstructed Blaivas-Groutz nomogram; no patient has presented incontinence. The advantages of this technique are, according to the authors, that urethroplasty with dorsal buccal flap in women offers mechanical support, which reduces the risk of sacculation and neovascularization. It also permits a more physiological urethral reconstruction that allows to model the urethral meatus upwards, and thus achieve a more physiological voiding. Furthermore, it maintains the ventral part of the urethra intact, leaving the possibility of eventual anti-incontinence procedures in the mid urethra.

CONCLUSIONS

Urethral stricture in women is an uncommon cause of bladder outlet obstruction; its diagnosis is not clearly established. It would seem logical that patients with a urodynamic diagnosis of obstruction would be labeled as urethral stricture if they have injuries observed in imaging tests, inability to catheterize, or if the urethroscopy shows a narrowing. These patients would be candidates to treatment for obstruction.

Treatment of urethral syndromes with no clear obstructive cause with dilation should be avoided because there is no scientific evidence that urethral dilations help to improve the symptomology of the lower urinary tract of women.

In a case of urethral stricture, the following must be assessed: the length, location with respect to the urinary sphincter, integrity of the sphincter, the condition of the healthy portion of the urethra, and whether the patient has received prior treatments.

The therapeutic algorithms show an initial management for short strictures in women with dilation and/or internal urethrotomy; however, patients must be warned of the possibility of recurrence, and their manual dexterity should be assessed because they might need to self-catheterize.

In cases of recurrent or long strictures, the possibility should be considered of a urethroplasty with vaginal flap with wide pedicle to ensure adequate vascularization and interposition of a periurethral or a Martius flap. Another option is urethroplasty with buccal mucosa graft in which the dorsal approach should be considered. Taking into account how extraordinary these cases are, the possibility should be entertained of referring these patients to specialized centers.

REFERENCES


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