Female Urethral Reconstruction

Ignacio Alvarez de Toledo

Contents

Abstract

Female urethral reconstruction encompasses a variety of different entities including female urethral stricture (FUS), female urethral diverticulum (FUD), and vesicovaginal fistula

I. Alvarez de Toledo (✉)
Buenos Aires British Hospital, University of Buenos Aires, Buenos Aires, Argentina

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(VVF). Although very different in their etiologies, they all have in common a vague and nonspecific onset of symptoms and, usually, a delayed diagnosis. Once identified and evaluated, urologists must review management options with the patient which range from minimally invasive procedures to complex reconstructive surgeries. In complicated cases, we recommend referral to an experienced specialized center for definitive management.

Keywords

Female urethral stricture · Female urethral diverticulum · Vesicovaginal fistula · Urethroplasty · Urethral diverticulectomy · Buccal mucosa graft · Vaginal flap

Introduction

Much has been written regarding female pelvic reconstruction. Moreover, many of the early advances that were made in female pelvic dysfunction and reconstruction were later extrapolated to male patients and to urologic diseases in general. The opposite situation can be found when describing urethral diseases. It took some time for the urologic scientific community to remind us that *females have urethras too*.

For many years, female urethral diseases have been overlooked and, oftentimes, underdiagnosed. Although most female lower urinary tract symptoms (LUTS) can be attributed to multiple etiologies, bladder outlet obstruction (BOO) accounts for 8.3–29% of the cases [1, 2]. Within these patients, it is important to differentiate between functional versus anatomic causes of BOO. Anatomical causes of BOO include a wide variety of pathologic entities such as FUS, FUD, VVF, pelvic organ prolapse (POP), post-anti-incontinence procedure, and malignancy, among others. FUS disease accounts for a considerable proportion ranging from 4–18% of women with BOO [3], whereas the prevalence of FUD ranges between 0.6% and 4.7% according to the literature [4] and the real incidence of VVF is unknown although it has been reported to be between 0.3% and 2.0% [5].

Finding a suitable definition for FUS remains controversial. It has been proposed that a urethral lumen too narrow to admit a 17Fr flexible cystoscope or that has the feel of scar tissue by cystoscopic haptic feedback is diagnostic for stricture [3], whereas others define FUS as a fixed anatomical narrowing of the urethra such that the lumen will not accommodate instrumentation without disruption of the urethral mucosal lining [6]. On the contrary, FUD is well defined as a variably sized urine-filled periurethral cystic structure adjacent to the urethra within the confines of the pelvic fascia, connected to the urethra via an ostium [7]. Finally, VVF is defined as a pathologic connection between the bladder and the vagina.

A majority of female urethral disease can be attributed to four etiologies: idiopathic, iatrogenic, inflammatory, or traumatic. There is a small proportion of rare etiologies which include: urethral tuberculosis, urethral carcinoma, locally advanced cervical carcinoma, fibroepithelial polyps, and infection [8–10]. Most patients with FUS disease will have an unknown etiology (51.3%). Another large proportion (32.8%) will have a history of past surgical interventions in the form of urethral dilations, anti-incontinence surgery, transurethral bladder surgery, or other types of urethral surgery. A smaller percentage will occur due to inflammation (9.2%) or trauma (6.6%) [11]. Regarding FUD, the most accepted etiopathogenic theory relies on a history of chronic inflammation of peri-urethral ducts which ultimately result in sacculation and diverticulum formation [12]. Finally, it is important to discriminate between VVF diagnosed in developing versus developed countries. Most VVF's in developing countries occur as a result of obstructed labor during childbirth [13], whereas in developed countries VVFs are rare and often encountered after hysterectomies or as a consequence of complex pelvic surgery, malignancies, and/or radiation [14].

The purpose of this article is to describe complex female urethral diseases such as FUS, FUD, and VVF as well as to review the available reconstructive surgical techniques for these entities. Step-by-step videos of urethral stricture reconstruction and urethral diverticulectomy are

included. For instructive videos of VVF repair, we strongly recommend the Lee et al. (vaginal approach) and McKay et al. (abdominal approach) articles from prior issues of this journal [5, 15].

Diagnosis

Diagnosing female urethral pathology can be challenging. Frequently, these patients will see several specialists before a definitive diagnosis is made. Some authors reported that it can take up to 5 years between the onset of symptoms and the definitive diagnosis of FUD [16]. Clinicians should have a high index of suspicion in order to avoid a delay in treatment. Thorough investigation regarding past medical history, surgical history, voiding and sexual habits, and history of malignancies or radiation is crucial to differentiate urethral anatomic pathologies from functional ones.

Physical examination (PE) is mandatory. It is very important to perform a complete PE as it may provide the clinician with key information not only to arrive at a definitive diagnosis but also for surgical planning. Observation of poor tissue quality, meatal stenosis, or lichen sclerosus may guide our diagnosis toward a FUS, whereas a paraurethral bulging mass will be diagnostic of FUD in more than 80% of cases [17]. On the other hand, continuous vaginal leakage after a pelvic surgical procedure is suspicious for VVF. In every case, PE should be performed thoroughly, including bimanual pelvic, vaginal, and speculum exams.

Regarding lower urinary tract symptoms (LUTS), there are vague and generally non-pathognomonic signs. Classically, a 3D triad (dysuria, dyspareunia, and post-void dribbling) has been described associated with FUD but studies have shown that only 23% of patients have all three and, even more, 23% of the patients did not present with any of those symptoms [18, 19]. Patients with FUS might have a variety of symptoms ranging from minor discomfort to a wide spectrum of voiding and storage symptoms. Inconsistently, the classic obstructive picture with a weak urinary stream, sensation of incomplete voiding, and straining will suggest FUS. However, as Kuo demonstrated, the differential diagnosis of lower urinary tract dysfunction in women cannot be based on LUTS alone [20].

Patients with voiding dysfunction and suspicion for obstruction should have a uroflow and a post-void residual (PVR) checked as it contributes important initial information. While there are no specific cutoffs for uroflowmetry or PVR volumes, a curve that reaches a plateau, flow less than 12–15 ml/s, or PVRs >100, may suggest obstruction [21]. Cystourethroscopy (CU) is very useful in assessing tissue quality, an area of maximal stricture and/or finding anomalous communication between the urinary tract and the genitalia. When available, we encourage the use of pediatric cystoscopes in cases with a narrow lumen. We generally do not perform an office CU in suspected UD cases as it will not change our management. Simple urethral calibration with bougie-à-boule can also provide important information regarding urethral diameter and stricture location as well as tissue quality although we should not rely on urethral diameter itself to completely rule out FUS [22]. In cases where we want to assess bladder function, a urodynamic study (UDS) might be indicated. In obstructed patients, it will show a classic high-pressure low flow pattern. To maximize the information provided by UDS, we recommend adding fluoroscopy and performing a video-UDS, as it will provide critical anatomical information regarding bladder neck function as well as the location of any obstruction. It has been proposed that a detrusor contraction at a maximum of >25 cm H_2O, with a flow <12 cc/s, could be diagnostic of BOO, although there is no consensus regarding cutoff values [23]. Other fluoroscopic studies such as retrograde urethrogram or voiding cystourethrogram (RUG/VCUG) may be helpful in diagnosing an outpouching diverticulum or an anomalous communication in patients with suspected VVF. These studies may not be as helpful as in male patients as it can often be challenging to distinguish between a primary bladder neck obstruction, a urethral sphincter obstruction, a pelvic floor obstruction, or a urethral stricture itself. Cystoscopy with bilateral retrograde pyelography is often recommended to rule out ureteral involvement in the case of VVF.

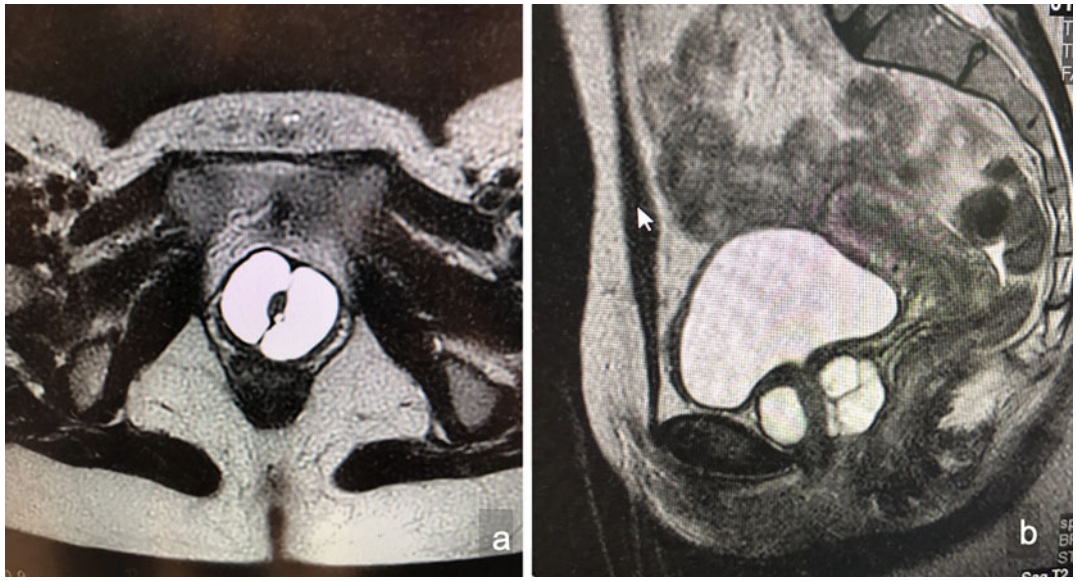

Fig. 1 Complex urethral diverticulum on MRI (**a**: axial; **b**: sagittal)

Finally, pelvic magnetic resonance imaging (MRI) plays a central role in the diagnosis and management of patients with urethral dysfunction, particularly FUD and VVF. In recent years, there has been an increasing interest in utilizing this diagnostic tool not only for diagnosis but also to rule out other pathologies such as malignancy, concomitant calculus, abscesses, or other findings. MRI's superiority relies on its multiplanar scanning capability, superior soft tissue differentiation, noninvasive nature, and overall excellent contrast resolution [24]. Additional features such as the ability to provide functional imaging make the MRI the gold standard diagnostic test for diagnosing periurethral entities [25]. (Fig. 1: **FUD seen on MRI**).

Anatomy

Female urethral surgery requires a great understanding of anatomy and surgical planes. The goal in performing urethral reconstructive surgery is to alleviate symptoms while preserving and hopefully improving voiding and sexual function.

The normal female urethra is a musculofascial tube approximately 3–4 cm in length, extending from the bladder neck to the external urethral meatus. The urethra is suspended by the urethropelvic ligament, which is a bilayered connective tissue. It is between these two layers that FUD usually develops [7].

The urethral lumen is lined proximally by urothelial tissue, and distally by nonkeratinized stratified squamous epithelium. The female urethra is lined by a longitudinal inner smooth muscle layer and outer circular smooth muscle layer. Its striated skeletal muscle component is omega-shaped and located in the mid-urethra, thinner in the dorsal aspect. This sphincteric mechanism is not completely described and it has been hypothesized that the inner longitudinal layer not only helps with micturition but also acts as a plug while contracted to help with the overall continence mechanism [26].

Beyond the lamina propria, there are a series of periurethral glands. These are located posterolaterally and have a central role in the pathophysiologic development of FUD. It has been proposed that chronic inflammation and obliteration of these glands may ultimately result in UD formation. The majority of these glands are located in the distal one-third of the urethra. The Skene glands (SG) are the largest and most distal

of these glands. These glands drain outside the urethral lumen and this is why when they obliterate, they have a similar presentation to FUD, but represent a different entity as SG are more distal, almost sub-meatal, and do not communicate with the urethra [7]. Finally, the neurovascular clitoral structures are located cephalad and lateral to the dorsal aspect of the external urethral meatus, so the risk of injury and compromising sexual function is low.

Management

Urethral Diverticulum

Female urethral diverticulum has been described as one of the most challenging diagnostic and reconstructive problems in female urology and we agree with that statement [7]. Its wide variety of clinical presentations and its surgical approach make it a unique challenge. In their series, Pincus et al. found that 21% of patients with a UD were asymptomatic, and only 51% of them needed a surgical excision [27]. In patients who do not undergo treatment, it is advisable to monitor the diverticulum. Alternatives to surgical reconstruction can be minimally invasive approaches such as endoscopic coagulation, marsupialization, fulguration, or endoscopic or open incision and drainage, although these might have high recurrence rates [28]. Bodner-Adler and colleagues reported their surgical management as follows: transvaginal resection of the UD ± reconstruction (84%), marsupialization (3.8%), transurethral endoscopic unroofing (2.0%), and various other techniques (9.7%) [4]. Furthermore, some authors propose a robotic approach for proximal dorsal FUD, reporting satisfactory results and feasibility with this technique [29]. Finally, there is a current debate on whether a concomitant stress urinary incontinence procedure should be done along with the urethral diverticulectomy. Juang et al. suggest that meticulous suture of the urethral defect left by the diverticulectomy with reconstruction of the periurethral fascia might enhance urethral resistance and thus overcome the problem of stress urinary incontinence, therefore a combined anti-incontinence procedure should not be mandatory [30]. If done, a bladder neck suspension or autologous fascial pubovaginal sling has proven to be safe and successful [31].

Urethral Stricture

We like to separate treatment options into conservative versus definitive management. Conservative management includes urethral dilation, which is the most utilized treatment modality by urologists [32]. The other minimally invasive option is a direct vision internal urethrotomy (DVIU), although it is not as popular as urethral dilation, and is only anecdotally reported. Urethral dilation is easy to do and has relatively low morbidity and complication rates.

Within definitive management, options include augmented urethroplasty using either flaps or grafts, and, very rarely, excision and primary anastomosis (EPA). Once considered as a second-line treatment, recently it has become more popular due to improved knowledge and training, and has made primary reconstruction a first-line treatment option, as suggested by Önol et al. [33].

Urethral reconstruction using flaps remains a valid option when considering approaches for urethroplasty in women. Flaps can be obtained from vaginal (U-shaped or C-shaped), labial, or vestibular tissue. They are relatively easy to obtain, with low donor site morbidity. One should take into consideration the health of local tissue before deciding to use a flap. In patients with lichen sclerosus or a history of radiation, the use of local flaps is discouraged and, in this case, we strongly recommend the use of grafts.

Within urethral reconstruction utilizing grafts, local grafts or oral mucosa grafts may be used. Local grafts can be obtained from the vagina as well as from the labia minora. As with local flaps, these grafts are contraindicated in patients with unhealthy tissues. Another aspect to take into consideration is treatment with local estrogens when considering local flaps or grafts. This type of adjuvant local treatment has proven to be safe and efficacious by Romero-Maroto et al.

[34]. As mentioned above, our preferred surgical technique is a urethral reconstruction using a buccal mucosa graft (BMG). As with male patients, BMG is popular because of its versatility and relatively low morbidity. Some authors presented their work using lingual mucosa grafts with acceptable results compared to the available literature [35]. In our experience, we only use lingual mucosa grafts when we have no available healthy buccal mucosa to harvest.

Vesico-Vaginal Fistula

VVF diagnosis includes a heterogeneous number of patients that range from minorly symptomatic to life-devastating cases and, because of this, it can be difficult to determine management options and treatment algorithms. Principles of VVF repair should include: treatment of infection, anemia, and malnutrition; ensure no foreign non-dissolving material or malignancy; tension-free watertight repair; and uninterrupted bladder drainage [5]. These repairs can be classified into simple or complex. Simple fistulas are small ($<$0.5 cm) and single in nonradiated patients with no associated malignancy. Complex fistulas are large ($\geq$2.5 cm), those that failed previous fistula repair, or are associated with chronic disease or post-radiation. A fistula sized between 0.5 and 2.5 cm is considered intermediate [36].

Conservative management can be attempted when we encounter a simple fistula. The first and simplest option is to insert a Foley catheter, drain the bladder, and prescribe an anticholinergic. This strategy alone has proven to be effective up to 39% of the time [37]. Many other minimally invasive treatments have also been reported such as injection of fibrin sealant/cyanoacrylic glue and/or electrocautery with laser or coagulation diathermy, all showing acceptable results although practiced in a small number of patients and with short follow-up.

Finally, if conservative measures do not resolve the VVF or if the fistula is not suitable for conservative management, a formal surgical repair is indicated. In these cases, the surgeon will have to sort through a series of dichotomies: immediate repair versus delayed repair; vaginal approach versus abdominal approach; open procedure or laparoscopic/robotic; interposition of tissue versus no interposition; and removal of fistulous tract versus no removal. All of these are still open controversies and there is a lack of sufficient data to recommend one over the other. In summary, we agree with Malik et al. who opined that VVF can be best managed following basic surgical principles, such as adequate exposure, identification of structures, wide mobilization, tension-free closure, good hemostasis, and uninterrupted bladder drainage [38]. Additional discussion can be found in the next heading.

Preoperative Planning

After a diagnosis is made, the reconstructive surgeon must consider additional imaging or studies, if necessary, to adequately plan intervention. Some authors suggest that performing UDS in patients with FUD is helpful as it may diagnose BOO in up to 50% of the cases [39]. Reeves et al. propose that in cases where MRI is needed, it should be done sagittal and post-void, in order to allow the UD to fill with urine and provide better imaging [31]. In patients where a cystourethroscopy might be needed, it may be beneficial to perform under sedation to avoid patient discomfort. Cystoscopy with bilateral retrograde pyelography may be indicated for patients with VVF to rule out ureteral involvement.

There is no consensus on whether or not to perform a preoperative urine culture. If the patient has a history of recurrent UTIs, it is beneficial to obtain one in order to adjust therapy according to the antibiogram. Some authors advocate the idea that a urine culture should be done for every patient before surgery [40]. In cases with VVF where urinoma or urosepsis is present, it is advised to delay the definitive repair for at least 6 weeks after drainage, if possible. This is also the case in a postpartum event since the uterus takes some time to return to its involute state [5]. In postmenopausal women, intravaginal estrogens may be administrated preoperatively to treat vaginal mucosal atrophy [34].

In patients with suspected malignancy, a biopsy should be done before undergoing a reconstructive procedure, as this would likely change management. It is in these cases where an MRI is potentially useful as well. Malignancies can present as part of a stricture, diverticulum, or fistula, so in every case the surgeon should be aware of this possibility and patients properly counseled.

As with male patients, the reconstructive surgeon must be ready to change the plan if intraoperative findings differ from the preoperative plan. It is highly recommended to be precise and clear with the patient before consenting to avoid misunderstandings. It is also of the utmost importance to manage patients' expectations appropriately before performing these procedures as, sometimes, resolving one urethral problem (FUS, FUD, and VVF) may bring on an additional urethral problem and more than one procedure may be needed.

Prep and Patient Positioning

Patients with urethral pathology are widely variable and ultimately each treatment option should be adjusted to each particular need. In general, we use the low lithotomy position as it provides us with access to the urethral meatus, vaginal introitus, and the vestibule as well as the abdomen. Interestingly, Reeves et al. propose a novel prone position stating it can provide better access in these patients, especially in complex high VVF [31]. We prep and drape our patients in the usual sterile fashion, using 2% chlorhexidine gluconate (CHG) or povidone-iodine solution according to the surgeon's preference. It is very important to carefully pad all pressure points to avoid nerve injury.

To help with retraction we use the Lonestar-Scott retractor with 4–6 blue (sharp) hooks, although labia minora could also be retracted with sutures. Oftentimes, the FUD ostium is difficult to encounter so in these cases we find it very useful to instill diluted methylene blue to help find the ostium and dye the diverticulum which is helpful during dissection. The same retractor is utilized in cases where a Martius flap is harvested.

Finally, in cases where we will need to harvest a buccal mucosa graft, the patient's mouth is also prepped and draped. Typically, we harvest our own grafts, however, it is acceptable to have a separate team harvest if desired. There is no need for nasotracheal intubation as this procedure can be done with an orotracheal tube in place carefully secured to one side, while we harvest from the opposite inner cheek.

Procedural Approach (Our Techniques)

Urethral Diverticulum

We start with 17 Fr rigid cystoscopy to assess the entire urethra and bladder. We look for the FUD ostium, which is not always found. If found it is usually in the posterolateral position. As mentioned prior, we use a Scott retractor and blue hooks for better visualization and instill dilute methylene blue. A 14 or 16 Fr catheter is then placed with 10 cc in the balloon. The bladder neck is marked for reference. A vaginal incision is made in an inverted-U fashion with a wide based flap and into the lateral sulci to permit the later use of a Martius flap, if needed. Further dissection is done sharply with Metzenbaum scissors. It is critical for the dissection to leave enough tissue to avoid thinning the flap and cause devascularization as well as to avoid entering the diverticulum. Bipolar cautery can be judiciously used to control small bleeders. Dissection continues until the level of the bladder neck. Once the diverticulum is identified, a transverse incision is made just through the endopelvic and endocervical fascia, and flaps are created in both cranial and caudal directions. The diverticulum is visible with a light blue hue and dissected circumferentially until it is defined in all planes. At this point, the diverticulum is opened in order to better appreciate its borders and avoid entry into the urethra. A lacrimal duct probe can be used to identify the os. Manipulating the Foley catheter can bring fluid into the diverticulum to assist in locating the position of the os. If the os is noted to be in a challenging position, consideration can be made to placing a stay suture to better identify the location for later closure. Once the diverticulum is traced

back to the os, it is truncated at that point. We always send the diverticulum as a specimen for pathologic analysis. Interrupted 4/0 absorbable sutures are placed to close the os. The flaps created previously can be closed with 4/0 absorbable sutures with a vest over pants, or pants over vest technique. Care needs to be taken when placing these sutures to avoid devascularization of the flaps. Over this flap, a Martius flap can be rotated in from either labia majora if the patient has a history of radiation or notably poor tissue quality. The vaginal closure is performed with 2/0 interrupted absorbable sutures and a vaginal packing is left in place overnight. The catheter is left in for 2–3 weeks.

Urethral Stricture

We prefer the dorsal onlay buccal mucosal graft although some might argue it is a more difficult approach. The risk of sexual dysfunction with this dissection is low, as the plane of dissection is well away from neurovascular clitoral structures. Leaving the ventral plane untouched is useful for a possible continence procedure in the future if indicated. In addition, a dorsal fixation helps prevent sacculation of the graft. We harvest, clean, and fenestrate a 4 × 2 cm buccal mucosal graft in the standard fashion. Urethral length is relatively constant, so these graft dimensions are generally sufficient even if the stricture is panurethral. A semilunar, suprameatal incision is made. Careful dissection is carried outside the corpus spongiosum until healthy urethra is encountered. We typically open the meatus, however, an alternate meatus-sparing technique is also acceptable. The dissection may be carried out to the bladder neck when necessary without fear of de novo stress urinary incontinence. The graft is sewn in with delayed absorbable suture; we favor 4-0 PDS. Several quilting sutures of 5-0 Vicryl are placed. We ensure patency to 30 Fr with intraoperative bougie-à-boule. A 14 French silicone catheter is left in place for 3 weeks.

Vesico-Vaginal Fistula

For most fistula, we prefer the vaginal approach. When possible the fistula is cannulated with either a 5 Fr ureteral catheter, a wire, or ideally a Fogarty balloon or small foley to aid in identification and manipulation. We start with an U-shaped incision the apex of which is at the fistula and develops a vaginal flap, taking care to preserve the peri-urethral fascia. Once we encounter the fistula we dissect and widely mobilize it. Typically, we will excise the tract and send it for pathology. The bladder is then closed in two layers, and inner running and outer interrupted layer with 4-0 absorbable suture. Based on the quality of the surrounding tissues and fistula etiology, a Martius flap may or may not be utilized. Typically, in radiated patients or redo cases we recommend the interposition of a Martius flap, which is almost always available. The Martius flap is raised based on the upper or lower vascular pedicle depending on the position of the fistula and the patient's anatomy. If the Martius flap is insufficient or not available, other flaps such as peritoneal, omental, or a gracilis interposition flap may be utilized. The repair is leak tested. The vaginal incision is then closed interrupted 2-0 Vicryl. A 14 Fr silicone catheter is left in place for 2–4 weeks. If a suprapubic catheter was present, this is also left in situ for maximal bladder drainage.

For complex, high, or recurrent fistula, an abdominal approach may be utilized. We prefer a minimally invasive robotic-assisted transvesical approach in these cases. Similar to the vaginal approach, the fistula is cannulated whenever possible. Temporary external ureteral catheters may be placed if the fistula is near the ureteral orifices. The bladder is opened at the posterior dome and the fistula is identified. It is widely mobilized and the tract is sent for pathology. The vagina is closed with 3-0 or 4-0 absorbable suture, and the bladder is similarly closed, in one or two layers avoiding overlapping suture lines. The cystotomy is finally closed with running 3-0 or 4-0 suture. The repair is leak tested. A 14 Fr silicone catheter is left in place for 2–4 weeks.

Excellent videos of both the vaginal [5] and abdominal approach to VVF [15] is available in a prior volume of *Urologic Clinics of North America (Volume 46, Issue 1)*.

Recovery and Rehabilitation

Recovery from urethroplasty for FUS is generally brief. Minor stress incontinence may be encountered initially, however, this generally resolves. In our institution, this is an outpatient surgery. We do leave a small labial drain for 1–2 days if a Martius flap was harvested. We usually leave a vaginal packing in place, which will be removed within the first 24 hours post-op. We discharge patients with pain medication as needed and also anticholinergic medication to help with bladder spasms. Unless the patient had recurrent UTI, we do not provide antibiotics during the catheterization period.

Most patients are seen in the office for a wound check within 1 week, and the catheter is removed between 2 and 4 weeks depending on the procedure performed. Any relevant pathology results are reviewed.

Outcomes

Urethral Diverticulum

Interestingly, some authors propose classification of urethral diverticulum into simple or complex in order to predict their postoperative outcomes. Complex FUD are those extending partially or circumferentially around the urethra. In their series, Nickles et al. showed that patients with complex FUD were most likely to present postoperatively with urinary tract symptoms (27% vs 3%) compared to patients following reconstruction for simple FUD [41]. In a different study, Ko et al. published an overall cure rate with surgery of 77.9% but when the different UD were broken down into simple, U-shaped, and circumferential, their cure rates were 100%, 75.0%, and 64.0%, respectively [42]. This demonstrates that successful surgical outcomes in these patients have a direct correlation with anatomical complexity. This is important for patient counseling.

Regarding complications, the most commonly reported are urethrovaginal fistula, de novo stress urinary incontinence, urethral strictures, recurrent UTIs, and recurrence of the diverticulum [4]. One study showed that the most common pathology was squamous metaplasia (31%) and also reported a 2.5% malignancy rate (adenocarcinoma) within their UD specimens [27], which is consistent with other malignancy reports (2%) found in the literature [31].

Finally, there is currently no existing data showing a well-documented comparison regarding different surgical approaches for UD. In the future, a proper randomized controlled trial comparing success and complication rates with each treatment would be useful to help guide practice.

Urethral Stricture

The goals for female urethral reconstruction are to restore function, urinate without obstruction, maintain continence, prevent vaginal voiding, and maintain sexual function. Although these goals are considered an ideal scenario, there is a dearth of literature considering all five variables when analyzing outcomes. Much of the available literature regarding FUS has been published within the last 5 years. The most common management is urethral dilation although its success rate ranges between 47% and 49% [11, 43], with success defined as the lack of need for further intervention. The mean time to failure was 12 months [44]. In our practice, we follow the same principle as in male patients with no more than one attempt at UD given the poor outcomes of repeated dilations (30%), unless the patient is not a surgical candidate [45].

There is no statistical difference in terms of success rate among reconstructive options. Both reconstructive surgeries using flaps or grafts have proven to be equally safe and efficacious

[46]. Success rates using flap urethroplasty were 92% with a mean follow-up of 42 months, whereas success rates with BMG graft urethroplasty were 89% with a mean follow-up of 19 months and 87% with vaginal graft urethroplasty with a mean follow-up of 15 months according to the most recent systematic review [11].

Acceptable complication rates were reported with flap procedures, with only 3.7% de novo SUI noted [11]. Furthermore, in patients with concomitant SUI, a pubovaginal sling could be placed without major morbidity. Where to place the graft still remains a controversy, with some authors advocating to place it dorsally while others opine it should be placed ventrally. There is no data available supporting one over the other, so, ultimately, it remains at the surgeon's discretion. Finally, de novo SUI was found to be similar in both approaches (3.6% with a dorsal approach versus 5.8% with a ventral approach) [11].

Vesico-Vaginal Fistula

Traditionally, the classic strategy has always been to repair within 1 week of injury or after a delay of 3–6 months to allow for healing of the traumatized tissue. Studies have shown that early repairs have similar rates of success as delayed ones [47]. When a delayed approach is selected, the surgeon must optimize preoperative patient factors such as nutrition, urinary drainage, and skincare. If there is a recurrence, data suggests that a revision VVF repair is less successful, highlighting that, generally, the best chance of fistula closure is at the time of the first operation [13].

VVF can be repaired via a vaginal approach or an abdominal approach. To date, there are no randomized controlled trials comparing the route of repair, so the decision is up to the surgeon's preference. Typically, simple VVF will be approached vaginally first, as the vaginal approach has demonstrated significantly shorter operative times, decreased blood loss, and a shorter duration of hospitalization [15]. Another advantage to the vaginal approach is that it can be done as an outpatient. On the other hand, in complex VVF or redo cases, an abdominal approach may be preferred. The estimated success rate of transvaginal repair ranges from 83–100%, whereas the overall success rate of laparoscopic/robotic VVF repairs was 80–100% [5]. Tissue interposition is advantageous in some cases. In our practice, we use a Martius flap if approached vaginally when necessary, but other tissue such as omentum or a peritoneal flap have been described as well. The utilization of minimally invasive techniques has significantly improved recovery times in these cases.

We agree with Lee et al. that heterogeneity of the fistula (size and location) and the occasional use of an interposition graft make treatment standardization very difficult [5].

Summary

Female urethral reconstruction is an evolving art that bases its principles on excellent knowledge of vaginal, urethral, and pelvic anatomy. Reconstructive surgeons eager to manage this type of pathology require the right skillset and armamentarium in order to find an appropriate solution for their patients. Oftentimes, the diagnosis will be delayed and in the context of a suffering patient with truly bothersome symptoms such as urinary leakage, recurrent UTIs, dyspareunia, dysuria, and voiding and storage symptoms. Managing patient expectations is crucial. The most important consideration when approaching these patients is to follow basic reconstructive surgical principles such as adequate exposure, broad mobilization, gentle handling of tissue, tension-free closure, and satisfactory hemostasis. Finally, in complex cases, it is always a wise option to refer these patients to an experienced specialized center for definitive management.

Conflicts of Interest

Dr. DeLong is a consultant for Urotronic, Inc. and for Urovant. Dr. Alvarez de Toledo has no conflicts to report.

Cross-References

- Urethral Diverticula Repair
- Vesicovaginal Fistula Repair: Abdominal Approach
- Vesicovaginal Fistula Repair: Minimally Invasive Approach
- Vesicovaginal Fistula Repair: Vaginal Approach

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