Female Urethral Diverticula—An Update

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Female urethral diverticula can arise from repeated infections with abscess formation within the periurethral and urethral glands. Symptoms or signs of female urethral diverticula are usually not typical, thereby resulting in a delayed or incorrect diagnosis. New radiographic imaging modalities, such as magnetic resonance imaging and a new method of virtual computed tomography urethroscopy, can also help to diagnose female urethral diverticula. An accurate preoperative understanding of the anatomic conditions with a female urethral diverticulum and complete evaluation of associated voiding dysfunction such as urinary incontinence can help to accurately and properly treat this disease.

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1. Introduction

Female urethral diverticula present some of the most challenging diagnostic and therapeutic problems in female urology. The presentations of female urethral diverticula are very diverse and can range from completely asymptomatic or incidental findings on a physical examination or radiologic images, to painful vaginal masses associated with post-micturition incontinence, frequent urinary tract infections (UTIs), dyspareunia, stones, and tumors.³ With the development of imaging techniques such as double balloon urethrography and magnetic resonance imaging (MRI), we have more-advanced understanding of female urethral diverticula. In addition, a video urodynamic study can also help to evaluate concomitant stress urinary incontinence (SUI). When a diagnosis of female urethral diverticulum is confirmed, excision and reconstructive surgery can be performed.³

2. Pathophysiology and Etiology of Female Urethral Diverticula

Female urethral diverticula are considered a localized outpouching of the urethra into the anterior vaginal wall. They may arise from repeated infections with abscess formation within the periurethral and urethral glands.³ Most urethral glands lie in the mid to distal portion of the urethra. When the obstructed glands rupture into the urethral lumen, an outpouching is formed. Once the outpouching is epithelialized, it becomes a true urethral diverticulum.³,⁴ Urethral diverticula may also form after obstetric trauma, urethral instrumentation, and urethral or vaginal surgery.³ In recent years, collagen injections were also described as a rare cause of urethral diverticulum, which result in a non-communicating diverticulum with obstruction of the periurethral gland and persistent accumulation of secretions.⁵ Moreover, urethral diverticula are also reported after tension-free vaginal tape procedures for SUI.⁷ Congenital formation of urethral diverticula was also suggested, particularly in pediatric patients.⁸

Inflammation and chronic irritation from the presence of urine and debris can induce malignant changes into an adenocarcinoma, transitional cell carcinoma or squamous cell carcinoma.⁹–¹¹ Among malignant tumors of urethral diverticula, 54% tend to be adenocarcinomas, 43% transitional cell carcinomas, and 22% squamous cell carcinomas.¹¹

Stasis of the urine in urethral diverticula can cause recurrent UTIs and stone formation in the diverticulum.
itself. Martinez-Maestre et al.\textsuperscript{12} reported an elderly woman with a firm vaginal mass, which was discovered to be a 5 × 6 cm stone in a urethral diverticulum. Stones in diverticula are rare, with the occurrence rate of stone formation in urethral diverticula being approximately 1.5–10%, and the stone formation results from stagnant urine, salt deposition, and mucus from the urothelial lining.\textsuperscript{12}

3. Prevalence

In 1952, Moore\textsuperscript{13} stated that urethral diverticulum as an entity was “found in direct proportion to the avidity with which it is sought”. After development of a series of imaging techniques including positive pressure urethrogram in the 1950s, the diagnoses of female urethral diverticulum increased. Female urethral diverticula are identified in 0.6–6% of women and are diagnosed most frequently in the third to fifth decade of life.\textsuperscript{14} In 1967, Andersen\textsuperscript{15} reported the results of positive pressure urethrography on 300 women with cervical cancer but without lower urinary tract symptoms, and the incidence of urethral diverticula was 3%. Lorenzo et al.\textsuperscript{16} reported the results of endorectal coil MRI on 140 consecutive female patients with lower urinary tract symptoms, and the incidence of urethral diverticula was approximately 10%. This percentage might not be reflective of the general population because of a selection bias at tertiary referral centers.

4. Signs and Symptoms of Female Urethral Diverticula

Historically the classic presentation of a urethral diverticulum was described as the “3 D’s”: dribbling, dysuria, and dyspareunia.\textsuperscript{2} However, these symptoms are neither sensitive nor specific for urethral diverticula. The presentation is very diverse, and the most common symptoms are recurrent UTI (9–61%), urinary incontinence (35–39%), and dysuria (9–55%). Post-void dribbling was noted by 4–31% of patients. Moreover, dyspareunia was noted by 6–24% of patients.\textsuperscript{5}

There should be a palpable urethral mass with an emergence of purulent discharge out of the meatus on milking the mass. However, in our series, we found that the presenting symptoms or signs of female urethral diverticulum were so diverse that a diagnosis of a female urethral diverticulum could easily be missed.\textsuperscript{17} They are usually misdiagnosed as chronic pelvic pain, voiding dysfunction, and uncomplicated recurrent UTI. Other symptoms and signs of female urethral diverticula may include urethral pain, urinary frequency, urinary urgency, urge incontinence, stress incontinence, nocturia, vaginal tenderness, and pyuria.\textsuperscript{17} If a female urethral diverticulum is not included in the differential diagnosis, diagnosis and management are usually delayed.\textsuperscript{1}

Figure 1 Preoperative urethral diverticulum of a female patient. The arrow indicates the bulging mass in the anterior vaginal wall.

5. Diagnosis and Evaluation

Diagnosis and comprehensive evaluation of the female urethral diverticula are best made with a combination of detailed history taking, physical examination, urine analysis and culture, endoscopic examination of the bladder and urethra, and radiologic imaging.\textsuperscript{2} Romanzi et al.\textsuperscript{1} reported their experience with diverse presentations of urethral diverticula in women and concluded that the symptoms of urethral diverticula may mimic other disorders. When female patients with pelvic pain, urinary incontinence and irritative voiding symptoms do not respond to therapy, the possibility of a urethral diverticulum should be considered.\textsuperscript{1}

A physical examination may show a tender urethra or a bulging mass in the anterior vaginal wall (Figure 1). Pus or turbid urine may be pressed from the urethral meatus when the suburethral bulging mass is compressed. However, if a firm mass is palpated over the anterior vaginal wall, stones or a carcinoma in the urethral diverticulum should be considered.\textsuperscript{5}

SUI may coexist with urethral diverticula, and urodynamic studies are important to evaluate the continence status. Even in the absence of a complaint of SUI, a urodynamic evaluation is wise. The need for extensive surgical dissection during a diverticulectomy may convert asymptomatic or occult stress incontinence into gross postoperative SUI.\textsuperscript{18}

6. Imaging

Appropriate evaluations play an important role in diagnosing female urethral diverticula and can provide maximum data about the number, location, size, configuration, and communication of a female urethral diverticulum.\textsuperscript{19} Radiologic imaging can provide the anatomic relationship between the urethral diverticulum and surrounding tissues. Some radiographic images, e.g., ultrasound, voiding cystourethrography (VCUG), double balloon urethrography
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Figure 2 Double balloon urethrography of a female patient with urethral diverticulum. The arrow indicates a near-circumferential urethral diverticulum.

Figure 3 T2-weighted magnetic resonance image of a female patient with a urethral diverticulum. The arrow indicates a circumferential urethral diverticulum.

(Figure 2), MRI (Figure 3) and the new method of virtual computed tomography (CT) urethroscopy, can also help in diagnosing a female urethral diverticulum. However, the modality that is most accurate remains controversial.

Double balloon urethrography is known as a positive pressure urethrogram; it is performed by inserting a double balloon catheter into the urethra, and the contrast medium is injected with high pressure into the isolated urethra. Then, the contrast can be filled into the urethral diverticulum from the ostia. Double balloon urethrography is considered to be a good choice for diagnosis and evaluation of a female urethral diverticulum. However, double balloon urethrography is not performed so widely for several reasons: first, this method requires a specially designed urethral catheter and an experienced radiologist; second, it is an invasive procedure for the patient with a urethral diverticulum; third, diverticular loculations cannot be well defined; and fourth, non-communicating urethral diverticula cannot be seen with double balloon urethrography, because the contrast medium cannot enter the diverticulum.

VCUG may also provide excellent imaging of female urethral diverticula. It is commonly used for diagnosing and evaluating patients with a known or suspected urethral diverticulum. The overall accuracy is about 65%. But it has several limitations including being invasive, possible urethral catheterization-related UTIs, and the potential for underfilling or non-visualisation of the urethral diverticulum due to a poor voiding effect by the patient. When the ostia or neck of the urethral diverticulum is obstructed because of acute inflammation of urethral diverticulum or non-communicating between urethra and diverticulum, VCUG cannot show the lesions.

Ultrasonography can also help to evaluate urethral diverticula with transvaginal, transperineal and transurethral techniques. Transvaginal ultrasonography can show the number, size, configuration, location, and possible contents of urethral diverticula. However, ultrasonography cannot produce high-resolution images of the urethral diverticulum and the surrounding anatomy. Increased resolution was noted with transurethral ultrasonography. But like double balloon urethrography and VCUG, transurethral ultrasonography is also an invasive procedure.

MRI may be considered the gold standard imaging technique for evaluating female urethral diverticula. Urethral diverticula appear as areas of decreased signal intensity on T1 images compared with the surrounding soft tissues and have a high signal intensity on T2 images. Compared with double balloon urethrography and VCUG, MRI is independent of voiding and free from ionizing radiation while still able to successfully image female urethral diverticula. In addition, MRI is relatively noninvasive, and produces high-resolution, multiplanar images of female urethral diverticula. Two kinds of MRI of surface coil and endoluminal techniques were developed. Endoluminal MRI for urethral diverticula places the magnetic coil into a body cavity near the urethra, such as the vagina or rectum. This produces an improved signal-to-noise ratio and a high-resolution image of the urethra, urethral diverticulum, and surrounding tissues. Both surface coil and endoluminal MRI appear to be superior to VCUG and double balloon urethrography for evaluating urethral diverticula, but the technology is expensive and not widely available.

With advances in imaging technology, virtual CT urethroscopy was developed as a new diagnostic technique for female urethral diverticula. CT urethrography consists of thin-section transverse images of VCU on a high-speed CT scan. These reformatted images are transferred to a workstation. Then, virtual CT urethroscopy can be performed under the aid of manufacturer-provided software. Virtual CT urethroscopy is less invasive than conventional cystourethroscopy. Virtual CT urethroscopy can better show the extraluminal anatomy and pathology than conventional cystourethroscopy. Chou et al. reported a female patient with a horseshoe-shape urethral diverticulum detected by virtual CT urethroscopy; it clearly
identified the neck and orifice of the diverticulum in the mid-urethra. VCUG and cystourethroscopy showed negative findings for a diverticulum in the same female patient.\textsuperscript{20} Kim et al.\textsuperscript{29} reported another two patients with urethral diverticula. In their series, virtual CT urethroscopy was better able to identify the ostia of the diverticula than VCUG, transvaginal sonography and MRI. Identification of the ostium of a urethral diverticulum is important for surgical management. Virtual CT urethroscopy can provide good identification of the ostium and neck of a urethral diverticulum and can help urologists in surgical planning.\textsuperscript{29} However, some limitations can also be noted for virtual CT urethroscopy. First, it is still experimental and time-consuming. Second, if the patient cannot void on the CT table, voiding images cannot be obtained. Third, there is significant radiation exposure to female patients of reproductive age.\textsuperscript{29}

7. Differential Diagnosis: Periurethral Cystic Lesions and Masses Other than Urethral Diverticula

Periurethral cystic lesions include vaginal cysts (müllerian cysts, Gartner’s duct cysts, and epidermal inclusion cysts), Skene’s duct cysts, Bartholin gland cysts, and perineal/vulvovaginal endometriomas.\textsuperscript{24,30} Such lesions are frequently noted near the distal urethra. Periurethral cysts do not communicate with the urethra and can be differentiated from urethral diverticula with endoluminal MRI.\textsuperscript{24} In addition, periurethral masses, such as vaginal leiomyomas,\textsuperscript{31} and solid urethral masses, such as carcinomas, nephrogenic adenomas, mesonephric adenocarcinomas and embryonal cell rhabdomyomas, may be mistaken for urethral diverticula.\textsuperscript{32} Ectopic ureters and ureteroceles that insert in or adjacent to the urethra may be mistaken for urethral diverticula or periurethral cysts.\textsuperscript{24} Ectopic ureteral orifices can be noted from the bladder neck to the external urethral orifice.\textsuperscript{33,34}

7.1. Vaginal leiomyomas

Vaginal leiomyomas are benign mesenchymal tumors of the vaginal wall that arise from smooth muscle elements. They commonly present as a smooth, firm, round mass on the anterior vaginal wall. These masses are apparent on a physical examination as freely mobile, firm, nontender masses on the anterior vaginal wall.\textsuperscript{25} They can be misdiagnosed as urethral diverticula.\textsuperscript{32} Excision or enucleation through a vaginal approach is often curative and is recommended to confirm the diagnosis, to exclude a malignant histology, and to alleviate symptoms.\textsuperscript{25}

7.2. Skene’s duct cysts

Skene’s duct cysts are lateral or inferolateral to the urethral meatus. Classically, compared with urethral diverticula, these lesions do not communicate with the urethral lumen.\textsuperscript{25} Skene’s duct cysts can be differentiated from urethral diverticula on physical examination, as these lesions are located relatively distal on the urethra, often distorting the urethral meatus, in contrast to urethral diverticula, which most commonly occur over the mid and proximal urethra.\textsuperscript{25}

7.3. Gartner’s duct cysts

Gartner’s duct cysts are mesonephric remnants and are found on the anterolateral vaginal wall.\textsuperscript{35} Because Gartner’s duct cysts are mesonephric remnants, they may have the function of draining ectopic ureters from poorly functioning or nonfunctioning upper pole moieties in duplicated systems. Other metanephric abnormalities, such as unilateral renal agenesis and renal hypoplasia, are associated with Gartner’s duct cysts.\textsuperscript{25,36} Treatment depends on symptoms and the association with ectopic ureters.

7.4. Bartholin gland cysts

Bartholin gland cysts are typically located in the posterolateral introitus medial to the labia minora.\textsuperscript{24,37} Most patients are asymptomatic. Infected or symptomatic cysts may require marsupialization.\textsuperscript{24}

7.5. Vaginal wall cysts

Vaginal wall cysts are usually presented as small asymptomatic masses on the anterior vaginal wall.\textsuperscript{25} They may arise from multiple cell types. A specific diagnosis cannot reliably be made until the specimen is excised and examined by a pathologist. Treatment is usually by a simple excision in symptomatic patients. Other periurethral masses, such as a urethral mucosal prolapse and urethral carbuncle,\textsuperscript{25} can be differentiated from urethral diverticula by a physical examination because of their special appearance.\textsuperscript{25}

8. Nonsurgical Treatment of Female Urethral Diverticula

Many patients do not have significant symptoms from urethral diverticula. Such asymptomatic patients can be treated with conservative methods including antibiotics, anticholinergics, simple observation, post-void digital decompression,\textsuperscript{5} and obliteration with oxidized cellulose\textsuperscript{38} or polytetrafluoroethylene.\textsuperscript{39} If an acute infection is noted in the urethral diverticulum, treatment with antibiotics should be performed before surgical intervention can be considered.\textsuperscript{19} Moran et al.\textsuperscript{40} reported four pregnant patients with urethral diverticula. Those patients were successfully treated with adequate antibiotic therapy and judicious aspiration.
9. Surgical Treatment of Female Urethral Diverticula

Generally, there are three surgical options for female urethral diverticula: (1) transurethral incision of the diverticular communication by transforming a narrow-mouthed diverticulum to a wide-mouthed one; (2) marsupialization of the diverticular sac into the vagina by incision of the urethrovaginal septum; and (3) excision with reconstruction. Excision and reconstruction are probably the most common surgical approach to urethral diverticula in the modern era.

Principles of a urethral diverticulectomy have been well described and include: (1) mobilization of one or more well-vascularized anterior vaginal wall flaps; (2) preservation of the periurethral fascia; (3) identification and excision of the neck of the urethral diverticula or ostia; (4) removal of the entire urethral diverticular wall or sac (mucosa); (5) watertight urethral closure; (6) multilayered, non-overlapping closure with absorbable sutures; (7) closure of the dead space; and (8) preservation or creation of continence.

The most common surgical techniques for female urethral diverticula were described by Leach et al. When the diverticulum is a saddlebag or circumferential, meticulous dissection with complete excision anterior to the urethra and behind the pubic bone is used. When a circumferential urethral diverticulum is noted, it may be necessary to completely divide and excise the involved segment of the urethra to expose the dorsal wall of the diverticulum. To reconstruct the continuity of the urethra, end-to-end urethroplasty or tubularization of the dorsal wall of the urethral diverticulum to construct a neourethra can be performed. Adequate drainage of the urinary bladder is important. Whether suprapubic catheter drainage or transurethral drainage is preferred is controversial. Some authors use both a suprapubic tube and transurethral Foley tube for perioperative bladder drainage. If only an indwelling transurethral Foley tube is used and unfortunately the transurethral Foley tube is obstructed postoperatively, then bladder spasms and a blowing out of the urethral diverticular repair may occur. After 10–14 days postoperatively, the transurethral Foley tube is removed, and VCUG is performed to evaluate the extravasation. If no extravasation is noted, the suprapubic tube is removed. However, if extravasation is noted, the suprapubic tube is kept in place for bladder drainage, and VCUG is repeated 1 week later.

Complication rates of a transvaginal urethral diverticulectomy range 5–46%. The most common complications of transvaginal urethral diverticulectomy include urinary incontinence (1.7–16.1%), urethrovaginal fistula (0.9–8.3%), urethral stricture (0–5.2%), recurrent UTI (0–31.3%), and recurrent urethral diverticula (1–25%). Porpiglia et al. reported their experience with preoperative risk factors with surgery for female urethral diverticula and showed that a delayed diagnosis (> 12 months), a large size (>4 cm), and a lateral or horseshoe-shaped diverticulum are the most important preoperative risk factors for complications with a female urethral diverticulectomy. A brief flow chart of the diagnosis, treatment, and potential surgical complications of female urethral diverticula is given in Figure 4.

10. Special Considerations for Concomitant Female Urethral Diverticula and SUI

The unique symptom of post-micturition incontinence can be used to differentiate urethral diverticula from genuine incontinence. In our previous study, 14 female patients with urethral diverticula were enrolled. Seven patients had minor SUI occurring immediately after voiding, while classic SUI patients typically do not have SUI immediately following bladder emptying. SUI was so dominant in two patients with large urethral diverticula that they were falsely treated with anti-incontinence surgery. Further inquiry showed that their stress incontinence only occurred immediately, but not 1 or 2 hours after voiding when the bladder contained more urine and stress incontinence should have more easily occurred. Nevertheless, patients with both genuine stress incontinence and a urethral diverticulum may have stress incontinence all the time, both immediately after voiding and when the bladder is fuller.

Bass and Leach reported 61% abnormal urodynamic studies in 41 female patients with urethral diverticula. Twenty patients had genuine SUI (49%), eight had SUI with detrusor instability (19.5%), two had detrusor instability alone (5%), and one had myogenic decompensation (2%). Bhatia et al. found that the urethral pressure profile decreases at the level of the diverticular ostium (biphasic pattern), but it may be difficult to show the biphasic pattern of the urethral pressure profile when the ostium is only a pinhole. Some patients may have evidence of bladder outlet obstruction on the urodynamic evaluation due to the obstructive or mass effects of the urethral diverticula on the urethra. Furthermore, SUI can coexist with an obstruction. There is also the potential that the urethral diverticulectomy may unmask occult SUI by removing an obstructive diverticulum. Therefore, it is important to determine the continence status before the operation for a urethral diverticulum. However, the urethral reconstruction may itself predispose a patient to an increased risk of SUI. Vaginal and periurethral surgical dissection performed during the diverticulectomy may alter the patient’s continence status by compromising urethral support or altering the neurovascular supply to the sphincter muscle. Alternatively, the pathophysiologic inflammatory pathway involved in urethral diverticula may alter the tissue integrity of the urethra.
and/or the sphincteric mechanism. For patients with urethral diverticula and SUI, concomitant anti-incontinence surgery can be performed. Several authors described successful concomitant repair of urethral diverticula and stress incontinence with needle suspension or autologous fascial pubovaginal slings, without increasing the risk of postoperative infection.3,45,49 However, the safety and efficacy of midurethral polypropylene tape procedures in patients with SUI and urethral diverticula have not been well studied.2

Alternatively, the procedures can be staged. In 2006, Juang et al.50 reported two female patients with middle urethral diverticula and SUI. They treated those two patients with only a diverticulectomy without concomitant anti-incontinence surgery. Those two patients received postoperative follow-up for 6 months and 2 years, and showed complete resolution of the SUI. They concluded that according to their experience, it is not mandatory to perform a combined vaginal diverticulectomy and anti-incontinence surgery for all patients with a urethral diverticulum presenting with SUI. Meticulous suturing of the urethral defect left by the diverticulectomy with reconstruction of the periurethral fascia might enhance urethral resistance and thus overcome the problem of SUI. For patients with a proximal or distal urethral diverticulum and symptoms of SUI, adding anti-incontinence surgery to the urethral diverticulectomy may be justified.

11. Conclusion

Symptoms or signs of a female urethral diverticulum are usually not typical, thereby resulting in delayed or wrong diagnoses. A high suspicion of this disorder, a detailed history taking, and a physical examination are important for detecting urethral diverticula in females. New radiographic imaging technologies especially MRI may be considered the gold standard for diagnosing female urethral diverticula. It can provide surgeons with an accurate preoperative understanding of the anatomic condition of the female urethral diverticulum. In addition, complete evaluation of the associated voiding dysfunction such as urinary incontinence can help to accurately and properly treat this disease.
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References


42. Rovner ES, Wein AJ. Diagnosis and reconstruction of the dorsal or circumferential urethral diverticulum. J Urol 2003;170:82–6.


