



Managing female urethral diverticulum with a standardized technique using a pacifier-trick artifice to facilitate dissection

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Abstract

Introduction and hypothesis Managing urethral diverticula is challenging because of recurrence rate and postoperative complications. Herein, we report a standardized, single-institution experience of surgical treatment of urethral diverticula in women.

Methods The medical record of 37 female patients treated for urethral diverticula between 2005 and 2017 in a single institution were reviewed. All patients were operated in a standardized genupectoral position using a technical artifice called the pacifier trick to inflate diverticula throughout the procedure and facilitate its dissection. Symptoms at diagnosis, imaging findings, surgical parameters, postoperative complications, and recurrence rates were collected and are presented.

Results Median age was 39 ± 11 (range 21–67) years. At diagnosis, recurrent urinary tract infections (UTI) (67%), vaginal mass (46%), pelvic pain (43%), dyspareunia (27%), and urinary incontinence (UI) (24%) were the most commonly reported symptoms. Median operative time was 98 ± 31 (range 40–150) min. After a mean follow-up of 1 year, recurrence occurred in one (3%) patient. Immediate de novo postoperative UI decreased from 27% immediately after surgery to 3% after pelvic physical therapy. Pathological analyses found no malignant histology.

Conclusions Surgical management of urethral diverticula in women is technically demanding. With our standardized pacifier-trick technique, satisfying anatomical and functional results were achieved.

Keywords Diverticulum · Urethra · Female · Treatment

Introduction

Urethral diverticulum (UD) is a rare condition. Its prevalence in the general population varies between 0.6 and 6%, with an incidence of 0.02% per year [1–3]. UD is found in ~1.4% of women consulting for urinary incontinence (UI) and accounted for >80% of all periurethral masses [4, 5]. UD is a pocket-like protrusion of the urethral mucosa through the periurethral muscular lining that usually extends between the urethra and the anterior vaginal wall. Continuity with the urethral lumen is maintained by a small opening: the diverticular collar. UD is more frequently acquired than it is congenital [6–8], and urethral trauma during childbirth was reported as a potential risk factor of its development [6].

Treatment of UD consists of a complete diverticulectomy, a precise and delicate surgery in which complete removal of the diverticulum must be associated with minimal damage to surrounding structures. Recurrence, reported to occur in up to 28% of cases; dyspareunia; de novo incontinence; urethral strictures; and the development of fistulas are the main complications of this surgery [1, 6, 9, 10].

To the best of our knowledge, there is no standardized technique to ensure complete dissection the UD and identify the collar, both of which are key points in surgical success. Therefore, we developed a standardized technique that allows complete dissection of the UD with minimal damage to surrounding structures. This technique is based on the pacifier-trick artifice. Herein, we report outcomes and a detailed description of this standardized technique.

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Patients and methods

Medical records of 58 screened patients undergoing diverticulectomy in our institution between February 2005

and February 2017 were retrospectively analyzed. The study was compliant with the Declaration of Helsinki Ethics Conference. Specifically, given the retrospective design of the study, the local ethics committee waived patients' written consent. Indications for diverticulectomy included recurrent urinary tract infections (UTIs), pelvic pain, lower urinary tract symptoms (LUTS) (dysuria, dribbling), pus leakage, and dyspareunia. Exclusion criteria were male patients, significant missing recorded information, operative differential diagnosis, and patients operated in nonstandardized fashion; 21 patients were excluded. Thirty-seven patients with a confirmed diagnosis of UD were operated on in the genupectoral position by one of three surgeons. Preoperative demographics and disease features were age at diagnosis, recent pregnancy, obesity, presenting symptoms, and imaging modalities before final diagnosis. Operative and postoperative outcomes were operative time and operative and postoperative complications (up to 90 days) graded according to the Clavien–Dindo classification [11]. We specifically looked for early complications, such as UTI, hematoma, abscess, and mid- and long-term complications such as fistula occurrence, dyspareunia, de novo SUI, and recurrence of urethral diverticulum with or without reintervention.

Surgical procedure

Patients underwent a complete diverticulectomy using an anterior transvaginal approach. After general anesthesia and intubation were initiated, the patient was placed in the prone, genupectoral position by lowering and bending the leg stands and tilting the table with a strong Trendelenburg. Shoulder pads and a prepubic block were placed to prevent compression. For better exposure, adhesive strips (Elastoplast™, Beiersdorf SAS, France) were placed on both sides of the buttocks and the labia majora to spread open the vulva. The final positioning allowed direct vision on the anterior vaginal wall and better ergonomic work environment for the surgeon (Fig. 1).

We standardized a technical artifice that allowed operative inflation of the UD with methylene blue dye and saline solution, facilitating dissection and collar identification. The artifice was constructed using a 16-F Foley catheter obstructed at its end with a Mersuture™ (polyethylene terephthalate, Ethicon, France) stitch. A sterilized second-generation pacifier (Dodie™, Laboratoires Polivé, Levallois-Perret, France) was inserted on the catheter ~3 cm beneath the balloon seal. A small incision was made in the catheter between the pacifier and balloon. After inserting the catheter in the bladder, the balloon was inflated and the pacifier pushed and maintained under tension to seal the urethral meatus (Fig. 2). This created an adjustable double-balloon-like closed system. A regular injection of the dyed saline solution in the catheter kept the diverticulum full of liquid during the entire procedure to



Fig. 1 Patient positioning in genupectoral position and vulva exposed with adhesives strips

facilitate its dissection and complete removal (Fig. 3). The catheter was clamped to maintain tension and the diverticulum refilled if needed.

The fully irrigated UD was easily located, and a U-shaped anterior vaginal incision was made to allow its dissection. The surgeon was cautious not to open the UD and to preserve adjacent structures (urethra and sphincter). The dissection ended with identification of the collar to complete the excision, leaving the urethra opened. The urethra was then closed with 4-0 PDS™ (polydioxanone, Ethicon, France) discontinuous stitches (Fig. 4). The pacifier artifice was removed and a new Foley catheter inserted. The anterior wall of the vagina was then sutured in different layers. Drains were not usually left unless the dissection was too wide. The vagina was packed with gauze and the patient positioned in the supine position. A suprapubic catheter was inserted to improve bladder drainage and perform a cystography at 2–4 weeks after surgery to ensure a proper micturition and assess urethral anatomy (fistula, remaining UD). The Foley catheter was removed before cystography.

Statistical analyses

Categorical variables are presented as proportions and continuous variables as mean ± standard deviation (SD). Statistical analyses were performed using R 3.0.0 (www.r-project.org).

Results

Demographics and disease characteristics of the 37 study patients are summarized in Table 1. Overall, 17 (46%) patients were referred by a gynecologist. Symptoms at diagnosis were often combined, with 22 (60%) of the patients presenting with at least two symptoms. A quarter of patients had a recent

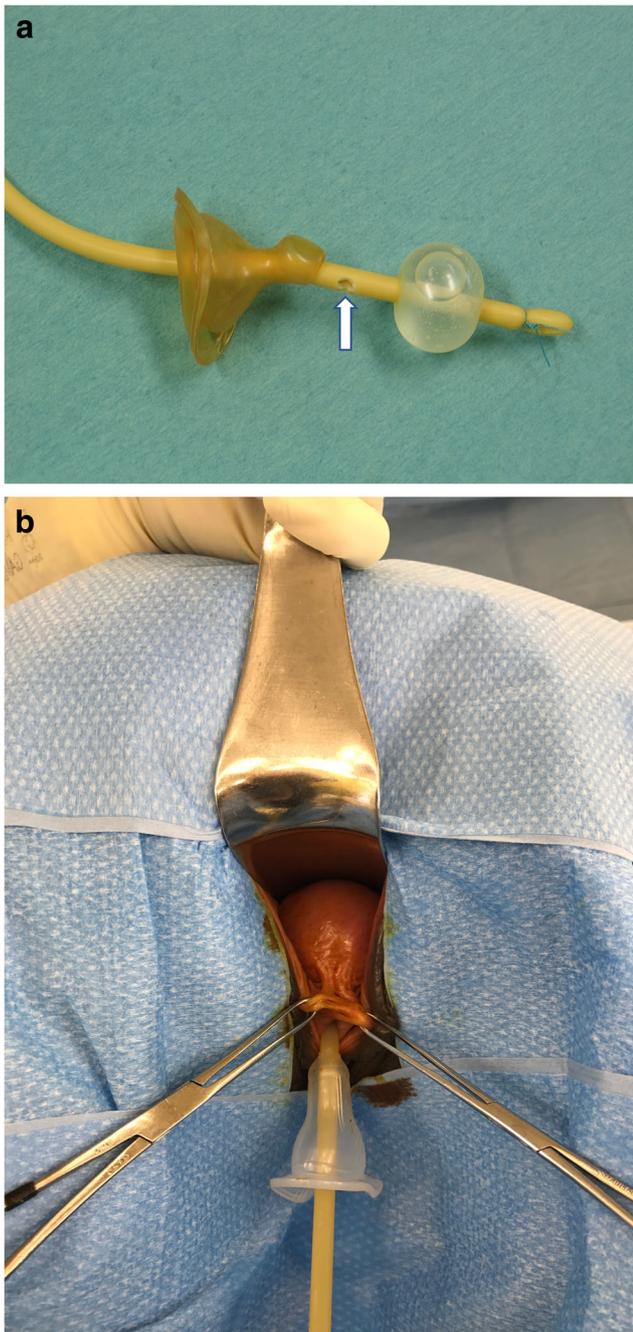


Fig. 2 **a** Pacifier-trick artifact: The urethral catheter is obstructed distally by a stitch. The pacifier is inserted far enough to seal the urethral meatus. The is cut open beneath the balloon (arrow) to allow the diverticulum to be filled during the procedure. **b** The artifact in place

history of pregnancy. Magnetic resonance imaging (MRI) was the most frequently used preoperative imaging modality.

Average operative time was 98 ± 31 (range 40–150) min. There was no reported operative surgical complication. One procedure was canceled because of an anaphylactic shock at anesthesia induction. This patient was excluded from our analysis. The suprapubic and trans-urethral catheterization time was 22 ± 7 and 12 ± 7 days,

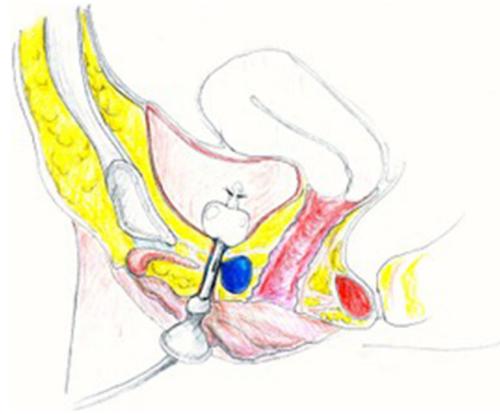


Fig. 3 Perioperative sagittal section of the pelvis depicting the technical artifact in place to fill the diverticulum through the cut on the catheter. The urethra is sealed by the catheter balloon on the bladder side and by the pacifier on the meatus side, creating a closed system including the diverticulum

respectively. Pathological analyses did not report any malignant histology. The 90-day complication rate was 27%, including one (3%) postoperative hematoma, which was surgically drained (grade III), and nine (24%) uncomplicated UTIs successfully treated with antibiotics per os (grade II). Postoperatively, 13 patients (35%) reported UI, of which ten (27%) were de novo. Symptoms included minor SUI ($n=9$, 24%), severe UI with pre-cautious voiding and/or padding ($n=1$, 3%), and urgency ($n=3$, 8%). UI was managed using physical therapy, and anticholinergic drugs when needed. At 1-year follow-up, one patient had persistent de novo incontinence (<3%) (Table 2).

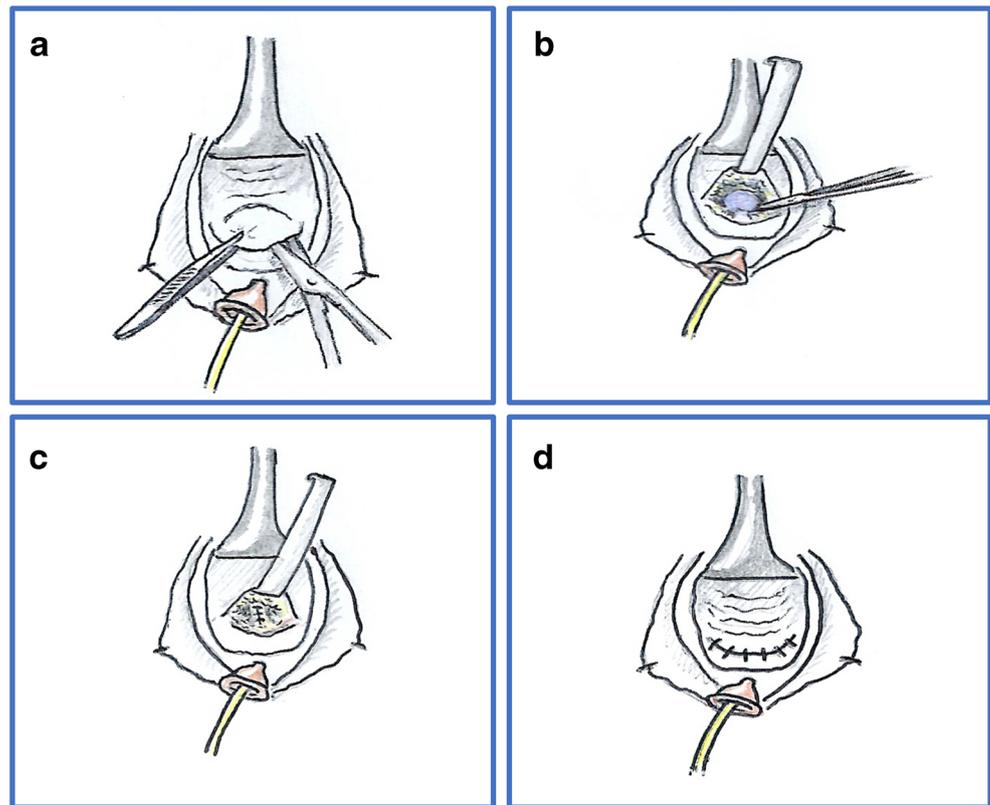
Late complications included dyspareunia and urethral stricture managed, respectively, by intravaginal lubing/analgesics and urethral dilation. One patient reported recurrence. She was not offered surgical repair due to loss of follow-up. There was no reported fistula.

Discussion

We report our experience using a novel, simple, and reproducible surgical approach to facilitate UD dissection using a pacifier-based device.

Surgery remains the sole treatment for UD. Any draining, puncturing, of transvaginal incision can lead to disease recurrence. Ccomplete removal of the diverticulum with excision at the base of the collar is mandatory to ensure favorable outcomes. The transvaginal approach seems to be the most efficient and easy approach, but there is no gold standard technique [6]. Our standardized technique combines two major aspects of the surgery: patient positioning and facilitation of the

Fig. 4 Main procedural steps: **a** The genupectoral position allows excellent visualisation for performing the U-shape incision on the anterior vaginal wall with the pacifier-trick artifice already in place. **b** The diverticulum, continuously filled with the dyed saline, is localized and carefully dissected. **c** After excision of the diverticulum at the level of the collar, the urethra is closed with discontinuous stitches **d** before closure of underlying tissue layers and the vaginal wall



UD dissection with a novel technical artifice. Placing the patient in the genupectoral position appeared to better facilitate surgeon ergonomics than with the patient in a regular gynecological position. This position allows direct visualization of the diverticulum after making the U-shaped incision in the anterior vaginal wall. This could be helpful in complex cases especially (large, circumferential, recurrent diverticula or associated with fistula).

Despite this positioning, these surgical procedures can be challenging in some cases. Therefore, we introduced the pacifier-trick artifice, the aim of which is to keep the UD filled throughout the procedure to better accommodate dissection. The use of dyed saline helps the surgeon to clearly delineate the anatomy of the diverticulum, maximize its complete removal, and decrease the risk of recurrence. The only role of the pacifier itself is to seal the urethral meatus. Closure of the urethral catheter and its puncture allows UD filling. Moreover, crafting this device is easy, reproducible, and did not impact overall operative time (increased of 2–3 min). In addition, sealing was easy in all cases.

The role of the artifice is to facilitate UD dissection, collar identification, and reduce unnecessary substance excision. This helps ensure a limited defect for the reconstruction step and a complete diverticulectomy. In addition, this easy and cheap constructible system is not associated with significant additional procedural costs. Our technique

replicates the principles of the double-balloon catheter used for imaging the urethra. However, it has several advantages. First, it is less costly than the double-balloon catheter. Second, it is easy to use and reproducible. Third, unlike the double-balloon catheter, the distance between the balloon sealing the bladder neck and the pacifier sealing the urethral meatus is not fixed and is adaptable to the anatomy of every patient. Finally, the pacifier is less cumbersome in the surgical field than the balloon and less likely to be accidentally pierced during dissection.

Success was first defined as the absence of UD recurrence. Our results mirror recent publications in terms of recurrence rates [6]. However, after literature examination, it seemed important to extend the definition to functional success, including improvement/disappearance of urinary symptoms. Our immediate results might seem questionable with 27% of the patients having de novo UI. However, after a few months of pelvic physical therapy without further surgery, only one woman had persistent incontinence, which counts for <3% of our cohort. This patient was not reoperated because of the low impact of the incontinence on her quality of life. Our overall percentage of failure is less than in some reports, where the dry rate ranged between 72 and 95% and the de novo incontinence rate was between 15 and 33% with a reintervention rate of ~10% for SUI [12]. Moreover, among the nine patients who presented with

Table 1 Patient demographics and disease characteristics

Characteristics	Statistics
Age, years: mean \pm SD (range)	39 \pm 11 (21–67)
BMI, kg/m ²	
• <25	20 (54%)
• 25–30	13 (35%)
• >30	4 (11%)
Recent pregnancy	9 (24%)
Symptoms	
• Recurrent UTI	25 (67%)
• Vaginal mass	16 (46%)
• Pelvic pain	16 (43%)
• Dribbling	14 (38%)
• Dyspareunia	10 (27%)
• SUI	8 (21%)
• Urgency	4 (11%)
• Dysuria	1 (3%)
Previous UD surgery	
• Diverticulectomy	2 (5%)
• Puncture	4 (11%)
Preoperative imaging	
• Retrograde urethrography	21 (57%)
• MRI	25 (67%)
• Ultrasound	19 (51%)

SD standard deviation, *BMI* body mass index, *UTI* urinary tract infection, *SUI* stress urinary incontinence, *UD* urethral diverticulum, *MRI* magnetic resonance imaging

presurgical SUI and/or UUI, six were completely symptom free after the procedure. Our first-choice strategy was not to surgically treat patients with de novo SUI. We believed the risk of developing complications or recurrence increases with the number of surgeries in the same topographic area. No patient with residual SUI was resistant to physical therapy and required surgical treatment. In such cases, however, the use of autologous nonconcomitant urethral sling has been widely reported [13]. In case of large defects, a Martius flap interposition seems to be a facilitating factor in a two-

step surgical treatment by creating a tissue bed between the sling and vaginal wall [6, 14]. Thus, patient counseling should include the risk of immediate SUI ranging between 30 and 50% following surgery, that most cases with mild symptoms respond to physical therapy, and that surgical treatment for SUI is possible in the worst-case scenario [12]. Malignant tumor arising from UD is a well-known phenomenon (6–9% of cases); none was reported in our series [8, 15, 16].

Our study has several limitations, most of which are inherent to the retrospective design. First, the low number of patients operated in a conventional gynecological position ($n=5$) did not allow us to perform a direct comparison to determine whether patient positioning is a potential confounding factor of outcomes. Therefore, we can draw no conclusions regarding the superiority of this technique over the conventional approach. However, our primary goal was to report an upgraded procedure with technical modifications that we believe are helpful to ensure optimal treatment. Second, the lack of standardized follow-up and the heterogeneity in postoperative data collection for UD is inherent to the low incidence rate of the disease and subsequent scarcity of high-level evidence in the literature. Regarding surgical technique, the need for a suprapubic catheter is questionable. Our primary goal of using the suprapubic catheter was to optimize bladder drainage and limit urine contact within the suture. However, UTI is a concern, and limiting the number of catheters, especially in simple cases, may decrease its occurrence in the postoperative course.

Despite a relatively short follow-up, our results demonstrated the utility of our pacifier-trick artifice to avoid recurrence of and limit de novo SUI. Our technique respects the major principles of UD:

- (1) dissection within proper anatomical tissue planes within the periurethral fascia and tight to the diverticulum;
- (2) complete excision of diverticulum and its neck and ostium;
- (3) water-tight closure of urethra;

Table 2 Postoperative complications

	Type	No. (%)	Clavien-Dindo grade
Early (<90 days)	Hematoma	1 (3%)	3
	Urinary tract infection	9 (24%)	2
Late (>90 days)	Urethral stricture	1 (3%)	3
	Urinary incontinence	13 (35%)	2
	Dyspareunia	1 (3%)	1

- (4) meticulous hemostasis;
- (5) closure of dead space in the dissection bed; and
- (6) multilayer closure.

Conclusion

Owing to the risk of recurrence and fistulas, treating the UD can be challenging. Our standardized technique using the pacifier-trick technical artifice combined with genupectoral positioning of the patient allowed complete diverticulectomy and subsequent satisfying outcomes. In addition to its novelty, it has the advantage of being easily reproducible without significant additional procedural costs or time. Ideally, patients should be referred to tertiary centers with dedicated surgeons, high caseload, and a well-standardized care path.

Compliance with ethical standards

Conflicts of interest None.

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