



Original Article

Role of urodynamics in management of urethral diverticulum in females

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Abstract

Background: Few studies have focused on the urodynamic findings of urethral diverticula (UD). We characterized the symptoms and urodynamic findings in women with UD.

Methods: A retrospective review of all women in a single center having surgical treatment for symptomatic UD between May 2004 and September 2014 was done. Lower urinary tract symptoms were evaluated with International Prostate Symptom Score and Overactive Bladder Symptom Score questionnaires. All patients underwent magnetic resonance imaging and videourodynamic study (VUDS) prior to surgery, and postoperative evaluation with VUDS.

Results: A total of 20 female patients were enrolled into the study. 12 (60%) UD patients presented with symptoms of stress urinary incontinence (SUI). However, there were merely 3 (15%) patients diagnosed as urodynamic SUI. 15 (75%) patients exhibited low catheter-free uroflow. Detrusor overactivity was demonstrated in 4 (20%) patients. Bladder outlet obstruction (BOO) was diagnosed in 8 (40%) cases. Postoperative VUDS revealed persistent BOO in 50% of patients with preoperative BOO. Of these, residual diverticulum was noted by VUDS in one patient.

Conclusion: For UD patients with urinary incontinence or voiding dysfunction, VUDS is helpful in accurately characterizing these symptoms. Copyright © 2017, the Chinese Medical Association. Published by Elsevier Taiwan LLC. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Keywords: Bladder outlet obstruction; Stress urinary incontinence; Urethral diverticulum; Videourodynamic studies

1. Introduction

Urethral diverticula (UD) are known as localized out-pouching of the urethral mucosa into the surrounding non-urothelial tissues.¹ The incidence of urethral diverticula in adult females is estimated to be less than 20 per 1,000,000 (<0.02 percent) per year.¹ Besides, they have rarely been reported in men or in children. The symptoms and signs are very diverse and usually not typical.² It could be asymptomatic or incidental findings on a physical examination or radiologic

images. The classic presentation “3 D's” are described as post-voiding dribbling (4–31%), dysuria (9–55%), and dyspareunia (6–24%).³ However, other common symptoms and signs include painful vaginal masses associated with post-micturition incontinence, urinary incontinence (35–39%), frequent urinary tract infections (9–61%), stones, and tumors.⁴

The diagnosis and complete evaluation of UD can be done with a combination of a complete history, physical examination, endoscopic examination of the bladder and urethra, and selected radiologic imaging.⁵ T2-weighted postvoid magnetic resonance imaging (MRI) is the most accurate method of diagnosis for UD with sensitivity and specificity both approaching 100%. Videourodynamics (VUDS) is diagnostic in 62–95% of patients. It also provides additional information regarding significant voiding dysfunction or stress urinary incontinence (SUI), which is present in up to 49% of cases.⁵

Conflicts of interest: The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

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To my knowledge, few studies have focused on the urodynamic findings of UD. In the present study, we evaluated the symptoms and urodynamic characteristics of UD.

2. Methods

A retrospective case note review of all women in a single center having surgical treatment for symptomatic UD between May 2004 and September 2014 was performed. The study was reviewed and approved by the ethics committee of our hospital (IRB number: TPVGH-IRB 2015-11-002AC). All patients were interviewed for their detailed personal and medical history. Lower urinary tract symptoms (LUTS) were evaluated with International Prostate Symptom Score (IPSS) or Overactive Bladder Symptom Score (OABSS) questionnaires. The IPSS questionnaires composed of urine storage-related and micturition-related symptoms. A subtotal score for question 1 (incomplete emptying), question 3 (intermittency), question 5 (weak stream), and question 6 (straining) was designated as the voiding subscore. A subtotal score for question 2 (frequency), question 4 (urgency), and question 7 (nocturia) was designated as the storage subscore.

All patients underwent MRI prior to surgery which provided information on location, number, size and configuration of the diverticula.

All patients underwent videourodynamic study (VUDS) before surgery and one month afterwards. The purpose of postoperative VUDS was to evaluate the residual UD and the change of voiding dysfunction. VUDS was performed with the patient in the sitting position. Abdominal pressure was measured using a 24F rectal balloon catheter. Intravesical pressure was determined using an 8F transurethral catheter in preoperative evaluation and an 18 F suprapubic catheter indwelled during diverticulectomy in postoperative evaluation. Filling cystometry was performed at a filling rate of 30 ml/min. Bladder outlet obstruction (BOO) was defined as radiographic evidence of obstruction between the bladder neck and distal urethra in the presence of a sustained detrusor contraction of any magnitude, as demonstrated by VUDS (Fig. 1).⁶ Urodynamic SUI was defined as the involuntary leakage of urine during increased abdominal pressure, in the absence of a detrusor contraction.⁷ Low catheter-free uroflow was defined as mean flow rate < 10 ml/s and maximum flow rate < 20 ml/s.^{8,9}

We characterized the symptoms and urodynamic findings in women with UD by descriptive statistics.

3. Results

A total of 20 female patients were enrolled into the study. Of these, 8 had simple UD, 9 had horseshoe-shape UD and the rest were diagnosed as circumferential UD. The mean age of the patients was 47.7 ± 8.3 years (range 28–63). Five women had been operated on previously for a UD at other institutions. Two women had undergone needle aspiration for suspected intravaginal cyst at other institutions. A further 4 women had previous genitourinary surgeries, including sling surgery ($n = 2$) and hysterectomy ($n = 2$).

Storage symptoms followed by (in order of prevalence) dysuria, anterior vaginal wall mass, stress incontinence and obstructive voiding symptoms were the most common presenting symptoms associated with urethral diverticula (Table 1). Mean scores for the questionnaires relating to LUTS severity were given in Table 2.

Eight patients underwent VUDS first to investigate urinary incontinence or obstructive voiding symptoms. 87.5% ($n = 7$) of the urodynamics diagnosed the diverticulum, and then pelvic MRI were performed for further evaluation. In cases clinically suspicious for UD, the MRI scan was performed first in 12 UD patients who received VUDS later for pre-operative evaluation. In general, VUDS was diagnostic in 90% ($n = 18$) of UD patients.

The urodynamic characteristics among UD patients were listed in Table 3. High detrusor pressure at maximum flow rate and low catheter-free uroflow rate which indicated the possibilities of BOO were observed in UD patients. Voiding cystourethrography adequately demonstrated the diverticulum in 18 of the 20 women (90%). 15 (75%) patients exhibited low catheter-free uroflow. Detrusor overactivity was demonstrated in 4 (20%) patients. BOO was diagnosed in 8 (40%) cases. There were merely 3 (15%) patients diagnosed as urodynamic SUI and all of them were simple UD.

7 (35%) of UD patients underwent diverticulectomy had residual diverticula shown on postoperative VUDS. Two of the UD patients with urodynamic SUI underwent urethral diverticulectomy along with concomitant suburethral sling using synthetic polypropylene mesh. The symptoms of SUI resolved in all after surgery and there were no postoperative complications. Nevertheless, the other one urodynamic SUI patients resolved as well without concurrent sling surgery. One patient (5.9%) developed de novo SUI during the follow-up period of 12.7 ± 10.6 months (range 0.6–33.8). Postoperative VUDS revealed persistent BOO in 50% of patients with preoperative BOO. Of these, residual diverticulum was noted by VUDS in one patient.

4. Discussion

In the present study, 12 (60%) UD patients presented with symptoms of SUI. However, there were merely 3 (15%) patients diagnosed as urodynamic SUI. A misunderstanding about post-micturition incontinence might be the cause. Classic SUI patients typically do not have SUI immediately following bladder emptying. Dribbling incontinence from intermittent diverticulum emptying in the urethra is part of the classic triad of clinical presentation. Nevertheless, SUI may coexist with UD which could result in stress incontinence all the time, both immediately after voiding and when the bladder is full. Differential diagnosis of the SUI from intermittent diverticulum emptying may be remarkably difficult without VUDS.¹⁰ In a small series of 14 patients who underwent diverticulectomy, 8 (57.1%) had symptoms of SUI and 7 of them were confirmed urodynamically.¹¹ In another series of 63 women, 39 (61.9%) had urinary incontinence as a presenting symptom, and genuine SUI was

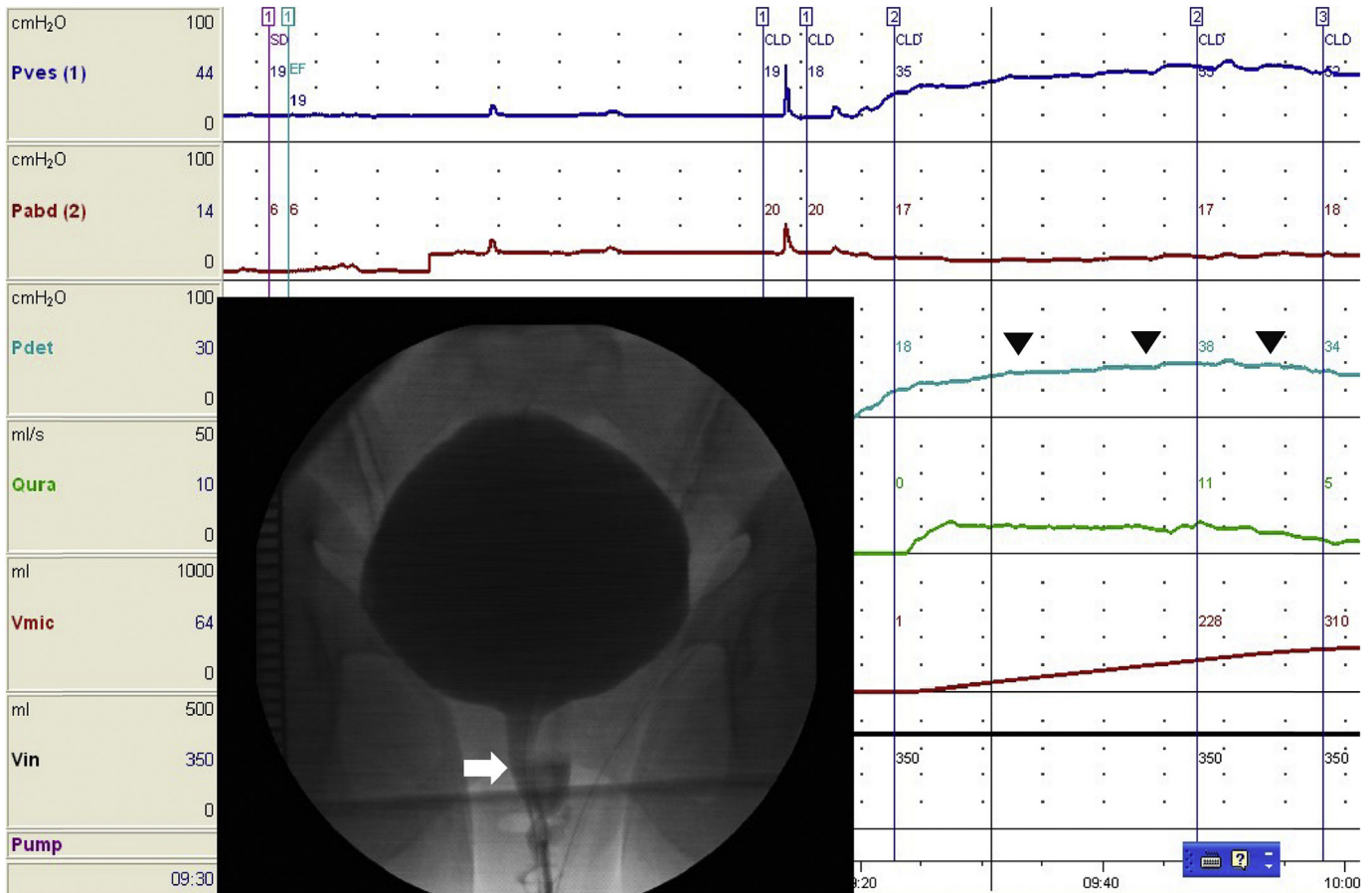


Fig. 1. Voiding videocystometrograms showed urethral diverticulum with radiographic evidence of obstruction at mid-distal urethra (arrow) in the presence of a sustained detrusor contraction (arrow heads), which compatible with bladder outlet obstruction.

Table 1
Symptoms experienced at presentation displayed as a percentage.

Symptom at presentation	Patients, n (%)
Irritative voiding symptoms	18 (90%)
Dysuria	13 (65%)
Anterior vaginal wall mass	12 (60%)
Stress urinary incontinence	12 (60%)
Obstructive voiding symptoms	12 (60%)
Urge urinary incontinence	3 (15%)
Postvoid dribbling	2 (10%)

Table 2
Questionnaires evaluation.

IPSS	Score
Frequency	3.6 ± 1.1
Urgency	1.9 ± 1.1
Nocturia	2.6 ± 1.0
<i>Storage subscore</i>	8.1 ± 1.4
Weak stream	2.5 ± 1.5
Intermittency	2.9 ± 1.6
Strain	1.7 ± 0.6
Incomplete empty	3.5 ± 2.0
<i>Voiding subscore</i>	10.6 ± 4.4
<i>Total score</i>	19.4 ± 5.9
Quality of life	4.2 ± 1.4
OABSS	Score
Frequency	1.3 ± 0.4
Nocturia	1.9 ± 0.6
Urgency	2.2 ± 1.0
UUI	1.5 ± 0.9
<i>Total score</i>	6.9 ± 2.0

IPSS: International Prostate Symptom Score; Overactive Bladder Symptom Score; UUI: urge urinary incontinence.

diagnosed in 28 out of 58 patients who underwent urodynamic studies.¹² Therefore, VUDS is important to evaluate the continence status. Additionally, the need for extensive surgical dissection during a diverticulectomy may convert asymptomatic or occult SUI into gross postoperative SUI.¹³ Urethral diverticulectomy may also unmask occult SUI by removing an obstructive diverticulum.¹⁴ In our study, one patient (5.9%) developed de novo SUI. De novo SUI has been reported in as many as 50% of patients in some series; however, most authors report de novo SUI in a much lower percentage of patients (8–29%).⁵ The results reveal that

Table 3
Urodynamic results.

Urodynamic parameter	Mean \pm SD
Filling phase	
First desire (ml)	165.7 \pm 69.9
Cystometric capacity (ml)	282.5 \pm 73.8
Voiding phase	
PdetQmax (cmH ₂ O)	33.5 \pm 10.7
PVR (ml)	24.7 \pm 22.8
Uroflowmetry	
Volume (ml)	206.4 \pm 91.3
Qmax (ml/s)	16.4 \pm 5.9
Qmean (ml/s)	7.7 \pm 3.2
Urodynamic diagnosis	
Patients, n (%)	
Detrusor overactivity	4 (20%)
Bladder outlet obstruction	8 (40%)
Urodynamic SUI	3 (15%)
Low catheter-free uroflow rate	15 (75%)

PdetQmax: detrusor pressure at maximum flow rate; PVR: post-void residual; SUI: stress urinary incontinence.

determining the continence status before the operation for UD is important.

For the three patients with UD and urodynamic SUI, we performed concomitant suburethral sling using synthetic polypropylene mesh in two and treated another one with only diverticulectomy depending on individual patient's preferences. The symptoms of SUI resolved in all after surgery and there was no postoperative complications. Several authors described successful concomitant repair of UD and SUI with needle suspension or autologous fascial pubovaginal slings, without increasing the risk of postoperative infection.¹⁵ Pre-existing SUI resolves after excision of UD alone in 50–100% of women and resolution of SUI was noted in 78% of patients with simultaneous anti-incontinence surgery.^{5,16} In order to avoid overtreatment, most surgeons suggest initial excision of the UD and subsequent reassessment of symptoms before proceeding with anti-incontinence surgery if it is indicated.⁵ Our group have reported on three patients with UD and SUI who underwent diverticulectomy along with suburethral sling using synthetic mesh.¹⁷ With a mean follow up of 33.3 months, there was no infection or exposure of synthetic mesh tape. In patients with UD and SUI, suburethral sling using synthetic mesh might be as effective and safe as facial sling in selected patients.

In our series, 60% presented with obstructive voiding symptoms, 75% had low catheter-free uroflow rate, and 40% was diagnosed as BOO. Ganabathi et al. showed that about 4% of female UD cause urinary retention.¹² Groutz et al. found that 3% of female BOO, which was defined as maximum free flow rate <12 ml/s and detrusor pressure at maximum flow >20 cmH₂O, were caused by UD.¹⁸ Theoretically, obstructive voiding might be secondary to the obstructive or mass effects of UD on the urethra. In our study, postoperative VUDS revealed persistent BOO in 50% of patients with preoperative BOO. Of these, residual diverticulum was noted by VUDS in only one patient. It seems that obstructive voiding is not totally dependent on the obstructive effects of UD on the urethra.

Haylen et al. reported that 20% of patients identified a urinary tract infection as the cause of pelvic floor dysfunction.¹⁹ Pelvic floor dysfunction might cause BOO. UD have been historically attributed to recurrent infection of the periurethral glands with sequential obstruction, suburethral abscess formation and subsequent rupture of these infected, enlarged glands into the urethral lumen. Additionally, 30% of UD patients in our series had the history of recurrent urinary tract infection. UD-related urinary tract infection might cause pelvic floor dysfunction which might result in BOO.

The most recommended treatment of UD is transvaginal surgical excision via an anterior vaginal wall inverted U or midline incision, with excision of the diverticulum and three-layer closure with or without a Martius labial fat pad.⁵ It is challenging because of the difficulty defining tissue planes between the urethra and the diverticulum.²⁰ Faerber et al. reported all 16 who underwent urethral diverticulectomy had symptomatic resolution at a mean follow-up of 25 months but 2 (12%) had small, stable residual diverticula.²¹ Reeves et al. noted that 3 out of 89 (3.4%) patients had a recurrent residual diverticulum following surgery.²² In the present study, seven patients (35%) had residual diverticula after diverticulectomy shown by VUDS. Risk factors affecting surgical success have been mentioned: purulent content, large size, proximal location, horseshoe shape, delayed diagnosis, and previous urethral surgery.²³ Of the seven patients with residual diverticula in our study, five presented with frequent urinary tract infection, four had received diverticulectomy before, four patients had complex UD, and one had received sling surgery before. These factors influenced the successful rate of diverticulectomy in our studies.

There are many inherent limitations to a retrospective review of an unusual condition. This is a small sample size from a single institution. We didn't have complete information regarding the subjective score of symptoms postoperatively and long-term consequences. Despite these limitations, few studies have focused on the urodynamic findings of UD and this study presented detailed urodynamic characteristics in female patients with UD.

In conclusion, female UD present with an array of nonspecific lower urinary tract symptoms. For UD patients with urinary incontinence or voiding dysfunction, VUDS is helpful in accurately characterizing these symptoms. 15% of UD patients accompany with SUI. 75% suffer from low uroflow and 40% have evidence of BOO.

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