
Characterization of urethral diverticula in males

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Introduction: Urethral diverticulum in a male is a rare entity and the literature is limited to case reports and small case series. The aim of our study is to characterize this disease in patients from three Mayo Clinic locations.

Materials and methods: Chart analysis was performed of patients across all three Mayo Clinic sites that had International Classification of Diseases (ICD) codes corresponding to urethral diverticulum or urethral diverticulectomy via CPT code. Data were available for patients that were seen from 6/1/2003 through 10/5/2018. Patients were classified by age, etiology, presenting symptomatology, location, treatment, pathology, and postoperative outcomes.

Results: A total of 87 men met the initial search criteria with 52 having documented urethral diverticula. The most common presenting complaint in these men was incontinence (37%). The majority of diverticula (83%)

were within the anterior urethra. The most common diagnostic modalities were retrograde urethrogram (46%) and cystoscopy (50%). Most diverticula were iatrogenic (77%). Of the men that were diagnosed, 42% went on to have diverticulectomy. Median follow up was 1.5 years. Eighteen percent of patients had persistent urinary symptoms following diverticulectomy with incontinence being the most common finding. Postoperative complications were experienced by 26% patients with the most prevalent complication being urethrocutaneous fistula. The patients who did not undergo diverticulectomy either had other surgical procedure to manage their coexisting conditions or were managed medically.

Conclusion: Urethral diverticulum in males is a rare yet important entity that requires special consideration, especially in those who have had prior surgery within the lower urinary tract.

Key Words: urethra, diverticulum, diverticula, reconstruction

Introduction

Male urethral diverticulum is a rare condition that is not well defined. Because it is rare, the current

knowledge on this disease process is based on case reports and small case series.^{1,2} A urethral diverticulum is an outpouching of the urethra that forms a saccular defect whose urothelial lining is continuous with the true urethra. These defects can vary in size, position, and caliber of the opening of the diverticulum. Many of the symptoms associated with this disease are due to urinary stasis and poor drainage of the saccular defect. A wide variety

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of presenting symptoms are described in various case reports including incontinence, urethral stone, urinary retention, penoscrotal or perineal mass, and recurrent infections.^{1,4,6,7} In many cases, patients are completely asymptomatic.

The common etiologies of diverticulum are congenital, traumatic, and iatrogenic. Up to a third of cases are estimated to be congenital.³ Of the iatrogenic etiologies, causes include prior urologic surgery such as urethroplasty, direct visualization internal urethrotomy, hypospadias repair, and artificial urethral sphincter and non-surgical causes such as radiation, penile clamp use, and prolonged catheterization.^{4,6,8,9} Throughout the literature, many different diagnostic studies including magnetic resonance imaging (MRI), cystoscopy, retrograde urethrogram (RUG), and ultrasound are used. Physical exam may be normal despite presence of diverticulum.² Once diagnosed, there is not one uniform approach to treatment. Male urethral diverticula vary in size, location, and symptomatology which direct treatment options based on feasibility, effectiveness, and need for intervention. The most common techniques described include non-operative management, diverticulectomy, endoscopic treatment, and urinary diversion.^{1,2,5} Previous studies have described low recurrence rate of only 8%-9% after diverticulectomy, though these are again based on a small studies.^{4,10}

The goal of this study is to provide further insight into this disease process. Specifically, this study adds to the current information on prevailing symptomatology, anatomic location, etiology, management, follow up, and complications after diverticulectomy, and it also provides new insight into common tools for diagnosis. To our knowledge, this is the largest study of male diverticula at this point in time.

Materials and methods

Data from Mayo Clinic sites in Minnesota, Florida, and Arizona were accessed using electronic health record. ICD-9 code 599.2 and ICD-10 code N36.1 were used to capture patients with a diagnosis of diverticulum. A further search was performed using the CPT code for urethral diverticulectomy, 53235. Chart review was performed on patients who met the above criteria and were seen at a Mayo Clinic campus between 6/1/2003 and 10/5/2018. Patients were omitted from study if they did not have urethral diverticulum documented elsewhere in their record. Of the patients who met criteria, data collected included age, etiology of diverticulum, presenting symptoms, location of diverticulum, treatment, pathology, and postoperative outcomes.

Results

The initial search based on ICD codes and CPT code yielded 87 men. Fifty-two of these men had documented urethral diverticula. See Table 1 for patient characteristics. Age at time of diagnosis ranged from 1 day old to 85 years old. Median age was 55 years. The three most common symptoms were incontinence (37%), infectious symptoms (23%), and obstructive symptoms (19%). Less common symptoms included ballooning of the penis with urination (10%), hematuria (8%), and pain (4%). Eight percent of men were asymptomatic or had diverticulum found incidentally.

The diagnostic modalities used for diverticulum were radiographic studies, cystoscopy, physical exam, and urodynamics (UDS). The majority of patients had a combination of studies to diagnose their diverticulum. See Table 2 for data. The two most common modalities

TABLE 1. Patient characteristics

| Presenting symptom | Percentage |
|------------------------------------|------------|
| Incontinence | 37% |
| Infectious | 23% |
| Obstructive | 19% |
| Other ^a | 12% |
| Ballooning of penis with urination | 10% |
| Incidental finding/asymptomatic | 8% |
| Hematuria | 8% |
| Pain | 4% |
| Location of diverticulum | Percentage |
| Anterior | 83% |
| Posterior | 17% |
| Etiology | Percentage |
| Iatrogenic | 77% |
| Urethroplasty | 19% |
| AUS complication | 17% |
| Hypospadias repair | 17% |
| Urethral stricture treatment | 12% |
| Other ^b | 12% |
| Trauma | 10% |
| Congenital | 8% |
| Unknown | 6% |

^aother includes: urethral stones, catheter erosion, intersex disorder, splitting of stream; ^bother iatrogenic causes included bladder neck contracture procedures, other congenital urethral surgeries, pelvic exenteration, chronic indwelling catheter, and radiation

used alone to diagnose diverticulum were cystoscopy (25%) and RUG (19%). Within the study population, RUG, VCUG, MRI, CT/PET and cystogram were used for diagnosis in 63% of patients. Percentages of patients who underwent each radiographic testing modality alone or in combination with other studies are as follows: RUG 46%, VCUG 10%, MRI 10%, and other 4%. Cystoscopy was used in 50% of patients. Physical exam was helpful in diagnosis in 12% of patients and UDS was used in 4% of patients.

Location, etiology, management, and follow up data were also collected. Anterior urethral diverticula were seen in 83% of patients, Table 1. Iatrogenic cause was the documented etiology in 77% of patients, Table 1. Further analysis of the iatrogenic category revealed most common causes were prior urethroplasty (19%), AUS complication (17%), prior hypospadias repair (17%), and prior surgical urethral stricture management (12%).

TABLE 2. Common diagnostic modalities for diverticulum

| Type of evaluation | Percentage |
|---------------------------------------|------------|
| Radiographic | 63% |
| RUG alone | 19% |
| RUG total | 46% |
| VCUG alone | 4% |
| VCUG total | 10% |
| MRI alone | 4% |
| MRI total | 10% |
| Other ^a alone | 4% |
| Other ^a total | 4% |
| Cystoscopy | |
| Alone | 25% |
| Total | 50% |
| Physical exam | |
| Alone | 2% |
| Total | 12% |
| Urodynamics | |
| Alone | 0 |
| Total | 4% |
| Intraoperative diagnosis ^b | 23% |
| Unknown ^c | 2% |

^aother radiographic studies used included 1 PET/CT and 1 cystogram; ^b3 were found during intraoperative cystoscopy and 3 during urethral dissection; ^cpatient had documented diverticulum with repair based on outside records but no detail of diagnostics modalities; RUG = retrograde urethrogram; VCUG = voiding cystourethrogram; MRI = magnetic resonance imaging

TABLE 3. Treatment of male urethral diverticulum

| | Percentage |
|--------------------|------------|
| Surgical | |
| Diverticulectomy | 42% |
| Ileal conduit | 8% |
| SPT placement | 4% |
| Other ^a | 21% |
| Non-operative | 21% |
| Unknown | 4% |

^atreatment included surgical management for coexisting problems such as direct visual internal urethrotomy (DVIU), photoselective vaporization of prostate (PVP), urethrostomy, incision of diverticulum, bladder neck closure with suprapubic tube (SPT) placement, urethral dilation

Other etiologies are as follows: trauma 10%, congenital 8%, and unknown 6%. Several patients were felt to have multiple contributing etiologies. With regards to management, Table 3 shows the full breakdown of management types in this patient population. The most common management was diverticulectomy which 42% of patients underwent. Pathologic analysis showed 0 patients with malignant changes to tissue. One patient's surgical specimen showed abscess. Of the 22 patients who had diverticulectomy, 4 (18%) had persistent urinary symptoms postoperatively. Six patients (18%) had complications; 4 patients had urethrocutaneous fistula, 1 patient required explant of artificial urinary sphincter, and 1 patient had recurrence, Table 4. After diverticulectomy, follow up ranged from 2.5 months to 12 years (median: 1.5 years). Of the subset who did not undergo diverticulectomy, 31% underwent

TABLE 4. Postoperative symptoms and complications in 22 out of 52 patients who underwent diverticulectomy

| | Percentage |
|--|------------|
| Persistent postoperative urinary symptoms ^a | 18% |
| Complications | |
| Urethrocutaneous fistula | 17% |
| Recurrence | 4% |
| Artificial urinary sphincter explantation | 4% |
| Total | 26% |

^apersistent symptoms in patients without complication or recurrence

other surgical procedure, 21% underwent medical management, and 4% were lost to follow up. Alternative surgical procedures for diverticulum or other coexisting condition included suprapubic tube placement, urethral dilation, direct visualization internal urethrotomy, photoselective vaporization of prostate, urethrostomy, bladder neck closure, urethrectomy, and ileal conduit +/- cystectomy. Patients who proceeded with medical management either were asymptomatic or mildly bothered or were poor surgical candidates.

Discussion

Our study identified 52 men who met criteria of having a urethral diverticulum. Presenting symptoms of incontinence, infection, obstructive voiding symptoms, ballooning of penis with urination, hematuria, and pain. Incontinence was the most common. These symptoms are well represented in published case reports and incontinence was also described as the most common symptom in a paper by Cinman et al evaluating 22 men with urethral diverticulum.⁴ Incontinence in these patients is often described as post-void dribbling though stress urinary incontinence has also been described.¹¹ Infectious symptoms were the second most common presenting symptom in this population and have been previously described as the most common symptom in other studies.¹⁰

When looking at anatomic location of diverticulum and etiology, our data followed expected trends. The majority of diverticulum in this study were anterior (83%). Within the current literature, the vast majority of male urethral diverticulum are located anteriorly. Posterior urethral diverticulum represent only a small subset of this disease process and are often associated with prior rectal surgeries for congenital defects such as imperforate anus.¹² With regards to etiology, only 8% of patients within this study had congenital diverticulum. Various studies report that up to one third of male urethral diverticulum may be congenital, though most agree that acquired causes are much more common.^{3,4} Iatrogenic causes were the most common, and surgical causes (prior urethroplasty, AUS, hypospadias repair, stricture treatment) represented the majority. This mirrors the data from Cinman et al who cite trauma and non-surgical iatrogenic causes such as radiation or prolonged catheterization as less frequent etiologies.⁴

Diagnosis of diverticulum was made using radiographic studies, cystoscopy, and urodynamic studies. The majority of patients (63%) had a radiographic study, with RUG being most common (46%). RUG was the only diagnostic study used

in 17% of men. Other studies have described RUG as the gold standard for diagnosis of male urethral diverticulum.⁸ Our data show that RUG is commonly used and often sufficient on its own to diagnose male urethral diverticulum. The second most common modality used was cystoscopy. This was used in 50% of patients and a total of 25% of patients underwent cystoscopy alone for diagnosis. In review of the literature, there is not a single diagnostic algorithm used for diverticulum. This is likely due to the rareness of this disease process and need for very high suspicion to do a focused male urethral diverticulum work up. Diagnostic approach generally follows typical pathway for evaluation of the patient's symptoms.

The patients in this study fell into three main treatment groups: diverticulectomy, other surgical management, and medical management. A total of 42% of patients underwent diverticulectomy. These patients were followed for a median of 1.5 years (range 2.5 months to 12 years). Other studies have shown a median follow up of 2.5 years in patients post diverticulectomy (range 1.5 months to 11 years).⁴ Our research did not evaluate the types of techniques used for diverticulectomy within this population. However, two studies by Cinman et al and Alphs et al describe similar techniques of resection with primary end to end anastomosis in smaller defects of < 3-4 cm and resection with urethral replacement from local flap or onlay graft for larger diverticula > 3-4 cm.^{4,10} Next, data on complications was analyzed revealing a complication percentage of 26% with the most common being urethrocutaneous fistula (17%). Other observed complication included explantation of AUS. Complications described in other studies include febrile urinary tract infection, urinary retention, and epididymo-orchitis.^{4,10} The recurrence percentage based on our data is 4% which is slightly lower than the percentages of 8%-9% cited in other studies.^{4,10} Despite these low recurrence percentages, 18% in this study without complications or recurrence had persistent urinary symptoms after diverticulectomy. When looking at other surgical management options, ileal conduit was performed in 8% of patients. None of these patients had urethral diverticulum alone and had coexisting severe stricture disease, eroded or infected AUS, contracted bladder, or other. In these cases, a large surgical procedure was undertaken to treat the combination of conditions present.

Conclusion

This is the largest study known to date of male urethral diverticulum. This data confirms that the majority

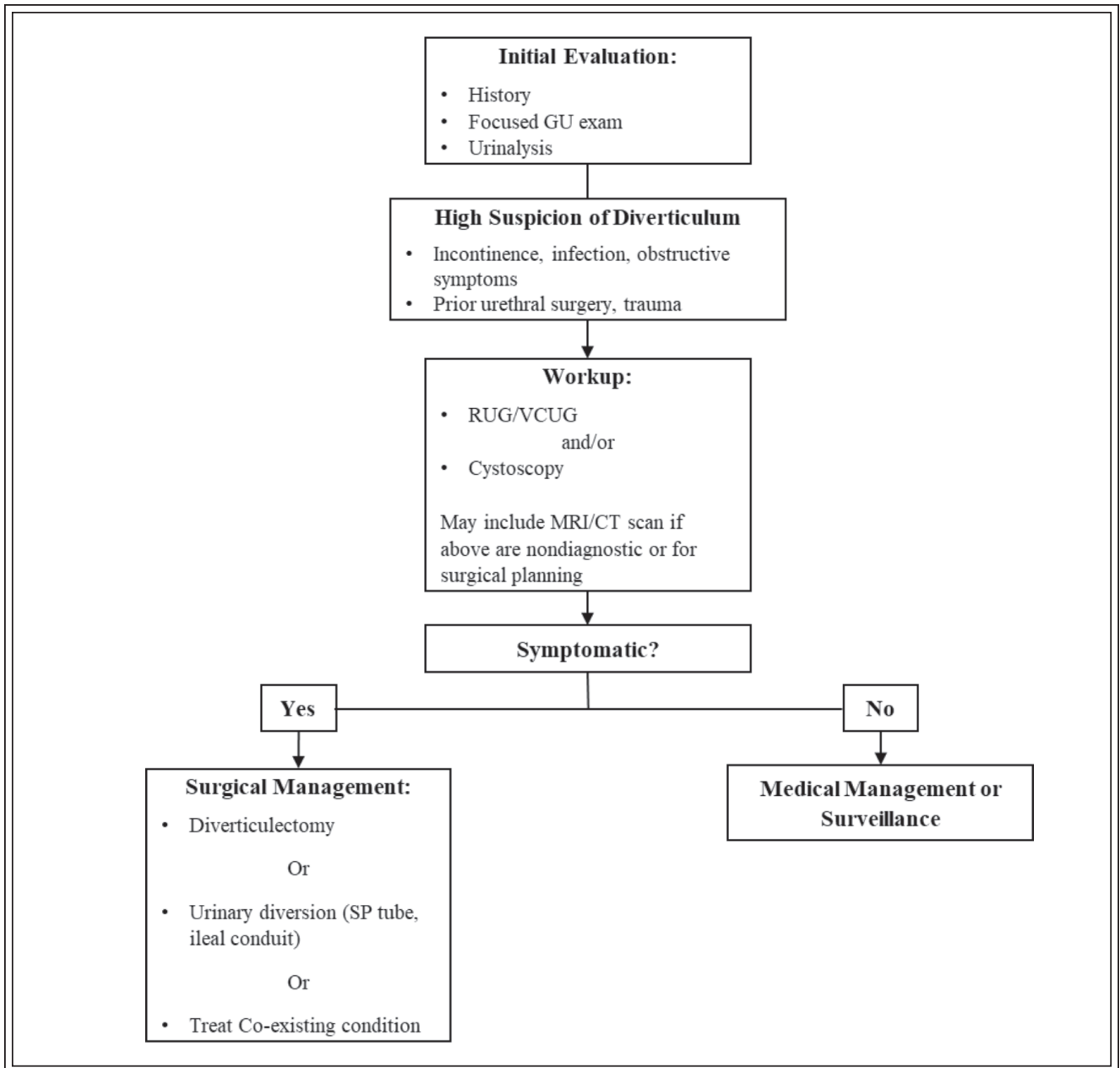


Figure 1. Male urethral diverticulum treatment and management.

of men have incontinence or other urinary voiding symptoms, they are typically located anteriorly, and iatrogenic causes are most common. RUG and cystoscopy are the most commonly used diagnostic modalities, either alone or in combination. Treatment options vary based on presence of bothersome symptoms, surgical candidacy, and other coexisting conditions that would benefit from separate operation. When diverticulectomy is performed, recurrence is low. However, the data from this study suggested

complications occur in about a quarter of patients with the majority of these complications being urethrocutaneous fistula. The results of our findings are visually represented in the management and treatment algorithm seen in Figure 1.

Limitations of this study include the low number of patients, lack of complete data on all subjects, and short follow up in some cases. Despite this being a large study on this disease process, there were still only 52 men included. Four percent of these patients were lost

to follow up and treatment modality unknown. Of the men who underwent diverticulectomy, 32% followed up for less than a year postoperatively meaning the rates of complications and recurrence may be under represented. □

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