Flexible Cystoscope for Evaluating Pelvic Fracture Urethral Distraction Defects

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Key Words

Pelvic fracture urethral distraction defects • Flexible cystoscope • Image analysis • Diagnosis

Abstract

Objective: To describe the value of flexible cystoscopy versus conventional urethrography (retrograde urethrography and cystourethrography) in diagnosing pelvic fracture urethral distraction defects (PFUDDs). **Patients and Methods:** Between May 2010 and June 2011, 120 male patients with PFUDDs were evaluated. In this study, all patients underwent conventional urethrography after admission. Flexible cystoscopy was also used for comparison, followed by conventional urethrography. The flexible cystoscope was introduced into the posterior urethra and the area was evaluated for the length of the proximal urethra and any possible fistulas, false passages, calculi or displacement of the posterior urethra. **Results:** Severe allergic reaction or obvious discomfort did not occur in any patients after conventional urethrography or flexible cystoscopy. By comparing the data obtained from flexible cystoscopy to those from conventional urethrography, no statistical difference was found in the measured length of the proximal posterior urethra (4.31 ± 2.28 vs. 4.02 ± 3.12 , $p > 0.05$). However, the rate of detection in other abnormalities was higher in flexible cystoscopy than in conventional urethrography (48.3 vs. 10.8%, $p < 0.05$).

Seventeen (14.2%), 9 (7.5%) and 32 (26.7%) patients were detected with fistula, false passage and calculus, respectively, according to flexible cystoscopy. In comparison, fistula, false passage and calculus were only observed in 2 (1.7%), 7 (5.8%) and 4 (3.3%) patients, respectively, through conventional urethrography imaging. **Conclusions:** Flexible cystoscopy is a valuable procedure in the evaluation of the posterior urethra and bladder neck, and in patients with urethral distraction defects before surgery. More details about fistulas, false passages, calculi and urethral defects could be obtained through this method.

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Introduction

The majority of posterior urethral strictures result from pelvic fracture, and are known as pelvic fracture urethral distraction defects (PFUDDs). The most frequent point of distraction is at the level of the junction of the membranous and bulbospongiosus parts of the urethra [1]. The management of PFUDDs remains one of the most difficult tasks in urologic practice, particularly in cases of complex PFUDDs, which represent 5% of all urethral distraction defects. They are characterized by a stricture gap exceeding 3 cm, previous failed repair, rectourethral fistulas, periurethral cavities and false passag-

Fig. 1. Cystoscope is advanced until obliterative urethral stricture is encountered.

Fig. 2. The obliterative view from the bladder neck showing the verumontanum (arrow).

es. Defining the precise anatomy of the distraction defect is important in repairing any subsequent stricture. In all of these factors, the length of the proximal urethra is very important and dictates the ease or difficulty of surgery. Therefore, prior to surgery, knowledge of the length of the proximal urethra is of very high value.

There are a number of different techniques that may be used in imaging the male urethra. The most widespread methods include retrograde urethrography (RUG) and voiding cystourethrography (VCUG). Accurate diagnosis of stricture presence, number, location and length is of paramount importance in planning appropriate treatment. Although RUG and VCUG are often sufficient for this purpose, this is not always the case in certain complex situations, such as the evaluation of rectourethral fistulas, the periurethral tissues or false passages. In such circumstances the proximal urethra is not visualized on voiding cystography, meaning RUG and VCUG cannot achieve the desired diagnostic purposes. Recently, flexible cystoscopy has evolved to become an important component of urologic practice owing to its diagnostic and treatment capabilities. However, reports about the feasibility of this technique for diagnosing post-traumatic complex posterior urethral distraction defects are limited. We tried to describe the value of flexible cystoscopy in diagnosing PFUDDs, in particular focusing on the length of the proximal urethra and any associated pathology.

Patients and Methods

Between May 2010 and June 2011, 120 male patients with PFUDDs were evaluated. The mean patient age was 32.8 years (range 16–55 years). Ninety-two patients sustained injury as the result of a motor vehicle crash and 28 as the result of crush injury. These patients underwent diagnostic antegrade flexible cystos-

copy under a light sedation after an average of 6 months following the trauma. All patients had an indwelling suprapubic catheter. The diagnostic procedure was fully instructed to the patients and informed consent was obtained. We routinely performed simultaneous VCUG and RUG as well as antegrade flexible cystoscopy in all patients.

Imaging Examinations

RUG Combined with VCUG. Two hundred to five hundred milliliters of iodinated contrast material was instilled into the bladder through the suprapubic cystostomy catheter to the patient's tolerance. During fluoroscopic observation, the patient was asked to void and then approximately 20 ml of diluted (50%) ioxitalamate was infused simultaneously into the urethra with a syringe and a urethral catheter. Unless the patient could open his bladder neck, a curved metal sound was introduced into the posterior urethra through the suprapubic cystostomy opening. Images were obtained with the patient in the oblique position during maximum urethral distention. In addition to the length of atresia, we focused on measuring the proximal posterior urethral length. The proximal posterior urethral length on conventional VCUG images was determined by measuring the distance between the bladder neck and the distal end of the proximal urethra or the distal tip of the metal sound.

Flexible Cystoscopy Technique. All patients had received 10 ml of 2% lidocaine gel beforehand. The 7.5F flexible cystoscope was used to perform urethroscopy under lidocaine jelly 2% intraurethral anesthesia. A flexible cystoscope was advanced through the urethra until the obliterative urethral stricture was encountered (fig. 1). The flexible cystoscope was then easily introduced through a mature suprapubic tract often without any need for further dilatation. When we checked the bladder, the flexible cystoscope was introduced through the bladder neck to the posterior urethra up to the blinded point (fig. 2). The bladder, bladder neck and prostatic urethra were examined, and in cases of bulbar urethral stricture the external urethral sphincter and the distance of the stricture from the sphincter were also evaluated. The bladder and the bladder neck were initially inspected for any possible calculus, tumor or fistula. Then, the flexible cystoscope was introduced into the posterior urethra and the area was evaluated for any possible fistula, false passages or deviation of the posterior urethra. We measured the proximal posterior urethral length using the flexible cystoscope. We started from the bladder neck, making a

Fig. 3. From the bladder neck, the verumontanum (arrow 2) and the urethrorectal fistula (arrow 1) can be seen through a flexible cystoscope.

Fig. 4. Careless and repeated urethral dilatation leads to the formation of a urethral false passage (arrow), a strictured area with a fibrous-appearing band.

mark above the flexible cystoscope and then advanced it into the proximal posterior urethra until the obliterative urethral site was reached. Then we made another mark in the flexible cystoscope. We used the verumontanum as a landmark that determined the 6 o'clock position of the posterior urethra.

Statistical Analysis

Statistical software (SPSS, version 10; SPSS, Chicago, Ill., USA) was used to analyze the data. Linear regression analysis was performed to correlate the urethrographic and endoscopic measurements of proximal posterior urethral length in each patient. Any associated pathology between the urethrographic and endoscopic values were evaluated in each patient and compared with the Wilcoxon signed rank test. A p value <0.05 was taken to indicate a significant difference.

Results

A total of 120 patients underwent diagnostic flexible cystoscopy and radiological examination. Severe allergic reaction or obvious discomfort did not occur in any patients after the conventional urethrography or flexible cystoscope. The measured proximal posterior urethral length (4.31 ± 2.28 vs. 4.02 ± 3.12 , $p > 0.05$) was equivalent for both urethroscopy and cystourethrography in all patients who underwent both procedures.

The posterior urethra ended distal to the external sphincter in 16 patients (13.3%). Five patients (4.2%) had severe displacement of the posterior urethral end toward the rectum or the lower limit of the pubic bone. Prostatic urethrorectal fistula and bladder neck false passage were reported in 17 (14.2%) and 9 (7.5%) patients, respectively (fig. 3, 4).

In 32 patients, urethral calculi were identified proximal to the stricture only during urethroscopy (fig. 5). The standard VCUG did not show the above-mentioned infor-

Fig. 5. Calculus can be seen proximal to the urethral stricture.

mation except for urethrorectal fistula in 2 (1.7%), bladder neck false passage in 7 (5.8%) and urethral calculus in 4 (3.3%) patients. Patients with unresolved urethrography questions were confirmed on our endoscopic evaluation. Details of the cystoscopic findings are listed in the table 1.

Discussion

There are a number of different imaging techniques that may be used in imaging the male urethra. The most widespread methods include RUG and VCUG. However, other modalities, such as sonourethrography, computed tomography and magnetic resonance imaging (MRI), have been used as adjuncts. Accurate diagnosis of stricture presence, number, location and length is of paramount importance in planning appropriate treatment.

Fig. 6. The bladder neck cannot be opened during the VCUG procedure.

Fig. 7. A metal sound was put into the posterior urethra as a guide.

Sonourethrography was first introduced by McAninch to overcome the limitations of conventional radiographic techniques and better define the extent of urethral stricture disease [2, 3]. It is a noninvasive technique with no use of radiation but has a disadvantage in that it is operator dependent with poor delineation of the posterior urethra. It is especially useful in anterior urethral stricture disease [4]. Three-dimensional spiral computed tomography/cysto-urethrography has been used for determining the location of the distraction and the length of the misalignment of the urethral ends [5, 6]. Although this technique does not require an experienced operator and is simpler than conventional radiology, it is relatively expensive and not available at all centers. MRI is a valuable technique for defining the length of prostatomembranous defect and distorted pelvic anatomy [7, 8]. It can also be used to diagnose all cases of diverticula, tumors and fistula [9]. In cases of fistula, MRI can delineate the fistulous track and its connections with different areas, and it helps to exclude associated soft tissue masses [2]. On the other hand, MRI has some limitations in its use with patients with claustrophobia and patients with metal prosthesis or a pacemaker. MRI also has some further disadvantages that still limit its clinical application, including expensive cost, difficulty in obtaining digital subtraction details of the urethra and unfamiliarity to the urologist [2, 10].

Since 1973, when Tsuchida and Sagawara [11] reported the first dedicated flexible cystoscope that incorporated a rigid insertion tube into its design, flexible cystoscopy has evolved to become an important component of urologic practice owing to its diagnostic and treatment capabilities [12, 13]. Although there are different papers regarding the use of flexible cystoscopy for diagnosis and

Table 1. Specification of both urethroscopic and urethrographic findings

Feature	Urethroscopic findings	Urethrographic findings	p value
Length of proximal posterior urethra	4.31 ± 2.28	4.02 ± 3.12	>0.05
Urethro-rectal fistula	17 (14.2%)	2 (1.7%)	<0.05
False passage	9 (7.5%)	7 (5.8%)	<0.05
Posterior urethra	6 (5.0%)		
Bladder neck	3 (2.5%)		
Calculus	32 (26.7%)	4 (3.3%)	<0.05

treatment, there is not much information regarding its use during complex posterior urethral strictures.

Lewis and McCullough [14] performed this diagnostic procedure on 2 patients in 1985. Kielb et al. [15] reported their experience with initial flexible cystourethroscopic evaluation of suspected urethral injury due to blunt trauma in 10 patients. They concluded that primary flexible cystourethroscopy with placement of a urethral catheter streamlines evaluation of the traumatic posterior urethral injury. Cohen et al. [16] described 5 cases in which complete posterior urethral disruption associated with pelvic fracture was managed by flexible endoscope realignment 7–19 days after injury. This technique has been widely used for early realignment after pelvic fracture urethral distraction in recent years [16, 17].

We routinely performed VCUG, RUG and diagnostic antegrade flexible cystoscopy in all patients with PFUDDs who had complete separation of the urethral ends and in some patients whose bladder could not be opened during

Fig. 8. The preoperative urethrogram only showed a connection between the urethra and rectum. We suspected a large urethrorectal fistula but were unable to determine its location, size and orientation.

Fig. 9. Preoperative urography of the patient. The passage marked with arrow 1 is the false passage from the bladder to the urinary meatus. The passage marked with arrow 2 is the real urethra which was confirmed by flexible cystoscopy when the verumontanum was met.

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the VCUG procedure (fig. 6). Because the proximal urethra is particularly important for the choice of surgical approach, antegrade flexible cystoscopy is suggested for assessment of the bladder neck and the posterior urethra in cases in which the proximal urethra is not visualized on cystography. A flexible cystoscope can also be of some help in strictures to identify the grey zone proximal and distal to the stenosis, an area which should not be used in reconstruction.

Some studies suggest using a metal sound as a guide (fig. 7), but this process is blind. The advantage of flexible cystoscopy over using a metal sound method is that one can monitor the procedure from both sides and avoid creating a false passage. In certain complex situations, such as the evaluation of rectourethral fistulas and false passages, RUG and VCUG cannot provide much information (fig. 8, 9). In such cases, we often use flexible cystoscopy to confirm the diagnosis. The flexible cystoscope can easily pass the bladder neck and the urethrorectal fistula can be seen (fig. 3). In most cases, we use the flexible cystoscope in the diagnosis of bladder neck false passages, which are mainly caused by previous manipulations. It is also valuable in the evaluation of proximal urethral length and fistula, especially when the proximal urethra is not visualized on voiding cystography. Flexible cystoscopy is used in some cases of particularly serious damage resulting in severe deformation of the pelvis and posterior urethra. It is also valuable in determination of the severe proximal deviation of the urethral end and helps us do an exact and sighted opening of the posterior urethra in cases with severe displacement of the posterior urethral end. In 32 cases, we have found that the calculus accumulated in the posterior urethra, which in contrast was not often

apparent on VCUG. This provides a basis for the further evaluation of disorders.

Flexible cystoscopy provides an easy, safe and effective method of diagnosis and surveillance in patients with hematuria, lower urinary tract symptoms and bladder tumors. It helps us have better understanding of the bladder and its pathologic disease before the operation. Compared to rigid cystoscopy, flexible cystoscopy causes less pain and is associated with fewer postprocedure symptoms [18–20]. This diagnostic procedure is relatively easy and adds only 4–5 min to the total operative time. It is possible to perform the urethroscopy under local anesthesia (2% lidocaine jelly) with the patient in the supine position, making this procedure amenable to both office and emergency department settings. Staging of the stricture adequately in these settings may provide more accurate and more immediate information than RUG, improving the urologist's ability to select definitive therapy for the patient.

Flexible cystoscopy provides a direct visual assessment of the appearance along the length of the urethra up to the beginning of the stricture and a direct visual assessment of the caliber of the distal aspect of the stricture (the portion of the stricture closest to the tip of the penis). However, since the scope cannot be advanced through the stricture without trauma, the exact length of the stricture and the presence or absence of any additional strictures cannot be determined with urethroscopy. This information is best obtained with X-ray contrast imaging (RUG-VCUG).

Flexible endoscopy has undergone tremendous evolution. The advancement of flexible endoscopy has been fueled by the need to facilitate the diagnosis and treatment of surgical diseases. The most recently introduced

endoscopic procedures are less invasive alternatives to traditional operative interventions, but it is too early to determine whether these new treatments will become the standard. It is clear, however, that flexible endoscopy will continue to evolve. Surgeons have been major contributors in the development of all aspects of endoscopy and we are well positioned to evaluate these technologies for efficacy [21].

Conclusion

Flexible cystoscopy is a valuable procedure for evaluating the posterior urethra and bladder neck in cases of PFUDD and complements the results of VCUG before surgery. Flexible cystoscopy combined with RUG and VCUG may provide more accurate and more immediate information of diagnosis and surveillance in patients, improving the urologist's ability to select definitive therapy for the patient.

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