

Misdiagnoses caused by use of indwelling urethral catheters in children with ureterovesical junction anomalies

Süleyman Çelebi · Serdar Sander · Özgür Kuzdan ·
Seyithan Özaydın · Ünal Güvenç · Sevgi Yavuz ·
Aysel Kiyak · Oyhan Demirali

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Abstract

Purpose Children commonly undergo vesicograms for diagnosing vesicoureteral reflux (VUR). This requires urethral catheterization with transurethral replacement. We report misdiagnosed or related complications due to indwelling urethral catheters unintentionally placed in the ureter.

Methods From our computerized urology records over an 18-year period from January 1995 to May 2013, we retrospectively identified nine cases of 1850 vesicograms that had misdirection of a urethral catheter placed in a ureter. Foley catheters with inflating balloons were used to obtain the vesicograms.

Results In all, 1850 vesicograms were performed (746 males, 1104 females; age 1 week to 14 years, mean age 3.8 years) using standard radiological techniques. Size 6–10 Fr indwelling urethral catheters were used, depending on the patient's age and gender. In nine cases

(five females, four males), a misdirected urethral catheter was discovered in one of the ureters. The urethral catheter was in the left ureter in four patients and in the right ureter in five patients. Cystoscopic examination found ectopic ureteral openings in six patients: at the bladder neck in four and just below the bladder trigone in two. Three patients in this group with ectopic ureters were followed due a misdiagnosis of VUR. The remaining three patients had grade 3 or 4 VUR. In this group, the catheter passed into the ureter because of the enlarged ureterovesical junction. In one patient with VUR, intraparenchymal fluid leakage and transient hematuria occurred due to the rapid tension increase following the fast injection of contrast with liquid to one ureter.

Conclusion Although placing an indwelling urethral catheter is a relatively safe procedure, complications can occur, particularly in patients with ureterovesical anomalies, such as high-grade VUR or an ectopic ureter. Using catheters with inflating balloons can cause rapid increases in tension in the ureter, and related complications.

S. Çelebi (✉) · Ö. Kuzdan · S. Özaydın · Ü. Güvenç ·
O. Demirali
Department of Pediatric Surgery, Kanuni Sultan Suleyman
Education and Research Hospital, Istanbul, Turkey
e-mail: celebisuleyman@hotmail.com

S. Çelebi
Tahtakale mah. T32 cad. Bizimevler 4 C2, D:48 Ispartakule-
Avcılar, Istanbul, Turkey

S. Sander
Department of Pediatric Urology, Kanuni Sultan Suleyman
Education and Research Hospital, Istanbul, Turkey

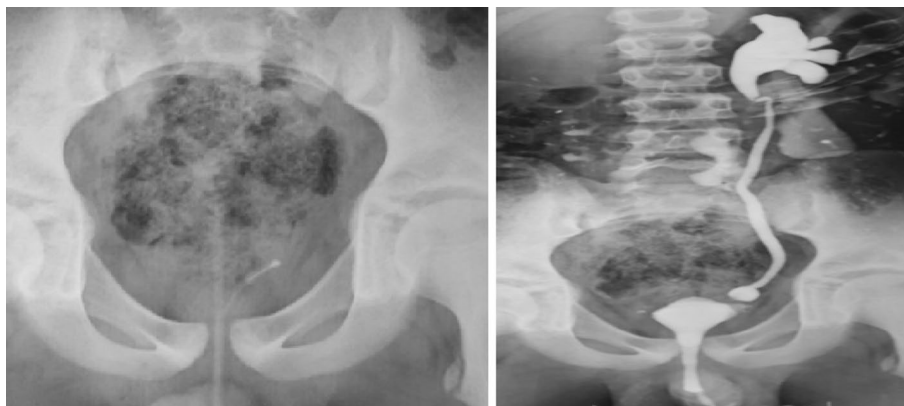
S. Yavuz · A. Kiyak
Department of Pediatric Nephrology, Kanuni Sultan Suleyman
Education and Research Hospital, Istanbul, Turkey

Keywords Indwelling urethral catheters · Ureterovesical junction anomalies · Ectopic ureteral openings

Introduction

Children commonly undergo urethral catheterization for vesicograms when diagnosing vesicoureteral reflux (VUR) and for urodynamic studies. For this purpose, a catheter is inserted in the bladder through the urethra, and contrast material is injected at a constant pressure, with the volume based on the weight of the child. Insertion of an indwelling urethral catheter is a relatively safe procedure and is fairly

Fig. 1 A patient with a urethral catheter in the left ureter



routine in many hospitals. However, a urethral catheter can be inadvertently placed within the ureter in patients with VUR or an ectopic ureter.

Although this is a rare complication, it can be serious [1]. There are only a few case reports of complications in the medical literature, and most involve adults [2]. This study represents the largest series of pediatric patients. Cases of malpositioned catheters are summarized, and the possible etiologies of this complication are discussed.

Methods

Institutional review board approval was obtained for this study. We retrospectively identified cases from our computerized inpatient and outpatient urology records. Patients undergoing vesicograms using standard radiological techniques while being investigated for urinary tract infections (UTI) in the Pediatric Nephrology Department or Pediatric Urology Department over the 18 years from January 1995 to May 2013 were included in this study.

For VCUG, indwelling urethral catheters of size 6–10 Fr were used, depending on the patient's age and gender. Foley catheters with inflating balloons are primarily used at low pressure, delivering 1–1.5 mL. Expected bladder capacity was calculated using the Hjalmas equation: [expected capacity (mL) = 30 + (age in years × 30)]. A bag containing contrast medium was hung 1 m above table height and filled the bladder via gravity drip. Filling was considered complete when the drip stopped completely.

All of the clinical and radiological data of these patients were reviewed, and the management and outcome details were analyzed. Misdiagnoses due to an indwelling urethral catheter in the ureter or related complications were investigated. Relevant medical records were also reviewed to obtain information on patient demographics, comorbidities, and indications for and complications of urethral catheters.

Results

In all, 1850 vesicograms were performed (746 males and 1104 females; age 1 week to 14 years, mean age 3.8 years) using standard radiological techniques. In nine patients (five females, four males), the urethral catheter passed through the ureterovesical junction to the ureter. The urethral catheter was in the left ureter in four patients and in the right in five patients.

The patient presentations varied: One patient presented with groin pain, another had back pain, a third was admitted with transient hematuria, and the others were asymptomatic with aberrant Foley catheter placement discovered incidentally.

All of the patients had ureterovesical anomalies (Fig. 1). On cystoscopic examination, six patients had ectopic ureteral openings: Four were at the bladder neck, and two were just below the bladder trigone. Three patients in the group with ectopic ureters were followed due a misdiagnosis of VUR.

The remaining three patients had grade 3 or 4 VUR (Fig. 2). In one patient with VUR, intraparenchymal fluid leakage and transient hematuria occurred due to the rapid tension rise causing severe hydronephrosis with liquid contrast injection into one ureter. Peripelvic and pyelointerstitial extravasation were seen due to retrograde urine flow. With increasing intrapelvic pressure, the contrast infiltrated the pelvis, calyx around the pelvis, and parenchymal interstitium, leading to renal parenchymal injury (Fig. 3). This patient was in the follow-up period. USG data correlated with increased echogenicity and decreased corticomedullary differentiation with parenchymal thinning.

Two of the patients had a sensory disorder inhibiting their pain response, and two patients were being followed for anorectal malformations (ARM). None of the patients had pyuria. No surgical treatment was required. There was new moderate left hydronephrosis and a proximal hydro-ureter in one case.

Fig. 2 A urethral catheter in the right ureter caused severe hydroureteronephrosis

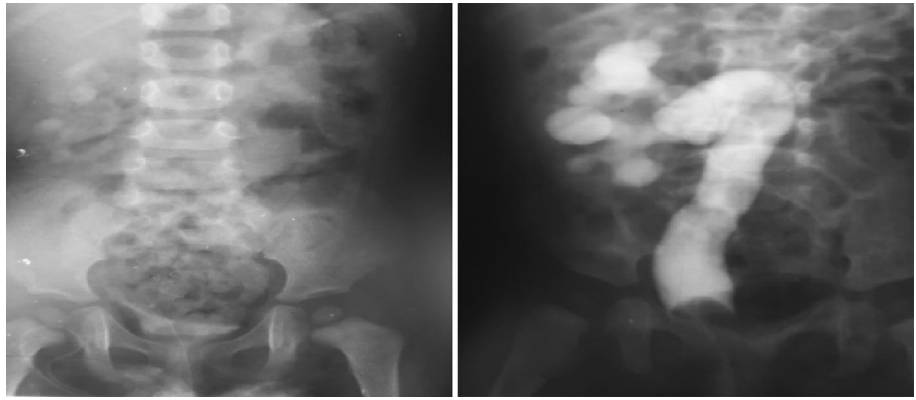


Fig. 3 A right indwelling urethral catheter (Foley catheter) in the ureter resulted in peripelvic and pyelointerstitial extravasation

Discussion

Transurethral indwelling catheterization is defined as passage of a catheter into the urinary bladder via the urethra. Urethral catheterization is common in hospitalized pediatric urology patients, for radiological imaging and urodynamic studies [1]. A voiding cystourethrogram (VCUG) is commonly performed via urethral catheterization in children after a UTI, or when hydronephrosis is detected antenatally. It is used in children with congenital anomalies of the renal or lower urinary tract, such as a posterior urethral valve, bladder neck trauma, and urolithiasis, or to assess an unstable bladder; it is the standard investigation for studying VUR.

Short-term use of an indwelling urethral catheter is a safe, effective strategy for maintaining bladder and renal health and judicious use contributes to improved outcomes with urological problems. However, insertion of an indwelling urethral catheter is not without the risk of complications, especially in children with ureterovesical anomalies, such as ectopic ureter openings and dilation of the ureter, such as in VUR. Rathaus et al. [1] described

this complication in three of 843 VCUG studies; all three patients had VUR and presumably patulous ureteral orifices. Three of our patients with ectopic ureters and no VUR were mistakenly followed for VUR because of contrast in the ureter and were diagnosed with grade 2 VUR. Cystoscopy done when radiograms suspected indwelling urethral catheter into the ureter and confirmed the ectopic ureters in these patients.

In women, urethral catheterization is a straightforward procedure due to the short length of the urethra. This could facilitate urethral catheterization of the ureter. There are four reported cases of ureteric catheterization with a urethral catheter, all of which involved females [3]. We had five girls in our group: two with ectopic ureters and three with high-grade reflux.

At least 25 % of the clinical problems seen in pediatric urology are the result of neurological lesions that affect lower urinary tract function [4]. Two patients in our series had sensory disorders. If children cannot sense pain because of a neurological impairment, they will not feel pain when an improperly placed catheter balloon is inflated [5]. In addition, such patients mostly have high-grade VUR, which facilitates catheterization of the ureter. Two patients in our group had ARMs, and the anatomy elsewhere might have also been abnormal. Therefore, care must be taken when catheterizing patients with anomalies, such as ARM or neurological impairment.

The signs and symptoms of ureteral catheterization differed markedly in children compared to adults. In adults, most misdirected urethral catheters in the ureter are diagnosed due to complications, such as ureteral rupture, vesicoenteric fistulas, and peritonitis [6, 7]. In comparison, we rarely see complications in children, probably because the anatomy of a child differs from that of adults. The ureter is more elastic and the ureteral orifice larger in patients with VUR. In addition, less fluid is given at a slower rate during pediatric vesicograms.

An inflated catheter balloon in the ureter with the liquid given for VCUG can cause hydronephrosis [8]. Peripelvic

and pyelointerstitial extravasation of urine is the most common form of retrograde urine flow. This increases the pressure in the pelvis and calyx around the pelvis. The parenchymal interstitium is infiltrated with the contrast, which can lead to ureteral and renal parenchymal injury, as one of our cases. Using an uncuffed catheter without an inflating balloon, rather than a Foley catheter, may reduce complications associated with injection of contrast medium under high pressure.

If inadvertent ureteral catheterization is strongly suspected or confirmed, then consideration can be given to attempted removal by gentle pulling on the catheter after deflating the balloon [9]. CT, ultrasound, or emergency cystoscopy can be performed if there is any doubt concerning complications [10]. Similarly, abdominal radiographs can show the aberrant Foley balloon shadow along the expected course of a ureter, instead of its expected location in the bladder. Enlargement of the renal shadow will be seen if there is accompanying hydronephrosis on ultrasonography. If ureteral rupture is present, then a urine collection will be seen in the area of rupture and possibly in the dependent region of the pelvis. On ultrasound, more proximal hydro-ureter and hydronephrosis can also be seen due to ureter obstruction [11].

If ureteral injury is present, management requires either stent placement or surgery, depending on the type of injury and time elapsed before detection [12]. If the injury is recognized late and there are complications that would interfere with ureteral healing, such as abscess formation, urinary tract infection, or urinary fistula formation, then proximal urinary drainage via a percutaneous nephrostomy should be performed [13]. These patients should also be monitored for ureteral stricture development over the following months/years [14].

To avoid ureteral injury, we need to stick to basic principles; if one cannot obtain a return of urine, it is necessary to aspirate urine or irrigate the indwelling urethral catheter to confirm the location, and advancing the catheter no farther than 1–2 cm after urine is obtained. It has also been suggested that ureteral catheterization is more common when the patient is catheterized with an empty bladder [10]. One must consider ectopic ureters and remember that with reflux urine will flow through the catheter, which could mislead physicians to believe that the catheter is in the bladder.

The two most common complications associated with Foley catheter use, particularly in males, are urethral trauma and retention of the catheter balloon in the urethra [15]. Serious complications, such as bladder perforation, peritonitis, and a rectovesical fistula, have been reported [16]. Although cases of urethral complications caused by balloons connected to inflated Foley catheters have been reported in other series, this is the largest series

of inflation-related ureteral complications. As observed in our cases, complications of ureteral cannulation include hydronephrosis and pyeloureterectasis, as well as various renal injuries. And also Foley catheter used in instances of bladder irritation can produce false VCUG results. The best comprehensive preventative approach is to completely avoid inappropriate use of a Foley catheter.

In conclusion, we believe that this report highlights potential patient presentations and the imaging appearance of indwelling urethral catheters in the ureter, a complication that clinicians and radiologists might be unfamiliar with. The possibility of inadvertent ureteral catheterization should be kept in mind. The rules for urethral catheterization using uncuffed catheters should never be ignored, as this may prevent complications of ureteral catheterization.

Conflict of interest Authors declare that there is no conflict of interest.

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