Transurethral incision of a ureterocele in children under ultrasound control

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Abstract

Introduction

Transurethral incision (TUI) is a popular method of treatment used in children with ureteroceles. The procedure can be difficult because of dimensions, localization and thickness of a ureterocele as well as its **relation to other ureteral orifices**.

The aim of the present study was to evaluate the usefulness of ultrasound guidance for incision of a ureterocele and decompression of the upper urinary tract during endoscopy.

Material and methods

Analysis included 34 children treated for ureteroceles at the Department of Paediatric Surgery and Traumatology in Lublin between 2005 and 2015. A ureterocele in a duplicated collective system was noted in 24 children. Twenty children with the functional upper system underwent TUI. Four children with the non-functional system were subjected to classical surgical procedures. A ureterocele in a single collective system was treated with TUI in 10 children. The correctness of incisions was controlled with ultrasound during cystoscopy. No urinary outflow obstruction, vesicoureteral reflux or urinary infections were observed, which implies good long-term outcomes.

Results

Endoscopic treatment resulted in good short- and long-term outcomes in all children with the functional upper system of a duplicated kidney. In the remaining patients with the non-functional upper system, good outcomes were observed following classical surgical procedures. Endoscopic treatment yielded good short- and long-term results in all patients with single system ureteroceles.

Conclusions

Endoscopic incision of a ureterocele is the treatment of choice in cases with good renal function.

Ultrasound guidance during ureterocele incision improves the efficacy and safety of the procedure.

Key words: ureterocele, incision, children

Introduction

A ureterocele is a cystic dilatation of the intravesical ureter and one of the important causes of secondary hydronephrosis in children, which is usually diagnosed prenatally [1, 2]. Its aetiology has been continuously debated and some hypotheses have been put forward [1]. One of them suggests that the ureterocele results from incomplete dissolution of the Chwalle's membrane, which separates the ureteric bud from the urogenital sinus. According to the second hypothesis, the ureterocele is formed due to poor muscular development of the

intravesical ureter. The third theory implicates that there is a stimulus that responds to distention of the bladder and of the intravesical portion of the ureter. Ureteroceles are more commonly found in girls than in boys (4:1 versus 6:1) [1, 3, 4].

There are two most common classifications of ureteroceles, which include 1/ single system ureteroceles (SSU) and duplex system ureteroceles (DSU), 2/ intravesical (orthotopic) and extravesical (ectopic) ureteroceles [1, 5, 6]. The above classifications are helpful in urological management: endoscopic – transurethral uretercoele incision (TUI) (with cold knife, cutting current of electrocoagulation, laser) or traditional surgical procedures – ureteropyelostomy, anti-reflux surgery, hemi-nephrouretectomy. The treatment is to preserve the kidney function, prevent urinary tract infections (UTIs), resolve vesicoureteral reflux (VUR), remove the bladder outlet obstruction, improve the lower urinary tract function, and repair the detrusor's defect behind the ureterocele [3, 4, 5, 6, 7].

The aim of the study was to evaluate the usefulness of ultrasound (US) guidance for ureterocele incision and decompression of the upper urinary tract during endoscopy.

Material and methods

A retrospective study was carried out; analysis involved medical records of 34 children treated because of ureteroceles at the Department of Paediatric Surgery and Traumatology in Lublin between 2005 and 2015. The study population included 20 boys and 14 girls aged 2 months – 14 years (mean age 27 months).

Preoperative diagnostics consisted of abdominal US, voiding uretrocystography (VCUG) and dynamic renal scintigraphy with 99m Tc-dimercaptosuccinic acid (DMSA). Patients were diagnosed accidentally on US screening or due to recurrent UTIs.

Ureteroceles classified as DSUs were noted in 24 children. Twenty children with the functional upper system (DMSA) underwent transurethral ureterocele incision with electrocoagulation as the first procedure. Unilateral ureteroceles were found in 17 cases, bilateral ones in 3, (in total 23 renal units were affected). Ipislateral VUR (grade III-IV) into the lower system coexisted in 4 out of 20 patients and did not resolve within 1 year after TUI. VUR affected 2 patients with unilateral ureteroceles and 2 patients with bilateral ureteroceles; two of them required only endoscopic submucosal injection of a bulking agent (Deflux) as the second procedure (unilateral ureteroceles). Another two patients with ectopic (extravesical) ureteroceles needed ureteral reimplantation with detrusor's reconstruction (bilateral ureteroceles).

The remaining 4 children with the non-functional upper system (DMSA) underwent hemi-nephroureterectomy as the first procedure. Two of them required another surgery, i.e. excision of ectopic ureterocele with reconstruction of the detrusor muscle due to persistent bladder neck obstruction and recurrent urinary infections.

Ureteroceles classified as SSUs (intravesical) were found in 10 children - unilateral in 7 cases, bilateral in 3;, in total 13 renal units were affected). All 10 children underwent only TUI. Ipsilateral VUR coexisted in 1 child and resolved spontaneously within 1 year after TUI. .

The study group comprised only patients who underwent TUI as the first procedure – 30 children (36 renal units).

TUI was performed under general anesthesia after the administration of an intravenous antibiotic. A 0°cystoscope with the direct working channel was introduced into the bladder. The bladder was filled with the solution of 5% glucose for good conduction of electric current. A ureterocele was incised at its base with a monopolar electrode (cutting current) – one or two punctures for better

emptying. The correctness of electrode position and of incision was US-controlled during cystoscopy – reduction in the ureterocele's diameter and stasis in the upper urinary tract indicated good early outcome (fig. 1-8).

After 3 months the patients were checked with US. The long-term results were evaluated 12 months after TUI with US, VCUG, DMSA and urodynamic testing.

Lack of urine outflow obstruction and of vesicoureteral reflux, preservation of kidney function and no recurrent UTIs were indicative of good long-term results.

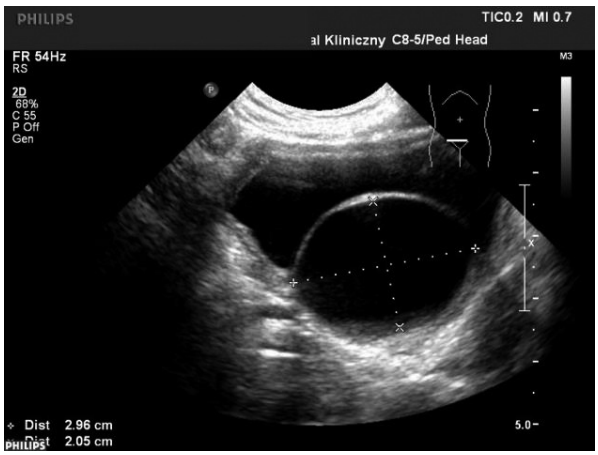

Fig. 1. A ureterocele before incision – US scan, marked with dots and crosses

Fig. 2. A ureterocele before incision – endoscopic image

Fig. 3. The ureter before incision – US scan marked with dots and crosses

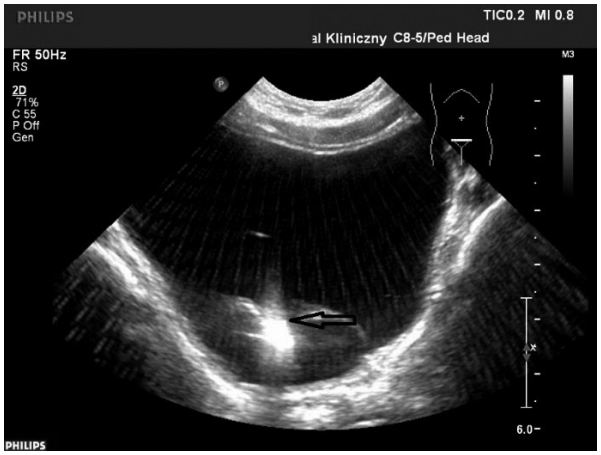

Fig. 4. Incision of a ureterocele – US scan, an electrode marked by an arrow

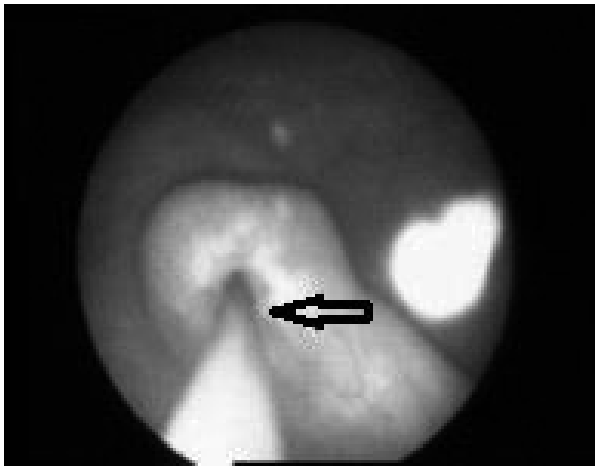

Fig. 5. Incision of a ureterocele – endoscopic image, an electrode marked by an arrow

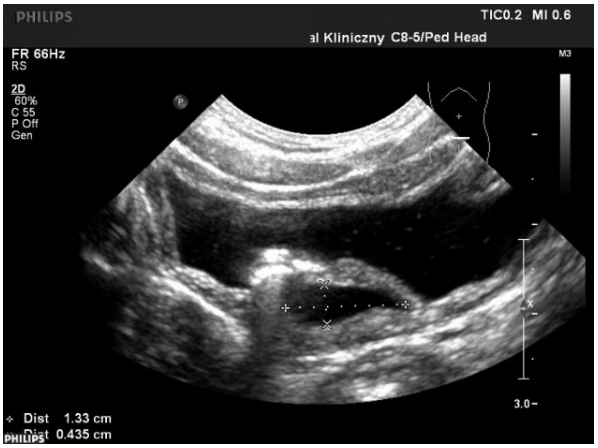

Fig. 6. A ureterocele after incision – US scan marked with dots and crosses

Fig. 7. A ureterocele after incision – endoscopic image

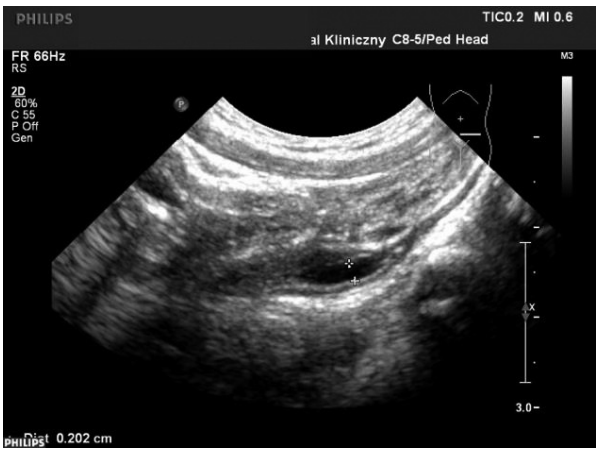

Fig. 8. The ureter after incision – US scan marked with crosses

Results

Endoscopic treatment (TUI) of DSU gave good short-term results in all 20 children with the functional upper system of the duplicated kidney (table 1). Long-term results were good in 16 children (17 renal units). Long-term outcomes in the remaining 4 children with recurrent UTI and VUR initially or 1 year after TUI were found to be unsatisfactory (6 renal units). In those cases, positive therapeutic results were achieved after the second procedure (submucosal injection of Deflux or anti-reflux surgery).

Endoscopic treatment (TUI) of SSU yielded good short- and long-term results in all 10 patients (13 renal units).

Table 1. Long-term results of transurethral ureterocele incision (TUI)

<table>
<tr><td colspan="4">DSU – 20 chld., (23 RU)</td></tr>
<tr><td colspan="2">unilateral cele – 17 chld.</td><td colspan="2">bilateral cele – 3 chld.</td></tr>
<tr><td>15 chld.
(15 RU)
15 - GR</td><td>2 chld.
(2 RU)
2 – UR (VUR)
⇩
sub. inj.
⇩
2 - GR</td><td>2 chld.
(4 RU)
2 – UR (VUR)
⇩
surgery
⇩
2 - GR</td><td>1 chld.
(2 RU)
1 - GR</td></tr>
<tr><td colspan="4">SSU – 10 chld., (13 RU)</td></tr>
<tr><td colspan="2">unilateral cele – 7 chld.</td><td colspan="2">bilateral cele – 3 chld.</td></tr>
<tr><td colspan="2">7 chld.
(7 RU)
7 - GR</td><td>2 chld.
(4 RU)
2 - GR</td><td>1 chld.
(2 RU)
1 – GR
(VUR – resolved after TUI)</td></tr>
</table>

DSU – double system ureterocele
SSU – single system ureterocele
chld. – children
RU – renal units
VUR – vesicoureteral reflux
GR – good long-term result
UR – unsatisfactory long-term result
sub. inj. – subureteral injection of bulking agent (Deflux)
surgery – ureteral reimplantation

Discussion

Many authors emphasize that there is no standardized, universal method for the treatment of children with ureteroceles [1, 5, 6, 7, 8, 9]. On the other hand, the aims of therapy are clearly

defined, i.e. preservation of the kidney function, prophylaxis of urinary tract infections, resolution of vesicoureteral reflux, and removal of bladder outlet obstruction. As mentioned in the introduction, there are different surgical techniques for limiting the adverse effects of ureteroceles.

One of the most popular technique applied by paediatric and adult urologists is transurethral ureterocele incision (TUI) [1, 3, 5, 6, 7, 10]. Since TUI is rather easy and safe, it is recommended as the first-line therapy, especially in single system, intravesical ureteroceles[1, 5, 6, 7, 8, 10, 11, 12, 13]. Different cutting devices are available, which can be used for incision of a ureterocele. The oldest one is a resectoscope cold knife, yet cutting with it is sometimes difficult due to a stiff, thick-walled ureterocele, or bleeding [4, 5, 6, 9, 14]. The newest and precise device is a laser beam, which is effective in experienced hands [5, 14, 15]. A monopolar electrode (popular Bugbee) with cutting current is most commonly used [1, 2, 3, 4, 6, 16, 17, 18].

This method was also applied in our patients and we found it superior to the other two techniques mentioned above as there is actually no risk of bleeding (a clear operative field), the operator can cut quite thick-walled celes and the ureterocele opening will be slightly larger than the electrode diameter due to a small necrotic ring. Moreover, accidental injuries to the bladder caused with the electrode will not be so serious for the patient. Our study presents a completely new approach to TUI in which US was applied during the procedure. US controls the correctness of electrode positioning and of incision. Thanks to that the surgeon knows that only the ureterocele was opened, no unintentional damage was done and he observes emptying of the upper urinary tract. The literature lacks any reports regarding this method of treatment.

It is worth stressing that Arevalo tried to visualize the anatomy of the ureterocele and the ureter by injecting a contrast medium into the ureterocele during cystoscopy – retrograde ureterocelogram (RUC) [16]. Furthermore, Swana described a very important procedure for differentiation of the uretreocele from obstructive megaureter and the treatment of the latter; the procedure involved the injection of a contrast medium into the distended ureter, ureteropyelography and formation of a new ureteral orifice with the holmium laser beam [15].

Individual operators have their own experience in treating children with ureteroceles. In cases of SSU and intravesical ureterocele with good renal function (DMSA), the majority of researches agree that TUI is the first-line and usually definitive management [2, 5, 6, 7, 8, 9, 10, 11, 13, 18].

All our patients with SSU (10 children with 13 renal units affected) had good renal function and were treated exclusively with TUI, which yielded good long-term results. However, there is no consensus regarding the treatment of DSU and extravesical ureterocele cases. .

According to some authors [1, 2, 4, 6, 7, 10, 11, 13, 14, 18], TUI should be the first procedure to decompress the upper urinary tract, remove the bladder outlet obstruction, protect the kidney function (procedure performed before DMSA, in young children when the renal function is unknown), and diminish the risk of urinary tract infections. Resective or reconstructive procedures are required whenever the course of management is found unfavourable. Moreover, de novo VUR usually resolves spontaneously after TUI.

The approach of some other authors is more radical [5, 8, 9, 12, 17], i.e. in cases with good renal function, primary reconstruction of the lower urinary tract should be performed first; however, the child has to wait for the DMSA scan and therefore is more prone to all adverse effects of the ureterocele. In cases with the poorly-functioning or non-functional kidney, resective procedures are performed. .

The approach to and management of DSU and extravesical ureterocele cases in our material were consistent with the first opinion mentioned above. TUI was the first-line treatment in all children, with good long-term results observed in 80% of cases (74% of renal units). Submucosal injection of a bulking agent or anti-reflux surgery were necessary in the remaining 20% of cases (26% of renal units) because of persistent, primary VUR. Fortunately, long-lasting outcomes of those procedures were good.

Conclusions

Endoscopic incision of a ureterocele is the treatment of choice in cases with good renal function.

Ultrasound guidance during ureterocele incision improves the efficacy and safety of the procedure. Moreover, the early outcome of treatment is immediately visible, i.e. decompression of the ureterocele and the upper urinary tract.

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