

Laser-puncture Versus Electrosurgery-incision of the Ureterocele in Neonatal Patients

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Purpose: To compare the holmium-laser puncture and electrosurgery-incision in neonates with intravesical ureterocele.

Materials and Methods: We retrospectively analyzed the results of laser-puncture of ureterocele (LP group) in 12 patients (mean age 9.8 days, range 4-28) and electrosurgery-incision in 20 patients (ES group) (mean age 10.2 days, range 6-28), treated at our institution. Patients had their records reviewed for preoperative findings, endoscopic procedure description, and postoperative outcomes.

Results: There was the need for retreatment in one (8.3%) patient in LP group and in four (20%) patients in ES group ($P = .626$). Duration of general anesthesia in LP and ES groups was 16 (range, 10-24) minutes and 15 (range, 10-20) minutes, respectively ($P = .355$). There was no statistically significant difference in terms of hospitalization (LP group one day, ES group 1.35 days) ($P = .286$). Complications were not found in LP group. There were two (10%) patients with pyelonephritis after the treatment in ES group ($P = .516$). After one month, obstruction was observed on ultrasound examination in one (8.3%) and two (10%) patients, respectively. After three months, obstruction was not found in any patient in both groups. After six months, vesicoureteral reflux was found in one (8.3%) patient after laser-puncture of the ureterocele and in 13 (65%) patients after electrosurgery-incision ($P = .003$).

Conclusion: Both laser-puncture and electrosurgery-incision endoscopic techniques are highly effective in relieving the obstruction. There is no significant difference regarding hospitalization, need for retreatment and the occurrence of complications. The incidence of de novo vesicoureteral reflux is significantly lower in patients treated with holmium-laser, as well as the need for upper pole partial nephrectomy.

Keywords: ureterocele; neonates; laser puncture; electrosurgery incision.

INTRODUCTION

Ureterocele is a cystic dilation of the distal part of the ureter⁽¹⁾. Ureterocele can be located inside the bladder or include the bladder neck and urethra. This anomaly may reflect insufficient ureteral maturation, the fetal process by which the developing ureteral bud separates from the mesonephric duct and moves to the bladder⁽²⁾. It may be associated with a single or, usually, with duplex system, associated with the upper pole⁽³⁾. Characteristic presenting sign in some patients is prolapse of the ureterocele. Pathognomonic clinical sign may be the presence of mucosa-covered intralabial masses with difficult voiding⁽⁴⁾. The first clinical sign of the anomaly, sometimes, may be urosepsis. On the other hand, the state is characterized by the absence of clinical signs in some patients⁽⁵⁾.

Prenatal and postnatal ultrasound investigation, magnetic resonance imaging, radionuclide renal scan and voiding cystourethrogram (VCUG) are procedures used to define a complex anatomy of the urinary tract of these patients, but the final diagnostic procedure is endoscop⁽⁶⁻¹¹⁾.

Surgical treatment of ureterocele in neonatal period has to be performed to eliminate the obstruction and uri-

nary tract infection (UTI) and to avoid the occurrence of vesicoureteral reflux, and, also, to preserve renal function and prevent urinary incontinence. The overall procedural morbidity has to be minimized. The options for the treatment are: transurethral incision, excision of ureterocele with (or without) ureterocystoneostomy or ureteroureterostomy, upper pole haeminephroureterectomy. Transurethral incision or puncture of the ureterocele may prevent the obstruction and vesicoureteral reflux in majority of patients. Also, the necessity for subsequent surgery can be minimized. The endoscopic surgical treatment can be performed with electrosurgery, cold-knife and holmium-laser^(12,13).

PATIENTS AND METHODS

Study population

The study was conducted at Mother and Child Health Care Institute of Serbia "Dr Vukan Cupic". Patients were divided into two groups. In the first group the results of laser-puncture of intravesical ureterocele in 12 patients were analyzed, treated between November 2012 and November 2016 (LP group). In the second group the results of electrosurgery-incision of intravesical ureterocele in 20 patients were analyzed, treated between November 2005 and November 2012 (ES group).

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Table 1. Preoperative findings in patients

Characteristics	LP group (N=12)	ES group (N=20)	P - value
Female	8 (67)	14 (70)	1
Age, days; mean ± SD (range)	9.8 ± 6.5 (4-28)	10.2 ± 5 (6-28)	0.409
Weight, kg ; mean ± SD (range)	3.6 ± 0.6(2.2-4.4)	3.6 ± 0.4 (2.4-4.0)	0.845
Double system ureterocele	9 (75)	16 (80)	1
Left side	7 (58)	12 (60)	1
Diagnosed prenatally	9 (75)	14 (70)	0.7

Abbreviations: N, number of patients; LP, laser-puncture; ES, electrosurgery.

*Data is presented as mean ± SD or number (percent).

Inclusion criteria: only neonates with intravesical single or double system ureterocele were included in the study. Exclusion criteria: patients after neonatal period (older than 28 days), patients with extravescical ureterocele and patients with comorbidities that may affect the outcome of the treatment of ureterocele were excluded.

Surgical technique

Ultrasound, VCUG and radionuclide renal scan were performed in all patients in order to confirm the diagnosis. Urinalysis, urine culture and kidney function tests were evaluated. All patients were under antibiotic prophylaxis. Cystoscope 7.5-F was used for the endoscopic evaluation and the treatment. All endoscopic procedures were done under general anesthesia. The source of energy in LP group was holmium: yttrium-aluminum-garnet laser (Holmium: YAG laser). We used 200 and 550-microm laser probes for ureterocele puncture (**Figure 1**). In ER group, electrocautery was used. The size of the probe was 3-F. All anatomic conditions were considered after transurethral placing of the cystoscope: the capacity of the urinary bladder, mucosal appearance, the presence of trigone, ureteral orifices and the presence of ureterocele. The side and the size of ureterocele, its tension and eventual propagation into the urethra were also evaluated. All these conditions were considered with regard to the fulfillment of the bladder.

LP group: Laser probe was placed through the working channel of the cystoscope near to the bladder floor, to the lowest and medial portion of the ureterocele. We used micro laser fibers generating 0.2 to 1 J at a frequency of 5 Hz. A few punctures (4 to 10) were made at the ureterocele wall, while ureterocele has been collapsed. We performed all procedures without placing ureteral stent. Foley catheter was placed if there was a risk of bladder neck obstruction.

ES group: Electrocautery probe was placed through the working channel of the cystoscope. Front wall of the ureterocele was incised with electrocautery. We have assumed an undisturbed visualization of the ureterocele interior as the sign of obstruction removal.

Outcome assessment

In postoperative period all patients received antibiotic prophylaxis. The level of obstruction was assessed with ultrasound examination on the first postoperative day. During the follow-up period ultrasound examination was performed one and three months after the surgery, and, also, dynamic radionuclide renal scan, in order to confirm the obstruction removal. VCUG was performed to evaluate the possibility of vesicoureteral reflux. VCUG was a mandatory procedure in all patients in ES group, according to the protocol of our institution during the follow-up period for patients in ES group. In LP group VCUG was not mandatory. Protocol was changed in order to avoid negative impact of ionizing radiation during the routine VCUG investigation. If there was no urinary tract infection and ultrasound was normal, we performed observation only.

Results are presented as counts (percents) or median (range). Fisher's Exact test and Mann-Whitney *U* test were used to assess the differences between groups. SPSS 20.0 was used for data analysis. All *p* values less than 0.05 were considered significant.

RESULTS

As mentioned in patients and methods section, twelve patients were included in LP group and twenty patients in LS group. Demographic data of the patients in the two study groups have been outlined in **Table 1**. There was no statistically significant difference between the groups regarding clinical parameters, including double/

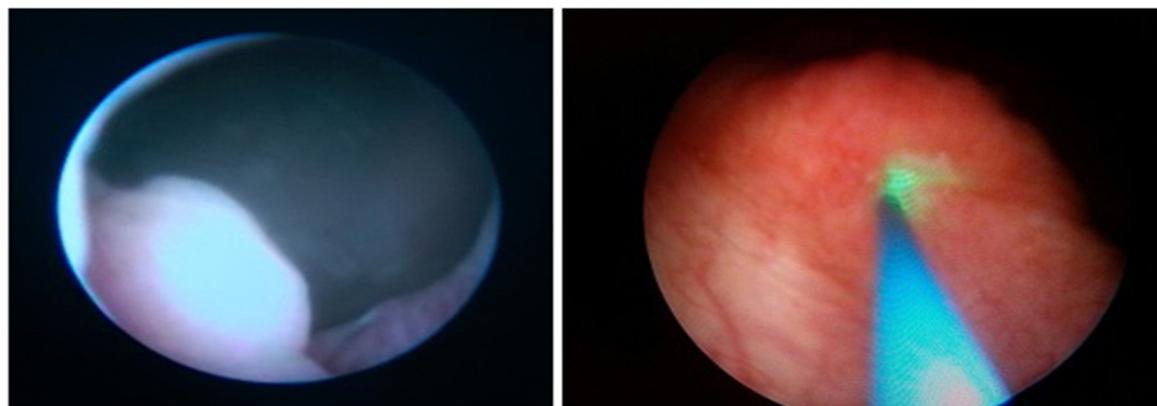


Figure 1. Endoscopic view of ureterocele. Punction of the ureterocele with laser beam.

Table 2. Postoperative findings in patients

Characteristicsa	LP group (N=12)	ES group (N=20)	P - value
No. of retreatments (percentage)	1 (8.3)	4 (20)	0.626
Anesthesia, minutes; median \pm SD, (range)	16 \pm 4 (10-24)	15 \pm 2.9 (10-20)	0.355
Hospitalization, days; median \pm SD (range)	1 \pm 0 (1-1)	1.35 \pm 1.09(1-5)	0.286
Complications	None	2 (10%)	0.516
Obstruction (after three months)	None	none	1
Vesicoureteral reflux –overall (after six months)	1 (8.3)	13 (65)	0.003
Vesicoureteral reflux grade III	1(8.3)	3 (15)	
Vesicoureteral reflux grade IV	None	5 (25)	
Vesicoureteral reflux grade V	None	5 (25)	

Abbreviations: N, number of patients; LP, laser-puncture; ES, electro-surgery.

^aData is presented as median \pm SD or number (percent).

single system ratio, type of the ureterocele, side of the ureterocele and diagnosis period (prenatally or postnatally).

Operative data and postoperative investigations have been illustrated in **Table 2**. Puncture of the ureterocele with holmium-YAG laser was performed in the total number of 13 procedures in 12 patients in LP group. In ES group electro-surgery-incision of ureterocele was performed in the total number of 24 procedures in 20 patients. There was no statistically significant difference between the groups regarding the need for retreatment and duration of general anesthesia. Complications were found only in two patients in ES group. In both patients pyelonephritis occurred and VCUg showed vesicoureteral reflux grade V. There was the difference between groups regarding complications, but without statistical significance. There was no statistically significant difference regarding postoperative obstruction. Three months after the surgery ultrasound and radio-nuclide renal scans showed the absence of obstruction in both groups. There was a significant superiority of laser-puncture technique regarding the occurrence of vesicoureteral reflux: low grade reflux in one patient in LP group (grade III) and high grade reflux in majority of patients in ES group.

DISCUSSION

In majority of patients ureterocele is associated with some other disorder of the urinary tract, like megaureter, duplicated ureter, renal dysplasia, renal parenchyma damage, vesicoureteral reflux, contralateral agenesis, etc. The treatment of the ureterocele represents the treatment of all these disorders⁽³⁻⁵⁾. The reasons for the immediate treatment are the relief of the obstruction, prevention of the urinary tract infections and prevention of vesicoureteral reflux⁽⁷⁾. The treatment of the ureterocele enables preservation of renal function. Nowadays, prenatal treatment is reality. Fetal cystoscopic treatment of the ureterocele is well documented^(14,15).

Ureterocele occurs more often in female. Currently, the most complex forms of this anomaly occur in girls^(1,7). On the other hand, male urethra in neonate has very small caliber. Placing of the endoscopic instruments is very demanding and difficult. The use of adequate equipment is essential. We used cystoscope 7.5-Fr in all patients and we didn't have any problems when passing through the urethra. With the use this cystoscope, an adequate relationship is achieved between patient safety, good visualization, and the ability to perform surgical intervention. Here the surgeon's experience plays a very

important role.

Most patients with ureterocele have normal or slightly lower body mass. Because of that, the body mass index does not have significant role in the preparation of the patient for the surgical intervention, as well as during the surgical intervention itself⁽¹¹⁾. In our study, there were no problems related to the body weight of the patients.

In recent decades, earlier surgical intervention was suggested to relieve the obstruction in patients with ureterocele and prevent significant damage of the urinary tract. Nowadays, some patients are treated prenatally. Besides, there are some controversies in the literature: can early treatment protect the urinary tract from serious damage^(6,8). In our study, the treatment was performed in neonatal period, immediately after necessary diagnostic procedure. All patients had completed initial surgical treatment (laser-puncture vs. electro-surgery-incision) by the age of 28 days.

Electro-surgery-incision, cold-knife incision and laser-incision are described surgical techniques for the treatment of ureterocele for relieving the obstruction. The technique in which a few separate punctures on the ureterocele wall are made is also described^(10,12,13). The punctures are being made until ureterocele collapses. In our first investigation group (LP group) we decided to perform that technique, using holmium: yttrium-aluminum-garnet laser. A better endoscopic control of the extensibility of the punctures was the reason to perform that endoscopic procedure. On the other hand, in our second investigation group (ES group) we performed standard electro-surgery-incision.

Ureterocele is not a very common anomaly. Most studies dealing with initial surgical treatment of ureterocele do not have much more respondents than in our study. In particular, laser-puncture (not incision) of ureterocele is not sufficiently mentioned in the literature, that's why we can discuss about it like, in a way, relatively new surgical technique^(14,15,16). Regardless of the small number of patients, when we compare the results of the two techniques in our study, we can preliminary state that there is no significant difference between laser-puncture and electro-surgery-incision in means of relieving the obstruction. After three months all patients are free of obstruction. Considering reported decompression rate in most series between 70% and 90%^(16,17), it is very clear that both techniques described in our study are highly effective in relieving the obstruction in patients with intravesical ureterocele.

De novo vesicoureteral reflux after the endoscopic treatment of ureterocele in neonates is well known. Accord-

ing to the literature, the incidence of a new reflux ranges from 0% to 75%^(16,18,19). During the endoscopic incision it is very difficult to estimate what lengthiness of the incision line is sufficient to relieve the obstruction and, at the same time, to prevent reflux. On the other hand, during the laser puncture the moment of collapsing the ureterocele was the sign to stop making the punctures. We presumed that the new punctures may contribute to the reflux. In our series the occurrence of de novo reflux is far more common in patients treated with electrosurgery-incision. It seems to be the main difference between two described endoscopic techniques.

The degree of the vesicoureteral reflux is a very important parameter. Theoretically, all degrees of reflux may occur in these patients. However, high grade reflux (grade IV and V) is more common. The occurrence of reflux, especially high grade reflux, often determine the necessity of appropriate surgical treatment. Currently, surgical technique of the initial endoscopic decompression of the ureterocele should imply prevention of vesicoureteral reflux. According to the literature, laser-puncture provides better protection of reflux^(19,20,21). Our study also proved this. Although this is a small group of respondents, it is very clear that possibility of reflux is lower after laser-puncture. The bottom line is that the puncture with laser beam is well controlled by the surgeon, who can stop to make the punctures immediately after collapsing of the ureterocele. It is supposed to be the critical moment when antireflux mechanism is still preserved.

It is still controversial in the literature is VUCG a mandatory procedure to all patients. Until 2012 we decided not to perform routine VUCG after the ureterocele decompression in order to avoid negative impact of ionizing radiation. If there was no urinary tract infection, ultrasound and radionuclide renal scan were normal, we performed observation only, like many other centers. Collapse of the ureterocele and reduction of the upper urinary tract dilation are reliable signs of decompression during the ultrasound examination and dynamic radionuclide renal scan after the endoscopic treatment of ureterocele. If the ureterocele is not collapsed and dilation persists, retreatment has to be performed. About 10% to 30% patients need retreatment^(10,17,18). In our series there is the difference between the groups in need for retreatment, but without statistical significance. In LP group retreatment means making a few new punctures on the ureterocele wall until it collapses. In ES group the line of the incision was extended 3 to 4 mm. Control ultrasound examination and diuretic renal scan showed the absence of the obstruction. It is clear that retreatment solves the problem of the obstruction, but the dilemma is: does it increase the risk of de novo vesicoureteral reflux?

It is important for the endoscopic treatment to be as short as possible, given that the procedure is performed in neonates. Twenty-three minutes was the median duration of general anesthesia, reported by Pagano et al.⁽²⁰⁾. Without significant difference between the groups, our study showed that both laser-puncture and electrosurgery-incision techniques allow the shortest possible patient's exposure to general anesthesia. Expediency of the surgical team plays a major role in this respect. Most patients with ureterocele are treated as outpatients. Extended hospital stay is reserved for patients with complications after the endoscopic treatment or

if some co-existing disorder implies prolonged postoperative follow-up^(10,18,21,22). Comparing our groups of patients, we found the difference between the groups: extended hospital stay is longer in patients treated with electrosurgery-incision, due to higher rate of postoperative complications, but without statistical significance. De novo vesicoureteral reflux, persistent obstruction, urinary tract infection, incontinence, forming of calculus, etc. are possible complications after the initial endoscopic treatment of ureterocele^(3,4,10,18,23,24). Obstruction and VUR were already discussed. There are many reasons for the occurrence of UTI. Stasis of urine contributes to the occurrence of UTI in any case. It is difficult to find relevant data in the current literature about the complications regarding endoscopic treatment of ureterocele (except vesicoureteral reflux and obstruction). In our series complications were found only in patients treated with electrosurgery-incision. In both patients, acute pyelonephritis was the complication, caused by high grade vesicoureteral reflux. However, we did not find statistically significant difference between the groups regarding complications.

It was already mentioned that there are many options for subsequent surgery after the initial treatment of ureterocele. The decision about what kind of surgery is the best choice for the patient depends on the complex anatomy of the urinary tract. Upper pole partial nephrectomy is one of the most probable options, if there is no function of the upper pole. Besides, there are authors who raise a question about partial nephrectomy^(25,26). We performed that procedure only if there were high grade vesicoureteral reflux and urinary tract infections, despite proven nonfunctional upper pole. Since there was no high grade reflux in patients treated with laser-puncture, upper pole partial nephrectomy was performed in none of the patients treated with that procedure. That is obviously a very important fact when talking about laser-puncture, like initial treatment of patients with intravesical ureterocele.

Endoscopic treatment of ureterocele is well documented in the literature. There are also publications about using holmium-laser, but, laser incision (not puncture) was mostly described^(20,27). The number of patients in these series is, mainly, too small for detailed analysis. Holmium-laser puncture (fenestration) of ureterocele has not been sufficiently discussed⁽²²⁾. On the contrary, using the holmium-laser in the treatment of other disorders of the urinary tract is widely documented, particularly in the treatment of stone-disease⁽²⁸⁻³⁰⁾. A laser beam penetrates the soft tissue to the depth of 0.5 mm⁽²⁸⁾. We decided to perform controlled use of laser beam in the endoscopic puncture of ureterocele, taking into account our experience in holmium-laser lithotripsy⁽³⁰⁾.

CONCLUSIONS

Both laser-puncture and electrosurgery-incision endoscopic techniques are highly effective in relieving the obstruction in neonates with intravesical ureterocele. There are no differences regarding hospital stay, the need for retreatment and the occurrence of complications. The incidence of de novo vesicoureteral reflux is significantly lower in patients treated with holmium-laser, as well as the need for upper pole partial nephrectomy. These facts make laser-puncture the preferred surgical technique for the treatment of intravesical ureterocele in neonatal patients.

CONFLICT OF INTEREST

The authors report no conflict of interest.

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