S H O R T
C O M M U N I C A T I O N S

UDC:616.61-003.7-053.2-089
https://doi.org/10.2298/VSP161010012I

Possibilities of retrograde intrarenal surgery in the treatment of renal lower pole stones in children

Mogućnosti retrogradne intrarenalne hirurgije u lečenju kalkulusa u donjem polu bubrega kod dece

Predrag Ilić*, Dejan Kostić†‡, Slobodan Džambasanović*, Mirjana Janković*, Vladimir Kojović*

Mother and Child Health Care Institute of Serbia "Dr Vukan Čupić",
***Urology Department, Belgrade, Serbia; Military Medical Academy,**
†Institute of Radiology, Belgrade, Serbia; University of Defence,
‡Faculty of Medicine of the Military Medical Academy, Belgrade, Serbia

Abstract

Background/Aim. Renal stones located in the lower pole of kidney represent a serious challenge for surgical treatment in children. The options are: open surgery, extracorporeal shock-wave lithotripsy, percutaneous nephrolithotomy and retrograde intrarenal surgery. Reports about the endoscopic treatment in children are limited. The aim of the study was to evaluate the effectiveness of retrograde intrarenal surgery in pediatric patients with renal stones in lower pole of the kidney. **Methods.** We retrospectively analyzed the results of the retrograde intrarenal surgery in 24 patients with renal stones in lower pole, between April 2012 and April 2016. Flexible ureterorenoscopy in combination with holmium laser lithotripsy were performed. We considered stone fragment size 3 mm or less as a measure of sufficient fragmentation of the stone. **Results.** Mean duration of general anesthesia was 68 (range, 40–90) minutes. Duration of hospitalization was 1–3 (mean, 1.6) days. Complications were found after two (8.4%) surgical procedures: perirenal haematoma in one (4.2%) and urinoma in one (4.2%) patient. The stone was completely fragmented in 18 (75%) patients. In 3 (12.5%) patients the stone was incompletely fragmented and in 3 (12.5%) patients the stone was not fragmented. Double J stent was placed in 5 (21%) patients. Mean follow-up was 9 (range, 6–18) months. **Conclusion.** Retrograde intrarenal surgery in children is the least invasive, effective and safe surgical procedure for stones in lower pole of the kidney, with minimal complication rate. Unsuccessful treatment in some patients was due to loss of ureterorenoscope deflection with laser probe in working channel.

Key words:
child; kidney calculi; lithotripsy, laser; postoperative complications; treatment outcome.

Apstrakt

Uvod/Cilj. Kalkulusi lokalizovani u donjem polu bubrega predstavljaju veliki izazov u hirurškom lečenju kod dece. Mogućnosti su: otvorena hirurgija, ekstrakorporalna litotripsija, perkutana nefrolitotripsija i retrogradna intrarenalna hirurgija. Broj publikacija o endoskopskom lečenju urolitijaze kod dece je ograničen. Cilj istraživanja bio je da se utvrdi efikasnost retrogradne intrarenalne hirurgije kod pedijatrijskih bolesnika sa kalkulusima lokalizovanim u donjem polu bubrega. **Metode.** Retrospektivno su analizirani rezultati retrogradne intrarenalne hirurgije kod 24 bolesnika sa kalkulusima u donjem polu, u periodu od aprila 2012. do aprila 2016. godine. Primenjena je fleksibilna ureterorenoskopija u kombinaciji sa laserskom litotripsijom. Kao mera uspešne dezintegracije kalkulusa smatrana je veličina partikule od 3 mm ili manja. **Rezultati.** Dužina opšte anestezije prosečno je iznosila 68 (opseg 40–90) minuta. Dužina hospitalizacije iznosila je 1–3 (prosečno 1,6) dana. Komplikacije su zabeležene posle dve (8,4%) hirurške intervencije: perirenalni hematom kod jednog (3,1%) i urinom kod jednog (3,1%) bolesnika. Kalkulus je bio u potpunosti dezintegrisan kod 18 (75%) bolesnika. Kod 3 (12,5%) bolesnika kalkulus je bio delimično dezintegrisan i kod 3 (12,5%) bolesnika kalkulus nije bio dezintegrisan. "Double J" stent plasiran je kod 5 (21%) bolesnika. Prosečni period praćenja iznosio je 9 (opseg 6–18) meseci. **Zaključak.** Retrogradna intrarenalna hirurgija kod dece je najmanje invazivan, efikasan i bezbedan metod hirurškog lečenja kalkulusa lokalizovanih u donjem polu bubrega, sa

Correspondence to: Predrag Ilić, Gandijeva 45a/27, New Belgrade, Serbia. E-mail: predrag.ilic70@yahoo.com

niskom stopom pojave komplikacija. Razlog neuspešnog ishoda kod pojedinih bolesnika jeste gubitak savitljivosti ureterorenoskopa sa laserskom sondom u radnom kanalu.

Ključne reči:
deca; nefrolitijaza; litotripsija, laser; postoperativne komplikacije; lečenje, ishod.

Introduction

The surgical treatment of urolithiasis in children is basically similar to treatment in adult patients, but anatomic and physiologic specificities makes it more difficult in pediatric patients [1, 2]. It is very clear that the narrow urinary tract in children is one of the biggest problems [3]. Renal stones located in the lower pole of the kidney represent the biggest challenge for surgical treatment in all patients, especially in children [4]. The options are: open surgery, extracorporeal shock-wave lithotripsy, percutaneous nephrolithotomy and retrograde intrarenal surgery. Open surgery is, in general, an out-of-date technique. Shock-wave lithotripsy is very limited for lower pole stones. Percutaneous nephrolithotomy is effective, but more invasive technique than the endoscopic treatment. Retrograde intrarenal surgery is the least invasive technique, but reports on the treatments in children are limited [5–7].

The aim of the study was to evaluate the effectiveness of a retrograde intrarenal surgery in pediatric patients with renal stones, located in lower pole calices of the kidney. We also evaluated the limitations of the endoscopic treatment in lower pole of the kidney.

Methods

We retrospectively analyzed the results of the retrograde intrarenal surgery in 24 patients with renal stones located in the lower pole calices of the kidney (Figures 1 and 2). The patients were treated between April 2012 and April 2016 (10 girls and 14 boys, mean age 9.2 years (range 4–18 years).

Fig. 1 – Stones in the lower pole of the left kidney, ureter and bladder (KUB) radiography.

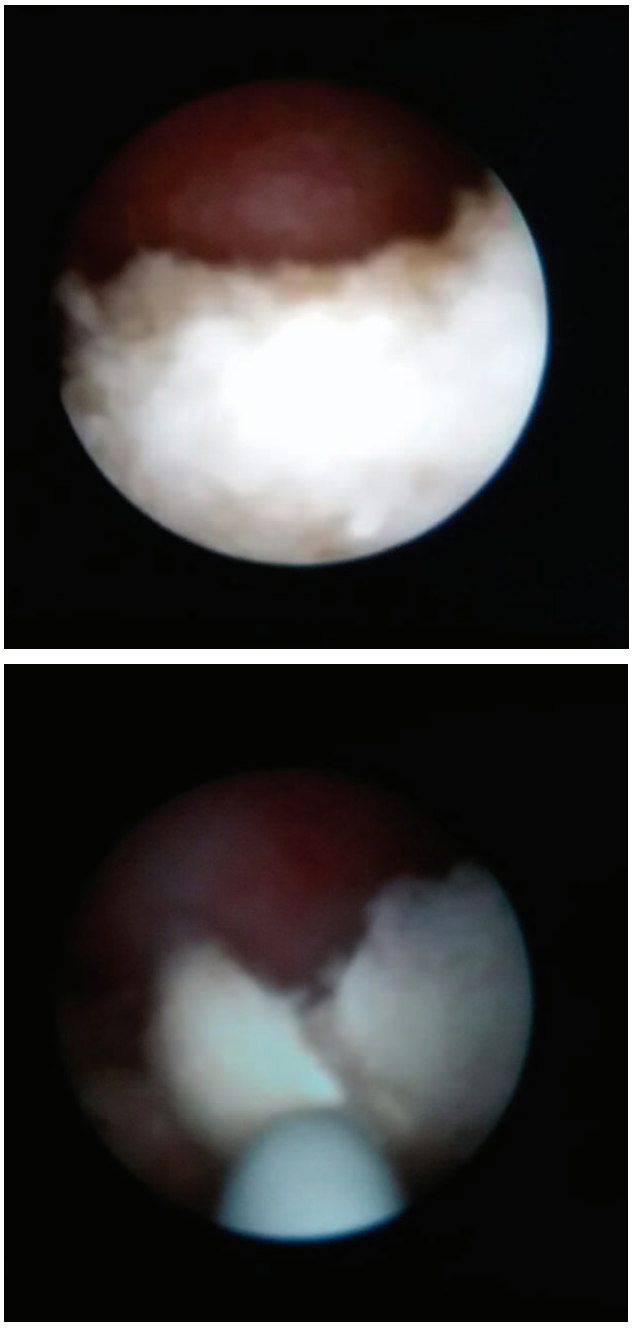

Fig. 2 – Endoscopic view of the retrograde intrarenal surgery in the lower pole of the kidney.

Patients with renal stones in other segments of the kidney (upper pole calices, renal pelvis) were excluded from the study. Flexible 7.5-F ureterorenoscopy with possibility of deflection of 270, in combination with holmium laser lithotripsy were performed in all patients, under the general anesthesia. Routine and bacteriological analysis of urine and kidney function tests were also evaluated. In all patients metabolic screening of urine was performed to find the cause

of stone formation. Ultrasound and kidney, ureter and bladder (KUB) radiography were performed to identify the location of the stone. Stones were measured by ultrasound. Patients received preoperative antimicrobial prophylaxis. After introduction through the ureteral orifice, flexible ureterorenoscope was placed through ureter to the renal pelvis. Then, the deflection of the flexible ureterorenoscope was performed in order to achieve an adequate stone visualization. We used a 365 μm and 230 μm probes with a 3 mV green helium light guide for transferring energy from the lithotripter to the stone. Micro laser fibers were used, generating 0.2 to 2 J at a frequency of 5 to 10 Hz. We considered stone size 3 mm or less as a measure for sufficient fragmentation of the stone. Some bigger particles were removed from the urinary tract by a stone-basket and smaller ones were left for spontaneous ejection. If ureteral wall damage was present, 4-F or 4.7-F double J stent was placed depending of the constitution and the age of the patient. We used to remove it after two to five days after the surgery. Ultrasound examination was performed in all patients during the first postoperative day. Depending on the severity of surgery, the patients were discharged between the first and the third postoperative day. After one, three and six months, patients were evaluated by urinalyses, kidney function tests, ultrasound and, in some cases, by KUB radiography. The size of the residual stone bigger than 3 mm was the indication for retreatment.

Results

Flexible ureterorenoscopy and holmium-laser nephrolithotripsy were performed in the total number of 35 procedures in 24 patients. There were 10 (41.7%) girls and 14 (58.3%) boys. Mean age was 9.2 years (range 3–18). In 20 (83.3%) patients a single stone was found and in 4 (16.7%) patients the multiple ones. Stones were located in left kidney in 9 (37.5%), in right kidney in 11 (45.8%) and in both kidneys in 4 (16.7%) patients. Mean stone size was 13 mm (range, 8–26 mm). Bacteriological findings of urine were normal in all patients (sterile urine culture) and also, kidney function tests (urea, creatinine) were within reference values (Table 1).

Table 1

Clinical profile of patients

Patients' characteristics	Values
Number of patients	24
female, n (%)	10 (41.7)
male, n (%)	14 (58.3)
Mean age (years), mean (range)	9.2 (3–18)
Single stone, n (%)	20 (83.3)
Multiple stones, n (%)	4 (16.7)
Stone side, n (%)	
left	9 (37.5)
right	11 (45.8)
bilateral	4 (16.7)
Mean stone size, mm (range)	13 (8–26)
Urine culture, n (%)	
sterile	24 (100)
UTI	/

n (%) – number (percentage) of patients; UTI – urinary tract infection.

Mean duration of general anesthesia was 68 minutes (range, 40–90 minutes). Duration of hospitalization was 1–3 days (mean, 1.6 days). Complications were found after two (8.4%) surgical procedures: perirenal haematoma in one (4.2%) and urinoma in one (4.2%) patient. The stone was completely fragmented in 18 (75%) patients. In 3 (12.5%) patients the stone was incompletely fragmented and in 3 (12.5%) patients the stone was not fragmented. Double J stent was placed in 5 (21%) patients. It was removed 2–5 days (mean 3.5 days) after the surgery. Mean follow-up was 9 months (range, 6–18 months) (Table 2).

Table 2

Results of surgical treatment

Parameters	Values
Number of procedures	35
Anesthesia duration (min), mean (range)	68 (40–90)
Retreatment, n (%)	11/24 (45.8)
Mean hospitalization (days), mean (range)	1.6 (1–3)
Complications, n (%)	2/24 (8.4)
perirenal haematoma	1/24 (4.2)
urinoma	1/24 (4.2)
Complete fragmentation, n (%)	18/24 (75)
incomplete fragmentation	3/24 (12.5)
no fragmentation	3/24 (12.5)
double J stent	5/24 (21)
Mean follow-up, (months), mean (range)	9 (range 6–18)

n (%) – number (percentage) of patients.

Discussion

Stones located in the lower pole calices of the kidney always represent one of the biggest problem in the surgical treatment of urolithiasis, especially in children [7, 8]. It is difficult to decide what kind of treatment is optimal in every particular case. Extracorporeal shock-wave lithotripsy (ESWL) is not sufficiently effective for stones located in that part of the kidney. On the other hand, there are many reports about very serious side effects of that kind of treatment in children after long term follow-up such as diabetes and hypertension. That is why many authors nowadays do not suggest ESWL as good choice of the treatment of renal stones in children [9, 10]. Also, some authors suggest combination of ESWL and retrograde intrarenal surgery for the most complicated cases [11].

When we talk about lower pole stones in children, the data in current literature are very limited. It is difficult to find guidelines or relevant suggestions on how to treat those patients [12]. Some authors suggest only observation/medical treatment option for asymptomatic patients [4]. Retrograde intrarenal surgery is mentioned like the best and less invasive surgical approach. However, that kind of treatment is associated with serious technical problems during flexible ureterorenoscopy in narrow urinary tract in children. When the stone is visualized and available for laser probe, the treatment is highly effective. In some patients, even if we visualize the stone, when the laser probe is inside the working channel, sufficient deflection of the flexible ureterorenoscope is lost. In that case the stone is not available for laser beam and the lithotripsy is impossible [12, 13].

Thus, the last observation represents limited success rate in the treatment of lower pole renal stones in children in our study. All other problems during flexible ureterorenoscopy were overcome, but problem of loss of ureterorenoscope deflection when the laser probe was inside the working channel could not be solved. We can state that was the only reason for unsuccessful treatment in one quater of our patients. Those patients were selected for percutaneous nephrolithotomy. The other option is open surgery, but that kind of treatment is no longer in the protocol for surgical treatment of nephrolithiasis in our institution [13–15].

The results of retrograde intrarenal surgery for the treatment of lower pole stones are different in various publications. Bozkurt et al. [4] report stone-free rate of 94%, while Kim et al. [8] report stone-free rate of 47%. In our series stone-free rate was 75%. Considering small invasiveness of that procedure in comparison with alternative surgical techniques, it represents a good result.

The occurrence of complications in retrograde intrarenal surgery is associated with stone composition, morphological and physiological conditions, constitutional characteristics of the patient, use of adequate equipment and surgeons' experience in endoscopic surgery. Ureteral perforation, urinoma, bleeding, renal puncture with instruments or accessories, postoperative hydronephrosis, urinary tract infection, urosepsis, etc. are possible complications [16–18]. None of them was found in our series. There were only two complications: perirenal haematoma in one patient and urinoma, also, in one patient. Those are, the so-called, "minor" complications, which do not affect the final outcome of the treatment (Grade II, Clavien-Dindo classification of surgical complications) [19]. Two days of prolonged hospitalization with bed rest and antibiotic intravenous therapy, were measures for the treatment of those patients. After three days ultrasound findings were correct.

Ureteral stenting after endoscopic lithotripsy was always controversial. In the past, that was a mandatory procedure, but recently it has been applied in fewer cases, required only in case of mucosal damage and in case there was a risk of ureteral stone particles obstruction [20]. In our series, five patients required double J stenting when the surgeon estimated that the degree of mucosal damage was significant. Double J stent was removed 2–5 days after the surgery and did not affect the final outcome of the treatment.

Conclusion

Retrograde intrarenal surgery in children is the least invasive surgical procedure for the treatment of stones, located in lower pole calices of the kidney. It is effective and safe kind of treatment, with minimal complication rate. In some patients retrograde intrarenal surgery is not effective because of specific anatomic conditions in lower pole, when the stone is not available for laser beam, even the deflection of flexible ureterorenoscope is maximal. In these patients the use of alternative surgical procedures should be considered, primarily percutaneous nephrolithotomy.

R E F E R E N C E S

1. *Copelovitch L.* Urolithiasis in children: Medical approach. Pediatr Clin North Am 2012; 59(4): 881–96.
2. *Hwang K, Mason MD, Peters CA.* Clinical practice: Surgical approaches to urolithiasis in children. Eur J Pediatr 2011; 170(6): 681–8.
3. *Thomas JC, DeMarco RT, Donohoe JM, Adams MC, Brock JW 3rd, Pope JC 4th.* Pediatric ureteroscopic stone management. J Urol 2005; 174(3): 1072–4.
4. *Bozkurt OF, Resorlu B, Yildiz Y, Can CE, Unsal A.* Retrograde intrarenal surgery versus percutaneous nephrolithotomy in the management of lower-pole renal stones with a diameter of 15 to 20 mm. J Endourol 2011; 25(7): 1131–5.
5. *Salerno A, Nappo SG, Matarazzo E, de Dominicis M, Caione P.* Treatment of pediatric renal stones in a Western country: A changing pattern. J Pediatr Surg 2013; 48(4): 835–9.
6. *Wu H, Docimo SG.* Surgical management of children with urolithiasis. Urol Clin North Am 2004; 31(3): 589–94, XI.
7. *Unsal A, Resorlu B.* Retrograde intrarenal surgery in infants and preschool-age children. J Pediatr Surg 2011; 46(11): 2195–9.
8. *Kim SS, Kolon TF, Canter D, White M, Casale P.* Pediatric flexible ureteroscopic lithotripsy: the children's hospital of Philadelphia experience. J Urol 2008; 180(6): 2616–9; discussion 2619.
9. *Kaye DM, Ahn HW, Hardy BE, Sherrod A, Huffman JL.* The effects of extracorporeal shock wave lithotripsy on renal growth, function and arterial blood pressure in an animal model. J Urol 1991; 146(2 Pt 2): 544–7.
10. *Abe T, Akakura K, Kawaguchi M, Ueda T, Ichikawa T, Ito H,* et al. Outcomes of shockwave lithotripsy for upper urinary-tract stones: A large-scale study at a single institution. J Endourol 2005; 19(7): 768–73.
11. *Ercil H, Alma E, Bas O, Sener NC, Vuruskan E, Kuyucu F,* et al. Treatment of Moderate Sized Renal Pelvis Calculi: Stone Clearance Time Comparison of Extracorporeal Shock Wave Lithotripsy and Retrograde Intrarenal Surgery. Urol J 2016; 13(1): 2490–5.
12. *Donaldson JF, Lardas M, Scrimgeour D, Stewart F, MacLennan S, Lam TB,* et al. Systematic review and meta-analysis of the clinical effectiveness of shock wave lithotripsy, retrograde intrarenal surgery, and percutaneous nephrolithotomy for lower-pole renal stones. Eur Urol 2015; 67(4): 612–6.
13. *Resorlu B, Issi Y, Onem K, Germiyanoglu C.* Management of lower pole renal stones: The devil is in the details. Ann Transl Med 2016; 4(5): 98.
14. *Shah HN.* Retrograde intrarenal surgery for lower pole renal calculi smaller than one centimeter. Indian J Urol 2008; 24(4): 544–50.
15. *Burr J, Ishii H, Simmonds N, Somani BK.* Is flexible ureterorenoscopy and laser lithotripsy the new gold standard for lower pole renal stones when compared to shock wave lithotripsy: Comparative outcomes from a University hospital over similar time period. Cent European J Urol 2015; 68(2): 183–6.
16. *Yahsi S, Tonyali S, Ceylan C, Yildiz KY, Ozdal L.* Intraparenchymal hematoma as a late complication of retrograde intrarenal surgery. Int Braz J Urol 2017; 43(2): 367–70.
17. *Berardinelli F, Cindolo L, de Francesco P, Proietti S, Hennessey D, Dalpiaz O,* et al. The surgical experience influences the safety

of retrograde intrarenal surgery for kidney stones: A propensity score analysis. Urolithiasis 2016; (In Press)

18. *Baş O, Tuygun C, Dede O, Sarı S, Çakıcı MÇ, Öztürk U*, et al. Factors affecting complication rates of retrograde flexible ureterorenoscopy: Analysis of 1571 procedures-a single-center experience. World J Urol 2017; 35(5): 819–26.
19. *Clavien PA, Barkun J, de Oliveira ML, Vauthey JN, Dindo D, Schulick RD*, et al. The Clavien-Dindo classification of surgical complications: Five-year experience. Ann Surg 2009; 250(2): 187–96.
20. *Chew BH, Seitz C.* Impact of ureteral stenting in ureteroscopy. Curr Opin Urol 2016; 26(1): 76–80.

Received on October 10, 2016.
Revised on December 23, 2016.
Accepted on December 28, 2016.
Online First January, 2017.