

ESWL Treatment of Urinary Stones in Children – The Overview of 14 Years of Experience

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ABSTRACT

Extracorporeal shock wave lithotripsy (ESWL) treatment has been used at Department of Urology, University Hospital »Osijek«, Croatia, since July 1988. Until December 2001 seven thousand and eight hundred patients underwent ESWL for urinary stones, 68 of them were children (0.87%). Sixty-eight children aged 4 to 15 years (average 10.14 years) underwent ESWL. They were treated for the total of 91 stones: 35 (38.46%) caliceal, 23 (25.27%) in pyelon, 7 (7.69%) in pyeloureteric segment and 14 (15.38%) ureteral. Staghorn calculi were found in 6 (6.59%) patients and multiple stones (four or more stones in the same kidney) in 6 (6.59%). There was total of 95 ESWL sessions performed in 68 patients (1.39 session per patient). Fifty-six patients (82.35%) without residual stones found at the control plain film and sonography of urinary tract were considered »stone free«. Addition of 5 patients with clinically insignificant residual fragments (less than 4 mm) increases overall success rate to 89.70%. ESWL is a simple, safe and effective procedure in the management of urolithiasis in childhood. Clinical experience of our institution confirms ESWL as the first line treatment for kidney stones in the pediatric age patients.

Key words: urolithiasis, children, ESWL.

Introduction

Extracorporeal shock wave lithotripsy (ESWL), the procedure resulting in urinary stones destruction allowing sponta-

neous expulsion of particles in urine, was introduced into routine clinical practice in 1980¹, fundamentally changing the

urinary stones treatment approach. The first paper on ESWL in children was published in 1986². The Urology Department, University Hospital »Osijek« began using the procedure in July of 1988^{3–13}.

The aim of this study was to evaluate indications, features, results, ancillary procedures, and complications related to the ESWL treatment for urinary stones in children applied at Urology Department, University Hospital »Osijek«.

Patients and Methods

Until December 2001, 7,800 patients underwent ESWL for urinary stones, of whom 68 (0.87%) were children, ranging from 4 to 15 years of age. Prior to the treatment, all patients underwent plain X-ray examination of the urinary tract, kidney sonography, intravenous pyelography, laboratory examinations of urine, laboratory examinations of blood (erythrocyte sedimentation rate, complete blood cells count, urea, creatinine, uric acid, blood clotting tests) and ECG. Some of the patients required metabolic evaluation of the urinary stones.

The ESWL treatment was performed using Siemens »Lithostar« lithotripter. All patients received antibiotic prophylaxis prior to the procedure, followed by abundant hydration with 1500–2000 mL of fluid intake and diuretics in adjusted dosage to induce forced diuresis. The results of a procedure were assessed by control plain film and urinary tract sonography 24 hours after the treatment. In patients with inadequate stone disintegration, ESWL was repeated 48 hours after the first session, within the same hospital admission. Stone particles appearing in urine were analyzed by infrared spectrophotometry. First outpatient control examination was scheduled 3 weeks after dismission. The final treatment results were evaluated 3 months after the last ESWL session, considering plain film

and urinary tract sonography, and laboratory (biochemistry and microbiology) findings.

Results

Of 68 children treated with ESWL for urinary stones, 43 were boys (63.24%) and 25 girls (36.76%). The average age was 10.14 years, ranging from 4 to 15. Twenty children (29.41%) were in the 4–9 years age group, and 48 (70.59%) were between 10 and 15 years old. We treated the total of 91 stones: 35 (38.46%) caliceal, 23 (25.27%) in pyelon, 7 (7.63%) in pyeloureteric segment, and 14 (15.38%) ureteral. Staghorn calculi filling up pyelon and at least one group of calices were found in 6 (6.59%) patients, whereas multiple stones (four or more in the same kidney) in 6 (6.59%). Fifty-one stones (56.04%) were less than 11 mm in diameter, twenty-one were 11–20 mm (23.07%), and 19 stones were more than 20 mm (20.88%) in diameter (multiple and staghorn calculi included).

Ancillary procedures were necessary in 13 patients treated with ESWL: 9 »JJ stents« were placed into 9.87% patients, the »push&bang« procedure was applied in 2 patients (2.94%), and in 2 other patients (2.94%) with ureteral radiolucent stones retrograde catheters were introduced for contrast imaging to be performed during ESWL treatment.

A total of 95 ESWL sessions were performed in 68 patients (an average of 1.39 sessions per patient). The average number of shock waves per session was 2,200 (ranging from 400 to 3,200), with an average 17.2 KV of energy delivered (range, 15.4–18.1 KV). The patients were exposed to fluoroscopy 1.1 minutes on average (range, 0.3–3.9 minutes), with an average of 2 X-rays exposures per session (range, 0–9).

The final validation of the treatment results was performed 3 months after the

last ESWL session (Figure 1) using the control plain film and urinary tract sonography. Patients without residual stones were considered »stone free«.

In 21 patients (30.88%), the ESWL treatment was performed under general anesthesia. In 34 patients (50.00%), an analgesic was administered intramuscularly: diclofenac in 26 and pentazocin in 8. Diazepam was added to diclofenac for another 13 patients (19.12%).

None of the patients experienced any of the possible, early or late, serious complications, including kidney hematoma and arterial hypertension. Five children (8.82%) had fever exceeding 38 °C, which disappeared following the antipyretic therapy. »Steinstrasse« appeared in 9 patients (13.23%). Four of them experienced spontaneous expulsion of »steinstrasse« particles in urine following conservative treatment, and 3 other children received »JJ stents« because of significant hydronephrosis and strong pain. In 2 patients ureterorenoscopy was necessary.

Discussion

Applying ESWL to children requires minimal technical changes, in comparison with the usual technique. Most of the authors recommend limited number of shock waves and limited energy rate to avoid possible damage to vulnerable kidney tissue. Our study included children who received the maximum of 3,200 shock waves per session. We preferred repeated sessions, i.e., treatment of the same stone 48 hours after the previous session, which is the reason for seemingly high 1.39 sessions per patient. Fluoroscopy was applied very cautiously (1.1 minutes on average), and so were the X-rays expositions (average of 2 per session), which is both less than in adults' treatments³.

Some authors mention pulmonary parenchymal damage occurring particularly in children shorter than 120 cm^{14,15}. The

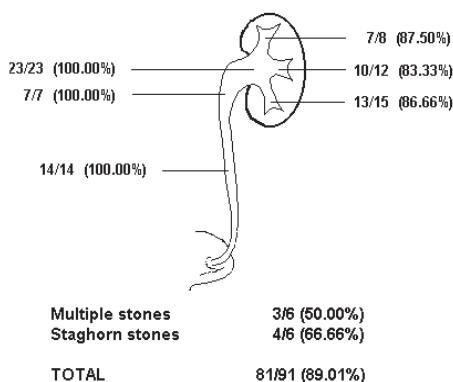


Fig. 1. Stone-free ratio three months after the ESWL treatment (n = 91).

second-generation device locates the stone more precisely and focuses shock waves more accurately with minimal energy dispersion into surrounding tissues, rendering chances for pulmonary damage to minimum^{16–19}. Still, we used polystyrene (»styrofoam«) shield to protect the lung tissue. The edges of the shield were marked by metal wire enabling continuous and accurate control of its position. There is a disputable and still poorly investigated possibility of shock waves affecting germinative ovarian tissue when treating stones located on the imaginary line between the middle and distal third of ureter^{20,21}. Therefore, some authors consider this stone location to be the contraindication for ESWL treatment in girls. In our study, 2 girls presented with stones in this location, and the possible risk of damaging the ovarian tissue was avoided by using the endoscopic procedure. In one of the girls we performed »push&bang«, and in the other the stone was moved proximally following »JJ« insertion.

Other authors reported the need for general anesthesia in 30–100% patients^{16,19,22–25}. Our experience was that

the choice of whether to perform the procedure under anesthesia depended primarily on the patient's age and psychological preparedness on one hand, and urologist's education and patience on the other. Initially, all patients under 12 years of age were operated on under general anesthesia. In time, age was rejected as the most important criterion. The growing experience with successful ESWL treatments justified use of only sedatives and analgesics even in a 5-years old child. General anesthesia was used in only one third of patients.

Comparing our results to those of other studies on ESWL of urinary stones in children, we run into some obstacles. First, the definition of a child is not consistent throughout the literature. Reports on children consider variable maximal age – 14, 16, or 18, and even 20 years^{14,16,22,25-28}. Second, the small proportion of children among patients with urinary stones (1–3%)²⁹ implicates poor experience with that kind of population

in particular centers, ranging in number from 8 to 79^{22,25}. The machines used vary in quality (first, second, and third generation), and in modalities of procedure. For the purpose of drawing parallels between different authors' results, a certain level should be achieved in the time length of patient's follow-up, as well as the criteria for considering the stone removal successful. Also, the knowledge on possible damages of ESWL to juvenile tissues (skeletal, germinative ovarian, late appearance of arterial hypertension, etc.), is poor due to the lack of long-term studies. The reason for this is in the fact that the method has been introduced recently (first report in 1986). However, the proportion of »stone free« patients after ESWL in this study (89.01%) is comparable to those most successful reported by other authors (from 50 to 97%)^{16-19,22,23,25,27,30,31}. The absence of serious early or late complications in the study is consistent with data referred from other centers^{17,18,24-26}.

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ESWL LIJEČENJE UROLITIJAZE KOD DJECE – ČETRNAESTOGODIŠNJE ISKUSTVO UROLOŠKE KLINIKE U OSIJEKU

S A Ž E T A K

U Klinici za urologiju, Kliničke bolnice Osijek, u srpnju 1988. godine uvedena je metoda izvantjelesne udarno-valne litotripsije kamenaca urotrakta (ESWL). Do prosinca 2001. godine ovom metodom liječeno je sedam tisuća i osam stotina bolesnika, među njima 68 djece (0,87%). Šezdeset i osmero djece starih od 4 do 15 godina (prosječna dob 10,14 godina) liječeno je ESWL-om. Ukupno je tretiran 91 kamenac: 35 (38,46%) u čašicama, 23 (25,27%) u nakapnici, 7 (7,69%) u pijeloureteralnom segmentu i 14 (15,38%) u mokraćovodu. Odljevni kamenci nađeni su u 6 (6,59%) bolesnika, a višestruki kamenci (četiri i više kamenaca u istom bubregu) u sljedećih 6 (6,59%). ESWL tretman urađen je litotriptorom »Lithostar«, Siemens. Ukupno je urađeno 95 ESWL seansi u 68 bolesnika (1,39 seansi po bolesniku). Dodatnih 5 bolesnika, s klinički beznačajnim zaostalim fragmentima (promjer manji od 4 mm), povećava stopu uspješnosti na 89,70%. ESWL je jednostavna, sigurna i učinkovita metoda za odstranjivanje kamenaca urotrakta u dječjoj dobi. Kliničko iskustvo naše ustanove potvrđuje ESWL kao metodu prvog izbora u liječenju dječje urolitijaze.