Journal of Pediatric Surgery (2013) **48**, 835–839

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Journal of Pediatric Surgery

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# Treatment of pediatric renal stones in a Western country: A changing pattern

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Received 17 May 2012; revised 3 August 2012; accepted 10 September 2012

**Key words:**
Nephrolithiasis;
Child;
ESWL;
RIRS;
PCNL;
Laser

**Abstract**

**Background:** Over the last 10 years the miniaturization of endoscopic instruments made minimally invasive procedures for kidney stones feasible even in children. The evolution in management of kidney stones in a tertiary care center in Europe is reported.

**Methods:** Patients treated in our hospital for kidney stones from 2002 to 2011 were reviewed and group A (2002 to 2006) was compared with group B (2007 to 2011). The therapeutic options offered were Extracorporeal Shock Waves Lithotripsy (ESWL), Retrograde Intrarenal Surgery (RIRS), Percutaneous Lithotripsy (PCNL) and open surgery. Outcome measures were: first treatment chosen, stone free rate after a single procedure, and retreatment. Results were compared by chi-square test, with $p < 0.05$ considered statistically significant.

**Results:** 333 patients, mean age 9.7 years, were treated, 161 in group A and 172 in group B. ESWL was the first option in both groups, but decreased by 34% in group B vs A. In contrast, RIRS and PCNL increased by 17% and 16%, respectively, in group B vs group A. Open surgery was never required in primary lithiasis cases without associated malformations.

**Conclusion:** The advent of PCNL and RIRS has significantly changed the pattern of renal stone treatment in the pediatric age group. A progressive increase of endourologic minimally invasive procedures was recorded. Open surgery should be a very rare option.



Urolithiasis in pediatric patients is a relatively rare condition with a prevalence of around 2% [1]. Recent studies have shown that the prevalence and treatment of stone disease have increased over last 10 years, especially in children <15 years [1]. Several factors can predispose children to develop urinary stones and among them, metabolic and genitourinary abnormalities are particularly important; diet, environmental factors and infectious causes may also play a role. Urolithiasis in children is associated with considerable morbidity and has a high recurrence rates, 5 fold more likely than in adults [2]. At diagnosis, most stones are found in the kidneys, with remnants being found in the ureters [3]. The surgical management of urolithiasis in children has evolved dramatically in the last 2 decades. Open

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http://dx.doi.org/10.1016/j.jpedsurg.2012.09.058

surgical procedures have progressively been replaced by minimally invasive and noninvasive procedures [4–6]. In 1978 the advent of Extracorporeal Shock Wave Lithotripsy (ESWL) revolutionized pediatric stone management. ESWL is currently the procedure of choice to treat most upper urinary tract calculi in industrialized countries. During the last few decades, advances in technology and the development of smaller and more versatile endoscopes have enabled endourologists to apply their skills in the treatment of pediatric stone disease [7]. We report our experience in the treatment of pediatric renal stones in the last decade, with attention to the evolution of management and minimally invasive techniques.

## 1. Material and methods

Since June 2002, all data regarding patients admitted for urinary stone disease to our Urology Department were prospectively collected in a specific database. The records of all patients treated for kidney stones from June 2002 to December 2011 were retrospectively reviewed. Ureteric and bladder stones and patients with stones secondary to obstructive uropathy (hydronephrosis and megaureter) were excluded. Patients were divided into two periods, Group A (2002 to 2006) and Group B (2007 to 2011). All patients underwent metabolic study on a 24 h urine collection (cystinuria, calciuria, citraturia, oxaluria) and imaging evaluation (urinary tract ultrasound, plain abdomen radiograph and computed tomography (CT) scan) if requested. The therapeutic options offered were: ESWL, endoscopic procedures (retrograde intrarenal surgery, RIRS), percutaneous nephrolithotripsy (PCNL), and open surgery. Medical therapy was undertaken in all patients according to the specific metabolic or genetic alteration. Prophylactic perioperative wide-spectrum antibiotics were administered to patients with sterile urine, and patients with bacteriuria were previously treated.

ESWL was performed using an Edap Sonolith 4000 lithotripter and Piezolith 3000, with real time ultrasound system of tracking. The mean energy used was 450,000 (330,000–694,000) kJ with 2500 (1900–3500) shock waves.

For RIRS and retrograde ureteroscopy (ULT), the children were placed in the lithotomy position on the endoscopy table with fluoroscopic imaging capability. Lithotripsy was performed with a semirigid ureteroscope (7.5 Fr, 6.5 Fr and 4.5 Fr). A flexible ureteroscope was used for nephroscopy. For inferior calyx stones, a relocation was performed in the pelvis or a superior calyx, if possible. At the end of the procedure a ureteric open-ended catheter was always left in place and removed in the next 24–72 h. When it was difficult to dilate the ureter or pass the ureteroscope, the patients underwent Double-J stent placement one month before definitive ureteroscopy.

PCNL was carried out in the supine position (Valdivia–Galdakao modified). Dilatation of the nephrostomy access was performed by Amplatz dilators to 24 Fr and a 22 Fr nephroscope was used for stone fragmentation. At the end of the procedure, flexible nephroscopy was performed in order to assess the complete stone clearance.

Energy sources used for lithotripsy included ballistic energy by 1.9 Fr probe for PCNL and Holmium-Yag laser by 400 micron fibers for RIRS. All procedures were carried out under general anaesthesia.

Patients were evaluated at 1 and 3 months after treatment by ultrasound and plain radiography. Success of treatment was determined as completely stone free or clinically insignificant residual fragments on a plain abdominal radiograph (largest fragment $<3$ mm). When residual fragments were $>3$ mm, ancillary procedures were performed. After ESWL, we performed ULT of residual fragments. After PCNL and RIRS residual fragments were treated with ESWL. Epidemiological data, treatment and outcome in the two groups were compared. Outcome measures were: first treatment chosen, stone free rate after a single procedure,

**Table 1** Demographic data.

| GROUP | A | B | *P*-value |
|---|---|---|---|
| | n 161 | n 172 | |
| Males | 90 (56%) | 86 (50%) | .56 |
| Age | 19 months–17 years | 1–15 years | .67 |
| Stone burden (cm) | 0.5-4 | 0.5-4 | |
| Inferior calyx | 20 (12.4%) | 28 (16.2%) | .22 |
| Superior calyx | 35 (21.7%) | 29 (16.8%) | .32 |
| Medium calyx | 31 (19.2%) | 36 (20.9%) | .41 |
| Pelvis | 32 (19.8%) | 38 (22.09%) | .38 |
| Staghorn stone | 43 (26.7%) | 41 (23.8%) | .21 |
| Cystina | 16 (9.9%) | 18 (10.4%) | .54 |
| Monohydrata calcium | 23 (14.2%) | 28 (16.2%) | .43 |
| Dihydrate calcium | 48 (29.8%) | 68 (39.5%) | .52 |
| Uric acid | 2 (1.2%) | 4 (2.3%) | .41 |
| Struvite | 36 (22.3%) | 40 (23.2%) | .62 |
| Other | 36 (22.3%) | 14 (8.13%) | <.05 |
| ESWL | 145 (90.06%) | 97 (56.3%) | <.05 |
| RIRS | 5 (3.1%) | 34 (19.7%) | <.05 |
| PCNL | 11 (6.8%) | 41 (23.8%) | <.05 |

**Table 2** Treatment modality in group A (2002–2006).

| Treatment modality | ESWL | PCNL | RIRS |
|---|---|---|---|
| No. patients | 145 | 11 | 5 |
| Mean age (years) | 8.03 | 13.04 | 7.08 |
| Mean diameter (mm) | 15 | 28 | 13 |
| Range diameter (mm) | 0.5–2.4 | 1.3–3.8 | 0.5–2.1 |
| Stone free rate (#) | 81 | 4 | 4 |
| % | 55.8% | 36.3% | 80.0% |
| Re-treatment (#) | 50 | 4 | 0 |
| Ancillary procedures (#) | 14 | 3 | 1 |