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What changed in the management of pediatric stones after the introduction of minimally invasive procedures? A single-center experience over 24 years

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Abstract *Objective:* To assess the impact of new technology on the management of pediatric urolithiasis by analyzing our local practice over the past 24 years, and determining the role of open surgery at the present time.

Methods: We retrospectively reviewed the charts of 768 children (783 procedures) who underwent surgical treatment for urolithiasis between June 1987 and October 2010. Data were analyzed with respect to patient characteristics and changing patterns of treatment with time. We compared the type of procedures performed between four time periods: the first was before ESWL, the second was after the introduction of ESWL, the third was after introduction of PCNL, and the fourth was our experienced period with a pediatric urologist.

Results: The mean age of the children was 7.50 years (range 9 months–17 years). There were 495 renal, 228 ureteral, 21 bladder, 11 urethral stones, and the remaining 13 had stones in multiple locations. Of the 783 procedures performed, 75.9% were open surgery during the first period (1987–1992), 29.7% during the second period (1993–1998), 6.1% during the third period (1999–2004) and 0.2% during the fourth period (2005–2010). The number of children who underwent urinary stone treatment increased significantly ($p = 0.001$) and the age of the children at the time of surgery decreased (9.09–6.08 years) ($p = 0.001$) with time.

Conclusion: The majority of stones in children can be managed using endourological procedures. Additionally, technological advances and improved surgical skills have greatly reduced the number of children requiring open surgery, which is mainly used for those with complex urinary calculi presenting with anatomic abnormalities. Minimally invasive techniques allow us to treat stones at an earlier age.

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Introduction

Pediatric urolithiasis has an overall incidence of 1%–2% of that observed in the adult population [1]. Urolithiasis is an endemic disease in our country and has an incidence of 17% among children, as stated by Tellaloglu et al., in 1984 [2]. Calcium oxalate stones are the most frequently seen type of urinary stone disease, which is consistent with other countries [3]. Non-calcium-containing stones (uric acid, struvite, cystine) are the other types determined in children. In the past 30 years, since the introduction of endoscopic managements including extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL) and ureteroscopy (URS), the surgical practice of urolithiasis has dramatically shifted towards these much less invasive procedures and away from open surgery. Following successful results in adults, minimally invasive modalities rapidly became a standard treatment for children with urolithiasis as well, while previously most children with urinary stones had undergone open surgery [4].

In addition, metabolic abnormalities contribute to pediatric urolithiasis more often than in adults. The higher risk of stone recurrence in children favors minimally invasive treatment rather than repeated open surgery. The aim of this study was to compare the current management of pediatric stone surgery at our institution with the situation before introduction of endourological procedures, and assess the impact of new technology on the management of pediatric urolithiasis by analyzing our local practice changing with time over the past 24 years.

Methods

A total of 867 procedures were performed at our institute for the purpose of stone removal or fragmentation between 1987 and 2010 in children who were 17 years or younger. We excluded 84 procedures due to missing data. Retrospective chart review of these children was performed focusing on age at presentation, treatment alternatives performed and outcome. Data were analyzed with respect to patient characteristics and changing patterns of treatment with time in our clinic. We compared the types of procedure performed during first (1987–1992), second (1993–1998), third (1999–2004) and fourth (2005–2010) time periods.

The first period covered the time before the introduction of ESWL, the second period was after the introduction of ESWL, the third period was after the introduction of PCNL, and the fourth was our experienced period having been joined by a pediatric urologist.

Procedures were categorized as follows: ESWL, URS, PCNL, endoscopic urethral and bladder stone extraction, and open surgery. The indications for surgery and the surgical approach were defined from the patient chart and operative notes. Concomitant urologic anomalies were determined by preoperative findings and confirmed by intraoperative data. ESWL treatment was counted as monotherapy for every single child regardless of the number of sessions. The results were designated as stone free or as having residual stones (any evidence of persistent stone fragments irrespective of size). Children were evaluated by IVU and/or ultrasonography 12 weeks after the treatment. The stone-free rates were determined according to the time periods.

Statistical analysis was performed using ANOVA with Tukey HSD, Chi-square test and *t*-test with statistical significance determined by $p < 0.05$. SPSS 15.0 program was used for the statistical analysis.

Results

Complete data were available for 783 procedures in 768 children. Of these, 54 were performed during the first period, 148 during the second period, 178 during the third period and 403 during the fourth period. Stone location was renal in 495, ureteral in 228, bladder in 21, urethral in 11, and the remaining 13 had stones with multiple locations. The mean age of the children was 7.50 years (range 9 months–17 years). Boys/girls ratio (M/F) was 1.36.

Overall, endourological procedures (ESWL, PCNL, URS, cystolithotripsy, endoscopic urethral stone extraction) were performed as an initial treatment in 686 cases (87.61%). The other 97 cases (12.39%) were treated by open surgery. Endourologic procedures were ESWL in 435 (55.56%), PCNL in 136 (17.37%), URS in 95 (12.1%), cystolithotripsy in 9 (1.14%), and endoscopic urethral stone extraction in 11 (1.41%) cases (Table 1).

A total of 13 endourological (24.1%) and 41 open (75.9%) procedures were performed during the first period. Stone-free rates were 100% (13/13) and 88.6% (36/41) for

Table 1 Types of open surgery and endourological procedures.

Type of surgery	<i>n</i> (%)	Overall <i>n</i> (%)	
Open surgery	Pyelolithotomy	39 (4.98)	97 (12.39)
	Nephrolithotomy	18 (2.29)	
	Ureterolithotomy	23 (2.94)	
	Cystolithotomy	14 (1.79)	
	Nephrectomy	2 (0.26)	
	Partial nephrectomy	1 (0.13)	
Endourological procedures	ESWL	435 (55.56)	686 (87.61)
	PCNL	136 (17.37)	
	URS	95 (12.1)	
	Urethral basket	11 (1.41)	
	Cystolithotripsy	9 (1.14)	

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