

Minimal access surgery in the management of pediatric urolithiasis

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Background: In contrast to adult patients, a relatively large number of open surgical procedures are still needed in the treatment of urolithiasis in children. Since almost all open surgical techniques may be reproduced by minimal access surgery (MAS), there is a rationale to apply the latter in the management of pediatric urolithiasis. Our study aimed to assess the feasibility and outcome of MAS in the treatment of pediatric urinary calculi.

Methods: The charts of patients with urolithiasis submitted to MAS between 1994 and 2007 were retrospectively reviewed. The inclusion criteria were contraindication for and failure of lithotripsy or endourology techniques. Demographic data, lithiasis characterization (location, dimension, composition), predisposing factors (anatomic or metabolic) and surgical approach (technique and outcome) were evaluated.

Results: Fifteen consecutive patients (eight girls, seven boys) with a median age of 108 months (range: 10–297 months) were elected for MAS. Eleven (73%) children had associated urogenital malformations and three (20%) presented metabolic abnormalities. A total of 17 procedures were performed laparoscopically: three nephrolithotomy (one transperitoneal, two by retroperitoneoscopy), four pyelolithotomies (retro), three ureterolithotomy (trans) and seven cystolithotomies (suprapubic approach). Five patients underwent concomitant correction of urological anomalies (three calyceal diverticula, one obstructive megaureter, one ureteropelvic junction obstruction). Complete removal of calculi was accomplished in 14 (82%) procedures. There were two perioperative complications (one intraperitoneal vesical perforation and one perivesical urinoma). At a median follow up of 4 years (range, 1 month to 11 years), four patients have developed recurrence.

Conclusions: MAS is an effective and safe approach for urolithiasis in children who are not candidates for minimally invasive modalities.

Keywords: Minimal access surgery (MAS); pediatric urolithiasis

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Introduction

The management of urinary tract calculi has dramatically changed in the past two decades, mainly due to the improvement and efficacy of pediatric endourology instruments and lithotripsy techniques. However, a substantial proportion of pediatric cases still need surgery

(1,2). Indeed, a surgical approach is required not only for failed endourologic or extracorporeal shock wave/percutaneous lithotripsy but also as a first choice in patients with anatomic considerations that preclude the use of these minimally invasive modalities (3).

Classical open procedures such as cystostomy, ureterostomy, myelotomy and nephrectomy have been

reported as reproducible by minimal access surgery (MAS) (4,5). The aim of the current study was to evaluate the feasibility and outcome of MAS in a series of pediatric patients with urinary stone disease.

Methods

The charts of patients suffering from urinary tract stones managed by MAS between 1994 and 2007 were retrospectively reviewed. The following parameters were analyzed: age, sex, associated urogenital malformations and metabolic abnormalities, location, size and composition of calculi, surgical approach and outcome.

Diagnostic work up included renal ultrasonography to localize stones and to check for urinary tract abnormalities and occasionally urography by magnetic resonance and succimer (DMSA) scintiscan; all patients underwent metabolic evaluation before or after stone removal. At time of surgery, they were free from infection and received a broad-spectrum intravenous antibiotic at the beginning of the procedure. MAS was considered in the cases of failure or contraindication of minimally invasive modalities, such as ESWL and endourology procedures; the latter were not available for small children.

The technique used for extraction of calculi was chosen according to the location and size of the stones. Briefly, pyelolithotomy was performed by the retroperitoneoscopic lateral approach, recently published (6). Stones were visualized and extracted with a rigid grasping forceps or a flat-wired basket; if too large to be passed through the trocar they were placed in a small laparoscopic bag (usually the finger of a glove) and removed at the end of the procedure. The myelotomy was then closed or a dismembered pyeloplasty was performed in the case of associated ureteropelvic junction obstruction. The approach for nephrolithotomy was the same. The thinnest part of the cortex was incised using ultrasonic scissors and the stones extracted. The nephrectomy was then sutured; in cases of calyceal diverticulum the thin wall of the diverticulum was excised when viable; if not, the urothelium was fulgurated and the cavity filled with biological glue. Ureterolithotomy by transperitoneal approach (usually with three ports) was favored for distal ureteral calculi; after ureteral identification, dissection down to the calculus was performed, and a loop or a Babcock forceps was placed around the ureter, proximal to the stone, to prevent migration. The ureter was incised longitudinally over the stone and the calculus grasped and removed; the

ureterostomy was then sutured; if there was no stricture, no ureteral drainage was left in place. Cystolithotomy was performed under cystoscopic control; if no urethra or Mitrofanoff conduit was available, the bladder was filled through a suprapubic cystostomy with a 22-gauge needle until easily palpable. A small suprapubic incision was made to introduce a 3- or 5-mm trocar (occasionally a 11-mm trocar) and telescope. The second suprapubic port was introduced under visual control. In the patient with augmentation enterocystoplasty, the incision was made as low as possible. Calculi less than 8 mm in diameter were extracted by suction; for calculi around 10 mm, a grasping forceps was used.

Results

During a 14-year period, 60 patients with urinary lithiasis were treated at our institution. Among them, 16 (27%) have spontaneously eliminated the stone, 21 (35%) were submitted to minimally invasive modalities (ESWL and endourology) and 23 (38%) underwent a surgical approach.

Fifteen consecutive patients (8 girls, 7 boys; mean age: 108 months; range, 10–297 months) were treated by MAS.

Seven (47%) patients had renal stones (four calyceal, three pyelic), three (20%) ureteral and five (33%) vesical. The average size of the stones was 13 mm (greatest diameter). The majority of patients (73%) presented urogenital abnormalities, the most common being calyceal diverticulum; three (20%) patients had metabolic abnormalities; only two children had no predisposing factors. Six (40%) patients were previously submitted to ESWL.

There were 17 procedures. There were three nephrolithotomy (one transperitoneal, two by retroperitoneoscopy), four pyelolithotomies (all by retroperitoneoscopy), three ureterolithotomy (all transperitoneal) and seven cystolithotomy (by suprapubic approach); concomitant correction of urological malformations was done in five patients.

Stone removal was effective in 14 (82%) procedures. Three cases remained with residual stones, but one stayed asymptomatic requiring no additional treatment; one case was re-operated due to intrinsic obstructive megaureter which was initially misinterpreted as secondary to obstructive stone, and the other was submitted to ESWL. Overall, there were two (12%) perioperative complications.

The mean operative length was 113 min (range, 20–235 min) with substantial differences due to the type of technique and associated malformations (mean,

nephrolithotomy: 117 min; pyelolithotomy: 160; ureterolithotomy: 188; cystolithotomy: 52). The average hospital stay was 2.3 days (range, 12 h to 5 days); the mean follow up was 4 years (range, 1 month to 11 years). Four patients (27%) developed lithiasis recurrence.

Discussion

Recent published literature emphasizes the substantial impact of technological advances in ESWL, ureteroscopy and percutaneous nephrostolithotomy on the treatment of pediatric urolithiasis. However, the need for surgical removal remains more frequent in children (up to 17%) than in adults (2%) (7,8); this may be due to different stone characteristics, patient size and success rate of minimally invasive modalities, and presence of associated anomalies needing simultaneous surgical correction (3). In fact, in our series 40% of the patients had been previously submitted to unsuccessful ESWL and 73% presented associated urogenital anomalies.

The ideal treatment should be effective and safe, i.e., it should achieve stone-free status after one anesthetic procedure with no morbidity. This assumption is even more important and difficult to achieve in children because there is a greater chance of stone recurrence due to the higher incidence of metabolic abnormalities, persistence of infections and a longer risk period; therefore, the opportunity to reduce the likelihood of repeated or major procedures is very attractive.

The first-choice treatment of urinary tract stone disease in children is, at present, a mini invasive modality (ESWL, ureteroscopy/laser lithotripsy, lithoclast or percutaneous nephrolithotomy), which is chosen mostly according to stone location (9).

For renal or proximal ureteral calculi, ESWL is the preferred option; however, the majority of pediatric patients submitted to ESWL need general anesthesia (7) and, as reported recently by Wadhwa *et al.*, the re-treatment rate may reach 58% (10). In the current series, 82% of procedures resulted in stone-free status, with 12 out of 15 patients cured after only one MAS procedure. Furthermore, factors such as small patient size, stone in anterior calyceal diverticulum and calculi greater than 20 mm are related to higher complication and lower stone-free rates for ESWL and endourology techniques (e.g., percutaneous nephrolithotomy) (10). These issues are less relevant for a MAS approach. Concerning the association of urolithiasis and urological congenital anomalies such

as ureteropelvic junction obstruction and obstructive megaureter, until recently it was consensual to perform open surgery in order to treat lithiasis and uro malformations simultaneously. Nowadays, if concomitant reconstructive surgery is necessary, laparoscopic (11,12) or robotic surgery are good options in experienced centers (13,14). The treatment of choice in the presence of calyceal diverticulum is not consensual; for most adult urologists it does not preclude the use of minimal invasive modalities (15), but in the pediatric population the limitations of the latter (size of instruments, accessibility) and the higher risk of recurrence (especially when residual stones are left in place) favor the surgical approach that allows stone extraction and concomitant excision of the symptomatic diverticulum (12). Ureteroscopy under general anesthesia may be the first-choice therapy for ureteral distal stones (16); isolated or complemented with laser/ultrasound lithotripsy it is effective in almost all patients (17). However, a not negligible proportion of ureteral stones in children are managed by open surgical procedures (17), because of the lower efficacy of lithotripsy for ureteral stones and the fact that recent pediatric instruments are not easily available or may not be applicable in smaller children. In our series, there were three ureterolithotomy performed by transperitoneal approach with one operative complication (18). In vesical lithiasis the surgical approach has been advocated as the most efficient technique (19). In our series all cases presented associated predisposing abnormalities, and some have required previous vesical endoscopic or surgical procedures/manoeuvres (one vesical exstrophy, one vesical rhabdomyosarcoma, one posterior epispadias submitted to enterocystoplasty). Six out of seven vesical stones measured 10 mm or more, which makes minimally invasive modalities less effective and complete extraction of the stone/fragments virtually impossible. The advantages of minimal access cystolithotomy over 'open' surgery are obvious and unequivocal; our results demonstrate its feasibility. In male patients this approach additionally protects the urethra; this is more relevant in those patients with chronic vesical problems that may induce further vesical stone formation and consequently more stone removal procedures. In our series one patient experienced two recurrences, but there were no residual stones; only one operative complication (vesical perforation) occurred, when introducing the suprapubic trocar, which resolved after drainage.

In conclusions, MAS was highly effective and safe in the treatment of pediatric urolithiasis, with the great majority

of patients being cured or symptom free (13/15, 87%) after a single procedure with low morbidity. The role of MAS as first choice therapy deserves consideration as long as different techniques are individualized.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical statement: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Being our study retrospective, formal consent is not required.

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