

Comparison of Endourological and Open Cystolithotomy in the Management of Bladder Stones in Children

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Abbreviations and Acronyms

PCCL = percutaneous cystolithotomy

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Purpose: Vesical stones are common in children in developing countries. Cystolithotomy is the traditional treatment but a percutaneous approach has been advocated. The aim of this study was to evaluate retrospectively our experience with percutaneous cystolithotomy, cystolitholapaxy and open cystolithotomy in children with bladder stones.

Materials and Methods: A total of 107 children (96 boys and 11 girls) with vesical stones were treated at our center between January 1992 and March 2008. Mean patient age at the time of diagnosis was 5 years (range 2 to 15). The patients were stratified retrospectively into 2 groups according to the procedure of stone removal. Group 1 (53 patients) underwent open cystolithotomy, and group 2 (54) underwent endourological treatment via the transurethral route (27) or the suprapubic approach (27). Stone size ranged from 0.7 to 5 cm (mean 2.8).

Results: In all cases the stones were removed successfully. Operative time was comparable in both groups. The hospital stay was significantly shorter after endourological procedures compared to open surgery (2.6 vs 4.8 days, $p < 0.05$). In the open surgery group 1 patient had a small intestinal injury that necessitated repair, while in the endourological group 2 patients had urinary extravasation (1 urethral and 1 vesical). There were no early or late complications in group 1. In comparison, 4 patients (7.4%) in group 2 had early complications in the form of persistent urinary leakage from the suprapubic site and 1 patient had a bulbous urethral stricture 1 year after transurethral stone disintegration.

Conclusions: Open and endourological management of vesical stones in children is efficient, with a low incidence of complications. Endourological management offers a shorter hospital stay compared to open surgery. However, open cystolithotomy seems to be safer.

Key Words: child, cystoscopy, urinary bladder calculi, urologic surgical procedures

In developing countries children with vesical stones often present with a large stone burden.¹ Vesical calculi can be managed by transurethral or percutaneous suprapubic lithotripsy. In children, especially boys, because of the small caliber penile urethra and concerns about iatrogenic urethral stricture, transurethral cysto-

lithotripsy may be more difficult but is considered safe if the stone burden is less than 1 cm.

Percutaneous cystolithotomy is a safe alternative, with low morbidity and a low complication rate for large burden vesical stones.^{2,3} Percutaneous cystolithotomy has been performed safely for bladder stones up to 5 cm.

Using the percutaneous suprapubic approach, a 26Fr nephroscope can be introduced into the bladder without urethral injury. The large and hard stones can be disintegrated and removed in large fragments, so that intervention can be performed quickly. The technique is also more advantageous than open surgery with regard to cosmetic outcome and length of hospital stay.^{2,3}

Open cystolithotomy has the inherent problems of a long scar, prolonged catheterization, extended hospitalization and risk of infection. It is still recommended for multiple bladder calculi and even for solitary vesical stones of any size where PCCL is unavailable. The aim of this study was to evaluate retrospectively our experience with percutaneous cystolithotomy, cystolitholapaxy and open cystolithotomy in children with bladder stones.

MATERIALS AND METHODS

A total of 107 children (96 boys and 11 girls) with vesical stones were treated at our institution between January 1992 and March 2008. Mean patient age at the time of diagnosis was 5 years (range 2 to 15). The patients were followed for at least 1 year (mean 1.8). Stone size ranged from 0.7 to 5 cm (mean 2.8). Modes of presentation are outlined in table 1. The diagnosis of vesical stones was made by plain radiograph, excretory urography, ultrasonography or urethrocytostocopy. Impacted urethral stones were pushed back into the bladder.

Patients were stratified retrospectively into 2 groups according to the method of stone removal. Group 1 (53 patients) consisted of children who underwent open cystolithotomy, and group 2 (54) included those who underwent endourological treatment via the transurethral route in the form of cystolitholapaxy (27) or a suprapubic approach with percutaneous cystolithotomy (27). The main factors for stratification into the 2 groups were patient age and stone size at the time of diagnosis. For patients younger than 2 years open cystolithotomy was chosen for stones greater than 1.5 cm and percutaneous cystolithotomy for smaller stones. For children 2 years or older the transurethral route was used for stones 1 cm or smaller and the suprapubic approach in the form of open or percutaneous cystolithotomy for stones greater than 1 cm. There was bias in the study criteria due to the retrospective nature of the study and because some surgeons did not follow the criteria owing to surgeon preference.

Patient age, stone size and fragmentation methods are summarized in table 2. Cystolithotomy incisions were 3 to

Table 2. Patient characteristics by treatment approach

| | Open | Endourological | |
|-------------------------------|---------------|---------------------------------------|-----------------------------------|
| | | Suprapubic | Transurethral |
| No. pts | 53 | 27 | 27 |
| Mean \pm SD age (yrs) | 5.9 \pm 4.6 | 7.2 \pm 3.8 | 6.5 \pm 4.1 |
| Mean \pm SD stone size (cm) | 3.1 \pm 1.6 | 1.8 \pm 0.8 | 1.2 \pm 0.6 |
| Lithotripsy type (No. pts) | — | Swiss LithoClast (20), ultrasound (7) | Swiss LithoClast (17), laser (10) |

4 cm long and were performed midway between the umbilicus and symphysis pubis. At the end of the procedure a tube drain was routinely inserted.

The interventions were performed with the patient under general anesthesia. The techniques of the endourological approaches have been described elsewhere. For the transurethral route the Swiss LithoClast® lithotripter was used to fragment vesical stones in 17 cases. The 3Fr metal rod of the instrument fits the working channel of 10Fr and 12Fr pediatric cystoscopes. The laser was used in 10 cases. In the percutaneous cystolithotomy approach the procedure was initiated with urethrocytostocopy to exclude any subvesical obstruction (urethral valve, urethral stricture) or to push back the urethral stone into the bladder. An 8Fr to 10Fr Foley catheter was left indwelling.

Depending on bladder capacity, 150 to 300 ml NaCl mixed with diluted contrast medium were instilled. A 1 cm transverse incision was made 1 to 2 cm above the symphysis. Through this incision the bladder was punctured with an 18 gauge needle, the same that is used in percutaneous nephrolithotomy. The dilation was made with telescopic metal dilators up to 30Fr to admit the Amplatz sheath, and then the 26Fr nephroscope was introduced into the bladder and the stone was removed with stone forceps intact if less than 1 cm or after ultrasonic or Swiss LithoClast disintegration if larger. Over distention of the bladder is also avoidable to prevent extravasation of urine into the peritoneal cavity or extravascular space, which can cause postoperative abdominal discomfort and temporary ileus. We also strove to remove tiny fragments even if they could pass spontaneously, because they could cause bothersome dysuria for the children.

At the end of the intervention an 18Fr to 20Fr suprapubic catheter was left indwelling and fixed to the skin. The suprapubic and urethral catheters were removed on postoperative days 1 and 2, respectively. Perioperative antibiotics were given for 3 to 5 days. In surgeries without complications patients were discharged from the hospital on postoperative day 2. Intraoperative, early and delayed complications were recorded. Operative times and postoperative hospital stays were compared. Followup included voiding symptoms, urinalysis and cultures. Uroflowmetry was performed only when indicated.

Statistical analysis using SPSS®, version 15 was performed using chi-square tests. The statistical significance level used was $p < 0.05$.

Table 1. Mode of presentation of vesical stones

| Presentation | No. Pts (%) |
|-----------------------------|-------------|
| Acute urinary retention | 43 (40.2) |
| Difficulty voiding | 24 (22.4) |
| Vague abdominal pain | 15 (14) |
| Recurrent urinary infection | 14 (13.1) |
| Incidental finding | 11 (10.3) |

RESULTS

Stone-free rate was 100% in the postoperative period, and at 1 year all patients were observed to be stone-free on ultrasound and x-ray of the kidneys, ureters and bladder. There was no significant difference in operative times between the 2 groups, with a mean \pm SD of 38 ± 12 minutes in group 1 and 46 ± 14 minutes in group 2.

Operative and postoperative complications are outlined in table 3. Intraoperative complications occurred in 1 patient (1.9%) in group 1 who had an incidental peritoneal perforation and a sharp small intestinal injury during tube drain fixation. The injury was repaired and the hospital stay was prolonged. Antibiotics were used prophylactically.

Intraoperative complications occurred in 2 patients (3.7%) in group 2. During transurethral litholapaxy using the Swiss LithoClast 1 patient (3.7%) had a urethral rupture, and marked extravasation at the penile, scrotal and perineal areas was observed at the end of the procedure. The stone was 1.2 cm, and the urethral manipulation was difficult and prolonged. Fixation of the suprapubic tube was performed. Two weeks of drainage provided adequate urethral channel for the boy to have spontaneous voiding. In addition, during suprapubic percutaneous litholapaxy 1 patient (3.7%) had intraperitoneal bladder perforation with leakage of urine, which was explored and repaired.

There were no early or late complications in group 1, while 4 patients (7.4%) in group 2 had complications. One patient treated via the urethral route had a bulbar stricture 1 year postoperatively, which was treated with visual internal urethrotomy using a pediatric 13Fr sheath and weekly passage of a 10Fr catheter to prevent recurrent stenosis. Three patients treated with the suprapubic approach had early complications. Persistent leakage of urine was observed in 1 patient. A transurethral catheter left indwelling for 5 days allowed the fistula to close. The remaining 2 patients were rehospitalized because of acute abdomen during postoperative week 1. Diagnosis of intraperitoneal bladder perforation was established using sonography and ascending urethrocytography. Exploration and peritoneal toilet together with repair of the bladder and peritoneal perfora-

tions were carried out. The postoperative course for these 2 patients was uneventful.

The composition of the removed stones was calcium oxalate dihydrate. The hospital stay was significantly less after endourological procedures than after open surgery (2.6 vs 4.8 days, $p < 0.05$). In all patients voiding symptoms resolved, and urinalysis and cultures were negative for pyuria and microbial growth.

DISCUSSION

Urolithiasis in childhood is rare in the developed world, representing 1% to 5% of all urinary tract stones.⁴ Moreover, bladder stones are exceedingly rare.⁵ At the same time in developing countries pediatric urolithiasis accounts for 30% of all urinary tract stones,⁴ and the so-called endemic bladder stone is still common in childhood.⁶ In developed countries the main component of the rare bladder stone is struvite, while in the developing world the main component is ammonium acid urate.⁷ In our study the most common composition of stones was calcium oxalate dihydrate.

In the last few decades transurethral lithotripsy has become an alternative method to open cystolithotomy.⁸ However, this approach is restricted in children by the narrow caliber of the urethra.⁹ With increasing use of percutaneous techniques a plausible simple solution offers itself for percutaneous suprapubic bladder stone removal in children.¹⁰ PCCL has been demonstrated to be adequate, safe and rapid in managing vesical stones in children. Based on a study of 155 children 8 months to 14 years old with bladder stones ranging in size from 0.7 to 4 cm treated with PCCL, Salah et al concluded that PCCL is a safe and effective method for the treatment of endemic bladder stones, and found it reduces morbidity, hospital stay and cost of treatment.⁷ The reported complications of PCCL in their study included paralytic ileus (9.7% of patients) and abdominal distention (0.6%) due to escape of irrigating fluid into the abdominal cavity. In our study the complications of PCCL included 3 cases of intraperitoneal bladder rupture, of which 1 was recognized and repaired intraoperatively and 2 presented during postoperative week 1 as acute abdomen. In addition, 1 patient had persistent urinary leakage from the suprapubic site, which was closed after 5 days of transurethral catheterization.

Our results show that postoperative complications are increased with the percutaneous approach. We observed no postoperative complications with the open approach, compared to 3 cases of urinary leakage (5.6%) with the percutaneous approach. In addition, the reduced postoperative morbidity of PCCL compared to open cystolithotomy performed through a 2 to 3 cm suprapubic incision has been questioned. Mahran and Dawaba compared the ef-

Table 3. Complications

| | No. Complications (%) | | |
|-----------------|-----------------------|---------|---------|
| | Operative | Early | Late |
| Open | 1 (1.9) | — | — |
| Endourological: | | | |
| Suprapubic | 1 (3.7) | 3 (11) | — |
| Transurethral | 1 (3.7) | — | 1 (3.7) |
| Overall | 2 (3.7) | 3 (5.6) | 1 (1.6) |

ficacy of open cystolithotomy and cystolitholapaxy in pediatric patients with primary bladder stones.¹¹ Operative times were similar in the 2 groups. Hospital stay was significantly shorter after endourological procedures compared to open surgery. However, there were significantly more complications with the endourological procedures. These results are consistent with our findings.

Isen et al reported their experience in the management of bladder stones by pneumatic lithotripsy using a ureteroscope (8Fr to 9.8Fr Wolf semirigid ureteroscope or 9.5Fr Storz ureteroscope) in 27 boys 3 to 14 years old with bladder stones treated with transurethral cystolithotripsy (stones less than 2 cm).¹² They concluded that pneumatic lithotripsy using a ureteroscope is an effective and safe treatment for bladder stones in children. It is minimally invasive, and involves a reduced hospital stay and decreased overall cost. However, the procedure can cause some problems in terms of spontaneous passage. Thus, it may be used as an alternative treatment option in selected patients.

CONCLUSIONS

Open and endourological management of vesical stones in children is effective, with a low incidence of

complications. Endourological management offers a shorter hospital stay than open surgery. However, open cystolithotomy seems to be safer.

To reduce the morbidity of PCCL, we offer several recommendations. 1) Perform the percutaneous puncture with the bladder near filling under radiological control, and avoid over distention of the bladder during the procedure to prevent extravasation of urine into the peritoneal cavity or extravascular space, which can cause postoperative abdominal discomfort and temporary ileus. 2) All of the fragments should be removed if possible to avoid unnecessary dysuria. 3) Open cystolithotomy is preferable for large bladder stones (greater than 2 cm). 4) In cases with difficult tract creation prolonged urethral catheterization should be allowed. 5) Close followup of patients after PCCL, especially during postoperative week 1, including clinical and ultrasound examination of the abdomen and pelvis to detect any missed bladder perforations, is routinely recommended, especially in patients experiencing prolonged ileus, abdominal discomfort and distention. 6) The morbidity of urethral damage in young patients can be minimized by use of a laser fiber through fine flexible endoscopes or ureteroscopes.

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EDITORIAL COMMENTS

The authors review their extensive surgical experience with the treatment of solitary bladder calculi in children, and compare open cystolithotomy to transurethral and percutaneous lithotripsy. This article advocates selection of the technique based on patient age and stone burden but these criteria were not uniformly followed due to surgeon preference, and at times significant complications occurred.

Although a shorter hospital stay was noted with endourological techniques, these procedures had a higher rate of complications, including intraperitoneal bladder rupture following PCCL. Urethral rupture and extravasation also occurred after transurethral lithotripsy for a larger calculus, and the authors would currently advocate a suprapubic open cystolithotomy for all calculi greater than 2 cm.

The authors are to be commended for a 100% stone-free rate postoperatively and at 1 year. In my experience extraction of all stone fragments during PCCL can be facilitated by the use of a laparoscopic entrapment bag.¹

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1. Lam PN, Te CC, Wong C and Kropp BP: Percutaneous cystolithotomy of large urinary-diversion calculi using a combination of laparoscopic and endourologic techniques. *J Endourol* 2007; **21**: 155.

This retrospective review compares open and endourological treatment of pediatric bladder stones. The endourological group underwent transurethral and percutaneous approaches, with the choice being dictated by patient age, stone burden and surgeon prerogative. The authors concluded that all 3 forms of treatment were efficacious with a 100% stone-free rate. However, differences arose when hospital stay and complications were compared. Hospital stay was significantly shorter with the endourological approaches but this advantage is mitigated by a greater number of complications. The complications may even be underestimated due to a short followup period.

Many urologists would argue that open vesicolithotomy should be performed through a small incision without postoperative catheter drainage, as

an outpatient procedure or with an overnight stay. This approach would further decrease any advantage that the more complex endourological procedures might offer. Transurethral extraction with appropriately sized cystoscopic instruments is the treatment of choice if the stone is small and can be completely removed with minimal manipulation and no urethral trauma. However, in any other case perhaps a simple open vesicolithotomy, while not fancy or cutting-edge technology, offers the most effective and lowest morbidity patient care. There is no sense in making it harder than it is.

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