BANGLADESH JOURNAL OF
UROLOGY
Bangladesh J. Urol. 2024; 27(2): 89-94
www.banglajol.info/index.php/BJU
DOI: https://doi.org/10.3329/bju.v27i2.71217

Original Article
ISSN : 2304 - 8514 (Print)
ISSN : 2304 - 8522 (Online)

Mini-Percutaneous Cystolithotripsy (mPCCL) for Vesical Stone in Preschool children: Our Experience in SOMCH

Ashraful Islam[1], Md Abdul Alim[2], Md Motiur Rahman[3], Md Shafiqul Islam[4], Mohammad Hasibul Islam[5], Syed Ehsan Mahmud[6]

Received: 01-01-2024
Accepted: 28-01-2024
Conflicts of interest: None

Abstract:

Background: *Pediatric bladder stone disease is common in certain regions Asia. Traditionally, pediatric bladder stones have been managing by open surgeries due to narrow caliber of the urethra. However a percutaneous suprapubic approach to the bladder circumvents the problem of urethral caliber in these situations.*

Aim: The aim of the study was to manage vesical calculus in children by mini-percutaneous cystolithotripsy (mPCCL).

Patients and Methods: *Twenty children presenting with bladder stones underwent mini-percutaneous suprapubic cystolithotripsy (mPCCL) between January 2020 and June. The age ranged from 2 to 5 years and all of them were male. The stone size ranged from 1 to 4 cm. The procedure was done under general anesthesia, and the equipment was the same as for upper tract endourology. The bladder was distended with saline and a suprapubic puncture made. The nephroscope was introduced after tract dilation and the stone removed, intact if small or after fragmentation if >1 cm. A suprapubic catheter was left in for 48 hours and perurethral catheter for 5 days.*

Results: *All patients had an uneventful recovery following stone removal. Complete clearance was achieved in all patients while the mean duration of surgery was 35.6 + 8.95 min with range of 20-60 min. The mean hospital stay was 1.5+ 0.65 days.*

Conclusion: *Mini-percutaneous cystolitholapexy is a minimal invasive procedure that reduces morbidity and hospital stay and. It is suitable among children with high success rate and minimum complications like postoperative fever, hematuria, urinary leakage and pain.*

Keywords: Per Cutaneous Cystolithotripsy, mPCCL, Vesical Stone

Introduction:

Urinary stone disease is a common disease in Asian countries.[1] Among children bladder stone is common. These are crystals formed by protein and minerals in urine that precipitate and accumulate in bladder finally converting to a solid stone.[2] Bladder stones account for 5% of total urinary tract stones, with a male to female ratio of 10: 1 due to the differences in the anatomy of the male and female urethras.[3] Among girls due to short urethra mostly stone debris is passed easily and does not retain in bladder that's why incidence of bladder stone is low. In case of males stone debris is retained in bladder and accumulates to form bladder stone.[4] Bladder stone is also called vesical stone, bladder calculai or cystoliths.[5]

1. Assistant Registrar, Department of Urology, Sylhet MAG Osmani Medical College Hospital (SOMCH), Sylhet, Bangladesh.
2. Associate Professor, Department of Urology, Sylhet MAG Osmani Medical College Hospital (SOMCH), Sylhet, Bangladesh.
3. Assistant Registrar, Department of Urology, Shaheed Ziaur Rahman Medical College Hospital (SZMCH), Bogura, Bangladesh.
4. Assistant Professor, Department of Urology, Sylhet MAG Osmani Medical College Hospital (SOMCH), Sylhet, Bangladesh.
5. Assistant Professor, Department of Urology, North East Medical College Hospital, Sylhet, Bangladesh
6. Urology Resident, Department of Urology, Sylhet MAG Osmani Medical College Hospital (SOMCH), Sylhet, Bangladesh.

Correspondence: Dr. Ashraful Islam, Assistant Registrar, Department of Urology, Sylhet MAG Osmani Medical College Hospital (SOMCH), Sylhet, Bangladesh. Email: rana.somc36@gmail.com

Epidemiological data showed that the cause of stone formation among children is nutritional deficiency of phosphates due to replacement of milk products by carbohydrates leading to the formation of insoluble salts and high excretion of ammonia.[6] Excessive use of oxalate rich foods and low animal proteins are also contributing factors. Growth of stone depends on deposition and reabsorption of insoluble salts which continue for years.[7] Bladder stones from children in the developing countries are most often composed of ammonium acid urate.[8-10]

The incidence of bladder stone peaks at three years in children in developing countries, and 60 years in adulthood.[11] Bladder stones are commonly found in children from developing countries and are thought to be related to malnutrition without any anatomic abnormality. On the other hand, among children from industrialized countries, bladder stones are most often found with spinal cord injuries or congenital abnormalities such as spina bifida.[12] Secondary stones are most common, formed in the renal system initially and then migrate down into bladder. Primary stones also can be formed in presence of anatomical abnormalities such as diverticulum and posterior urethral valve.[13-16] The common composition of bladder stone in children of the developing countries are ammonium acid urate.[13-15]

Bladder stones may be asymptomatic. Common presentations are lower abdominal pain, burning micturition, urinary interruption and rubbing and pulling of penis, frequency, dysuria and urinary retention.[17]

Bladder stones in children can often be challenging to manage. The size and composition of the stone, underlying comorbidity, previous surgery, patient morphology and compliance, operative costs, surgical expertise, and available resources are considered before planning of definite treatment. Open cystolithotomy is traditionally applied to treat bladder stones in children. It has the inherent problems of a long hospital stay, being cosmetically bad from the suprapubic scar, prolonged catheterization, need for analgesics, and the risk of wound infection.[18]

However, due to high chances of recurrence of this disease, subsequent open procedure becomes more difficult technically. In the last decades transurethral lithotripsy has become an alternative method to open cystolithotomy.[19] Transurethral cystolithotripsy is an alternative but not ideal in pediatric population due to small urethral caliber limits effective treatment of large bladder stone burdens.[20]

The minimally invasive procedures include transurethral stone fragmentation using holmium laser or intra-corporeal cystolithotripsy, percutaneous cystolithotripsy and cystolitholapexy are specially applied for adults. These all methods are cost effective with low morbidity, minimum complications and short hospital stay required.[21]

Mini-percutaneous cystolithotripsy (mPCCL) is now used worldwide in paediatric groups. It has less morbidity than open surgery and fewer limitations than the transurethral endoscopic route.[22] We present our experience of minimally invasive percutaneous cystolithotripsy using 'mini-perc' instruments in the treatment of the bladder stones children.

Materials and methods:

This is a prospective observational study of consecutive patients conducted from January 2020 till June 2022. Consent from legal guardian was taken. All the patients in the study were age group between 2 and 5 years diagnosed to have bladder stone either by ultrasound or plain X-ray KUB. The inclusion criteria were patients aged between 2-5 years of age who underwent mini-percutaneous cystolithotripsy for bladder stone. At first cystoscopy was done with 7 Fr pediatric cystouretroscope (Karl Storz, Germany). All patients underwent mPCCL using 12 Fr mini nephroscope with a 15 Fr access sheath (Olympus). The initial puncture was done under vision, after filling the bladder with irrigation fluid during cystoscopy. Single-step dilatation was done using a screw dilator and 15 Fr access sheath was placed in the bladder. Using mini-nephroscope, the calculus was fragmented with pneumatic lithotripsy and fragments were retrieved. Postoperatively, there was 12 Fr bichannel foleys catheter placed the puncture site and dressed without any suture and a 6 or 8 Fr plain or Foley's urethral catheter was placed for drainage of urine. The SPC was removed after 48 hours and urethral catheter after 5 days. All patients were followed up at one month and six months with ultrasonography. Both the initial diagnosis and the stone-free rate (SFR) were based on ultrasound. SFR was defined as complete absence of stones. Complications were graded according to the Clavien-Dindo grading.

Figure 1: *Olympus 15Fr mini Nephroscope*

Figure 2: *Puncture site*

Figure 3: *Fragmented stone*

Figure 4: *After the procedure*

Results:

A total of 20 patients underwent bladder stone surgery. The mean age were of 3.5 + 1.1 years (range: 2-5 years), and all were male. The mean stone size was 1.5+ 0.65 cm (range: 1- 4 cm) and the mean operative time was 35.6 + 8.95 min (range: 20-60 min). There were no intra or post operative complications. There was no incidence of post-operative pyrexia, hematuria or suprapubic urine leak. All patients were discharged at 2nd POD after removal of SPC. SFR was 100% evident by cystoscopy.

Table I: *Frequency of variables and patient values (n=20)*

Variables	Values
Age in years(Mean±SD)	3.5 + 1.1
Gender (male: female)	1:0
Stone size(mm)	1.5+ 0.65

Table II: *Operative and postoperative statistics values and variables*

Variables	Values
Operative time in minutes (mean ± SD)	35.6 + 8.95
Stone free rate	100%
Hospital stay in days (mean ± SD)	1.5+ 0.65
Intraoperative complication	0
Postoperative complications (hematuria, infection)	0
Additional treatment	0

Discussion:

Bladder stones are common of all pediatric urolithiasis, that reaching up to 15% in developing countries and 1–5% incidence in developed world.[23] The need for an effective method for management of bladder stones in male children with sparing of the delicate, growing urethra led to the development of variant techniques aiming to extract bladder stones with the least morbidity.

Open suprapubic cystolithotomy was the procedure of choice for treating vesical calculi, as well as it was also the preferred method for managing posterior urethral stones after being pushed back to the bladder.[24] As it is a simple, cheap, achieving stone free rate up to 100% in a single session, and sparing the urethra from manipulation had made open cystolithotomy the preferred method till now in some centers.[24,25]

A lot of modifications had been achieved to the traditional open cystolithotomy aiming at decreasing hospital stay and morbidity.[26] Yet, this technique had some problems like longer hospital stay, increased analgesia requirement, wound and catheter related complications, postoperative hematuria, urinary tract infection and fever are also common in this technique. Delayed complications include urethral stricture formation.[27]

Now minimally invasive techniques have brought revolution in this field with minimum complications and better outcomes.[28]

In transurethral endoscopic approach most of the urologists are familiar with, involves fragmentation of the calculus either by a mechanical lithotrite or by intracorporeal lithotripsy devices like pneumatic or laser fragmentation. Although the mechanical lithotrite fragments the stone, it may not be effective in large and hard calculi. Rather, it is associated with a higher risk of bladder mucosal injury, bladder perforation, urethral injury and stricture formation.[29]

But transurethral instrumentation in pediatric population with smaller urethral caliber is difficult, precluding its use in young children.[30] The additional drawback of transurethral approach in very small urethra is difficulty in clearance of fragments following endoscopic lithotripsy.

To overcome the drawback of traditional procedures, suprapubic transvesical percutaneous cystolithotripsy has been described.[30,31] mPCCL offers an alternative method for managing bladder stone in children, with less operative time and morbidity compared with open cystolithotomy, with high success rates. Another advantage of mPCCL is that it spares the delicate narrow calibered urethra in children.[32,33]

With the advancement in endourology and availability of small size nephroscopes, mPCCL has additional advantage over cystolithotrispy and open cystolithotomy. There is no need to incise the bladder like open procedure, so there is minimal damage to the bladder wall. All the steps of mPCCL are under vision hence that no collateral damage. The procedure is also extraperitoneal just like open surgery. Additional advantage of mPCCL over surgery is the Amplatz sheath, which is slightly larger than nephroscope size. The size of scar in mPCCL is equal to the diameter of the Amplatz sheath which in our series was 15 Fr, that is, 5 mm which concludes as another major cosmetic advantage. mPCCL also involves the cystoscopic evaluation of the bladder before procedure to diagnose associated urethral and bladder pathology like posterior urethral valve and diverticula.

Salah et al. experienced with cystolithotripsy in 155 children from Pakistan and Yemen with a mean age of 4.5 years with an average bladder stone burden of 2.3 cm (range 0.7–4cm). All the children were treated successfully and safely using a 26 Fr nephroscope through a 30 Fr sheath through a 1 cm suprapubic incision.[34] As compared to this study, we have achieved clearance of similar range of the stone sizes using smaller scope of 15 Fr and smaller incision of 5 mm only. Gan et al. reported on their experience using a 16 Fr peel-away sheath with a ureteroscope to treat bladder stones with an average size of 1.4 cm in 15 boys.[35]

Gan et al. and Salah et al. fixed a suprapubic tube and a urethral catheter at the end of their PCCL procedures.[36,37] Agrawal et al. fixed a suprapubic tube only at the end of their case series of the procedure.[38] In this study, we placed a urethral catheter and a suprapubic tube to reduce patient morbidity and the need for further intervention and maneuver.

The working tract in mPCCL enabled us to extract stone easily with less operative time, and this favors mPCCL in cases of large and multiple bladder stones. However, mPCCL has the risk of bowel injury, paralytic ileus, and escape of irrigation fluid to the peritoneal cavity.[38] But there were no such major

complications in our series. Our series is so far largest pediatric mPCCL at a single center in Bangladesh with successful application and easy reproducibility.

Limitations:

The main limitations of our study include small sample size, single-centre experience, and lack of randomization. Due to a small number of patients we could not identify which patient would benefit from mPCCL. Prospective randomized multicentre studies may be required to validate our results and this should be a subject of future investigation.

Conclusion:

mPCCL is a safe and effective method in treating with bladder stones in male children. Mini-percutaneous suprapubic cystolithotripsy using mini-nephroscope is an alternate technique to transurethral cystolithotripsy. This may be considered as the preferred management option of bladder stones specially in preschool children due to small urethral caliber.

References:

1. Hasan O, Ellis A, Powers R, Vidal P. Vesical megalithiasis. Urology case reports. 2019 Mar; 23:41. https://dx.doi.org/10.1016%2Fj.eucr.2018.11.012.
2. Bimandama MA, Kurniawaty E. Benign Prostatic Hyperplasia dengan Retensi Urin dan Vesicolithiasis. Jurnal Agromedicine. 2018 Dec 22; 5(02):655-61.
3. Turney BW, Reynard JM, Noble JG, Keoghane SR. Trends in urological stone disease. BJU Int 2012; 109:1082–1087.
4. Zumstein V, Betschart P, Abt D, Schmid HP, Panje CM, Putora PM. Surgical management of urolithiasis–a systematic analysis of available guidelines. BMC urology. 2018 Dec 1; 18(1):25. https://doi.org/10.1186/ s12894-018-0332-9.
5. Teferi GT, Kifle AT. Management of urolithiasis at hawassa university referral hospital, Ethiopia: A retrospective, descriptive study. East and Central African Journal of Surgery. 2020 Jun 30; 25(2).
6. Raheem OA, Khandwala YS, Sur RL, Ghani KR, Denstedt JD. Burden of urolithiasis: Trends in prevalence, treatments, and costs. European urology focus. 2017 Feb 1; 3(1):18-26. https://doi.org/10.1016/j. euf.2017.04.001.
7. Gottlieb M, Long B, Koyfman A. The evaluation and management of urolithiasis in the ED: A review of the literature. The American journal of emergency medicine. 2018 Apr 1; 36(4):699-706. https://doi. org/10.1016/j.ajem.2018.01.003.
8. Salah MA, Holman E, Khan AM, Toth C. Percutaneous cystolithotomy for pediatric endemic bladder stone: Experience with 155 cases from 2 developing countries. J Pediatr Surg 2005;40:1628-31.
9. Gan W, Guo H, Yang R, Lian H, Yao L. Minimally invasive percutaneous cystolithotomy: An effective treatment for bladder stones in infants aged <1 year. BJU Int 2010;106:275-7.
10. Kancha RK, Anasuya A. Contribution of Vitamin A deficiency to calculogenic risk factors of urine: Studies in children. Biochem Med Metab Biol 1992;47:1-9.
11. Naqvi, S.A.Bladder stone disease in children: clinical studies. J Pak Med Assoc. 1984; 34: 94.
12. Ceullar D, Roberts WW, Docimo SG. Minimally invasive treatment of bladder calculi. In: Docimo SG, editor. Minimally Invasive Approaches to Pediatric Urology. Abigdon: Taylor and Francis; 2005. p. 75-8.
13. Salah MA, Holman E, Khan AM, Toth C. Percutaneous cystolithotomy for pediatric endemic bladder stone: Experience with 155 cases from 2 developing countries. J Pediatr Surg 2005;40:1628-31.
14. Gan W, Guo H, Yang R, Lian H, Yao L. Minimally invasive percutaneous cystolithotomy: An effective treatment for bladder stones in infants aged <1 year. BJU Int 2010;106:275-7.
15. Kancha RK, Anasuya A. Contribution of Vitamin A deficiency to calculogenic risk factors of urine: Studies in children. Biochem Med Metab Biol 1992;47:1-9.
16. Palmer LS, Franco I, Kogan SJ, Reda E, Gill B, Levitt SB, et al. Urolithiasis in children following augmentation cystoplasty. J Urol 1993;150:726-9.
17. Jung JH, Park J, Kim WT, Kim HW, Kim HJ, Hong S, Yang HJ, Chung H. The association of benign prostatic hyperplasia with lower urinary tract stones in adult men: A retrospective multicenter study. Asian journal of urology. 2018 Apr 1;

5(2):118-21. https://doi. org/10.1016/ j.ajur.2017.06.008.

18. Safwat AS, Hameed DA, Elgammal MA, Abdelsalam YM, Abolyosr A. Percutaneous suprapubic stone extraction for posterior urethral stones in children: efficacy and safety. Urology 2013; 82:448–450.
19. El-Khader K, Ibn-Attya A, Mamoun M, Koutani A, Hachimi M, Lakrissa A: Role of ultrasound lithotripsy in the treatment of lithiasis of the lower urinary tract. Apropos of 38 cases. J Urol Paris 1995;101:165–168.
20. Salah MA, Holman E, Khan AM, Toth C. Percutaneous cystolithotomy for pediatric endemic bladder stone: Experience with 155 cases from 2 developing countries. J Pediatr Surg 2005;40:1628-31.
21. Giriþgen Ý, Yüksel S, Karcýlý K, Becerir T. Evaluation of the composition of urinary tract stones in children from the Inner Western Anatolian Region in Turkey. Turkish journal of urology. 2020 Mar; 46(2):152. https://dx.doi.org/10.5152%2Ftud.2019.19170.
22. Agrawal MS, Aron M, Goyal J, Elhence IP, Asopa HS. Percutaneous suprapubic cystolithotripsy for vesical calculi in children. J Endourol 1999; 13:173–175.
23. Rizvi SA, Naqvi SA, Hussain Z, Hashmi A, Hussain M, Zafar MN, et al. Pediatric urolithiasis: developing nation perspectives. J Urol 2002; 168:1522–1525.
24. Safwat AS, Hameed DA, Elgammal MA, Abdelsalam YM, Abolyosr A. Percutaneous suprapubic stone extraction for posterior urethral stones in children: efficacy and safety. Urology 2013; 82:448–450.
25. Barnes RW, Bergman RT, Worton E. Litholapaxy vs. cystolithotomy. J Urol 1963; 89:680–681.
26. Rattan KN, Bhatia V, Ratan SK, Sharma M, Rohilla S. Catheterless and drainless open suprapubic cystolithotomy in children: a safe procedure. Pediatr Surg Int 2006; 22:255–258.
27. Deswanto IA, Basukarno A, Birowo P, Rasyid N. Management of bladder stones: the move towards non-invasive treatment. Medical Journal of Indonesia. 2017 Aug 18; 26(2):128-33. https://doi.org/10.13181/ mji.v26i2.1602.
28. Dhondup T, Kittanamongkolchai W, Vaughan LE, Mehta RA, Chhina JK, Enders FT, Hickson LJ, Lieske JC, Rule AD. Risk of ESRD and mortality in kidney and bladder stone formers. American Journal of Kidney Diseases. 2018 Dec 1; 72(6):790-7. https://doi.org/10.1053/j.ajkd.2018.06.012.
29. Bapat SS. Endoscopie removal of bladder stones in adults. Br J Urol 1977;49:527-530.
30. Madhu S. Agrawal, Monish Aron, Jitendra Goyal, Indu P. Elhence, And Hari S. Asopa. Percutaneous Suprapubic Cystolithotripsy for Vesical Calculi in Children. Journal of Endourology. March 2009, 13(3): 173-175. https://doi.org/10.1089/end.1999.13.173.
31. Wollin TA, Singal RK, Whelan T, Dicecco R, Razvi HA, Denstedt JD. Percutaneous suprapubic cystolithotripsy for treatment of large bladder calculi. J Endourol. 1999;13(10):739–44.
32. Al-Marhoon MS, Sarhan OM, Awad BA, Helmy T, Ghali A, Dawaba MS. Comparison of endourological and open cystolithotomy in the management of bladder stones in children. J Urol 2009; 181:2684–2687; [discussion 7–8].
33. Ahmadnia H, Younesi Rostami M, Yarmohammadi AA, Parizadeh SM, Esmaeili M, Movarekh M. Percutaneous treatment of bladder calculi in children: 5 years experience. Urol J 2006; 3:20–22.
34. Salah MA, Holman E, Khan AM, Toth C. Percutaneous cystolithotomy for pediatric endemic bladder stone: Experience with 155 cases from 2 developing countries. J Pediatr Surg 2005;40:1628-31.
35. Gan W, Guo H, Yang R, Lian H, Yao L. Minimally invasive percutaneous cystolithotomy: An effective treatment for bladder stones in infants aged <1 year. BJU Int 2010;106:275-7.
36. Gan W, Guo H, Yang R, Lian H, Yao L. Minimally invasive percutaneous cystolithotomy: an effective treatment for bladder stones in infants aged<1 year. BJU Int 2010; 106:275–277.
37. Salah MA, Holman E, Khan AM, Toth C. Percutaneous cystolithotomy for pediatric endemic bladder stone: experience with 155 cases from 2 developing countries. J Pediatr Surg 2005; 40:1628–1631.
38. Agrawal MS, Aron M, Goyal J, Elhence IP, Asopa HS. Percutaneous suprapubic cystolithotripsy for vesical calculi in children. J Endourol 1999; 13:173–175.