

## Original Article

# Transurethral fragmentation of bladder stone in children: Our experience

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## ABSTRACT

**Background:** This study is performed to find the outcome of transurethral fragmentation and clearance of bladder stones in children as well as assessment of stone recurrence after the procedure.

**Methods:** It was a retrospective analysis of the medical record of 365 patients with bladder stones, treated with transurethral fragmentation at the Department of Pediatric Urology, The Children's Hospital and the Institute of Child Health, Lahore, over a period of 5 years. Bladder stones were fragmented by using ureterorenoscope (URS) and pneumatic Lithotripsy under general anesthesia. Patients were asked to void next day for spontaneous passage of stone fragments. Duration of procedure, hospital stay, perioperative, and postoperative complications were recorded on a self-structured proforma. The collected data was analyzed with SPSS, version 22.

**Results:** The mean age of the patients was 4.7±2.31 years, and male to female ratio was 6:1. Clinical presentation was painful micturition with milking of penis (55%), followed by straining during micturition (17.5%), urinary retention (10%), increased frequency of urine (8%), febrile UTI (7.5%), and hematuria (2%). The mean stone size on ultrasound was 17.2 ±3.8 mm (Range 7-25 mm). The average operating time was 18 minutes (Range: 12-35 minutes). The transurethral fragmentation was successfully done in all (100%) patients. Average hospital stay was 24 hours. Most patients (98.5%) passed all stone fragments in urine & were stone free at one week, confirmed by ultrasound and X-Ray Kidney, Ureter, and Bladder (KUB). Postoperative minor complications were found in (6%) patients including hematuria (3%), dysuria (2%), febrile UTI (1%), failure to void (0.5%). Stone recurrence was 0.27% and no urethral stricture was noted up to one year follow up.

**Conclusion:** Endoscopic treatment of bladder stone in children appears effective and safe by fragmenting the stone into multiple small pieces, which passed out spontaneously without any need for extraction of stone. The associated complications and recurrence rate are very negligible.

**Keywords:** Urinary bladder stone, Children, Endoscopic, Trans-urethral, Fragmentation

## INTRODUCTION

Bladder stones in children is evident from archeological discoveries, and the historical reports show that 2-3 % of children can develop urinary calculi.[1] Nonetheless, in nations where stone disease is endemic, urolithiasis remains a serious problem accounting 4-8% cases of end-stage renal disease during the childhood.[2] High prevalence of bladder stones has been reported in Europe and North America in 18th and 19th centuries.[3] This trend later on shifted to East, stretching in a broad stone belt from Egypt through Iran, Pakistan, India and Thailand to Indonesia.[4] The prevalence of pediatric urolithiasis ranges from 5-15% in our part of world as compared to 1-5% in developed

countries. Urinary bladder stone contributes about 50% of pediatric urolithiasis.[5]

The etiology of primary bladder stones in children is either Idiopathic or related to late weaning and nutritional deficiency. These children are often found consuming predominantly cereal based diet that is poor in animal protein and low in phosphate which leads to hypophosphaturia and hyperammonuria, promoting the precipitation of both calcium oxalate and ammonium acid urate.[4] Combined with low dietary intake of vitamin B1, B6, and magnesium, can lead to hyperoxaluria. The deficiency of Vitamin A causes urothelial degeneration which may also promote stone formation.[6] Some patients may have associated

secondary causes like congenital urinary tract anomalies, metabolic deficiency, or neurological diseases.[7]

Open cystolithotomy was considered the gold standard treatment for the pediatric bladder stones.[8] Now it has fallen into disfavor as less invasive techniques have come to the fore. Currently, the bladder stones in children are managed either by open cystolithotomy (OCL), or percutaneous Cystolithotomy (PCL) and transurethral fragmentation by pneumatic or LASER energy.[9,10] There is complete retrieval of stone fragments and short hospital stay in percutaneous cystolithotomy but there is surgical scar and need for prolonged catheterization in open cystolithotomy. Transurethral fragmentation of bladder stone is scarless with short hospital stay, and there is also short-period catheterization postoperatively. But the problem with this modality is the retrieval/clearance of stone fragments. This research was done to identify the outcome of transurethral fragmentation of bladder stone and clearance of broken pieces with spontaneous voiding. We also investigated recurrence of bladder stones due to small fragments or nidus which may be left in the bladder after the treatment.

**METHODS**

It was a retrospective analysis of the medical record of 365 patients with bladder stones and treated with transurethral fragmentation at the Department of Pediatric Urology, The Children’s Hospital and the Institute of Child Health, Lahore. The duration of study was five years (January 2015 to December 2019). Approval from Institutional Review Board (2019-38-CHICH) of the hospital was taken. The patients with radiopaque stone of size ≤ 2.5cm and all radiolucent stones regardless of size were included in the study. The children with urethral abnormalities (meatal stenosis, stricture, or previous surgery), neurogenic bladder dysfunction with poor emptying, and incomplete record were excluded from this study. The diagnosis was based on history, physical examination and radiological investigations (Ultrasound Fig.1A and X-ray Fig.1B). We obtained laboratory investigations (CBC, PT, APTT, urinalysis, urine culture and renal function tests) in every patient before the surgical procedure.

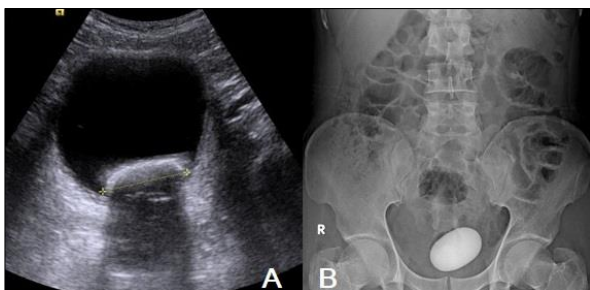


Figure 1: A) Bladder stone on ultrasonography. B) Bladder stone on plain x-ray.

Operative Technique: Endoscopic transurethral fragmentation in all patients was carried out in lithotomy position under general anesthesia. Active urinary tract infection was treated, and negative urine culture was

ensured pre-operatively. Cystourethroscopy was performed firstly with pediatric cystoscope (9.5 Fr) to rule out any urethral abnormality and see the bladder stones (Fig.2a). Then ureterorenoscope (Size 6/7.5 Fr) was inserted and pneumatic lithoclast was used for fragmentation of bladder stones. Stone was fragmented into multiple small pieces of 3mm or less (Fig.2b). Foley catheter was inserted in all the patients at the end of the procedure which was removed on next morning (Range 12-20 hours). Patients were discharged after successful voiding trial and called for follow up after one week, three months, six months, and one-year interval with ultrasound and X-ray KUB. The fragments of stone passed out spontaneously per-urethra in 1-2 days in majority of the children (Fig.2c).



Figure 2: A) Bladder stone before fragmentation. B) After fragmentation. C) Stone fragments voided on the gauze.

The information on demography, history, physical examination, diagnosis, hospital stay, procedure time, fragmentation of stone, outcome (clearance), and pre-operative /postoperative complications were recorded on a self-structured Performa and analyzed with SPSS, version 22.

**RESULTS**

A total of 365 patients were included in the study. There were 305 (83.5%) male and 60 (16.5%) female with a male to female ratio of 6:1. The mean age of patients was 4.7 ± 2.31 years, with age ranging from 1-15 years. Most common clinical presentation was painful micturition with milking of penis (55%) followed by straining during micturition (Fig.3).

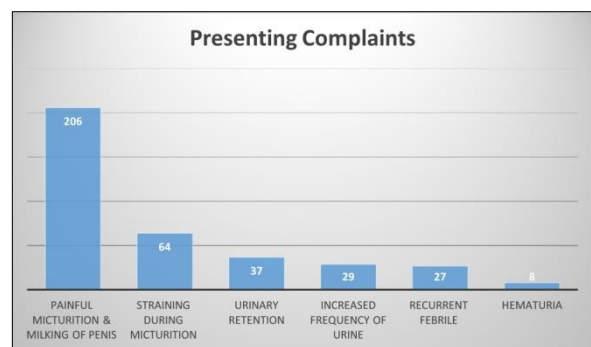


Figure 3: Clinical presentation of study population

The mean stone size on ultrasound was 17.2 ± 3.8mm with size ranging from 7-25 mm. Radiolucent bladder stone were found in 14% (rest were radiopaque) of patients and all were of size 10-18mm. The average operating time (from cystoscopy & fragmentation to catheterization) was 18 minutes with a range of 13-35 minutes. The transurethral fragmentation of bladder stone was successfully done in all patients. Average

hospital stay was 24 hours. On first follow-up after a week, 98.5% patients were stone free, as confirmed on ultrasound and X-ray KUB, while two (0.5%) patients had residual large fragments which were fragmented & cleared in the second session. No patient was converted to open cystolithotomy.

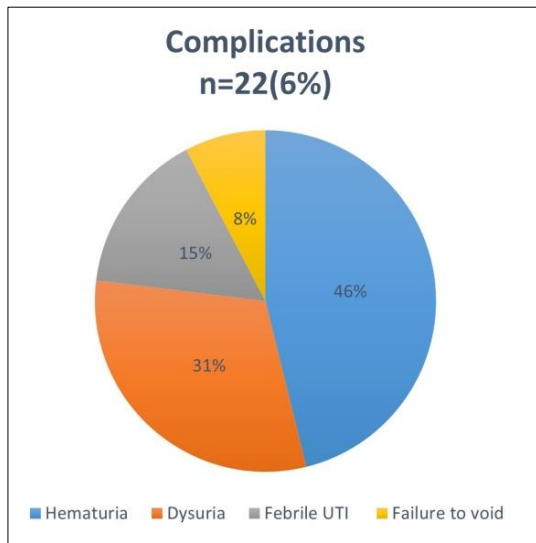


Figure 4: Complications encountered in the study population.

Postoperative complications (Hematuria, dysuria, Febrile UTI and failure to void) were encountered in 22 (6%) patients. (Fig.4) Early postoperative minor complication like mild hematuria was settled in few hours with hydration without need for blood transfusion. Dysuria was also improved in 2-3 days with analgesic and anti-inflammatory medicines. Two patients (0.5%) did not void on first post-operative day after removal of catheter, they were re-catheterized and retrial was successful after 3 days. Total 313 patients remained on follow up for one year and recurrence (BSD) was found in one patient (0.27%) and no urethral stricture was noted after this transurethral endoscopic treatment.

## DISCUSSION

Pediatric bladder stone disease is endemic in Pakistan with the prevalence of up to 1-15%. Bladder stone in children is higher in this area due to unbalanced diet and nutritional deficiencies of protein, phosphorus, vitamins and magnesium.[4] Furthermore, dehydration due to hot weather, diarrhea, fever, and infection may reduce urine output and increased crystallization.[4, 6] Prematurity and exposure to melamine-contaminated formula milk were associated with urinary stone in infants.[11]

Bladder stone in children can be treated by open surgery to percutaneous cystolithotomy (PCCL) or per urethral cystolithotripsy (PUCL). Open cystolithotomy (OCL) is a common practice in our part of world.[5, 8] Percutaneous cystolithotomy is a safe and effective alternative for the treatment of bladder stones in children. [12, 13] Although this modality has have some benefits over conventional open cystolithotomy, but requires prolonged postoperative catheterization, with added risk of wound infection or fistula formation due to suprapubic incision. The standard treatment of pediatric

bladder stones in developed world is transurethral LASER lithotripsy with 100% success rate and negligible morbidity. [14, 15] Masood A and colleague concluded that transurethral pneumatic lithotripsy using semi rigid ureterorenoscope is a safe and effective modality in the treatment of bladder calculi up to 25mm in pediatric male patients. [16] But LASER equipment is costly and takes longer time to disintegrate the stone, however, can be used safely through the fine caliber miniscope in babies less than one year of age.[10] Economic restraints and the will to provide less invasive, safe and effective treatment to these young patients have led urologists to explore the non-conventional method of using a semi rigid URS with pneumatic lithotripsy.[9, 17, 18] Few centers in Pakistan, are doing transurethral fragmentation in children but with removal of fragments by Elik's evacuator or grasper which is a cumbersome and time-consuming process.[17, 19, 20]

In this study, we have observed the free passage of stone fragments with normal urinary flow. We also investigated the second concern with this approach that is presumably high recurrence rate due to retained or residual nidus in the bladder. We believe that in experienced hands, the minimally invasive transurethral approach is the best choice. Urinary bladder stone is common in boys and affects mainly younger children. The mean age of patients in different studies varies from 2-7 years with male predominance.[8, 9] In our study, the mean age was  $4.7 \pm 2.31$  years with male to female ratio of 6:1, which is in accordance with literature.[17-19]

The symptoms such as painful micturition with milking of penis, Straining, Urinary retention, increased frequency of urine were comparable to a series of 100 patients reported by Khosa et al.[9] but there was higher number of children presented with urinary retention (21%) and hematuria (13%) which may reflect late presentation in their series. In another regional study by Ahmadnia et al. showed the most common presenting complaints of bladder stone disease were urinary retention, frequency and hematuria.[21]

In this study, the spontaneous passage and clearance of stone was found in 98.5% patients at 1-week follow-up which is comparable to Ali et al.[19] who reported a success rate of 97.5%. Shaikh et al.[20] and Khosa et al.[9] reported a 100% success rate, but they all removed the stone fragments manually with Elik's evacuator or tommy syringe. Masood et al. presented a series of 57 patients in whom they assessed the spontaneous passage of stone fragments with a success rate of 96.4% (mean operative time of 28 minutes, stone size 5-25mm).[17] Mean operating time in our study was 18 minutes which is significantly shorter than reported mean operative time of 25-27 minutes for same size of stones in literature.[9, 17, 19] The time was shorter in our patients because we did not remove the stone fragments manually, however in other studies people consumed time in stone fragments removal. Isenet al. reported the mean operating time of 22 minutes for the mean stone size of 14 mm (Range 8-22mm) in their series of 27 patients,[18] while Kareem et al. showed the

mean operative time of 41.57 minutes for the stone size of 8-17 mm.[22]

Our major concern of postoperative voiding symptoms and complications due to spontaneous passage of stone fragments as pointed out by Kareem et al.[22] However, we only observed minor complications in 6% of the cases. The reported rate of postoperative hematuria is 5-12.5% and that of dysuria is 4.2-10% even with removal of fragments with Ellik's evacuator or grasper. [9, 18, 19, 20] The reported complications rate of spontaneous passage of stone fragments per urethra is 28% and include mainly dysuria (10.5%) and hematuria (7%), which is much higher than our results. Hematuria may occur due to inflamed bladder or urethral mucosa and iatrogenic mucosal injury, which can be avoided by meticulous surgical techniques and performing fragmentation in absence of infection (UTI).[17]

Postoperative dysuria and urinary retention may occur due to large residual fragments or urethral trauma. Akmal et al. reported a 5% urethral stone impaction in their series of 40 patients, requiring redo cystolithotripsy.[23] Isen et al. reported acute urinary retention in 7.4% of the patients in a series of 27 patients' Kareem et al showed acute urinary retention in 2.5% cases in their series of 40 children. [18, 22] In our series, postoperative dysuria and acute urinary retention were negligible, reflecting the diligent endoscopic technique and utmost fragmentation of stone to  $\leq 3$ mm. Four (1%) of our patients had febrile UTI after the procedure, which is inconsistent with the reported range of 2.5%-7.4% in literature.[17-19]

We did not observe urethral stricture in any of the patients till one year of follow-up which is inconsistent with findings of Al-Marhoon who reported urethral strictures in 3.7% of the patients after transurethral cytolithotripsy.[24] Shaikh et al. reported a stricture rate of 0.4% in their series, but the mean follow-up was of 1.3 months, which is considered inadequate to assess the post-operative stricture formation a late complication.[20] Mishra et al. described that the transurethral cystolithotripsy is more difficult in boys due to the small penile urethra and concerns about iatrogenic urethral strictures.[25]

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There was only one case (0.27%) of recurrent bladder stone in our study which reflects almost clearance of all broken fragments by spontaneous voiding and obviates the assumption that leaving small pieces in bladder may predispose to high recurrence. Recurrence of endemic primary bladder stone in children is variable and ranges widely from 3-67%. [20, 26] However, lithogenic factors may also play a role in the recurrent stone formation which includes persistent infection, metabolic disorder, nutritional deficiency, urinary stasis and foreign body. Long term follow-up is necessary to detect urinary stone recurrence. A balance diet with plenty of water intake is recommended for prevention of recurrent stone.[27]

The strengths of our study are a large sample size (to our knowledge) and good follow-up. The limitation of our study is its non-comparative design which generates less quality evidence; yet randomized control trails are required to determine and compare its safety and efficacy.

## CONCLUSION

Transurethral management of bladder stones ( $\leq 25$ mm) in children is very effective and safe by fragmenting the stone into multiple small pieces which can pass out spontaneously per-urethra, without any need for extraction of the stone fragments. This modality is not associated with high recurrence rate, and urethral stricture formation as seen in this series.

**Conflict of Interest:** GMZ and AI are members of the editorial team, however, the manuscript was independently handled by another editor and they were not involved in decision making of this manuscript.

**Consent to Publication:** The authors declared taking consent for publication from legal guardians of the patient.

**Authors Contribution:** Author(s) declared to fulfill authorship criteria as devised by ICMJE and approved the final version. Authorship declaration form, submitted by the author(s), is available with the editorial office.

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