Original Article

Safety and efficacy of transurethral pneumatic lithotripsy for bladder calculi in children

Ali Sher Khosa, Muhammad Hussain, Manzoor Hussain
Sindh Institute of Urology and Transplantation (SIUT), Civil Hospital, Karachi.
Corresponding Author: Ali Sher Khosa. Email: info@siut.org

Abstract

Objective: To determine the safety and efficacy of transurethral pneumatic lithotripsy for bladder calculi in children.

Method: The study included 100 children up to 15 years of age undergoing pneumatic cystolithoclast for bladder stones. The descriptive study was conducted from September 2006 to February 2007 at the Sindh Institute of Urology and Transplantation, Karachi. The inclusion criteria was children up to 15 years of age with a bladder stone of up to 3cm, pre-operative negative urine culture, no coagulopathy and fit for general anaesthesia. An X-ray and ultrasound of Kidney and Urinary Bladder (KUB) was mandatory. The procedure was done under general anaesthesia with a single dose of pre-operative antibiotic. A mini-scope of 4FR or a semi-rigid ureteroscope of 7/8.5 FR with pneumatic wolf lithoclast was used for the fragmentation of stones. Duration of procedure, any per-operative and post-operative complications and the duration of hospital stay were recorded. Post-operatively, the patient underwent ultrasound Kidney and Urinary Bladder at the first follow-up to assess stone clearance after one week.

Result: Mean patients age was 4.95±3.3 years. The male-to-female ratio was 11.5: 1

The mean hospital stay was 9.2±2.5 hours. The mean operating time was 25 (10 -65) minutes. Ten (10%) patients developed minor complications out of which 5 (5%) developed haematuria and 4 (4%) developed difficulty in passing urine. One (1%) of the patients developed post-operative retention of urine. All the patients were stone-free after the procedure.

Conclusion: The transurethral pneumatic lithoclast is very effective and safe in children with bladder stones up to 3cm.

Keywords: Transurethral pneumatic lithotripsy, Bladder stone. (JPMA 62: 1297; 2012)

Introduction

Countries in the Afro-Asian stone belt (from Egypt and Sudan, through the Middle East, India, Pakistan, Burma, Thailand, Indonesia and the Philippines) falling within the tropical and subtropical regions have consistently reported a high incidence of bladder stones.[1] There is a marked variation in the pattern of urolithiasis in children in the developed and the developing nations.[2] Paediatric urolithiasis remains endemic in developing nations, affecting children at ages less than 1 year to adolescence. The prevalence rate is high at 5% to 15% compared with 1% to 5% in developed countries.[3] A survey of stone disease in the subcontinent by Mc Carrison in 1931 showed a high incidence in the northern part, while South India had the lowest. The highest incidence was in Sindh and Punjab provinces.[4]

Archaeological discoveries provide sufficient proof for the assumption that vesical calculi among children has occurred since antiquity.[5] During the last century, the predominant form of the stone in Western countries was endemic bladder calculus which almost disappeared by

1920. But it is found even today in the developing countries.[6] Recent studies in Pakistan[3] have shown that the percentage of bladder stones in paediatric urolithiasis is 30%. In Pakistan the geographical distribution of bladder stone in children is under a transitional phase. The disease continues to be endemic in rural areas of the country and in the poor localities of big cities. Endoscopic management of urinary calculi is standard therapy at university centres and community-based hospitals worldwide. There are currently a variety of approaches to the patients with bladder stones. Commonly accepted modalities include extracorporeal shockwave lithotripsy, transurethral lithotripsy with pneumatic lithotripsy or laser lithotripsy, percutaneous suprapubic lithotripsy or open surgery.

Transurethral pneumatic cystolithotripsy has proven quite effective in fragmenting large, hard bladder calculi with minimal tissue injury in adults, but its use in paediatric bladder calculi through the transutheral route is not well reported in literature. Because of small body habitus, delicate tissue and long-term implications of complications, proper and detailed planning of surgical procedure is of the utmost importance in paediatric patients.[7]

Pneumatic lithoclast is based on a jackhammer principle.[8] A projectile in hand piece is propelled by compressed air to the probe. The compress air originates from a smaller generator that is connected to a dry, clean air supply. The ballistic energy produced is conveyed to the probe base. Continued impaction of probe tip against the stone result in stone breakage once the tensile forces of calculus are overcome. The pneumatic lithotripsy has ability to crack harder stones such as those composed of calcium monohydrate or cystine.[7,9,10]

This study was undertaken to determine the safety and efficacy of transurethral pneumatic lithotripsy for bladder calculi in children.

Patients and Methods

The quasi-experimental study was conducted between September 2006 and February 2007 at the Sindh Institute of Urology and Transplantation, Karachi. All the children of up to 15 years of age with bladder stones and candidate for cystolithoclast were evaluated for inclusion in the study. A stone of 0.5 to 3 cm in size, no coagulopathy and negative urine culture was the criteria for inclusion. Children having bladder stones in augmented bladder and difficult per urethral access were excluded from the study.

The study was approved by the Institutional Review Board of SIUT. A detailed history was taken, physical examination performed, laboratory investigations, including complete blood count, clotting profile, serum urea, serum creatinine electrolytes, urine analysis, urine culture sensitivity, and radiological investigations like X-ray and ultrasound KUB were done. A written and informed parental consent was taken.

A prophylactic intravenous antibiotic such as third-generation cephalosporin was administered before the surgery. The patients were placed in lithotomy position under general anaesthesia and transurethral cystolithoclast was performed using miniscope 4FR for up to 5-year-old children, and in more than 5 years old children, 7/8.5FR ureteroscope was used with pneumatic lithoclast probe. The smaller pieces of stones were evacuated with the help of Ellicks' evacuator by using 11 FR and 14 FR cystoscopic sheaths in smaller and older children respectively. The lithoclast probe used was of 0.8mm in size. Suprapubic canula was also placed to decompress the bladder and reduce the chances of perforation and over-distention. After the completion of procedure, 10-12FR Foleys catheter was placed. Post-operatively the patients were kept in paediatric urology ward and discharged within 12 hours with Foleys catheter and with the instructions to have it removed after 24 hours at our institution or a nearby hospital. Out-patients follow-up was advised. Duration of procedure, any per-operative or post-operative complications like fever, blood in urine, residual stones, difficulty in passing urine and retention of urine were recorded. These children were followed-up at the dedicated paediatric stone clinic of the institute. Data was stored and analysed on SPSS version 10. The data was expressed as percent for qualitative variables while the quantitative data was expressed in mean ± SD.

Results

During the period of study, a total of 100 children with bladder calculi were included in the study and were

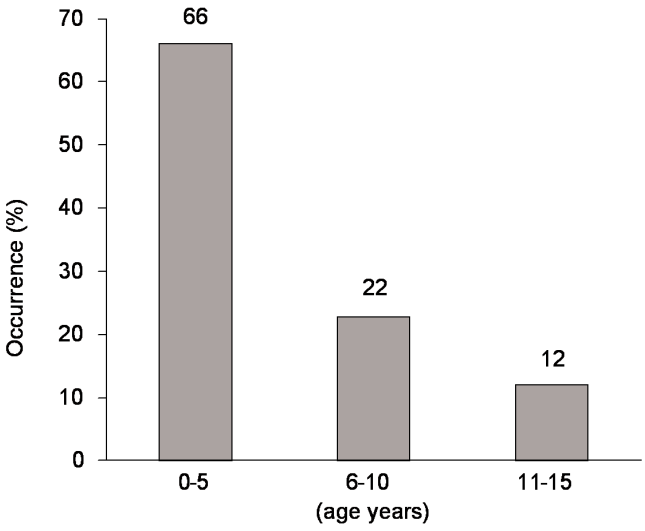

Figure: The occurrence of the bladder stones in relation to the patient age.

Table-1: Common clinical signs and symptoms.

Signs & Symptoms	No.	%
Poor urinary stream	65	65
Dribbling of urine	60	60
Crying during micturation	55	55
Retention of urine	21	21
Straining during micturation	20	20
Milking of penis	15	15
Haematuria	13	13
Increased frequency of urine	10	10

Table-2: Post-operative complications.

Complications	No.	%
Haematuria	5	5
Dysuria	4	4
Retention of urine	1	1

treated with pneumatic cystolithoclast. There were 92 (92%) males and 8 (8%) females, with the male-female ratio being 11.5: 1. Age range was from nine months to 15 years with peak age of up to 5 years constituting 66% of all cases (Figure). Almost all the patients belonged to poor families of rural areas or poor localities of Karachi city. The stone size in 6 (6%) patients was between 2.5 to 3.0 cm and all were having ages between 13 to 15 years.

Most patients presented with complaint of poor urinary stream, dribbling of urine and crying during micturation. Of the total, 21 patients presented with retention of urine (Table-1).

The bladder stone size ranged from 0.5 - 3 cm, while 50% had stone size up to 1 cm, 38 (38%) had it from 1.1 to 2.0cm, and 12 (12%) had a stone size between 2 and 3cm. Ten (10%) patients had radiolucent stones and were detected by ultrasound; 11 (11%) patients had associated renal stones out of which 5 (5%) had bilateral stones. The size of stones increased with the patient's age. The average operating time was 25 minutes with a range of 10 - 65 minutes. The mean hospital stay was 9.2 ± 2.5 hours.

Ten (10%) patients developed minor complications (Table-2). Five (5%) patients developed immediate post-operative haematuria which was settled within a couple of hours in all such patients. Four (4%) patients developed difficulty in passing urine after the removal of the catheter which settled by itself on the first follow-up in a week's time. One (1%) patient developed retention of urine and we had to keep the Foleys catheter in situ for 24 hours after which he passed urine comfortably. After one session of cystolithoclast, 100% children became stone-free and were discharged from the hospital in 10 to 12 hours.

Discussion

Bladder calculi in children in the absence of obstruction, infection or neurology diseases are considered to be endemic.[11] These stones have almost disappeared in developed countries, but are still present in under-developed countries like Pakistan. The bladder stones are endemic in the rural areas of the country and poor localities of big cities.

The treatment options available for bladder stones in children include extracorporeal shockwave lithotripsy, transurethral cystolithotripsy, open cystolithotomy and percutaneous suprapubic cystolithotripsy. The traditional method of treatment for patients with the bladder stone is cystolithotomy[8] and this is a viable option in cases of large, hard vesical calculi.[7] But this treatment modality has inherent problems of a large scar, prolonged catheterisation; prolonged hospitalisation and the risk of infection.[12]

Extracorporeal shockwave lithotripsy treatment is technically easy method to treat the bladder stones,[13] but in children its application may be questionable because of difficulty in passing the stone fragments. In the case of large or hard bladder stones, to achieve a higher success rate, more sessions are needed and chances of complications increase as well.

Recently percutaneous suprapubic lithotripsy has become an alternative treatment option for bladder stones in children. A study performed by Salah et al[14] in 155 children with bladder stones concluded that this procedure is safe and effective in children with endemic bladder stones. In their study the average duration of hospital stay was 2.7 days (range 2-5 days) and patients had a suprapubic catheter in place for 1 day and a urethral catheter for 2 days. The reported complications of percutaneous suprapubic lithotripsy in their study included paralytic ileus (9.7% of patients) and abdominal distension (0.6%). A study by Al-Marhoon et al[15] reported similar complications and same prolonged hospitalisation.

The main concerns in children are small calibre of urethra and the clearance of small stone fragments. The advent of improved endoscopic techniques, and related technology have made endoscopic management of bladder stones feasible.[8]

Transurethral pneumatic cystolithotripsy has proven quite effective in fragmenting large, hard bladder calculi with minimal tissue injury in adults,[5] but its use in paediatric bladder calculi through transurethral route is not well reported in literature. The main worry in young children is the narrow caliber of urethra and fragment clearance after stone breakage. With miniaturisation of ureteroscope and cystoscope size in recent years and the use

of video camera and monitor for direct visualisation, this technique can be made applicable to children from 1 to 15 year of age. Larger bladder stones are fragmented into small pieces with the help of pneumatic lithoclast.

The results of our study are comparable to the study done by Ramakrishnan et al.[16] In their study they treated bladder stones in children endoscopically by transurethral route by using holmium laser. All the children were stone-free following a single session. During the follow-up period, none of the children developed recurrence or urethral strictures.

More recently, another study was done by Isen et al[17] in children with bladder stones by using transurethral pneumatic lithotripsy. In this study, slightly more complications were observed compared to our study, as 7.4% of the patients required a second procedure to clear the fragments and relieve acute retention. The mean hospital stay was also significantly higher.

The present study showed that this treatment option can be recommended as a safe and effective treatment in children with bladder stones of up to 3cm. All these results indicated that with advancement and refinements in the paediatric endoscopic instruments, the surgeons having experience in dealing with such a procedure played an important role in reducing the complication rate and achieving 100% stone-free rate in our study.

Conclusion

Excellent stone-free rates with transurethral pneumatic lithotripsy as a day-care procedure with minimal complications make it a preferred treatment option for endemic bladder calculi of 0.5 - 3cm size.

Acknowledgement

We would like to thank Dr. Sajid Sultan for his guidance in writing this paper, Miss Sakina Yousuf for her help in data analysis, and Mr. Shamshad Hussain for his assistance in layout and bibliography.

References

1. Rizvi SA, Naqvi SA, Hussain Z, Hashmi A, Hussain M, Zafar MN, et al. The management of stone disease. BJU Int 2002; 89: 62-8.
2. Ramello A., Vitale C, Marangella M. Epidemiology of nephrolithiasis. J Nephrol 2000; 13: S45-50.
3. Rizvi SA, Naqvi SA, Hussain Z, Hashmi A, Hussain M, Zafar MN, et al. Pediatric urolithiasis: developing nation perspectives. J Urol 2002; 168: 1522-5.
4. Mc Carrison RA. Lecture on causation of stone in India. Br Med J 1931; 1: 1009.
5. Naqvi SA, Rizvi SA, Shahjehan S. Bladder stone disease in children, clinical studies. J Pak Med Assoc 1984; 34: 94-101.
6. Colin BA. The epidemiology formation, composition and Medical Management of idiopathic stone disease. Curr Opin Urol 1993; 3: 316-22.
7. Desai M. Endoscopic management of stones in children. Curr Opin Urol 2005; 15: 107-12.
8. Faerber GJ. Pediatric urolithiasis. Curr Opin Urol 2001; 11: 385-9.
9. Denstedt JD, Eberwein PM, Singh RR. The Swiss Lithoclast: a new device for intracorporeal lithotripsy. J Urol 1992; 148: 1088-90.
10. Teh CL, Zhong P, Preminger GM. Laboratory and clinical assessment of pneumatically driven intracorporeal lilhotripsy. J Endourol 1998; 12: 163-9.
11. Rizvi SA, Naqvi SA, Hussain Z, Shahjehan S. Renal stones in children in Pakistan. Br J Urol 1985; 57: 618-21.
12. Maheshwari PN, Oswal AT, Bansal M. Percutaneous cystolithotomy for vesical calculi: a better approach. Tech Urol 1999; 5: 40-2.
13. Hussain I, el-Faqih SR, Shamsuddin AB, Atassi R. Primary extracorporeal shock wave lithotripsy in management of large bladder calculi. J Endourol 1994; 8: 183-6.
14. Salah MA, Holman E, Toth C. Percutaneous suprapubic cystolithotripsy for paediatric bladder stones in a developing country. Eur Urol 2001; 39: 466-70.
15. 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: 2684-7.
16. Ramakrishnan PA, Medhat M, Al-Bulushi YH, Gopakumar KP, Sampige VP, Al-Busaidly SS, et al. Holmium laser cystolithotripsy in children: initial experience. Can J Urol 2005; 12: 2880-6.
17. Isen K, Em S, Kilic V, Utku V, Bogatekin S, Ergin H: Management of bladder stones with pneumatic lithotripsy using a ureteroscope in children. J Endourol 2008; 22: 1037-40.