International Journal of Research in Medical Sciences
Rajput M et al. Int J Res Med Sci. 2021 Mar;9(3):798-803
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20210881

Original Research Article

Endourological management of pediatric urolithiasis in Northeast India

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Received: 08 January 2021
Revised: 06 February 2021
Accepted: 09 February 2021

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ABSTRACT

Background: Urolithiasis affects between 5-10% of the population during their lifetime, 2-3% of them are children. In the last decade, technological advancement and miniaturization of instruments has changed the management of pediatric urinary-stone disease. Extracorporeal shockwave lithotripsy (ESWL) has been preferred method of management of pediatric stone disease, whereas the endoscopic approach is limited to a few centers.
Methods: This retrospective study was conducted among the pediatric patients (6-15 years) presenting with urolithiasis during 1st January 2017 to 31st December 2019 to the department of urology, Dispur hospital Pvt. Ltd., Assam. Only confirmed cases of pediatric urolithiasis were included in this study. Medical records were reviewed for clinical and laboratory data including gender, age at diagnosis, clinical presentation, presence of urinary tract anomalies, and urinary tract infections (UTI) in the form of urinalysis, urine culture and complete blood count. Metabolic evaluation was advised in all children. Finally, a total of 100 pediatric urolithiasis cases were included in this study.
Results: ESWL was performed in 28 children. The stone-free rate was 85.7%. The total number of shocks per treatment ranged from 1000 to 2000. A total of 10 percutaneous nephrolithotomy (PCNLs) were done with complete stone clearance in 83.33%. In the URS group, urethroscopy was successful in 20 cases (75%). Cystolithotripsy was done in 08 cases with 100% clearance rate. 30 patients were managed conservatively.
Conclusions: ESWL is highly effective in children for small stone burden. Early metabolic evaluation and treatment may prevent further renal damage and recurrence.

Keywords: Pediatric urolithiasis, PCNL, ESWL

INTRODUCTION

Urinary lithiasis affects between 5-10% of the population during their lifetime, 2-3% of them are children.[1] The literature on incidence, etiology and natural history of pediatric urolithiasis varies due to geographic, dietary and socioeconomic differences. Pediatric urolithiasis is known to be associated with urinary infection, anatomic and metabolic abnormalities. Management of stone disease in children necessitates complete stone clearance, eradication of urinary infection and appropriate correction of any underlying metabolic or anatomical abnormalities. [2]

Genetic inheritance, nutrition, metabolic abnormalities, environmental factors, anatomical characteristics, and calculus-inducing medication are the factors predisposing for urolithiasis in children. Clinical and metabolic patterns of urolithiasis have changed over the years.[3] As most children with stone disease have an underlying metabolic abnormality, it is necessary that these children should be cautiously evaluated so that the etiology of their disorder can be obtained.[4]

In the last decade, technological advancement and miniaturization of instruments has changed the management of pediatric urinary-stone disease. Although

there is international consensus on the guidelines for the management of stone in adults, consensus on the management of pediatric stone disease is lacking. Extracorporeal shockwave lithotripsy (ESWL) has been preferred method of management of pediatric stone disease.[5,6] whereas the endoscopic approach is limited to a few centers.[7]

METHODS

This retrospective study was conducted among the pediatric patients (6-15 years) presenting with urolithiasis during 1st January 2017 to 31st December 2019 to the department of urology, Dispur hospital Pvt. Ltd., Assam. The purpose of the study was to assess our data and review recent guidelines on management of pediatric urolithiasis. Only confirmed cases of pediatric urolithiasis were included in this study. Initial diagnosis of stone disease was done by ultrasound and confirmed by non-contrast computed tomography.

Medical records were reviewed for clinical and laboratory data including gender, age at diagnosis, clinical presentation, presence of urinary tract anomalies, and UTI in the form of urinalysis, urine culture and complete blood count. Metabolic evaluation was advised in all children. Urine tests included urinalysis, urine culture, calcium, oxalate, citrate, uric acid. Biochemical investigations included serum calcium, serum phosphorus, serum creatinine, serum uric acid, serum electrolytes, serum parathyroid hormone and serum albumin. Finally, a total of 100 pediatric urolithiasis cases were included in this study. The data was analyzed in Microsoft excel 2013 software.

Ureteroscopic lithotripsy (URSL)

The patient is shifted to lithotomy position, following General anaesthesia. Under fluoroscopy guidance, a safety hydrophilic wire (0.038 in) is inserted into the respective ureteral orifice via a pediatric cystoscope. The wire is advanced into the renal pelvis, bypassing the stone. A flexible 6/7.5-Fr ureter scope is used. The stone is evaporated with a 200-mm laser fiber. A ureteral stent is left in place for 4 weeks. For renal stones, we use an access sheath of 9.5 Fr. our preferred energy source is the Ho: YAG laser for stone disintegration. Fragments are extracted with a basket.

Percutaneous nephrolithotomy

Adequate antibacterial agents should be given prophylactically prior to Percutaneous nephrolithotomy (PCNL). A hydrophilic wire is introduced into the ureter via a cystoscopy while patient is in the lithotomy position. The wire is then replaced by a 5 Fr ureteral catheter, and the collecting system is filled with contrast dye. Dilatation of the tract is done using Amplatz dilators up to 18 Fr. After tract dilatation, rigid 14 Fr nephron-scope is inserted under direct vision. Stone fragmentation is done with pneumatic lithotripter.

Extracorporeal shockwave lithotripsy

Extracorporeal shockwave lithotripsy (ESWL) was performed on in-patient basis. Pre-procedure preparation is done in the form of light diet at the night before procedure. Patient is advised nil per orally for 6 hours. Patient received single dose of injectable antibiotic half an hour before starting the procedure (usually a fluoroquinolone/third generation cephalosporin) and continued the same antibiotic orally for 3 days post procedure. Stone is localized using fluoroscopy. 1 unit of intra-venous fluid is given-NS with 10 mg of Lasix as a diuretic. ESWL was done using stone lith (electrohydraulic lithotripter). Shocks were given starting at 8-10 mA at 60 shocks per min (1 Hz) and around 1000 to 2000 shocks were applied. If the stone fragmentation was inadequate, another session was planned at interval of 2-3 weeks. Stone clearance was assessed with X-ray KUB at 1 month and 3 months after SWL.

RESULTS

A total of 100 children were managed at our center. Among them, 67 children were male and 33 were female. At our center the mean age of presentation was 10 years. At our center abdominal pain (52%) was the most common presenting symptom in children, followed by Nausea and vomiting (24%). Renal stones were more common on the right side while ureteral stones were more common on the left side.

The most common location for urinary stones was the kidney, accounting for 50 out of 100 cases. Stones in the ureter and urinary bladder accounted for 32 and 18 stone sites respectively. Children with a small stone burden (3 mm) were managed conservatively. PCNL was done in 10 cases. A single tract was made at 09 stone sites, while two tracts were made for 1 stone site. Post percutaneous nephrolithotomy nephrostomy tube placement was done in all cases.

Ureteroscopic retrieval of stone was done at 20 stone sites using a semi-rigid ureteoscope of size 6 Fr/7.5 Fr scope. For stone fragmentation we used Ho: YAG laser and pneumatic lithotripter. Post URS DJ stent placement was done for at least 2 weeks in younger children and children where multiple manipulations of distal ureter and ureteric orifice were done. Percutaneous cystolithotripsy (PCLT) for urinary bladder stone was done in 08 children. Stone clearance was 83.33% in the PCNL group while 75% stone clearance was noted after URS.

ESWL for residual renal stones after PCNL was done at 1 month follow up. A minor complication such as post PCNL pyrexia or persistent urine leak after tube removal was present in 2 patients of the PCNL group,

respectively. Post PCNL pyrexia was managed conservatively with intravenous antibiotic, while persistent urine leak was also managed conservatively.

Twenty-eight children with urinary stones were managed by ESWL. At our center, routine DJ stent placement before ESWL is done. Stone clearance rate was 85.7% in all the children. Single session ESWL was done in 24 (85.7%) children while more than one session was given in 04 (14.3%) children. After ESWL, no complication was noted.

Metabolic workup could be done in all children. A metabolic abnormality was seen in 64 children. The most common abnormality was normocalcemic hypercalciuria in 34 (53.1%), followed by hypocitraturia, hyperoxaluria and hyperuricosuria in 04 (6.25%), 14 (21.8%) and 12 (18.75%) children, respectively.

Table 1: Gender.

Gender	Frequency
Male	67
Female	33

Table 2: Age at presentation.

Age (year)	Frequency
<5	10
5-10	58
10-15	32

Table 3: Presentation.

Symptomatic children	Number
Abdominal pain	52
Gross hematuria	04
Nausea and vomiting	24
Lower urinary tract symptoms (difficult voiding)	18
Urinary retention	00
Asymptomatic children	
Diagnosed by ultrasonography for different reasons	02

Table 4: Distribution of stone.

Distribution of stone	Number
Renal	50
Ureteric	32
Vesicle calculus	18
Type of stone	
calcium oxalate	28
Calcium phosphate	04
Uric acid	06
Ammonium urate	02

Table 5: Urine culture.

No. of patients	Positive	Negative
100	39	61

Table 6: Treatment.

Treatment	No.	Success rate (%)	Auxiliary procedures
Renal stone			
DJ stenting and ESWL	28	85.7	ESWL
PCNL	10	83.33	
ESWL and PCNL	--		
Ureteral stone			
ESWL	--		
URS	20	75	ESWL
Open surgery	--		
Vesical calculus			
Open surgery	04	100	
Cystolithotripsy	08	100	
Conservative	30		

Table 7: Metabolic abnormalities.

Metabolic abnormalities	No./percentage
No metabolic abnormality	36 (36)
Metabolic abnormality present	64 (64)
Hypercalciuria	34 (53.1)
Hypocitraturia	04 (6.25)
Hyperoxaluria	14 (21.8)
Hyperuricosuria	12 (18.75)

Figure 1: Pediatric cystoscope.

Figure 2: Semi rigid ureteroscope (6/7.5 Fr).

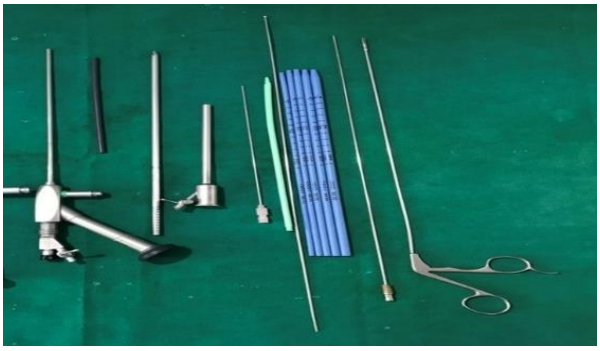

Figure 3 : PCNL armamentariums.

Figure 4: ESWL machine.

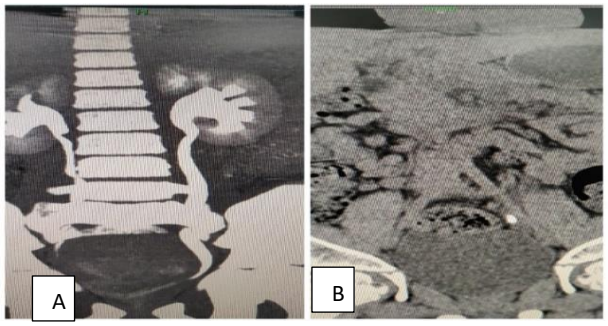

Figure 5: 10 years child with left lower ureteric calculus (8x5 mm, 850 HU) with HDN managed with URSL.

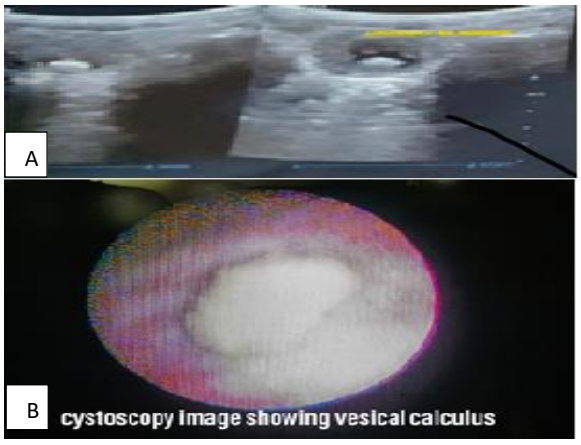

Figure 6: 4 years child with vesical calculus, managed by cystolithotripsy.

Stone analysis could be done for 20 stones. Of 20 stones in the upper tract, 14 (70%) were calcium oxalate stones. Numbers of uric acid stones were 03 (15%). For vesical calculi, the most common stone composition was calcium phosphate in 02 followed by ammonium acid urate in 01. Recurrence of urolithiasis was seen in 09 children after a mean follow-up of 1.5 years. It was more common among children who had a metabolic abnormality and those in whom small residual fragments were seen on follow-up.

DISCUSSION

The rates of urolithiasis have increased in developed countries, and there has been a shift in the age group experiencing a first stone episode.[9,10] More than 1% of all urinary stones are seen in patients aged <18 years. In the context of India, urolithiasis is prevalent, with an expectancy of 12% in a total population reported to be prone to urinary stones as a result of malnutrition and racial factors. Pediatric urolithiasis remains an endemic disease in some areas (e.g., Turkey and the far East); elsewhere, the rates are similar to those observed in developed countries.[11-14]

Pediatric urolithiasis is unusual in its presentation and if left untreated, it can cause significant morbidity. Several factors like the anatomy of the collecting system; and the presence of obstruction and infection of the urinary tract are important factors to consider must be considered when selecting treatment procedures for children. Compared to adults, children pass fragments more rapidly after ESWL.[6]

Medical expulsive therapy (α-blockers) is very common in adults but there are limited data to demonstrate their safety and efficacy in children; however, tamsulosin seems to support stone passage.[9,15-17]

Extracorporeal shock wave lithotripsy remains the least-invasive procedure for stone management in children.[17] Stone-free-rates of 67-93% in short-term and 57-92% in long-term follow-up studies have been reported. It is more effective in fragmentation of stone in children than adult. The retreatment rate is 13.9-53.9%, and the need for ancillary procedures and/or additional interventions is 7-33%.[17]

General or dissociative anesthesia is administered in most children aged <10 years, to prevent patient and stone motion and the need for repositioning.[18,19] with modern lithotripters, intravenous sedation or patient-controlled analgesia have been used in selected co-operative older children. There are concerns regarding the safety and potential biological effects of ESWL on immature kidneys and surrounding organs in children. However, during short- and long-term follow-up, no irreversible functional or morphological side effects of high energy shock waves have been demonstrated.[18]

We performed PCNL in 10 cases with complete stone clearance in 83.33% cases. PCNL can be performed safely by experienced operators, with less radiation exposure, even for large and complex stones.[18,19.] Stone-free rates are between 68 and 100% after a single session, and increase with adjunctive measures, such as second-look PCNL, ESWL and URS.[18]

The urological association of Asia clinical guideline for urinary stone disease (2019) recommends conservative management as a first-line therapy in children with uncomplicated ureteral stones ≤10 mm. it also recommends both SWL and URS as the treatments of choice for children with ureteral stones who are unlikely to pass the stones or who have failed conservative management (LE: 2, GR: B). However, all modalities (SWL, URS, PCNL) are acceptable treatment options for children with renal stones.[20]

European association of urology guideline (2020) recommends shock wave lithotripsy (ESWL) as first line option for children with single ureteral stones less than 10 mm if localization is possible. Urethroscopy is a feasible alternative for ureteral stones not amenable to ESWL. Children with renal stones with a diameter of up to 20 mm (~300 mm^2) ESWL can be offered.

Children with renal pelvic or calyceal stones with a diameter > 20 mm (~300 mm2) percutaneous nephrolithotomy should be offered. Retrograde renal surgery is a feasible alternative for renal stones smaller than 20 mm in all locations.

Indications for open surgery include: failure of primary therapy for stone removal; very young children with complex stones; congenital obstruction that requires simultaneous surgical correction; severe orthopedic deformities that limit positioning for endoscopic procedures; and abnormal kidney position.[15,17]

Limitations

Limitations of the study were 1) this study is a single centre retrospective study with a limited sample size 2) long-term follow-up is required.

CONCLUSION

ESWL is highly effective in children for small stone burdens. As the abnormality is quite common, metabolic evaluation should be done in all pediatric urolithiasis cases. Early metabolic evaluation and treatment may prevent further renal damage and recurrence.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Rajput M, Paul SL, Deka PM. Endourological management of pediatric urolithiasis in Northeast India. Int J Res Med Sci 2021;9:798-803.