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Comparison of percutaneous vs. open cystolithotomy for urinary bladder stone in pediatric population

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Abstract---Introduction: Urinary Bladder stone can result in variety of lower urinary tract symptoms. Bladder stone is common in extreme of ages i.e. pediatric population and geriatric population. Overall prevalence of the disease is not that high. With increase in health care facilities and screening investigations like ultrasound, this condition is easily diagnosed. Traditionally just like renal or ureteric stones open cystolithotomy was the treatment of choice but with advancement in endourological instruments and miniturization it is now frequently dealt by minimally invasive techniques like percutaneous cystolithotomy. The aim of our study was to compare the results of urinary bladder stone surgical managements. Methods: After ERC approval we conducted this descriptive retrospective study. For data collection record of pediatric patients admitted in Urology Unit, Khyber Teaching Hospital Peshawar Pakistan during the period from April 2022 to January 2023 was used. 110 pediatric patients with urinary bladder (UB) stones who underwent surgery were enrolled in

our study. According to type of intervention, patients were stratified into two groups, (Group O) underwent open cystolithotomy, and (Group P) underwent endo-urological treatment via the percutaneous route. 60 patients underwent open cystolithotomy (OCL), while 50 patients underwent percutaneous cystolithotomy (PCCL). Data including the demographics, pre-operative baseline investigations including ultrasound or x-ray pelvis (AP view), surgical procedure time, stone size, hospital stay, pre-treatment urine culture, post-operative complications were recorded. Results: A total of 110 patients were included out of which 89 were male and 21 were female. Overall mean age of patients was 6.75 ± 3.71 (1 – 14), mean surgical procedure time was 35.50 ± 9.10 (19-41min) , mean hospital stay was 2.32 ± 0.65 (1-4 days), mean stone size was $2.62 \text{cm} \pm 0.87$ (1-4.5cm). Conclusion: Both open cystolithotomy and percutaneous cystolithotomy are safe procedures. There is no significant difference in the mean age, operative time, hospital stay and stone size of both the treatments.

Keywords---bladder stone, children, open cystolithotomy, percutaneous cystolithotomy.

Introduction

Urinary Bladder stone can result in variety of lower urinary tract symptoms. Bladder stone is common in extreme of ages i.e. pediatric population and geriatric population. Overall prevalence of the disease is not that high, with increase in health care facilities and screening investigations like ultrasound, this condition is easily diagnosed. Traditionally just like renal or ureteric stones open surgery (cystolithotomy) was the treatment of choice but with advancement in endourological instruments and miniaturization it is now frequently dealt by minimally invasive techniques like percutaneous cystolithotomy (PCCL). Prevalence of urinary bladder stone has been found to be between 3.8%⁽¹⁾ and in another study around 5%⁽²⁾. Frequency is higher in the countries with large populations or in countries with poor hygiene and nutritional deficit in pediatric population⁽³⁾.

Over the past few years urinary bladder stones are now being treated by variety of surgical techniques. In the beginning open cystolithotomy was the most common and effective mode of treatment⁽⁴⁾. After advancement in endoscopic instruments it was possible to pass urethral instruments in juvenile population and then further miniaturization resulted in percutaneous cystolithotomy, cystolitholapaxy and transurethral cystolithotomy. Urethral manipulation in specially male pediatric population always carries a risk of urethral injury⁽⁵⁾, Urologists came up with another minimal invasive technique called percutaneous cystolithotomy. Principle of PCCL is same as that of percutaneous nephrolithotomy (PCNL). Now widely used throughout the world.⁽⁶⁾

Data shows that all the techniques used for urinary bladder stone fragmentation and removal i.e. Open cystolithotomy, percutaneous or transurethral cystolithotomy or even cystolitholapaxy all have good stone clearance rates⁽⁷⁾. In

pediatric population all these surgeries are under taken in general anesthesia. Laser lithotripsy is also advancement in this field but availability of laser is still a big issue in itself ⁽⁸⁾.

Methodology

Study Population

After ERC approval we conducted this descriptive retrospective study. For data collection records of pediatric patients admitted in Urology Unit, Khyber Teaching Hospital: From April 2022 to January 2023 were included. A total of 110 pediatric patients with bladder stones who underwent UB stone surgery were enrolled. According to type of intervention, patients were stratified into two groups. (Group O) underwent open cystolithotomy, and (Group P) underwent endo-urolological treatment via the percutaneous route. First group included 60 patients that underwent open cystolithotomy (OCL); second group had 50 patients who underwent percutaneous cystolithotomy (PCCL). Data includes the Demographics, pre operative baseline investigations including ultrasound or x ray pelvis (AP view), surgical procedure time, stone size, hospital stay, pre-treatment urine culture, post-operative complications were recorded. Before proceeding to surgery baseline investigations including Urine culture and sensitivity and renal function tests were recorded.

Primary Objective

To compare mean operating time of percutaneous cystolithotomy (PCCL) and open cystolithotomy (OCL).

Secondary Objective

To compare post-operative hospital stay for both PCCL and OCL.

Material and Methods

Study design

Retrospective descriptive study

Inclusion Criteria

Age 15yrs or less, no previous bladder surgery.

Exclusion Criteria

- Additional pathology other than bladder stones, age>15, concurrent renal or ureteric stones.
- Incomplete data in files or online record.

Sampling Technique

Convenient sampling technique was used so sample size calculation is not warranted.

Data collection

Data was retrieved by HIMS and file records.

Data storage

Collected data was kept in locker with keys only with principal author.

Data Analysis

Data was analyzed by SPSS version 20.

Operational definition**Surgical time**

Time taken from the time of induction till the time of recovery noted in anesthesia notes.

Study population

Pediatric population with bladder stone treated by PCCL or OCL (open cystolithotomy) operated by a Pediatric Urologist with atleast 5 years experience.

Study Outcome

Demographics data, Clinical features, intraoperative and postoperative complications were recorded. Operative times from beginning of urethrocystoscopy till catheter indwelling; and postoperative hospital stay were compared.

Surgical Technique

- As per protocol single shot intravenous antibiotics was administered before surgery
- All the procedures were performed under general anesthesia
- If previously cystourethroscopy was not performed then CU was done at the start of surgery.

PCCL

- Consent was taken
- Patient positioned supine.
- Urinary bladder filled with 3 ways catheter or during CU performed
- Just 2 cm above pubic symphysis, around 1 cm incision was given and 18 or 21 gauge needle was used to puncture bladder

- Followed by tract dilatation
- 26 Fr or 28 Fr Amplatz sheath was placed
- 24 Fr or 26 Fr nephroscope and LithoClast lithotripter were introduced and stone fragmentation was done
- particles were removed with forceps.
- Finally, double drainage left in situ (per urethral as well as cystostomy).

OCL

- Consent was taken
- Patient in In supine position
- Urinary bladder filled with 3 ways catheter or during CU performed
- 3-4cm skin incision given, abdominal muscles separated
- Urinary bladder identified and stay sutures taken
- UB opened between stay sutures and stone removed
- Drain and catheter placed
- Abdomen closed

Data Analysis

Statistical Package for the Social Sciences (SPSS) (version 20) was used to perform paired t-test, independent t-test; also quantitative outcomes were showed through descriptive statistics (mean \pm standard deviation). The $P < 0.05$ was considered as the statistical significance level.

Tables and Results

A total of 110 patients were included out of which 89 were male and 21 were female. Group O had 60 patients while group P had 50 patients included. Overall mean age of patients was 6.75 ± 3.71 (1-14), mean surgical procedure time was 35.50 ± 9.10 (19-41min), mean hospital stay was 2.32 ± 0.65 (1-4 days), and mean stone size was $2.62 \text{cm} \pm 0.87$ (1-4.5cm).

Table 1
Demographic and Clinical Data

Variable	All Cases (n = 110)	OCL (n=60; 54.5%)	PCCL (n=50; 45.5%)	P-value
Gender	Male: 89(80.9%) Female: 21(19.1%)	Male: 52(47.27%) Female: 8(7.27%)	Male: 37(33.63%) Female: 13(11.81%)	
Age(years)	6.75 ± 3.71 (1 - 14)	6.73 ± 3.78	6.77 ± 3.65	0.95
Stone size(cm)	2.62 ± 0.87 (1-4.5cm)	2.76 ± 0.92	2.46 ± 0.79	0.074
Mean operative time: MOT (min)	35.50 ± 9.10 (19-41min)	36.4 ± 9.32	34.4 ± 8.80	0.26
Mean Hospital stay MHS (days)	2.32 ± 0.65 (1-4days)	2.35 ± 0.63	2.30 ± 0.67	0.69

Abbreviation: OCL, open cystolithotomy; PCCL, Percutaneous cystolithotomy; mean operative time; MHS, mean hospital stay; MSS, Mean stone size.

Most of the patients 97(88.2%) were electively admitted out of these 54 patients underwent open surgery. Only 13(11.8%) were admitted through emergency and 6 had open surgery. Male patients who underwent Open surgery and were admitted through Out-patient department were 47 and female were only 7 in number, while patients who were treated by PCCL and also had elective admissions, included 30 males and 13 females. Very few patients had history of bladder stone surgery 5(4.5%). 80% of those patients were male. It was also noted that out of these 110 patients only 9 had positive urine culture that was treated according to sensitivity before the surgeries. 7 out these 9 positive culture patients were male. 6 out of 9 patients with positive urine culture underwent open surgery. 99 patients had single stone out of which 81 were male and 52 underwent open surgery. On the other hand 11 patients had multiple stone and for the purpose of grouping all the multiple urinary bladder stone patients were placed in >1 stone group.

Table 2
Frequencies and Percentages

Variable	All Cases (n = 110)	OCL (n=60; 54.5%)	PCCL (n=50; 45.5%)
MOA (Mode of admission)	Elective 97(88.2%)	Male: 47(42.72%) Female: 7(6.36%)	Male: 30(27.27%) Female: 13(11.81%)
	Emergency 13(11.8%)	Male: 5(4.54%) Female: 1(0.90%)	Male: 7(6.36%) Female: 0
History of previous bladder stone surgery	Done 5(4.5%)	Male: 1(0.90%) Female: 1(0.90%)	Male: 3(6.36%) Female: 0
	Not done 105 (95.5%)	Male: 51(46.36%) Female: 7(6.36%)	Male: 34(30.90%) Female: 13(11.81%)
Pre-operative UCS	Negative 101(91.8%)	Male: 48 (43.63%) Female: 6 (5.4%)	Male: 34 (30.9%) Female: 13 (11.81%)
	Positive 9(8.2%)	Male: 4(3.63%) Female: 2(1.81%)	Male: 3(2.72%) Female: 0
Number of STONES	1 STONE 99(90%)	Male: 46(41.81%) Female: 6(5.4%)	Male: 35(31.81%) Female: 12(10.90%)
	>1 STONES 11 (10%)	Male: 6(5.4%) Female: 2(1.81%)	Male: 2(1.81%) Female: 1(0.90%)

Abbreviation: OCL, open cystolithotomy; PCCL, Percutaneous cystolithotomy; mean operative time; MHS, mean hospital stay; MSS, Mean stone size.

Discussion

Urinary bladder stones are most of the time symptomatic, main symptoms include hematuria, pain at the tip of penis or hypogastric pain, urinary retention usually relieving with change of posture and voiding lower urinary tract symptoms as well. Urinary bladder can result as a result of pathology like foreign body, posterior urethral valves, and urethral strictures and sometimes in VUR as well. Patient with hematuria and retention may present to emergency department.

If the stone migrated from upper tract then most of the time patient or the family is aware of the fact that the patient is a stone former. It is also previously established that urinary bladder stones are common in underdeveloped countries and predisposing factors may include recurrents Urinary tract infections and dietary insufficiency as well. With increasing awareness and world health and food programs this pathology is decreasing as reported by Lal et al ⁽⁹⁾

In spite of all the measures, fair amount of patients still suffer from the condition and for that treatment options are increasing day by day with advancement of medical science. Previously only treatment option medical practitioner would offer was open cystolithotomy then with the passage of time and miniaturization of instruments we are now able to deal most of the urolithiasis with endo-urolithotomy instruments. ⁽¹⁰⁾ Till date we are offering open surgery to pediatric population depending on the stone size and instruments available and choice of the attendants. Therefore in our study more than half of the patients (60/110) treated for bladder stone underwent open cystolithotomy (OCL). The other treatment options generally offered nowadays to pediatric population are per cutaneous cystolithotomy (PCCL) and transurethral cystolithotomy (both cystoscope and nephroscope have been used) or cystolitholapaxy. ⁽¹¹⁾⁻

By applying one sample T Test and comparing the means of stone size, age, hospital stay and operative time. The study conducted by Javanmard et al ⁽¹²⁾ had mean stone size of 2.76cm in comparison to mean stone size of 2.62 ± 0.87 and range of (1-4.5cm) in our study, the p-value came out to be 0.11 (not significant) and mean difference of stone size was -0.13cm. Mean age was compared in both the studies as well. Our study showed mean age with S.D value of 6.75 ± 3.71 and range of (1 - 14) while mean age was 8.3 ± 5.1 and ranged from (0.5-17.5years) with significant p value of 0.00 with mean difference -1.55years. Mean hospital stay in our study with range was 2.32 ± 0.65 (1-4days) while in their study it was 2.85 ± 1.23 with range from 1 to 8 days; p-value was statistically significant i.e.0.00.

Mean operative time 35.50 ± 9.10 (19-41min) while in fore mentioned study was calculated and came out to be 29.15 ± 7.12 (15-54days), mean difference was 6.35 and p-value was significant (0.000). Another study by Marhoon et al ⁽¹³⁾ in 2009 with sample size of 107 compared endo-urolithotomy treatment of stone with open surgical treatment. After applying one sample t-test following results were obtained. Mean age was 6.75 ± 3.71 and range of (1 - 14) in our study while it was 5years with range from 2 to 15years in their study. The mean difference was 1.75years and p-value was also significant 0.000. Overall Mean stone size was 2.62 ± 0.87 in our study while it was 2.8cm (range 0.7 to 5cm) in Marhoon et al study, so the p-value was statistically significant i.e. 0.041. The mean stone size of OCL group in our study was 2.76 ± 0.92 while it was 3.1 ± 1.6 cm and the mean stone size of PCCL group in our study was 2.46 ± 0.79 while it was 1.8 ± 0.8 cm in their study.

Overall mean hospital stay was 2.32 ± 0.65 (1-4days) while in their study it was 3.7 days. The mean difference of hospital stay was (-1.37days) with significant p-value of 0.00. Mean hospital stay for group OCL in our study was 2.35 ± 0.63 while in their study was 4.8days, similarly mean hospital stay in Group PCCL was in

our study was 2.30 ± 0.67 while it was 2.6 days. Overall mean operative time (in mins) was 35.50 ± 9.10 (19-41min) while in their study it was 42 ± 13 mins. the mean difference of hospital stay was (-6.4mins) with significant p-value of 0.00. Mean operative time for group OCL in our study was 36.4 ± 9.32 while in their study was 38 ± 12 , similarly mean operative time for Group PCCL was in our study was 34.4 ± 8.80 while it was 46 ± 14 minutes.

Table 3
Comparing our study with previous studies

Studies	No. of Cases	Mean Stone Size		Mean Hospital stay		Mean Operative time	
		OCL	PCCL	OCL	PCCL	OCL	PCCL
Tariq et al 2023	110	2.76 ± 0.92	2.46 ± 0.79	2.35 ± 0.63	2.30 ± 0.67	36.4 ± 9.32	34.4 ± 8.80
Al-Mahroon et al 2009	107	3.1 ± 1.6	1.8 ± 0.8	2.6	4.8	38 ± 12	46 ± 14
Javanmard et al 2018	146	2.89 ± 1.1	2.6 ± 1	3.55 ± 1	2.49 ± 0.72	26.06 ± 6.32	30.54 ± 5.27

Abbreviation: OCL, open cystolithotomy; PCCL, Percutaneous cystolithotomy;

Only 7 patients included in our study had post-operative complications. In Group O one patient had urinary tract infection post-operatively while two had hematuria. In Group P two patients had leakage from puncture site and were treated by prolonged catheterization and two patients had post-operative hematuria. All of them were categorized as grade 1 or 2 complications by Clavian grading system.

Limitations

- Retrospective study
- Small sample size
- As mentioned it was a retrospective study therefore we had some missing data especially in patients' follow up.

Conclusion

Both open cystolithotomy and percutaneous cystolithotomy are safe procedures. There is no significant difference in the mean age, operative time, hospital stay and stone size of both the treatments. But when compared with international studies there were significant variations in the mean age, hospital stay, operative times and stone size of the patients compared to our study.

Ethical Considerations

Researchers undertook to do the research subjects based on the ethical committee of Khyber Medical University.

Conflict of Interests

The authors declare no conflict of interest.

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