Check for updates

OPEN ACCESS

DOI: 10.46903/gjms/23.1.1784

ORIGINAL ARTICLE

COMPARISON OF OPEN URETERO-LITHOTOMY AND SEMI-RIGID URETEROSCOPY IN PAKISTAN'S PAEDRIATIC POPULATION WITH RESPECT TO MEAN OPERATIVE TIME, MEAN STONE FREE RATE, AND OTHER POSTOPERATIVE COMPLICATIONS. RETROSPECTIVE CROSS-SECTIONAL COMPARATIVE ANALYSIS

Ghulam Mujtaba Zafar[1], Muhammad Nadeem Sajjad[1], Fawad Humayun Akhtar[1], Fazal Ur Rehman Khan[2], Muhammad Zaheer[1], Hanan Yousuf[1]

Departments of Pediatric Urology, [1]Children's Hospital, [2]Shaikh Zayed Hospital, Lahore, Pakistan

ABSTRACT

Background: Pediatric urolithiasis is a significant health problem with considerable morbidity. In recent times, the treatment approach for these stones has evolved from traditional open surgical approaches to minimally invasive endourological techniques. The purpose of this study was to compare the results of open ureterolithotomy and semi-rigid ureteroscopy in the treatment of ureteric stones in the paediatric population in a tertiary care facility in Pakistan.

Materials & Methods: In this retrospective cross-sectional comparative study, 337 individuals with ureteric stone complaints who were under 15 years old and from a Pakistani tertiary care hospital were split into two groups at random and investigated retrospectively from June 2015 to December 2023. Two groups were created from all children under the age of 15 who had secondary hydronephro-ureter, ureteric stones, and failed MET. About 108 children in Group-B underwent open uretero-lithotomy, while 229 children in Group-A underwent semi-rigid ureteroscopy. We used the chi-squared test to compare the research groups. It was deemed statistically significant when the probability value was less than 0.05. A computer application called SPSS version 25.0 was used for all statistical calculations.

Result: The average age, stone size, and operating time for the 229 patients in Group-A were 7.01+2.530 years, 13.07+3.178 mm, and 45.31+6.712 minutes, respectively. Following one effort, the stone-free rate was 87.3%. Of these individuals, ureteral stricture only happened in 0.4% of cases, 0.9% had urinomas, and 7.0% had a fever. The mean stone size was 26.28+5.412 mm, the mean operative duration was 87.07+9.543 minutes, and the mean age of the 108 patients in Group-B was 10.06+3.627 years. Following one effort, the stone-free rate was 98.1%. Fever was reported by 1.9% of these patients, urinomas by 1.9%, and wound infections by 5.6%.

Conclusion: According to the study's findings, for paediatric patients, semi-rigid ureteroscopy with lithotripsy is safer and more less invasive than open uretero-lithotomy.

KEY WORDS: Semi-rigid ureteroscopy; uretero-lithotomy; ureteric stones; stone free rate; postoperative complications.

Cite as: Zafar GM, Sajjad MN, Akhtar FH, Khan FUR, Zaheer M, Yousuf H. Comparison of open uretero-lithotomy and semi-rigid ureteroscopy in Pakistan's paediatric population with respect to mean operative time, mean stone free rate, and other postoperative complications. Retrospective cross-sectional comparative analysis. Gomal J Med Sci 2025 Jan-Mar;23(1):22-7. https://doi.org/1046903/gjms/23.1.1784

Corresponding Author:

Dr. Muhammad Nadeem Sajjad
Senior registrar
Department of Paediatric Urology
Children Hospital
Lahore, Pakistan
E-mail: Sherishhina@gmail.com

Date Submitted: 09-02-2024
Date Revised: 26-11-2024
Date Accepted: 04-03-2025

INTRODUCTION

Urolithiasis refers to presence or formation of the mineral deposits, commonly known as stones or calculi, within the urinary tract.[1] It ranks as the 3rd most prevalent condition noticed by urologists, following prostate disease and UTIs (urinary tract infections). The prevalence of urolithiasis ranges from 2% to 20%, influenced by socioeconomic as well as geographic factors within a society.[2] While stone disease occurs less commonly among children compared to adults, it remains a significant health concern, especially in

the endemic regions. In the developed countries, pediatric stone disease accounts for 1% to 5% of all cases of urinary tract stone disease, while in developing countries, it constitutes 30% of cases. The pediatric stone disease incidence increases by 3 percent each year.[3] Pakistan has elevated incidence of renal stones, reaching levels as high as 10%. [4]

Effective management of urolithiasis hinges on factors such as the stone's location and size, the patient's age, and the anatomy of urinary tract.[4] Pediatric patients face a heightened risk of recurrence, underscoring the importance of thorough stone clearance to prevent future episodes.[5]

There are various surgical techniques available for treating the ureteric stones such as ureterolithotomy, semi rigid ureteroscopy (URS) and intracorporeal lithotripsy, flexible ureteroscopy & LASER (FUS) and extracorporeal shockwave lithotripsy (ESWL) .[6,7] In the past, all stones were typically treated by ureterolithotomy. At present, however, the majority of stones are managed using minimally invasive surgery (MIS), marking a significant shift in treatment approach. Performing MIS among small children presents challenges, but these have been partly addressed through advancements in technology, such as the development of miniaturized instruments.[5] Modern, sophisticated fine-caliber rigid and flexible ureteroscopes with enhanced optics are currently accessible. Coupled with advancements in high-power laser disintegration technology as well as fine retrieval instruments like nitinol baskets and graspers, these innovations have revolutionized the minimally invasive surgery among children.[5,8,9]

Therapeutic strategy for the surgical management of ureteric stones in children has not been well-defined. In this study we compared the semi-rigid ureteroscopy and lithotripsy (UL) with open ureterolithotomy (OU) performed in children during period of seven years, for various peri-operative factors, stone free rates and complications.

MATERIALS AND METHODS

After approval from institutional review board (2020-164-CHICH), the data of patients with ureteric stones were collected by simple random sampling from June 2015 to December 2023. All children up to 15 years of age, with symptomatic ureteric stones, secondary hydronephro-ureter and failed medical expulsive therapy (MET) were included. Antibiotics were added to treat urinary tract infection (UTI) according to culture and sensitivity. Ultrasound of kidney, ureter and bladder (KUB) and X-Ray KUB was done in all patients. Intravenous urography (IVU) was done in patients with normal RFTs and radio-opaque stones. Computerized tomography KUB (plain) was done in children with radiolucent stones or with deranged renal function.

In group-A, UL was performed in lithotomy position using semi-rigid ureteroscope (4.5-6.5 Fr & 6.0-7.5 Fr) with pneumatic lithotripsy (PL) or LASER lithotripsy (LL) under general anesthesia with full muscle relaxation. In group B, OU was performed and ureter was accessed by subcostal, McBurney's and Gibson incision, depending on the location of stones in the ureter. By extraperitoneal approach, the ureter was identified and suspended with sling proximally to prevent the migration of stones. The ureter was opened by longitudinal incision to extract the stones and closed with 5/0 absorbable suture in interrupted fashion. In both groups, the ureters were stented with 3.0-4.7 Fr double J (DJ) stent according to age of patients. X-Ray KUB or Ultrasound KUB were done 2 weeks postoperatively to evaluate the clearance of stones. The DJ stent was removed one month postoperatively.

Comparison of study groups was done using Chi-square test. A probability value $\leq$0.05 was considered statistically significant. All statistical calculations were done using computer program SPSS version 25.0.

RESULTS

In the current study, 337 patients were randomly assigned to two groups. There were 108 patients in Group B (open urtero-lithotomy) and 229 patients in Group A (semi-rigid ureteroscopy). The demographic variables are presented in Table:1.

Table-1: Demographic information

	Group-A Semi-Rigid Ureteroscopy		Group-B Open Uretero-Lithotomy		P-value
	N	%	**N**	**%**	
Age (years)					
$\leq$5	75	32.7	19	17.6	0.000
6-10	133	58.1	40	37.0	
>10	21	9.2	49	45.4	
Total	229	100.0	108	100.0	
Mean $\pm$SD	7.01$\pm$2.530		10.06$\pm$3.627		
Gender					
Male	158	69.0	72	66.7	0.668
Female	71	31.0	36	33.3	
Total	229	100.0	108	100.0	

Of the 229 patients in Group-A, 37 (16.1%) had bilateral stones, 89 (38.9%) had right-sided stones, and 103 (45.0%) had left-sided stones. Nine (8.3%) of the 108 patients in Group-B had bilateral stones, while 57 (52.8%) had right-sided and 42 (38.9%) left-sided stones. Rest of the stone characteristics are described in Table:2.

Table-2: Stones characteristics

	Group-A Semi-Rigid Ureteroscopy		Group-B Open Urete-ro-Lithotomy		P-value
	N	**%**	**N**	**%**	
Stone laterality					
Right	89	38.9	57	52.8	0.027
Left	103	45.0	42	38.9	
Bilateral	37	16.1	9	8.3	
Total	229	100.0	108	100.0	
Stone location					
Upper Ureter	69	30.1	18	16.7	0.000
Mid Ureter	35	15.3	39	36.1	
Lower Ureter	125	54.6	51	47.2	
Total	229	100.0	108	100.0	
Stone size (mm)					
≤10	35	15.3	6	5.6	0.000
11-20	193	84.3	9	8.3	
>20	1	0.4	93	86.1	
Total	229	100.0	108	100.0	
Mean ±SD	13.07±3.178		26.28±5.412		

Table-3: Procedure outcomes

	Group-A Semi-Rigid Ureteroscopy		Group-B Open Uretero-Lithotomy		P-value
	N	**%**	**N**	**%**	
Operative time (minutes)					
≤60	229	100.0	3	2.8	0.000
>60	0	0.0	105	97.2	
Total	229	100.0	108	100.0	
Mean ±SD	45.31±6.712		87.07±9.543		
Hospital stay (days)					
1-2	226	98.7	0	0.0	0.000
3-4	3	1.3	14	13.0	
>4	0	0.0	94	87.0	
Total	229	100.0	108	100.0	
Mean ±SD	2.01±0.132		5.07±0.575		
Stone free rate (single attempt)					
Yes	200	87.3	106	98.1	0.001
No	29	12.7	2	1.9	
Total	229	100.0	108	100.0	

In Group-A, the mean operating time was 45.31+6.712 minutes, and all patients (100.0%) had operative times less than 60 minutes. Only 3 (2.8%) of the patients in Group-B had an operation lasting less than 60 minutes, while the majority of 105 (97.2%) had an operation lasting more than 60 minutes. Other outcomes are described in Table:3.

There was no blood loss among Group-A patients, whereas the mean blood loss for Group-B patients was 30.17+2.322 ml. According to the results, two (1.9%) patients in Group-B and sixteen (7.0%) patients in Group-A both had fevers. Rest of the complications are discussed in Table:4.

Table-4: Complications

	Group-A Semi-Rigid Ureteroscopy		Group-B Open Urete-ro-Lithotomy		P-value
	N	**%**	**N**	**%**	
Blood loss (ml)					
Nil	229	100.0	0	0.0	0.000
≤30	0	0.0	83	76.9	
>30	0	0.0	25	23.1	
Total	229	100.0	108	100.0	
Mean ±SD	–		30.17±2.322		
Fever (UTI)					
Yes	16	7.0	2	1.9	0.050
No	213	93.0	106	98.1	
Total	229	100.0	108	100.0	
Urinoma					
Yes	2	0.9	2	1.9	0.439
No	227	99.1	106	98.1	
Total	229	100.0	108	100.0	
Stricture					
Yes	1	0.4	0	0.0	0.492
No	228	99.6	108	100.0	
Total	229	100.0	108	100.0	
Wound infection					
Yes	0	0.0	6	5.6	0.000
No	229	100.0	102	94.4	
Total	229	100.0	108	100.0	

DISCUSSION

Pediatric ureteric stone is a significant health problem with considerable morbidity. Present study was carried out to compare the semi-rigid ureteroscopy versus open uretero-lithotomy among children. To acquire appropriate outcomes, 337 children aged up to 15 years were divided in to two groups. In Group-A, 229 children experienced semi-rigid ureteroscopy & lithotripsy (UL) while in Group-B, 108 children experienced open uretero-lithotomy (OU). Study revealed that majority of the children in both groups were above five years old. The mean age of the patients in UL group was 7.01±2.530 years while in OU group was 10.06±3.627 years. A similar study carried out by Omran and teammates highlighted that mean age of the patients in UL group was 8.3±3.6 years.[8] Another study conducted by Brohi and fellows reported that mean age of the patients in OU group was also 8.33±5.6 years.[10]

The findings of our study highlighted that the disease was more prevalent among male patients, as the most of children in both groups were males. In the UL group, 69.0% patients were male and 31.0% were female. Similarly, in the OU group, 66.7% patients were male and 33.3% were female. This indicates a higher incidence of the disease among males across both groups. The findings of our study are comparable with a study undertaken by Topaktas and comrades who also reported that majority (60.6%) of the patients who experienced semi-rigid ureteroscopy & lithotripsy were males and 39.4% were females.[2] Brohi and fellows also confirmed in their study that most of the patients (63.9%) who experienced open uretero-lithotomy were males and 36.1% were females.[10]

It was found during our study that within the UL group, 38.9% patients had right-sided stones, 45.0% had left-sided stones and 16.1% had bilateral stones. However, within the OU group, 52.8% patients had right-sided stones, 38.9% had left-sided stones and 8.3% had bilateral stones. A study performed by Omran and teammates elucidated that among patients treated with UL, 44.1% had right-sided stones and 55.9% had left-sided stones.[8] But a study done by Brohi and fellows confirmed that patients who experienced open uretero-lithotomy, 58.3% had right-sided stones, 27.8% had left-sided stones and 13.9% had bilateral stones.[10] During study,stone location was also assessed among patients of both groups, our study indicated that in UL group, 30.1% had upper ureteric stones, 15.3% had mid-ureteric stones and 54.6% had lower ureteric stones. Likewise, in OU group, 16.7% patients had upper ureteric stones, 36.1% had mid-ureteric stones and 47.2% had lower ureteric stones. The results of a study conducted by Abdulkareem and Moussa also confirmed that in UL group, majority of the patients (53.0%) had lower ureteric stones while 30.6% had mid-ureteric and 16.3% had upper ureteric stones.[11] Our study further disclosed that the mean stone size in the UL group was 13.07 ± 3.178 mm, whereas in the OU group, it was significantly larger at 26.28 ± 5.412 mm. The findings of a study undertaken by Sripathi and companions highlighted that the mean stone size in the UL group was 8.5 mm.[12] But a study performed by Brohi and fellows exhibited different scenario that the mean stone size in the OU group was only 2.54±1.32 mm.[10]

As far as operative time is concerned, study revealed that semi-rigid ureteroscopy was more efficient than open uretero-lithotomy. The mean operative time in the UL group was 45.31±6.712 minutes, significantly shorter than the 87.07±9.543 minutes observed in the OU group. This difference underscores the efficiency and potential time-saving benefits of semi-rigid ureteroscopy over open uretero-lithotomy. The findings of our study are comparable with a study conducted by Dogan and coworkers who also reported that mean operative time in the UL group was 45.8±23.8 minutes.[13] Similarly, Fragoso and associates also confirmed in their study that mean operative time in the OU group was 188 minutes.[14] In our study the mean hospital stay in UL group was 2.01±0.132 days while in OU group was 5.07±0.575 days. However, the results of a study performed by Iqbal and collaborators are better than our study who asserted that the mean hospital stay in UL group was 1.32±0.88 days.[15] Another study carried out by Topaktas and comrades also confirmed that the mean hospital stay in UL group was 1.2 days.[2] When the stone-free rate after a single attempt was assessed among patients, our study found that the rate was 87.3% in the semi-rigid ureteroscopy group compared to 98.1% in the open uretero-lithotomy group. This indicates that while semi-rigid ureteroscopy, a minimally invasive technique, provides lower success rates in achieving stone-free status, the open uretero-lithotomy group showed somewhat better results. However, it is important to consider that the minimally invasive nature of semi-rigid ureteroscopy typically results in less tissue damage, reduced pain, quicker recovery times and short hospital stay compared to the more invasive open uretero-lithotomy. The findings of our study are comparable with a study performed by Eraslan and partners who reported that the stone free rate was 87.3% in the semi-rigid ureteroscopy group compared to 100.0% in the open uretero-lithotomy group.[16] Another study carried out by Rizvi and colleagues showed similar scenario that the stone free rate in UL group was 96.0% and in OU group was 100.0%.[17]

During study, complications were also compared

in both groups and found that patients in the UL group experienced fewer complications than those in the OU group. Specifically, there was no blood loss reported in the UL group, whereas the OU group had a mean blood loss of 30.17±2.322 ml. Additionally, none of the patients in the UL group while 5.6% of patients in the OU group developed wound infections. Urinoma was present in 0.9% (two patients) of the UL group and 1.9% (two patients) of the OU group. Ureteral strictures were observed in 0.4% (one patient) of the UL group, but none of the OU group patients experienced this complication. However, fever was more common in the UL group, with 7.0% (sixteen patients) presenting with it, compared to only 1.9% (two patients) in the OU group. A study carried out by Mursi et al. reported complications in the UL group across thirty-five procedures. The complications included colicky pain in 2 percent of cases, hematuria (blood in the urine) in one percent, stone migration in 7 percent, equipment failure in 5 percent, access failure in 8 percent, mucosal injury in 7 percent, fever in 2 percent, and extravasation (leakage of fluid) in 3 percent.[18] In another study, Mu and assistants indicated that in UL group, 7.84% patients were presented with fever.[3] The findings from a study conducted by Brohi et al. revealed that within OU group, 1.4% of patients experienced hydronephrosis, and an additional 1.4% had pelvic ureteric junction obstruction.[10]

CONCLUSION

Present study compared the semi-rigid ureteroscopy versus open uretero-lithotomy among children. Study concluded that semi-rigid ureteroscopy and lithotripsy offers superior minimal invasiveness and safety compared to open uretero-lithotomy for pediatric patients. Further studies are required to be conducted on large scale to compare the semi-rigid ureteroscopy versus open uretero-lithotomy among children.

REFERENCES

1. Cao B, Daniel R, McGregor R, Tasian GE. Pediatric nephrolithiasis. Healthcare. 2023;11:552. https://doi.org/10.3390/healthcare11040552
2. Topaktas R, Aydin C, Altin S, Akkoc A, Aydın ZB, Urkmez A. The efficacy of ultra-thin semi-rigid ureteroscopy with holmium laser lithotripsy in pediatric ureteral stones: a single-center experience. Cureus. 2019;11(8):e5496. https://doi.org/10.7759/cureus.5496
3. Mu XN, Guo LF, Wang PX, Zhang LY, Wang SJ. Semirigid ureteroscopy therapy against childhood kidney stones. Appl Bionics Biomech. 2022;2022:5. https://doi.org/10.1155/2022/7771920
4. Iqbal N, Chishti NF, Iqbal S, Ali SI, Farouk A, Hussain I, et al. Ureteroscopy in children-a single centre study from a developing country. ARC J Urol. 2019;4(3):7-11. https://doi.org/10.20431/2456-060X.0403002
5. Sultan S, Aba Umer S, Ahmed B, Naqvi SAA, Rizvi SAH. Update on surgical management of pediatric urolithiasis. Front Pediatr. 2019;7:252. https://doi.org/10.3389/fped.2019.00252
6. Ballesteros N, Snow ZA, Moscardi PRM, Ransford GA, Gomez P, Castellan M. Robotic management of urolithiasis in the pediatric population. Front Pediatr. 2019;7:351. https://doi.org/10.3389/fped.2019.00351
7. Reggio E, Danilovic A, Silvinato A, Bernardo WM. Urinary lithiasis-conventional open surgery. Rev Assoc Med Bras. 2020;66(12):1615-9. https://doi.org/10.1590/1806-9282.66.12.1615
8. Omran M, Sakr A, Desoky EAE, Ali MM, Abdalla MMH. Miniature semi-rigid ureteroscopy with holmium-yttrium-aluminium-garnet laser vs shockwave lithotripsy in the management of upper urinary tract stones >1 cm in children. Arab J Urol. 2020;18(2):106-11. https://doi.org/10.1080/2090598X.2020.1738105
9. Mahmoud HM, Mohamed AZ, Abd-elgawad AH, Tawfiek ER. Semi-rigid ureteroscopy in children using pneumatic lithotripsy: safety and efficacy. MJMR. 2020;31(3):400-6. https://doi.org/10.21608/mjmr.2022.220330
10. Brohi LB, Bajwa IA, Ali F, Ahmad S, Sohail H, Babar TSN, et al. Clinical characteristics and patient outcomes of urolithiasis and ureteral stones in a pediatric population: a prospective analysis from a tertiary care centre. PJMHS. 2022;16(9):268-70. https://doi.org/10.53350/pjmhs22169268
11. Abdulkareem AS, Moussa SH. Efficacy and safety of pediatric ureteroscopy in the treatment of ureteric calculi in children. Duhok Med J. 2018;12(2):1-9. https://doi.org/10.31386/dmj.uod.18.12.2.1
12. Sripathi V, Chowdhary SK, Kandpal DK, Sarode VV. Rigid ureteroscopy in children: our experience. J Indian Assoc Pediatr Surg. 2014;19:138-42. https://doi.org/10.4103/0971-9261.136462
13. Dogan HS, Onal B, Satar N, Aygun C, Piskin M, Tanriverdi O, et al. Factors affecting complication rates of ureteroscopic lithotripsy in children: results of multi-institutional retrospective analysis by Pediatric Stone Disease Study Group of Turkish Pediatric Urology Society. J Urol. 2011;186:1035-40. https://doi.org/10.1016/j.juro.2011.04.097
14. Fragoso AC, Steyaert H, Arnaud P, Esposito C, Estevao-Costa J, Valla JS. Minimal access surgery in the management of pediatric urolithiasis. Transl Pediatr. 2016;5(4):262-5. https://doi.org/10.21037/tp.2016.09.09
15. Iqbal N, Hussain I, Waqar S, Sadaf R, Tashfeen R, Nabil NN, et al. Ureteroscopy for management of ureteric stones in children-a single centre experience. J Coll Physicians Surg Pak. 2016;26(12):984-8.

16. Eraslan A, Mohamed AH, Cimen S. Clinical features and surgical outcomes of the children with urolithiasis at a tertiary care hospital: first report from Somalia. Front Pediatr. 2022;10:930136. https://doi.org/10.3389/fped.2022.930136

17. Rizvi SA, Sultan S, Ijaz H, Mirza ZN, Ahmed B, Saulat S, et al. Open surgical management of pediatric urolithiasis: a developing country perspective. Indian J Urol. 2010;26(4):573-6. https://doi.org/10.4103/0970-1591.74464

18. Mursi K, Elsheemy MS, Morsi HA, Ghaleb AKA, Abdel-Razzak OM. Semi-rigid ureteroscopy for ureteric and renal pelvic calculi: predictive factors for complications and success. Arab J Urol. 2013;11:136-41. https://doi.org/10.1016/j.aju.2013.04.008

CONFLICT OF INTEREST
Authors declare no conflict of interest.
GRANT SUPPORT AND FINANCIAL DISCLOSURE
None declared.

AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	GMZ, MNS
Acquisition, Analysis or Interpretation of Data:	GMZ, MNS, FHA, FURK, MZ
Manuscript Writing & Approval:	GMZ, MNS, FHA, FURK, HY

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.