Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v2024i1.878
*Biol. Clin. Sci. Res. J., Volume, **2024**: 878*
Original research article

OUTCOMES OF URETERORENOSCOPY WITH PNEUMATIC LITHOCLAST FOR URETERIC STONE MANAGEMENT AT A REGIONAL CENTER: A RETROSPECTIVE STUDY

SHAHZAD I[1], MANZOOR M[2], AWAN KH[3*], YOUSUF MA[4], PATHAN GM[1], KUMAR S[5]

[1]*Department of Urology, Liaquat National Hospital, Karachi, Pakistan*
[2]*Department of General Surgery, Kutyana Memon Hospital, Karachi, Pakistan*
[3]*Department of Urology, Bantva Memon Hospital, Karachi, Pakistan*
[4]*Usman Memorial Hospital, Hussainabad, Pakistan*
[5]*Department of Urology, Ahalia Hospital Musafah Abu Dhabi, UAE*
**Correspondence author email address:* khadim786awan@gmail.com

(Received, 17th January 2024, Revised 20th May 2024, Published 5th June 2024)

Abstract: *The management of ureteric stones has significantly evolved with the advancement of minimally invasive techniques. Ureterorenoscopy (URS) with pneumatic lithoclast has become favored due to its efficacy and safety, providing high success rates across various stone locations.* ***Objective:*** *To share our experiences and outcomes of treating ureteric stones using ureterorenoscopy and pneumatic lithoclast at our regional center.* ***Methods****: From 2014 to 2022, 220 patients with ureteral calculi at our regional center underwent 221 URS procedures using a pneumatic lithoclast. Preoperative evaluation included plain radiography, ultrasound scan, intravenous urography, and CT KUB. Postoperative assessments with plain film radiography and, if necessary, ultrasound or CT KUB were conducted immediately or a few days after the procedure.* ***Results:*** *The overall stone-free rate achieved was 95.4%. Specific success rates based on stone location were 88.4% for upper, 97% for middle, and 100% for lower ureteral stones. The primary cause of treatment failure, occurring in 4.5% of cases, was stone migration.* ***Conclusion:*** *Ureteroscopic intra-corporeal lithotripsy is a reliable and safe treatment modality for ureteric stones of various sizes and locations, demonstrating high efficacy when performed by experienced practitioners.*

Keywords: Intra-corporeal lithotripsy, Pneumatic lithoclast, Stone migration, Ureteric stones, Ureterorenoscopy, Urology, Stone-free rate

Introduction

Over the past two decades, the landscape of urinary stone treatment has undergone significant transformations in various regions, including ours. Historically, extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy, and laparoscopic ureterolithotomy have been prominent among the endourological treatment options for managing urinary stones. (1, 2). However, due to the absence of advanced lithotripsy machines in our facilities, ESWL often falls short of effectively addressing a substantial fraction of ureteral calculi cases, necessitating more invasive approaches. (3, 4).

Ureterorenoscopy with intra-corporeal lithotripsy (URS-ICL) has emerged as a preferred intervention in cases where ESWL is unsuccessful (5). Indications for URS-ICL include failed ESWL treatments, steinstrasse conditions post-ESWL, larger stone sizes, radiolucent stones, and, specifically, lower ureteral stones. Our clinical preference leans towards URS as the primary treatment modality following unsuccessful medical management, particularly for most lower and middle ureteric stones, where the efficacy of ESWL has been notably poor (6, 7).

Recent advancements have seen the introduction of smaller-calibre semirigid ureteroscopes (4.5 and 6 Fr) alongside more effective intracorporeal lithotriptors such as the lithoclast and holmium laser (8). These innovations have significantly enhanced the success rates and reduced the morbidity associated with these procedures. In this context, our experience with using an 8.5 Fr semirigid ureteroscope alongside a lithoclast has shown promising results in the management of ureteral calculi (3, 9).

The objective of this report is to rationalize the use of semirigid ureterorenoscopy in our clinical setting, presenting outcomes that underscore its efficacy and safety, thereby supporting its role as a fundamental treatment modality for ureteral calculi where non-invasive options are limited or ineffective (10, 11).

Methodology

Between January 2014 and October 2022, a total of 220 patients suffering from ureteral calculi underwent ureterorenoscopy with intra-corporeal lithotripsy (URS-ICL) at Kutyana Memon Hospital, Karachi, Pakistan. This hospital is recognized as the largest regional centre in the area, providing services comparable to those of a tertiary care centre (12). The procedures were exclusively conducted by a single urologist. The patient cohort included 190 men and 30 women, yielding a gender ratio of 6.3:1. The average age of the patients was 34.45 years, ranging from 20 to 53 years. Of the cases reviewed, 208 involved unilateral stones, while 12 cases involved bilateral stones, totalling 221 treatment sessions. Notably, one patient required a repeat URS due to postoperative haematuria (13, 14).

Before undergoing URS-ICL, each patient was subjected to a comprehensive pre-operative assessment that included a detailed history, physical examination, routine biochemical

[Citation: Shahzad, I., Manzoor, M., Awan, K.H., Yousuf, M.A., Pathan, G.M., Kumar, S., (2024). Outcomes of ureterorenoscopy with pneumatic lithoclast for ureteric stone management at a regional center: a retrospective study. *Biol. Clin. Sci. Res. J.*, **2024***: 878*. doi: https://doi.org/10.54112/bcsrj.v2024i1.878]

analyses, complete blood count, urinalysis, and urine cultures. Any pre-existing urinary tract infections were treated before surgery. Additionally, prophylactic antibiotics were administered intravenously one hour before the procedure. Diagnostic imaging, including a plain abdominal film of the kidneys, ureter, and bladder (KUB), intravenous urography or CT KUB, and sonography, was performed preoperatively. Postoperative imaging consisted of an immediate X-ray KUB and follow-up sonography two weeks after the procedure to assess for stone-free status or the presence of asymptomatic residual fragments smaller than 3 mm in diameter (15, 16).

During the procedure, conducted under spinal anaesthesia, patients were positioned in a semi-lithotomy stance. A semirigid ureteroscope, sized 8-9 6-Fr (Olympus/Richard Wolf, Germany), equipped with a pneumatic lithotriptor (Swiss Lithoclast Master, Germany), was introduced into the ureter. The ureteroscope was navigated over a securely placed guidewire, which was introduced through the ureteroscope after identifying the ureteric orifice. This technique, referred to as the non-dilating ureteric orifice technique, ensured minimal trauma and facilitated the introduction of the scope. Stone disintegration was primarily achieved using two lithoclast probes (0.8 mm and 1 mm). Most fragmented stones were left in situ for spontaneous passage, but larger fragments were extracted using stone forceps (17, 18).

Post-procedure management involved placing a ureteral catheter (4 or 5 Fr) or a double-J stent (4.7 or 6 Fr) if there were indications such as ureteral oedema, ureteral injury, impaired renal function, significant stone burden, or upward migration of stone fragments. The ureteral catheter was typically removed after 24 hours, and the double-J stent was removed two weeks postoperatively. In cases where stone fragments migrated upward, additional ESWL was administered postoperatively (4, 19).

This structured approach ensured high standards of care and patient safety, while the advanced imaging and surgical techniques contributed to effective treatment outcomes.

Results

In the retrospective analysis of ureterorenoscopy with intra-corporeal lithotripsy (URS-ICL) performed on 220 patients at Kutyana Memon Hospital, Karachi, Pakistan, the success rates varied according to the location of the ureteral stones. Specifically, success rates for single-session URS-ICL targeting upper, middle, and lower ureteral stones were 88.4%, 97.0%, and 100.0% respectively. For the seven patients with unilateral multiple stone locations, including cases with Steinstrasse, the success rate was 71.4%. Consequently, the overall success rate after a single session of URS-ICL was 94.5%, equating to 208 successful treatments out of 220 attempts. These results are detailed in Table 2.

Stone migration into the kidney was the primary cause of treatment failure, occurring in 8 patients with upper ureteral stones and one patient each with stones in the middle and lower ureter. Among the 10 patients (4.5%) who experienced upward stone migration, 8 underwent a single additional session of extracorporeal shock wave lithotripsy (ESWL), while two required two sessions. Additionally, one patient required a repeat URS due to complications of haematuria. Despite these challenges, the overall stone clearance rate eventually reached 100%, with all 220 patients achieving stone-free status.

The placement of double-J stents was necessary in 14.5% of cases (32 out of 220), reflecting the protocol for managing conditions such as ureteral oedema or significant stone burden. Complications were relatively minimal but included postoperative fever in 2.2% of patients (5 cases), which resolved with supportive treatments. One patient experienced haematuria and clot retention necessitating another procedure to remove an impacted fragment and subsequent Foley catheterization with normal saline irrigation. False passaging at the site of impacted stones occurred in two patients, necessitating double-J stent placement. Fortunately, there were no major complications such as ureteral avulsion. The details of these complications are summarized in Table 3.

Table 1: Patient characteristics and stone location:

	Upper Ureter (n=48)	Middle Ureter (n=25)	Lower Ureter (n=140)	Multiple and steinstrasse (n=7)	Total (n=220)
Failed ESWL (no)	03	02	07		12
Double-J stent (no)	13	07	05	07	32
Hospital stay (d)	01	01	01	01	4
Day case surgery (no)	-	-	03	-	03
ESWL = Extracorporeal shock wave lithotripsy.					

Table 2. Success rates according to stone location.

Stone location (*n*)	Success, *n* (%)
Upper ureter (*n* = 48)	40 (83.3%)
Middle ureter (*n* = 25)	24 (96.0%)
Lower ureter (*n* = 140)	139 (99.69%)
Multiple and steinstrasse (*n* = 7)	5 (71.4%)
Overall success rate (*n* = 220)	208 (94.5%)

Table 3. Complications of URS-ICL.

Adverse event	Patients, *n* (%)
Postoperative fever (> 38.5 °C)	5 (2.2%)
Hematuria with blood clot retention	1 (0.45%)
Total	6 (2.72%)

[Citation: Shahzad, I., Manzoor, M., Awan, K.H., Yousuf, M.A., Pathan, G.M., Kumar, S., (2024). Outcomes of ureterorenoscopy with pneumatic lithoclast for ureteric stone management at a regional center: a retrospective study. *Biol. Clin. Sci. Res. J.*, **2024***: 878*. doi: https://doi.org/10.54112/bcsrj.v2024i1.878]

Discussion

The minimally invasive management of ureteral calculi, notably through extracorporeal shock wave lithotripsy (ESWL) and ureteroscopy (URS), has evolved significantly, guided by factors such as stone size, location, composition, and the technology employed. ESWL acknowledged for its non-invasive and anaesthesia-free approach, is nonetheless limited by its dependency on multiple sessions and auxiliary procedures to achieve satisfactory outcomes, often accompanied by discomfort due to colic and other urinary symptoms. Conversely, URS, particularly with semirigid modalities, tends to yield higher stone-free rates, albeit with potentially higher direct costs as noted by Huang and colleagues in a cost-effectiveness study comparing URS and ESWL in a Taipei City hospital (20, 21).

Reflecting on the guidelines from the American Urological Association and the European Association of Urology, both ESWL and URS are considered viable first-line treatments for nonpregnant adults with unilateral ureteral stones, provided there is normal contralateral renal function. Notably, the meta-analysis of 244 studies identified URS as more effective for stones larger than 1 cm across all ureteral segments, except for proximal ureteral stones smaller than 1 cm where ESWL might be slightly superior (6, 22).

The current study underscores the high efficacy of URS-ICL, demonstrating a 94.5% overall clearance rate. The stratification by stone location revealed that lower ureteral stones had the highest clearance rate at 99.69%, followed by middle and upper ureteral stones at 96% and 83.3%, respectively. The only significant limitation to success was upward stone migration, occurring in 4.54% of cases. The incorporation of the holmium laser in other settings has been shown to enhance the efficacy of URS by reducing stone retropulsion, a problem less prevalent in our approach which utilizes pneumatic lithotripters (7, 23).

Our institution's strategy to mitigate stone retropulsion includes several procedural modifications such as the reverse Trendelenburg position with lateral rotation, reduced irrigant pressure, and the peripheral targeting of stones. Despite the availability of devices like the Stone Cone and NTrap to prevent retrograde stone migration, our experience with such tools is limited due to their unavailability and the reported complications in extracting disintegrated stone fragments from these devices (9, 10).

Stenting remains a critical component of post-URS management to alleviate symptoms of obstruction, facilitate stone passage, and prevent complications like strictures. In our series, stents were used in 14.5% of cases, mainly driven by complications such as upward stone migration or suspected ureteral injury. The decision to stent is predominantly determined intraoperatively based on surgical outcomes and specific patient conditions (11, 24).

The evolution of ureteroscopy has been further advanced by the development of flexible URS systems, which offer enhanced access and improved optics for the management of upper urinary tract calculi. Despite their high efficacy, as demonstrated in a series from the Mayo Clinic with a stone-free rate of 91.7%, the financial burden associated with the acquisition and maintenance of these devices limits their widespread adoption in resource-constrained settings like ours (12, 25).

In conclusion, while both ESWL and URS present effective modalities for the management of ureteral stones, the choice of procedure is contingent on a multitude of factors including stone characteristics, available technology, and institutional capabilities. Future technological advances and procedural refinements are expected to further enhance the efficacy and safety of minimally invasive stone management strategies.

Conclusion

Ureteroscopy has proven to be a highly effective, safe, and feasible approach for treating ureteric stones, achieving high success rates and low complication rates in our study, consistent with existing literature. This indicates that our accumulated experience has honed our skills in managing ureteral calculi effectively using this technique. As technological advancements continue, flexible ureteroscopy is poised to become increasingly vital in both diagnosing and treating upper urinary tract diseases at our centre, enhancing our capability to provide cutting-edge care to our patients.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate.
Approved by the department concerned. (IRB-LIMS-2013-021)

Consent for publication
Approved

Funding
Not applicable

Conflict of interest

The authors declared an absence of conflict of interest.

Authors Contribution

IQBAL SHAHZAD (Assistant Professor and Consultant)
Data Analysis
MUMTAZ MANZOOR (MBBS FCPS)
Revisiting Critically
KHADIM HUSSAIN AWAN (Consultant)
Final Approval of version
GHULAM MUSTAFA PATHAN (Assistant Professor and Consultant)
Drafting
SANTOSH KUMAR (MBBS FCPS) & MUHAMMAD ALI YOUSUF
Concept & Design of Study

References

1. Nour HH, Kamel AI, Elmansy H, Badawy MH, Shabana W, Abdelwahab A, et al. Pneumatic vs laser lithotripsy for mid-ureteric stones: Clinical and cost effectiveness results of a prospective trial in a developing country. Arab Journal of Urology. 2020;18(3):181-6.
2. Niazi AB, Asif M, Ahmed N. Comparison of utility and efficacy of Intracorporeal pneumatic lithoclast in

the treatment of distal ureteric calculi versus open ureterolithotomy. Annals of PIMS-Shaheed Zulfiqar Ali Bhutto Medical University. 2020;16(1):26-31.
3. Hamouche F, Charondo L, Stoller M. Ureteral Stones. The Ureter: A Comprehensive Review: Springer; 2024. p. 439-63.
4. Pricop C, Ivanuta M, Radavoi GD, Toma C-V, Cumpanaş A, Jinga V, et al. Determining whether previous SWL for ureteric stones influences the results of ureteroscopy as the second-line treatment: A clinical study. Experimental and Therapeutic Medicine. 2022;23(1):1-7.
5. Ayub MA, Akhlaque M, Shahzad I. Efficacy of Pneumatic Lithoclast in the Management of Different Metabolic Types of Stones in Lower one third of Ureter. Age (years). 2020;42:8.08.
6. Sirirak N, Sangkum P, Phengsalae Y, Kongchareonsombat W, Leenanupunth C, Ratanapornsompong W, et al. External validation of the STONE score in predicting stone-free status after rigid ureteroscopic lithotripsy. Research and Reports in Urology. 2021:147-54.
7. Sajid MT, Ameen M, Murtaza B, Alvi MS, Khan Z, Kiani F. Comparison of mean operative time in patients undergoing Ho: YAG laser lithotripsy and pneumatic lithotripsy in ureterorenoscopy for ureteric calculus. Pakistan Journal of Medical Sciences. 2021;37(2):415.
8. Akpayak IC, Agbo CA, Nabasu LE. Retrograde ureteroscopy in the management of distal ureteric stones: A retrospective analysis of outcome and complications. Annals of African Medicine. 2020;19(4):258-62.
9. Nerli RB, Sharma M, Gupta P, Adhikari P, Bidi S, Ghagane SC. Therapeutic ureteroscopy for urolithiasis in children younger than 60 months of age. Pediatric Surgery International. 2021;37:145-50.
10. Keller EX, De Coninck V, Traxer O, Shvero A, Kleinmann N, Hubosky SG, et al. Stones. Advanced Ureteroscopy: A Practitioner's Guide to Treating Difficult Problems: Springer; 2021. p. 105-54.
11. Kamadjou C, Eyongeta DE, Moby EH, Kuitche J, Angwafor F. Intraluminal Lithotripsy with Rigid Ureteroscopy for Proximal and Distal Ureteral Stones: Results of a Single Center in Cameroon. Open Journal of Urology. 2021;11(12):486-95.
12. Waseda Y, Takazawa R, Kobayashi M, Yoshida S, Uchida Y, Kohno Y, et al. Successful outcomes of endoscopic lithotripsy in completely bedridden patients with symptomatic urinary calculi. Scientific Reports. 2020;10(1):8839.
13. AKBAR SMA, AKHLAQUE M, SHAHZAD I, IMTIAZ S, KHAN S. To Compare the Outcome of Ureterorenoscopy (URS)/Lithoclast with (PCN) Percutaneous Nephrostomy and Ureterorenoscopy (URS)/Lithoclast alone in obstructed kidney due to ureteric calculus.
14. Orakzai AN, Wazir BG, Muhammad N, editors. Comparative Efficacy and Safety of Hand-Held and Conventional Intra-Corporeal Pneumatic Lithotripsy in the Treatment of Ureteric Stones. Medical Forum Monthly; 2023.
15. Haider A, Memon WA, Yaqoob U, Zubair R, Channa MA, Mirza MR, et al. Our Experience of Semi-rigid Ureteroscopy with Pneumatic LithoClast for Impacted Upper Ureteric Calculi. 2023.
16. Asad S, Gul B, Jalal-Ud-Din M, Khan SA, Bashir R, Rafaqat H. Frequency Of Stone Clearance After Transurethral Fragmentation Of Large Urinary Bladder Calculi Using Pneumatic Swiss Lithoclast. Journal of Ayub Medical College Abbottabad-Pakistan. 2023;35(1).
17. Umer M, Ayub A, Jumadin A. Efficacy of Pneumatic Lithoclast in Management of Different Metabolic Stones in Lower Ureter. Pakistan Journal of Medical & Health Sciences. 2022;16(08):99-.
18. Shalaby E. Assess the safety and effectiveness of a novel approach during transurethral pneumatic cystolithotripsy in large urinary bladder stone: quasi-clinical trial. Urolithiasis. 2022;50(2):189-97.
19. Shah RS, Shrestha N. Efficacy of Laser Vs Pneumatic Lithotripsy for Mid and Distal Ureteric Stone: A Comparative Study. Journal of Nepalgunj Medical College. 2022;20(1):16-9.
20. Morsi GA, Mahmoud AR, Deif HA, Mohammed MMO. Randomized Trial of Stone Fragment Active Retrieval Versus Spontaneous Passage after Pneumatic Lithotripsy of Ureteral Stones. The Egyptian Journal of Hospital Medicine. 2022;88(1):3999-4004.
21. Ahmad N, Khan K, Amjad S, Rasheed A, Iftikhar U, editors. Extracorporeal Shock Wave Lithotripsy versus Ureteroscopy Lithoclast in Management of Upper Ureteric Stones. Medical Forum Monthly; 2022.
22. Tahir M, Aeymon HM, editors. Comparison of Treatment Efficacy of Extracorporeal Shock Wave Lithotripsy and Pneumatic Ureteroscopic Lithotripsy for Lower Ureteric Stones. Med Forum; 2021.
23. Petca RC, Salaheddin Y, Mareş C, Popescu RI, Petca A, Diaconescu D, et al. Pneumatic Lithotripsy vs. Laser Lithotripsy in the Management of Proximal Ureteral Stones. Romanian Journal of Urology. 2021;20(3).
24. Galeti EH, Shahab S, Bharali MD. Comparison of pneumatic lithotripsy versus laser lithotripsy for upper ureteral calculi. International Surgery Journal. 2021;8(9):2644-9.
25. Bharali MD, Galeti EH, Shahab S. Semi-rigid Ureteroscopy and Pneumatic Lithotripsy for upper ureteric stones. International Archives of Integrated Medicine. 2021;8(6).

[Citation: Shahzad, I., Manzoor, M., Awan, K.H., Yousuf, M.A., Pathan, G.M., Kumar, S., (2024). Outcomes of ureterorenoscopy with pneumatic lithoclast for ureteric stone management at a regional center: a retrospective study. *Biol. Clin. Sci. Res. J.*, **2024***: 878*. doi: https://doi.org/10.54112/bcsrj.v2024i1.878]