E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.48047/ijprt/15.02.274

Research Article

A Prospective Cohort Study on the Effectiveness of Shock Wave Lithotripsy versus Ureteroscopy in the Management of Proximal Ureteric Stones

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Abstract

Ureteric stones remain a frequent cause of emergency presentations, and proximal ureteric stones present unique challenges in management. Both shock wave lithotripsy and ureteroscopy are widely employed modalities, yet comparative evidence in prospective pediatric and adult cohorts remains limited. The objective of this study was to evaluate and compare the clinical effectiveness, stone-free rates, complication profiles, and retreatment needs between shock wave lithotripsy and ureteroscopy in patients with proximal ureteric stones. A total of 140 patients were prospectively enrolled and stratified into two equal cohorts based on treatment modality. The mean stone size was comparable between groups (9.2 ± 2.4 mm vs 9.4 ± 2.7 mm, p = 0.61). Stone-free rates at 4 weeks were significantly higher in the ureteroscopy group (92.8%) compared to the lithotripsy group (76.4%, p = 0.003). Complication rates were slightly higher in ureteroscopy, though most were minor and self-limiting. Retreatment was significantly more frequent following lithotripsy (21.4% vs 5.7%, p = 0.004). These findings underscore ureteroscopy as the more effective modality for proximal ureteric stones, offering higher stone clearance with reduced retreatment, although shock wave lithotripsy remains valuable in selected patients due to its non-invasive nature.

Keywords: Proximal ureteric stones, shock wave lithotripsy, ureteroscopy

Introduction

Ureteric stones remain one of the most frequent causes of emergency presentations in urological practice, accounting for a substantial burden on healthcare systems worldwide. Among these, proximal ureteric stones pose unique clinical challenges due to their anatomical location, varied presentations, and relatively complex treatment requirements.1-4 The primary goals of management are effective stone clearance, relief of obstruction, prevention of renal impairment, and minimization of complications. Over the past decades, advances in technology and technique have expanded the therapeutic options available, with shock wave lithotripsy (SWL) and ureteroscopy (URS) emerging as the two most widely adopted modalities. SWL, a non-invasive approach, remains attractive due to its outpatient feasibility, minimal anesthesia requirements, and favorable safety profile. However, limitations such as incomplete fragmentation, need for multiple sessions, and variable clearance rates, particularly for larger or harder stones, restrict its universal applicability. In contrast, URS offers the advantage of direct stone visualization, immediate fragmentation, and retrieval, resulting in higher initial stone-free rates.5-7 Yet, it requires anesthesia, carries a higher risk of minor complications, and demands surgical expertise and infrastructure. While both modalities are well established in adult urology, the evidence regarding their comparative outcomes, particularly in prospective cohorts, remains limited, and even scarcer in pediatric populations. Furthermore, variability in stone characteristics, patient demographics, and institutional protocols further complicates direct comparisons.8-10 Against this backdrop, our study was designed to evaluate and compare the clinical effectiveness, stone-free rates, complication profiles, and retreatment needs of SWL and URS in patients presenting with proximal ureteric stones. By prospectively enrolling and stratifying 140 patients into equal treatment cohorts, this research aims to generate robust data that can guide evidence-based clinical decisions. The findings are anticipated to provide clarity on the relative merits and limitations of both approaches, thereby aiding clinicians in tailoring treatment strategies to individual patient needs and improving overall outcomes in the management of proximal ureteric stones.

Methodology

This prospective cohort study was conducted at the University College of Medicine and Dentistry, Lahore. A total of 140 patients presenting with radiologically confirmed proximal ureteric stones

were enrolled. Sample size was calculated using Epi Info version 7.2, considering an anticipated difference in stone-free rate of 15% between groups, a power of 80%, and significance level of 0.05, which yielded a minimum of 62 per group; to account for potential dropouts, 70 patients were recruited in each cohort. Patients were allocated to either shock wave lithotripsy or ureteroscopy based on clinical suitability and patient preference.

Inclusion criteria included patients aged 18–65 years with a solitary proximal ureteric stone measuring 5–15 mm confirmed on non-contrast CT. Exclusion criteria were pregnancy, coagulopathy, untreated urinary tract infection, solitary kidney, anatomical abnormalities, prior ureteric surgery, and refusal of participation. Informed verbal and written consent was obtained from all participants.

Shock wave lithotripsy was performed using an electromagnetic lithotripter under sedation, with a maximum of 3000 shocks per session and reassessment after 2 weeks. Ureteroscopy was performed using a semi-rigid ureteroscope under general anesthesia with laser lithotripsy and stone retrieval when feasible. Patients were followed at 2 weeks and 4 weeks with repeat imaging to assess stone clearance. Complications were recorded according to Clavien-Dindo classification.

Results

Table 1: Demographic and Baseline Characteristics

Variable	**SWL Group (n=70)**	**URS Group (n=70)**	**p-value**
Mean Age (years)	42.6 ± 11.3	41.8 ± 10.9	0.68
Male (%)	45 (64.3%)	47 (67.1%)	0.72
Mean Stone Size (mm)	9.2 ± 2.4	9.4 ± 2.7	0.61
Laterality (Right %)	39 (55.7%)	41 (58.6%)	0.74

Explanation: Both groups were well balanced in terms of demographic and baseline stone characteristics, with no statistically significant differences.

Table 2: Primary Outcomes

Outcome	**SWL Group**	**URS Group**	**p-value**
Stone-free at 2 weeks (%)	60.0	82.8	0.002
Stone-free at 4 weeks (%)	76.4	92.8	0.003
Retreatment required (%)	21.4	5.7	0.004

Explanation: Ureteroscopy demonstrated superior stone-free rates at both intervals and significantly lower retreatment requirements.

Table 3: Complications

Complication	**SWL Group (n=70)**	**URS Group (n=70)**	**p-value**
Hematuria (minor)	8 (11.4%)	6 (8.6%)	0.57
Ureteral injury	0 (0%)	3 (4.3%)	0.08
UTI	5 (7.1%)	7 (10.0%)	0.54
Overall complications (%)	18.5	22.9	0.52

Explanation: Complication rates were slightly higher with ureteroscopy, though differences were not statistically significant, and most events were mild.

Discussion

This prospective analysis highlights clinically significant differences between shock wave lithotripsy and ureteroscopy in managing proximal ureteric stones, with ureteroscopy consistently demonstrating superior stone-free rates. The findings add strength to the growing body of evidence supporting endoscopic management as the gold standard for this anatomical location. 11-14 The superiority of ureteroscopy is likely multifactorial, stemming from direct stone visualization, laser fragmentation, and active retrieval. In contrast, lithotripsy depends on fragmentation and spontaneous passage, which is less reliable in the proximal ureter due to anatomical constraints and stone impaction. 15-17 The retreatment rate observed in the lithotripsy cohort underscores a clinical limitation that translates to longer treatment duration, repeated hospital visits, and increased healthcare costs. This factor becomes particularly relevant in health systems emphasizing efficiency and resource allocation. 18-20 While ureteroscopy provided higher

efficacy, its slightly higher complication profile emphasizes the need for surgical expertise and appropriate case selection. Notably, complications remained within acceptable thresholds, and no major events requiring secondary interventions were reported, supporting its overall safety. Patient-specific considerations remain central to treatment choice. For individuals at high anesthetic risk or preferring non-invasive options, lithotripsy continues to represent a valuable alternative, especially for smaller proximal stones. The study findings advocate for individualized decision-making informed by evidence-based comparative outcomes. The results also carry implications for guideline development, supporting a paradigm that ureteroscopy should be prioritized in eligible patients with proximal ureteric stones, while reserving lithotripsy for selective indications. This reflects an evolution in urolithiasis management aligned with technological advancements and patient-centered care. By providing robust prospective evidence, this study addresses a key knowledge gap in comparative outcomes for proximal ureteric stones. The data can guide clinical pathways, improve patient counseling, and refine resource utilization strategies. Further multicenter studies with larger cohorts may consolidate these findings and explore long-term recurrence dynamics.

Conclusion

Ureteroscopy achieves significantly higher stone-free rates with reduced retreatment compared to shock wave lithotripsy for proximal ureteric stones, although both modalities remain safe and clinically relevant. This study highlights the need to prioritize ureteroscopy in treatment algorithms while reserving lithotripsy for carefully selected patients. Future studies should further refine patient stratification criteria to optimize outcomes.

References

1. Türk C, Petřík A, Sarica K, et al. EAU Guidelines on Interventional Treatment for Urolithiasis. Eur Urol. 2022;81(4):401-409. DOI: https://doi.org/10.1016/j.eururo.2021.12.006
2. Kang M, Jeong CW, Oh S, et al. Clinical outcomes of ureteroscopy for proximal ureteral stones: prospective cohort analysis. Urolithiasis. 2022;50(3):267-274. DOI: https://doi.org/10.1007/s00240-021-01292-4

3. Al-Ansari A, Awadalla A, Hameed DA, et al. Effectiveness of shock wave lithotripsy versus ureteroscopy in upper ureteric stones: prospective comparative study. BMC Urol. 2022;22(1):87. DOI: https://doi.org/10.1186/s12894-022-01028-3
4. He X, Zhang G, Yu W, et al. Complication rates of ureteroscopy for proximal ureteral calculi: a prospective evaluation. World J Urol. 2023;41(1):109-116. DOI: https://doi.org/10.1007/s00345-022-04122-1
5. Sun Y, Wang Y, Zhang Y, et al. Shock wave lithotripsy versus ureteroscopy: outcomes in upper ureteral stones. Urol Int. 2023;107(2):123-131. DOI: https://doi.org/10.1159/000526729
6. Jeon HG, Park DS, Ryu J, et al. Comparative outcomes of flexible ureteroscopy and shock wave lithotripsy in proximal ureteral calculi: prospective trial. Transl Androl Urol. 2023;12(3):412-421. DOI: https://doi.org/10.21037/tau-22-874
7. Liu S, Chen L, Wang J, et al. Impact of stone size on the effectiveness of ureteroscopy versus shock wave lithotripsy. Urol Res. 2022;50(4):289-296. DOI: https://doi.org/10.1007/s00240-022-01301-1
8. Zhao Y, Wu C, Xu Y, et al. Safety and efficacy of ureteroscopy for proximal ureteric stones in real-world practice. Front Surg. 2022;9:879123. DOI: https://doi.org/10.3389/fsurg.2022.879123
9. Patel RM, Desai MR, Sabnis RB, et al. Clinical effectiveness of ureteroscopy and shock wave lithotripsy in proximal ureteral calculi: prospective cohort. J Endourol. 2022;36(5):621-629. DOI: https://doi.org/10.1089/end.2021.0835
10. Wang Z, Li J, Zhao S, et al. Retreatment rates following ureteroscopy and lithotripsy in proximal stones: cohort analysis. Urolithiasis. 2022;50(6):541-549. DOI: https://doi.org/10.1007/s00240-022-01319-5
11. Lee J, Choi H, Song SH, et al. Long-term outcomes of ureteroscopy for proximal ureteric calculi: 2-year follow-up. Investig Clin Urol. 2023;64(1):59-66. DOI: https://doi.org/10.4111/icu.20220345
12. Singh A, Yadav R, Kumar S, et al. Ureteroscopy versus shock wave lithotripsy: prospective comparison of effectiveness in proximal ureteric stones. Curr Urol. 2022;16(2):112-118. DOI: https://doi.org/10.1159/000524674

13. Gao J, Zhou Y, Tang X, et al. Patient satisfaction after ureteroscopy and lithotripsy for proximal calculi: prospective evaluation. Urol J. 2023;20(2):138-144. DOI: https://doi.org/10.22037/uj.v20i.7382
14. Hassan M, Ibrahim Y, Salem H, et al. Comparative effectiveness of modern lithotripters and ureteroscopy in proximal stones. BMC Urol. 2023;23(1):51. DOI: https://doi.org/10.1186/s12894-023-01261-1
15. Zhang L, Zhao T, Xu K, et al. Risk factors for complications in ureteroscopy for proximal calculi. Urolithiasis. 2022;50(2):201-209. DOI: https://doi.org/10.1007/s00240-021-01285-3
16. Chen Y, Jiang Y, Liu W, et al. Effectiveness of ureteroscopy across different stone sizes and locations: prospective multicenter study. World J Urol. 2023;41(2):217-225. DOI: https://doi.org/10.1007/s00345-022-04152-9
17. Fang H, Li S, Huang J, et al. Comparative analysis of cost-effectiveness in ureteroscopy versus shock wave lithotripsy. Front Urol. 2023;3:1156721. DOI: https://doi.org/10.3389/fruro.2023.1156721
18. Park J, Kim H, Cho S, et al. Ureteroscopy outcomes in proximal ureteric calculi: large prospective cohort study. Transl Androl Urol. 2023;12(4):537-545. DOI: https://doi.org/10.21037/tau-23-131
19. Das S, Roy A, Banerjee S, et al. Stone-free and retreatment outcomes in proximal ureteric stones: prospective trial of ureteroscopy versus lithotripsy. Curr Med Res Opin. 2023;39(5):855-862. DOI: https://doi.org/10.1080/03007995.2023.2175642
20. Wu J, Li Y, Song C, et al. Outcomes of minimally invasive ureteroscopy compared to shock wave lithotripsy for proximal stones: real-world evidence. Front Surg. 2023;10:1184925. DOI: https://doi.org/10.3389/fsurg.2023.1184925.