

Success Rate & Complications of Extracorporeal Shock Wave Lithotripsy (ESWL) Treatment for Renal & Upper Ureteric Calculus

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Abstract: ***Background:** Extracorporeal shock wave lithotripsy (ESWL) remains a widely used, non-invasive first-line option for the management of small to moderate-sized renal and upper ureteric calculi. Its success is influenced by stone size, location, density, and patient-related factors. **Aim:** To study the success rate and complications of ESWL treatment for renal and upper ureteric calculus. **Materials and Methods:** A prospective observational study was conducted on 100 adult patients with solitary renal or upper ureteric calculi measuring 7–20 mm, with Hounsfield units (HU) less than 1200, attending the urology OPD of a government medical college and super specialty hospital in Nagpur, Maharashtra, over one year (1st April 2024 to 31st March 2025), with a further three-month follow-up. Outcomes (cure/non-cure) and complications following ESWL were recorded and analyzed using SPSS with chi-square testing and multiple regression analysis. **Results:** Of 100 patients (71 male, 29 female), 61 had renal calculi and 39 had upper ureteric calculi. The overall stone-free/cure rate was 97%, with a marginally higher success rate for renal calculi (98.36%) compared to upper ureteric calculi (94.87%). The most common complications were loin pain (31%), hematuria (22%), and urinary tract infection (13%). Only 2% of patients required secondary intervention (URSL or DJ stenting). **Conclusion:** ESWL is a safe and highly effective modality for the management of renal and upper ureteric calculi of 7–20 mm with HU < 1200, achieving a high success rate with a low incidence of major complications.*

Keywords: Extracorporeal shock wave lithotripsy, renal calculus, upper ureteric calculus, success rate, complications

1. Introduction

Urolithiasis is one of the most common conditions encountered in urological practice, with a lifetime prevalence and recurrence rate that place a significant burden on healthcare systems. Since its introduction, extracorporeal shock wave lithotripsy (ESWL) has transformed the management of renal and ureteric calculi by offering a non-invasive alternative to open and endoscopic surgery. It remains recommended as a first-line option for renal calculi up to 20 mm and upper ureteric calculi, particularly in settings where retrograde intrarenal surgery (RIRS) or percutaneous nephrolithotomy (PCNL) may not be readily accessible or where a less invasive approach is preferred.

Stone-free rates after ESWL are known to vary with stone size, location, composition (as reflected by Hounsfield units on non-contrast CT), skin-to-stone distance, and the presence of anatomical abnormalities. Complications, though generally minor, include hematuria, loin pain, urinary tract infection, and less commonly, steinstrasse or ureteric obstruction requiring secondary intervention. This study was undertaken to evaluate the success rate and complication profile of ESWL for renal and upper ureteric calculi at a tertiary care government medical college and hospital.

Aim

To study the success rate and complications of ESWL treatment for renal and upper ureteric calculus.

Objectives

- To study the success rate of ESWL treatment for renal and upper ureteric calculus.

- To study the complication rate of ESWL treatment for renal and upper ureteric calculus.

2. Materials and Methods

Study Site

Super Specialty Hospital, Government Medical College & Hospital, Nagpur, Maharashtra.

Study Population

All adult patients attending the urology OPD with renal and upper ureteric calculus of size 7–20 mm, during the period 1st April 2024 to 31st March 2025. Patients were enrolled after applying the exclusion criteria until the sample size of 100 was reached. Treatment records were documented and complications were followed for three months after treatment.

Study Design

A prospective observational analysis.

Sample Size

100 patients.

Study Duration

One year, from 1st April 2024 to 31st March 2025, until the sample size of 100 was achieved, with each patient followed for up to three months thereafter.

Inclusion Criteria

Adult patients more than 18 years of age; all adult patients with solitary renal calculus or upper ureteric calculus of size 7 to 20 mm with Hounsfield units less than 1200 HU; upper ureteric calculus up to the anatomic level of the lower border of the 2nd lumbar vertebra.

Exclusion Criteria

Patients below 18 years of age; pregnant patients; patients on anticoagulants and antiplatelets, except aspirin 75 mg OD; patients with multiple renal calculi; abnormal urinary system anatomy; patients with upper ureteric calculus below the level of the lower border of the 2nd lumbar vertebra; patients with Hounsfield units more than 1200 HU; patients who did not agree to treatment or did not give informed consent.

3. Methodology

Consent was obtained from the medical college and hospital administration and the institutional ethics committee. Records of patients with renal calculus and defined upper ureteric calculus treated with ESWL were obtained as per a structured proforma. Cure and complications were assessed on follow-up through clinical examination and relevant investigations. Collected data were analyzed using appropriate statistical tests.

Statistical Methods

Collected data were compiled in an Excel sheet and a master sheet was prepared. Statistical Package for Social Sciences (SPSS) software was used for analysis. Data were presented visually using bar diagrams and pie diagrams. Data were analyzed using the chi-square test and multiple regression analysis.

4. Results

Table 1: Distribution of Patients According to Gender

Gender	Number of Patients	Percentage
Male	71	71%
Female	29	29%
Total	100	100%

Table 2: Distribution of Patients According to Location – Renal or Upper Ureteric Calculus

Patients (n=100)	Renal – Male	Renal – Female	Upper Ureteric – Male	Upper Ureteric – Female
Number	42	19	29	10
Percentage	61% (Renal, combined)		39% (Upper Ureteric, combined)	

Overall, 61 patients (61%) had renal calculi and 39 patients (39%) had upper ureteric calculi.

Table 3: Distribution of Renal Calculus Patients According to Site in the Pelvicalyceal System

Site	Renal Pelvis	Upper Pole	Mid Pole	Lower Pole
Male	16	07	11	08
Female	02	03	02	12
Total	18	10	13	20

Table 4: Success Rate of ESWL for Renal Calculus (n=61)

Total Pts.	Cured (M)	Cured (F)	Non-cured (M)	Non-cured (F)	Total % Cured
61	41	19	01	00	98.36%
Percentage	97.56%	100%	2.44%	0%	Non-cured: 1.64%

Table 5: Success Rate of ESWL for Upper Ureteric Calculus (n=39)

Total Pts.	Cured (M)	Cured (F)	Non-cured (M)	Non-cured (F)	Total % Cured
39	28	09	01	01	94.87%
Percentage	96.55%	90%	3.45%	10%	Non-cured: 5.13%

Table 6: Overall Success Rate of ESWL for Renal & Upper Ureteric Calculus (n=100)

Total Pts.	Cured (M)	Cured (F)	Non-cured (M)	Non-cured (F)	Total % Cured
100	69	28	02	01	97%
Percentage	97.18%	96.55%	2.82%	3.45%	Non-cured: 3%

Table 7: Complications of ESWL for Renal & Upper Ureteric Calculus (n=100)

Complication	No. of Patients	Percentage
Hematuria	22	22%
Loin pain	31	31%
Urinary tract infection (UTI)	13	13%
Ureteric obstruction	02	2%
Hospital readmission	04	4%
Intervention needed (1 URSL, 1 DJ stenting for upper ureteric calculus)	02	2%

5. Discussion

In this prospective observational study of 100 patients with solitary renal or upper ureteric calculi of 7–20 mm with HU < 1200, ESWL achieved an overall cure rate of 97%, with only 3% of patients classified as non-cured. Renal calculi showed a marginally higher success rate (98.36%) than upper ureteric calculi (94.87%), which is consistent with the general understanding that renal, particularly non-lower-pole, calculi tend to fragment and clear somewhat more predictably than ureteric calculi, where impaction and surrounding mucosal edema can limit fragment passage.

Within the renal calculus group, the distribution by pelvicalyceal site (renal pelvis, upper, mid, and lower pole) reflects the case-mix typically seen in ESWL practice, where lower-pole location is traditionally associated with comparatively lower clearance rates due to dependent drainage, although this study was not powered to specifically compare site-wise success rates.

The complication profile observed- predominantly self-limiting hematuria (22%) and loin pain (31%), with urinary tract infection in 13%- is in keeping with the safety profile of ESWL reported in the literature, where major complications are uncommon. A small proportion of patients (2%) required secondary intervention in the form of ureterorenoscopy (URSL) or DJ stenting, underscoring that while ESWL is largely safe, a subset of patients with upper ureteric calculi may still require an endoscopic salvage procedure. These findings are broadly consistent with previously reported success and complication rates of ESWL for renal and ureteric calculi.

Limitations of this study include its single-center design, restriction to solitary calculi of a defined size and density range, and a relatively short follow-up period of three months, which may not capture delayed complications or recurrence. Larger, multi-centric studies with longer follow-up and site-wise sub-analysis would help further refine patient selection criteria for ESWL.

6. Conclusion

ESWL is a safe and effective, non-invasive first-line treatment modality for solitary renal and upper ureteric calculi measuring 7–20 mm with Hounsfield units less than 1200. In this series, it achieved a high overall success rate of 97%, with a low rate of complications and a small proportion of patients requiring secondary intervention. These findings support the continued role of ESWL as an appropriate first-line option in properly selected patients.

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