



Comparative Study between Ureteroscopic Lithotripsy vs Extra Corporeal Shock Wave Lithotripsy in The Management of Upper Ureteric Calculi

Dr. Dev Krishna Bharathi C^{1*}, Dr. Madhumita Sekaran², Dr K Sudhakar³, Dr. Suhas T⁴, Rahul Shanmugam⁵

^{1*}Assistant Professor, Department of Urology, Saveetha Medical College and Hospital, Chennai, India.

²Consultant Reproductive Endocrinologist, A C Hospital, Chennai, India

³Unit Head, Department of Urology, Indira Gandhi Government General Hospital and Post Graduate Institute, Pondicherry, India.

⁴Post Graduate, Department of Urology, Saveetha Medical College and Hospital, Chennai, India

⁵MBBS Final Year, Mahatma Gandhi Medical College and Research Institute, Pondicherry, India.

Abstract:

Background: Extracorporeal shockwave lithotripsy (ESWL) and ureteroscopic lithotripsy (URSL) are two popular therapeutic modalities used when conservative or medical expulsive therapy for upper ureteric stones fails. Present study was aimed to compare between ureteroscopic lithotripsy vs extra corporeal shock wave lithotripsy in the management of upper ureteric calculi. **Material and Methods:** Present study was prospective, observational study, conducted in patients > 20 years, diagnosed to have Upper ureteric stone of size 6 mm to 15 mm (L2 level to Upper border of sacrum), radio opaque stone. The decision was made based on the patient's choice for either ESWL or URS. **Results:** Total number of patients included in our study was 81. Most of the patients belonged to the age group of 20 – 30 years (37 %). Male: female ratio was 5.2: 1. Majority of patients had a stone size of 6 – 10 mm (53.1%) as compared to stone size of 11 – 15 mm (46.9 %). Out of the 81 patients, 84 % had successful stone clearance. Upper ureteric stones of sizes 6 – 10 mm were cleared in 93% cases and ureteric stones of sizes 11 – 15 mm were cleared in 73.7 % cases; difference was statistically significant. URSL had an overall success rate of 88.2 % while ESWL had an overall success rate of 76.7 % (23/30). URSL was successful in 27/28 (96.4 %) patients with stone sizes 6 – 10 mm and 18/23 (78.3%) patients with stone sizes 11 – 15 mm. ESWL was successful in 13/15 (86.7 %) patients with stone sizes 6 – 10 mm and 10/15 (66.7 %) patients with stone sizes 11 – 15 mm. **Conclusion:** Both procedures (Laser URSL and ESWL) can be safely and effectively used as a primary treatment for radio-opaque stones in proximal ureter of sizes 6 to 15 mm.

Keywords: Laser URSL, ESWL, Stones in Proximal Ureter, Stone Free Rate

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INTRODUCTION

Prevalence of urolithiasis (ureteral calculi) in men is 13 % and reported as 7% in females, also it is dependent on age and geographical area. The peak incidence is third to fourth decades of life¹. Environmental factors, socioeconomic status, genetics and certain metabolic conditions are the majority of risk factors of this condition.

Colic pain is commonly due to movement of stone and submucosal nerve fibers irritation, nausea, vomiting, dark or blood mixed urine, burning urination and fever the most common signs. Numerous strategies are there for ureteric stones based on the stone size, degree of obstruction, severity, stone location, kidney function, infection status.

While for stones 4-5 mm in size spontaneous passage may occur in 80% to 90% of cases^{2,3,4}, larger stones usually require treatment. At present, the different modalities available for the management of upper ureteric calculi include ESWL, rigid and flexible retrograde Ureterorenoscopy (URS), antegrade URS, laparoscopy and open surgery. ESWL and URS are the procedures of choice for the treatment of upper ureteric stones^{5,6,7} leaving a minor role for laparoscopy and open surgery^{8,9}

Extracorporeal shockwave lithotripsy (ESWL) and Ureteroscopic lithotripsy (URSL) are two popular

therapeutic modalities used when conservative or medical expulsive therapy fails. Both given techniques have specific advantages, disadvantages, and complications.¹⁰ Present study was aimed to compare between Ureteroscopic lithotripsy vs extra corporeal shock wave lithotripsy in the management of upper ureteric calculi.

MATERIAL AND METHODS

Present study was prospective, observational study, conducted in department of urology, at Saveetha Medical College & Hospital, Chennai, Tamil Nadu, India. Study duration was of 2 years (December 2015 to December 2017). Study approval was obtained from institutional ethical committee.

Inclusion criteria

- Patients > 20 years, diagnosed to have Upper ureteric stone of size 6 mm to 15 mm (L2 level to Upper border of sacrum), radio opaque stone, willing to participate in present study

Exclusion criteria

- Pregnancy
- Bleeding Diathesis
- Severe Hydronephrosis, Bilateral Ureteric Stones, Urinary Tract Abnormalities, Renal Insufficiency, Urinary



Tract Infection

- Concomitant Alpha Blocker Use

Study was explained to patients in local language & written consent was taken for participation & study. Detailed clinical history and clinical examinations were done for all patients. All the patients underwent necessary routine investigation. Patients having infection together with stones were treated with appropriate antibiotics and analgesic, antispasmodic agents in accordance with their age and medical situation. The patients whose stones were not cleared following the medical treatment period were advised to receive either ESWL or URS. The decision was made based on the patient's choice. In situ ESWL was applied by Dornier compact sigma under intravenous sedation without a Double J stent. We used Inj Tramadol 50 mg slow IV for sedation and analgesics purpose. The session intervals varied between 10 to 15 days. Pt having repeated colic, Stein Strauss required either a DJ stent or a Repeat URS(L) for stone clearance. Stones which could not be fragmented satisfactorily at the end of three sessions were classified as failure of ESWL. SWL failure cases shifted to URSL procedure were excluded from the current URSL group. URS was applied under spinal anaesthesia for upper ureteral stones using semi rigid 6-7.5 or 8-9.8 Fr ureteroscope (Richard Wolf). All patients undergoing URS had antibiotic prophylaxis. Each of them took intravenous Inj. Ceftriaxone 1 hour before URS. Many of the patients did not need balloon dilator for orifice entrance. Narrow ureteric orifice where URS could not pass were dilated. The stones were identified and fragmented with Holmium Laser. The majority of fragmented stones were left in situ for spontaneous passage, while relatively large stone fragments were removed with stone forceps. 5 Fr 26 cm Double-J stent was routinely used stents were removed 15- 20 days after the operation. Patients were discharged from the hospital one day after URS application. Retropulsion of the stone/fragment (visible in C-Arm) into the Kidney – requiring another ancillary procedure (either same sitting RIRS or ESWL) is considered failure of Laser URSL. All patients in each group were evaluated by X- Ray KUB, ultrasound (USG), and/or non-contrast spiral computerized tomography (CT) before the treatment. Patients were reviewed after 1 month from the day of discharge. X- Ray KUB /Ultrasound KUB will be done. Stone-free status or asymptomatic residual fragments of ≤ 3 mm in diameter on KUB are considered as optimal stone clearance. The collected data was analysed with IBM.SPSS statistics software 23.0 Version. To describe about the data descriptive statistics frequency analysis, percentage analysis was used for categorical variables and the mean & S.D were used for continuous variables. To find the significant difference between the bivariate samples in independent groups the Unpaired sample t-test was used. To find the significance in categorical data Chi-Square test was used similarly if the expected cell frequency is less than 5 in 2x2 tables then the Fisher's Exact was used. In all the above statistical tools the probability value .05 is considered as significant level.

RESULTS

Total number of patients included in our study was 81. Most of the patients belonged to the age group of 20 – 30 years (37 %). Out of 81 patients, 68 patients were male (84 %) and 13 patients are female (16 %). Male: female ratio was 5.2: 1. Total number of Right sided upperureteric stones were 32 (39.5 %) and total number or left sided upper ureteric calculus were 49 (60.5 %) & left: right ratio was 1.5: 1. Loin pain was the most common symptom (93.8 %) followed by nausea (86.4 %) and hematuria (49.4 %).

Table 1- General characteristic

Characteristic	Frequency	Percent
Age		
20 - 30 yrs	30	37.0 %
31 - 40 yrs	28	34.6 %
41 - 50 yrs	10	12.3 %
51 - 60 yrs	9	11.1 %
> 60 yrs	4	4.9 %
Sex		
Female	13	16 %
Male	68	84 %
Affected Side		
Left	49	60.5 %
Right	32	39.5%
Symptoms		
Loin pain	76	93.8 %
Nausea	70	86.4 %
Hematuria	40	49.4 %

In our study a greater number of patients had a stone size of 6 – 10 mm (53.1 %) as compared to stone size of 11 – 15 mm (46.9 %).

Table 2- Stone size

Size	Frequency	Percent
6 – 10 mm	43	53.1
11 – 15 mm	38	46.9

In our study of 81 patients a total of 51 patients chose URS(L) with holmium laser and a total of 30 patients chose Stone fragmentation by ESWL. In present study, mean age of patients in URSL group was 38.47 ± 11.31 years while in ESWL group was 34.27 ± 10.19 years. Mean stone size in URSL group was 9.94 ± 2.22 mm while in ESWL group was 10.33 ± 1.9 mm.

Table 3- Distribution According to Procedure

Characteristic	URSL (n=51)	ESWL (n=23)
Mean Age (years)	38.47 ± 11.31	34.27 ± 10.19
Gender		
Female	8 (15.7 %)	5 (16.7 %)
Male	43 (84.3 %)	25 (83.3 %)
Size on pre op USG / CT KUB (mm)	9.94 ± 2.22	10.33 ± 1.90

In our study out of the 81 patients, combining both the groups, a total of 68/81 patients (84 %) had successful stone clearance. Upper ureteric stones of sizes 6 – 10 mm were cleared in 40/43 (93%) of the cases and ureteric stones of sizes 11 – 15 mm were cleared in 28/38 (73.7



%) of the cases. There is a statistically significant better overall stone clearance rate for stone sizes 6 – 10 mm (P = 0.018).

Table 4- Stone Clearance with Size

Stone size	6-10 mm (n=43)	11-15 mm (n=23)	Total (n=51)
No	3 (7 %)	10 (26.3 %)	13 (16 %)
Yes	40 (93 %)	28 (73.7 %)	68 (84 %)
Total	43	38	81

In our study, 60/68 male patients were cleared of the stone (88.2%) and 8/13female patients were cleared of the stone (61.5 %). In our study male patients had a statistically significant better stone clearance than female patients (P = 0.016).

Table 5- Gender with Stone Clearance

Stone size	Female (n=13)	Male (n=68)	Total (n=81)
No	5 (38.5 %)	8 (11.8 %)	13 (16 %)
Yes	8 (61.5 %)	60 (88.2 %)	68 (84 %)
Total	13	68	81

In our study URSL had an overall success rate of 88.2 % while ESWL had an overall successrate of 76.7 % (23/30).

Table 6- Procedure-Wise Stone Clearance

	URSL (n=51)	ESWL (n=23)	Total (n=51)
No	6 (11.8 %)	7 (23.3 %)	13 (16 %)
Yes	45 (88.2 %)	23 (76.7 %)	68 (84 %)
Total	51	30	81

URSL was successful in 27/28 (96.4 %) patients with stone sizes 6 – 10 mm and 18/23 (78.3%)patients with stone sizes 11 – 15 mm.

Table 7- FOR URSL Stone Clearance with Size

Stone size	6-10 mm (n=28)	11-15 mm (n=23)	Total (n=51)
No	1 (3.6 %)	5 (21.7 %)	6 (11.8 %)
Yes	27 (96.4 %)	18 (78.3 %)	45 (88.2 %)
Total	28	23	51

ESWL was successful in 13/15 (86.7 %) patients with stone sizes 6 – 10 mm and 10/15 (66.7

%) patients with stone sizes 11 – 15 mm.

Table 8- FOR ESWL Stone Clearance with Size

Stone size	6-10 mm (n=15)	11-15 mm (n=15)	Total (n=30)
No	2 (13.3 %)	5 (33.3 %)	7 (23.3 %)
Yes	13 (86.7 %)	10 (66.7 %)	23 (76.7 %)
Total	15	15	30

In our study in the ESWL group among the successfully cleared patients (23/30), majority of the cases (18/23) 78.3 % required only a single sitting for stone clearance, followed by (4/23)

17.4 % required a second sitting and only (1/23) 4.3 % required a third sitting for stone clearance.

Table 9 - Stone Clearance In ESWL with Number of Sitzings Required

Retreatment / Sitzings	No Stone clearance (n=7)	Stone clearance done (n=23)	Total (n=30)

1	0	18 (78.3 %)	18 (60 %)
2	0	4 (17.4 %)	4 (13.3 %)
3	0	1 (4.3 %)	1 (3.3 %)
Failure	7 (100 %)	0	7 (23.3 %)
Total	7	23	30

DISCUSSION

ESWL is a non-invasive modality which is more accepted and tolerated by the patients, doesn't need anesthesia, and can also be performed as an out-patients facilities during which, high-amplitude sound waves (shockwaves) are generated via outside sources and passed through the body to fragment the stones which can easily be passed out. In this modality, no instrumentation is needed.

In URS an Uretero-reno scope placed into the affected ureter. Stones are fragmented into tiny pieces using laser energy or pneumatic energy probe; and the fragmented stones can pass out spontaneously. Therefore, it is important to know which method has merits over another technique in the management of upper ureteric stones.

Both procedures (Laser URSL and ESWL) can be safely and effectively used as a primary treatment for radio-opaque stones in proximal ureter of sizes 6 to 15 mm, however Laser URSL has a significantly higher initial stone free rate and lower retreatment rate than ESWL. Although ESWL has a higher retreatment rate with lower initial stone free rate, it has the advantage of being non-invasive and also being an outpatient procedure without anaesthesia.^{7,8}

In our study URSL had an overall success rate of 88.2 % (45/51). ESWL had an overall success rate of 76.7 % (23/30). URSL was successful in 27/28 (96.4 %) patients with stone sizes 6 – 10 mm and 18/23 (78.3 %) patients with stone sizes 11 – 15 mm. ESWL had an overall success rate of 76.7 % (23/30). ESWL was successful in 13/15 (86.7 %) patients with stone sizes 6 – 10 mm and 10/15 (66.7 %) patients with stone sizes 11 – 15 mm. Nabi G et al.¹¹ in Cochrane review found the stone-free rates were lower in the ESWL group (RR 0.83 95% CI 0.70 to 0.98). Kumar et al.,¹² for proximal ureteric stone and reported a stone free rate of 78.4 % for ESWL and 85.4 % for laser URS, with a retreatment rate of 78.4 % for ESWL and 17 % for Laser URSL for stone sizes less than 15 mm. The overall stone-free rates at 3-month follow-up were similar for both approaches: 82.2% for SWL and 86.6% for laser URS. Outcomes for patients with stones ≤10 mm were also similar, with 84.3% of SWL remaining stone free at 3 months compared to 86.3% of the patients treated with laser URS. Hamdy Aboutaleb et al.,¹³ noted that for proximal ureteric stones > 15 mm, at the 3- month follow-up, the overall stone-free rate in the shock wave lithotripsy group was 39/66 (59%) compared to 70/81 (86.4%) in the ureteroscopic laser lithotripsy group. Ureteroscopic laser lithotripsy achieved a highly significant stone-free rate (p = 0.0002) Saptarshi Mukherjee et al.,¹⁴ noted that 77.14% (n = 35) of patients who underwent ESWL therapy was stone free at the end of 2nd session. This rate was 85.71% (n = 35) for patients of URS group (p > 0.05). Retreatment was required in 51.43% of patients who underwent ESWL. The retreatment rate of cases who were operated with URS was 2.86% (p = 0.0000037, p < 0.05). Overall complications did



not vary significantly between the 2 groups. URS and ESWL have similar outcomes for the treatment of upper ureteric stones of 10–15 mm. ESWL has the superiority of minimal invasiveness and avoiding general anesthesia. Ureterorenoscopy (URS) with intracorporeal laser lithotripsy has the advantage of obtaining an earlier or immediate stone-free status. But it is an invasive procedure & needs hospitalization.

In study by Iqbal N et al.,¹⁵ mean age in ESWL and URS groups were 39.21±13.36, and 43.13±13.65 years respectively. Mean stone size was 10.47±3.7 mm (ESWL) and 13.6±6.6 mm (URS). Stone-free rate after single procedure was (125/200 patients) 62.5% for ESWL and (168/200 patients) 84% for URS group (p=0.001). Complications included post procedure sepsis in 3 (1.5%) patients of ESWL, while 7 (3.5%) patients of URS groups. Stein Strasse was seen in 4 (2%) patients of ESWL group. No mortality was seen in both groups. Mean costs for ESWL were US \$320±50 while US \$1100±150 for URS group (p=0.001).

Besides thinking about all the factors while deciding a specific treatment modality, priority should be always given to patient's preference. Some patients might have concerns regarding the anesthesia requirement and the invasive nature of URS. But there may be other set of patients who might prefer to have their stone removed and the pain alleviated at the earliest possible time, thus avoiding multiple treatment sessions that might be required in case of SWL as treatment modality.

CONCLUSION

Both procedures (Laser URSL and ESWL) can be safely and effectively used as a primary treatment for radio-opaque stones in proximal ureter of sizes 6 to 15 mm, however Laser URSL has a significantly higher initial stone free rate and lower retreatment rate than ESWL. Although ESWL has a higher retreatment rate with lower initial stone free rate, it has the advantage of being non-invasive and also being an outpatient procedure without anesthesia.

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