

Original Article

A Comparison of Ureterorenoscopy and Extra-Corporeal Shock Wave Lithotripsy for the Treatment Of Upper Ureteric Stone Measuring Less than 1cm.

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Abstract

Objective: To compare the efficacy of Extracorporeal Shock Wave Lithotripsy (ESWL) and Ureterorenoscopy (URS) in the management of upper ureteric stone measuring <1cm.

Methodology: Randomized clinical trial (RCT) was conducted by targeting the patient admitted in urology ward, Jinnah Hospital Lahore through a period of one year. A sample size of 132 patients fulfilling inclusion criteria were selected by employing Non-probability consecutive sampling technique was employed to select 132 (sample size) patients fulfilling inclusion criteria. Patients were randomly allocated into two groups (66 in each group A&B) using lottery method. In group-A, stones were treated using ESWL, while in group-B, URS was performed, and stones were broken with pneumatic energy. Data were analyzed using SPSS version 27, and a Chi-square test was conducted to compare the proportions of qualitative variables, while an independent sample t-test was applied to assess mean differences between two groups of quantitative variables. A significance level of ≤ 0.05 was adopted for determining statistical significance.

Results: The sociodemographic profile of the two groups was comparable. It was seen that stone free rate next to first session was higher in URS (81.8%) as compared to ESWL (63.6%) which later increased to 87.7% after completion of three session. The complaint of pain in ESWL was more as compared to URS (22.7% vs 12.1% $p=0.05$) while the differences between the rate of complications like fever, UTI, mucosal abrasion, hematuria or perforation were not statistically significant in both group. ($p>0.05$)

Conclusion: ESWL outperforms URS for the treatment of upper ureteric stones measuring <1cm in terms of efficacy and safety. Although not statistically significant, our findings suggest that URS achieves stone-free rates earlier than ESWL. However, according to our findings, ESWL is recommended as the treatment of choice for the majority of patients due to better compliance.

Keywords: Extra-corporeal Shock Wave Lithotripsy, Nephrolithiasis, Ureterorenoscopy.

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Introduction

Kidney stone disease, or nephrolithiasis, is a condition that affects people of all ages, races, and genders and is marked by acute pain that frequently returns¹. Kidney stone frequency varies by geography with reported prevalence in Asia ranging from 1% to 5%. Pakistan is located in a high stone belt with overall incidence of kidney stones as 12% and Dera Ghazi Khan having the highest rate, followed by Hyderabad and Sukkar². It is also reported in literature that incidence of urinary tract infections also increases with presence of stone³. It is the third most common urological ailment which is encountered increasing with increase in age.^{4,5}

The probability of recurrence also increases with time with risk of recurrence soaring to 39% after fifteen years of first occurrence of stone and remains a significant concern for the clinicians.^{6,7} End-stage renal disease, hypertension, diabetes, chronic kidney disease, and cardiovascular disease are all risks associated with kidney stones and nephrocalcinosis also exacerbates the complications.^{8,12}

There are several ways to the treatment of urinary stones. Extracorporeal shock wave lithotripsy (ESWL), or endourological therapy, is one of the most often utilized therapeutic techniques. Endoscopic combined intrarenal surgery (ECIRS) is a procedure that combines Ureterorenoscopy (URS) and percutaneous nephrolithotomy (PCNL) or both. Open, laparoscopic, or robot-assisted methods are seldom recommended and are only used in complicated instances. An ideal treatment option should be capable of complete removal of stone while limiting the danger of consequences. Thus, while choosing a therapy for symptomatic kidney stones, a personalized strategy is required depending on patient's choice, availability of the treatment option and competence of the surgeon.¹³

Both ESWL and URS treatments achieve comparable

outcomes in terms of stone-free rates; nevertheless, URS performs better than ESWL in reaching high stone-free rates. URS is a minimally invasive method that involves passing a rigid or flexible endoscope retrograde from the urethra to the ureter and subsequently to the kidney. A hard endoscope may only allow visibility of the ureter, but a flexible endoscope may provide visualization of both the ureter and the calyceal system of the kidney. The ureteroscope is outfitted with a laser, pneumatic, ultrasonic, or hydraulic energy source that fractures the stone. These fragmented small pieces can then be readily extracted using stone retrieval equipment. Small bits of the stone may pass on their own with the passage of urine. The risk of complications in URS is greater than in ESWL, at 9%-25%, although these problems are often insignificant and do not necessitate additional intervention.¹³

The non-invasive or minimally invasive methods of Ureterorenoscopy (URS) and extracorporeal shock wave lithotripsy (ESWL) are the most widely used therapeutic approaches for ureteric calculi. But literature guides as each method have its own advantages and disadvantages. In our country, there is, nevertheless, limited information about the relative merits of ESWL and rigid URS for the treatment of ureteric stones in proximal ureter. The objective of randomized clinical trial was to compare the effectiveness of URS and ESWL in treating upper ureteric stones that are less than 1 cm in size.

Methodology

The study was carried out after approval from institutional Ethical Review Committee along with all the concerned authorities and departments. (Ref no. 58/ ERB/AIMC) This Randomized clinical trial (RCT), was conducted in the urology ward, Jinnah Hospital Lahore from August 2022 to 2023 over a period of one year. Sample size of 132 was calculated with WHO sample size calculator at a

Significance level of 5%, 80% power of study, and taking expected Stone free rate after ESWL as 62.5% and after URS as 84%.¹⁴

Patients aged 18 years and above, both genders having upper ureteric stone measuring less than 10mm (1cm), which fail to respond to medical expulsive therapy were included in the study. Patients with distal and mid-ureteric obstruction, multiple stones or solitary kidney, previous ureteric surgery, or previous history of ESWL in the same ureter, ureteric calculi associated with neurogenic bladder and stricture urethra, Patients having urinary tract infection/ pregnancy/ bleeding disorders, congenital anomalies, morbid obesity or spinal deformity were omitted from the study. The selected patients were randomly divided in to two treatment groups A and B (66 in each group) using lottery method. Socio-demographic and clinical information was noted for all patients in a specially designed proforma. An informed consent was obtained after explaining details of the procedure to the patients. All procedures were kept aseptic and painless. In group A patients, stones were subjected to Extracorporeal Shock Wave Lithotripsy (ESWL) while in group B Ureterorenoscopy (URS) was performed, and stones were broken with pneumatic energy.

The patients were followed on 3rd post-operative week and at the end of 3 months. Finding was used strictly for scientific publication and the confidentiality of the information was assured as well as maintained.

The patients were also advised to visit the hospital in case of complaints other than their proposed follow-up time.

All the data were entered and analysed using SPSS version 27. Qualitative variables e.g., gender, age groups, side of the stone, stone free status, presenting complaints were all presented in the form of frequency and percentages. Mean and standard deviation were calculated for quantitative variables. Chi-

square analysis was performed to compare proportions of qualitative variables an independent sample t-test was applied to assess mean differences between two groups of quantitative variables. A significance level of ≤ 0.05 was adopted for determining statistical significance.

Results

In this study, a total of 132 patients were included, with 66 in group A (ESWL) and 66 in group B (URS). The mean age was 39.21 ± 13.36 for group A and 43.13 ± 13.65 for group B, and the mean BMI was 25.1 ± 5.86 kg/m² for group A and 24.3 ± 6.17 kg/m² for group B. There were no significant differences in gender, age, BMI, and co-morbidities between the two groups ($p > 0.05$). The average stone size for group A was 7.2 ± 2.5 mm and for group B was 8.6 ± 1.1 mm, but the difference between the two groups was not significant (mean stone size, $p = 0.67$). In this study, 53.1% of patients in group A had left ureteral stones, while 51.5% of patients in group B had stones in the left ureter. (Table-1).

All nephrolithiasis patients had a mean volume of 1.37 L urine per 24 hours, with a range of 1.20 - 1.62, and a mean pH of 5.4 (range = 5.2 - 5.7). Urine samples from 36 (54.5%) patients with kidney stones were positive for the presence of pus cells/RBCs. The mean creatinine, phosphate, calcium and uric acid levels in blood serum were 62.28 34.36 mol/L, 1.36 0.47 mol/L, 0.77 0.26 mol/L, and 222.72 89.51 mol/L, respectively. Concerning the associated complication with both procedures, pain was experienced by 15 (22.7%) and 8 (12.1%) patients after ESWL and URS, respectively, with a considerable difference among the two groups ($p = 0.05$) (Table-2.).

In terms of degree of hydronephrosis, the majority of 33 (50%) and 40 (60.6%) patients of group A and B, respectively, had mild hydronephrosis. There was no significant difference in the degree of hydronephrosis between patients treated

with ESWL and those treated with URS (p = 0.09) (Table-3).

Table 1: Demographic and Baseline Characteristics of the Patient

Variables	Group A (ESWL) n = 66	Group B (URS) n = 66	p - value
Age (Years)	39.21±13.36	43.13±13.65	0.83
Sex			
Male	53 (80.3 %)	46 (70 %)	0.17
Female	13 (19.6 %)	20 (30 %)	
BMI (kg/m ²)	25.1 ±5.86	24.3 ±6.17	0.89
Stone Size (mm)	6.2 ± 2.5	6.8 ± 2.9	0.67
Site of Stone			
Right	31 (46.9 %)	32 (48.5 %)	0.85
Left	35 (53.1 %)	34 (51.5 %)	
Comorbidities			
Diabetes Mellitus	16 (24 %)	17 (26 %)	0.79
Hypertension	22 (33.3 %)	25 (38 %)	0.57

Table 2: Urinary & Blood parameters of all patients presented with nephrolithiasis with signs & symptoms. (n = 132)

Parameters	Result Value
Urinary parameters	
Volume of urine (L/24 hr) *	1.37(1.20 – 1.62)
pH*	5.4 (5.2 – 5.7)
Presence of pus cells/RBCs	36 (54.5 %)
Serum parameters	
	Mean ± SD
Creatinine (µmol/L)	62.28 ± 34.36
Calcium (µmol/L)	1.36 ± 0.47
Phosphate (µmol/L)	0.77 ± 0.26
Uric Acid (µmol/L)	222.72 ± 89.51
Sign and Symptoms presented by patients	
	n (%)
Flank Pain	61 (91 %)
Poor stream	12 (18.1 %)
Dysuria	48 (73 %)
Incomplete emptying	4 (6 %)
Straining	4 (6 %)
*mean and range	

After the first session, the ESWL group had a stone-free rate of 63.6% (42 out of 66 patients had either no stone or had just residual pieces) while the URS

group had a stone-free rate of 81.8% (55/66 patients) (p=0.01). In ESWL patients, it was 77.2% (51/66 patients) and 87.8% (58/66 patients) after the second and third sessions, respectively. The average No of sessions for the group that received ESWL was 1.47±1.18. (Table-3).

Table 2: Degree of Hydroureteronephrosis and procedural outcomes/complications in patients of both groups (n=132)

Variable	Group A (ESWL) n = 66	Group B (URS) n = 66	P - value
Degree of Hydroureteronephrosis			
No	7(10.6 %)	15 (22.7 %)	
Mild	33(50 %)	40 (60.6 %)	0.09
Moderate	26(39.4 %)	11 (16.6 %)	
Outcomes			
Stone-free rate after first session	42(63.6 %)	54 (81.8 %)	0.01
Stone-free rate after 2 nd session	51(77.2 %)	
Stone-free rate after 3 rd session	58(87.8 %)	
Number of sessions (Mean ±S. D)	1.47 ±1.18	1 ± 0.00	0.78*
Complications			
Pain	15(22.7 %)	8 (12.1 %)	0.05
Fever	6 (9.0 %)	7 (10.6 %)	0.97
Mucosal abrasion	0 (0 %)	5 (7.5 %)	0.06
Mild to moderate Hematuria	5 (7.5 %)	6 (9.0 %)	0.08
Ureteral perforation	0 (0 %)	0 (0 %)	0.50
stein Strasse	2 (3.0 %)	0 (0 %)	0.56
UTI	3 (4.5 %)	3 (4.5 %)	0.98

Chi square test applied, * t-test applied. UTI: Urinary tract infection.

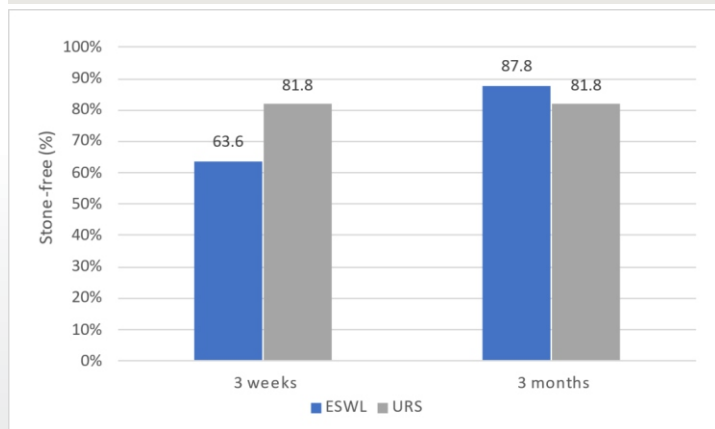


Figure-1. Stone free rate at 3 weeks and 3 months

Discussion

This study found that URS had a considerably better success rate (81.8%) than ESWL (63.6%) after the first session. However, when comparing the total success rates of both treatment methods (URS: 81.8% vs. ESWL: 87.8%), ESWL had somewhat higher success rates than URS. The failure of URS for a 1cm stone owing to the stone being pushed back to the pelvis in 12 (18.1%) instances can be linked to the higher success rate and efficacy of ESWL. Furthermore, the hospital stay for the URS group was much longer, but this comes with the benefit of a one-time treatment that does not need returning to the hospital save for follow-up visits and in the event of difficulties. These findings are consistent with a recent Spanish study comparing ESWL vs URS for stones smaller than 2 cm in diameter.¹⁵

In this research, stone-free rate after URS was determined to be 81.8% in the upper part of the ureter. According to the literature, ureteroscopy has a better success rate for stones measuring 10 mm or less in the lower part of the ureter, whereas it is for stones measuring more than 10 mm in the proximal ureter¹⁶. The size and position of the stone are very major elements that determine the success of ureteroscopy; nevertheless, the operating urologist's competence and experience also have a good impact on the efficacy.¹⁷

As per our study results, none of the other demographic and baseline clinical parameters (BMI, mean stone size, and co-morbidities, degree of hydronephrosis) of the patients were found significantly different between the two groups. While keeping track of the factors when deciding a particular treatment model, patient's preference should always take top priority because patient may require their stones to be removed and be relieved of pain as soon as possible¹⁸. However, Lee et al. did not find substantial differences in the satisfaction of the patients for both interventions.¹⁹

The SWL approach is thought to be inexpensive but the cost varies according to the setup. It is seen that the cost of URS is considerably high in private hospitals as compared to ESWL.²⁰ However, in public sector hospital the patient bears low or no cost regardless of the operation they undergo resulting in no financial hardship on the patients in either of the procedure.

In terms of complications, our study found that a considerably higher proportion of ESWL patients experience discomfort than URS patients. Mucosal abrasion, on the other hand, was shown to be considerably greater in individuals who received URS. Another study found that using ureteroscopy for the ureteral stones removal resulted in a higher stone free rate when compared to shockwave lithotripsy, but this was accompanied by a longer hospital stay and a higher rate of complications.¹⁸

Various research has reported varying evidence. The density of the stone and its impact on the patient, the patient's BMI, the urologist's experience, skin to stone distance, acceptable technology, and resources continue to be the best factors for educating patients about a treatment plan for ureteral stones in the proximal area. Our study was unique in that it included numerous parameters that could impact the success rate (stone free rate) in shockwave lithotripsy and URS, as well as comparing URS and shockwave lithotripsy treatment models for proximal ureteral stone removal. Limitation of the study were that it was a single center study with narrow sample size, thus further research considering larger population and multi-centre prospective are needed to highlight and substantiate the findings of our study.

Conclusion

This study concludes that in treating proximal ureteric stones, initial ureterorenoscopy (URS) showed better stone clearance rates compared to extracorporeal shock wave lithotripsy (ESWL). However, after three

sessions, ESWL had higher success rates for stones under 1 cm, with similar complication rates except for pain. Therefore, despite better initial URS outcomes, ESWL proves more effective and safer in managing smaller upper ureteric stones over three months, leading to better clinical results.

Conflict of interest: *None*

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Authors Contribution

SUF, MAS: Conceptualization of study

AA, SUF: Literature Search

SA, SJR, MAS: Statistical Analysis

HSC, SA: Data Collection and Analysis

HSC, SJR: Writing of Manuscript

AA: Drafting, Revision

All authors are equally accountable for accuracy, integrity of all aspects of the research work.