

# Extracorporeal Shockwave Lithotripsy Versus Ureteroscopy with Pneumatic Lithotripter in Treating Proximal Ureteric Stones

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## Abstract

**Introduction:** In recent years, ESWL (Extracorporeal Shockwave Lithotripsy) has proved a safe and easily reproducible method for treatment of calculi in upper urinary tract particularly above iliac crest. Recently other modalities, particularly ureteroscopy with LASER lithotripsy and pneumatic lithotripsy (URS/ICPL) to treat the upper ureteric stone are very popular with less morbidities and good stones clearance. So, this study aims to compare the success rate, complications and efficiency of ESWL and URS/ICPL for the upper ureteral stones.

**Methods:** Patients were prospectively included the radio-opaque, solitary stones of 5 to 20 mm size without evident UTI (Urinary tract infection) located between the UPJ (Ureteropelvic junction) and SI joint (Sacroiliac Joint) were included. Post procedural X-ray KUB was taken immediately in URS group and three weeks after ESWL group. Immediate and week after patients were assessed for complication. Disintegrations and clearance of the stones were assessed.

**Results:** Total of 78 patients were included in this study. Of which 46 were in ESWL and 32 were in URS/ICPL groups. Both groups had stones size and location of same size and site. In URS group majority had stone disintegration and clearance with proximal dislodgement of fragment or total stone of 21.9%. Multiple sessions needed to clear the stones in ESWL group was 17.3%. DJ Stenting needed after the URS was in 75% of cases.

In ESWL group, disintegration immediately after the procedure was noted in 82.6% of cases. Auxillary services needed after the URS were ESWL, ureterolithotomy, second session URS. Majority did not have major complication in either group. In URS group 12.5% of patients had fever and UTI, treated with conventional antimicrobials. Ecchymosis at the site in ESWL were in 28 cases ( $p=0.0001$ ). Efficiency Quotient (EQ) for ESWL and URS were 31.8% and 18.2% respectively ( $p=0.18$ ).

**Conclusion:** ESWL and URS/ICPL can be offered to patient for treatment of upper ureteric stone with minimal and acceptable complications. ESWL can be done on daycare basis whereas URS/ICPL needed to be admitted in hospital.

**Keywords:** Extracorporeal Shockwave Lithotripsy, ureteroscopy, ureteric stone

## Introduction

Reports of the efficacy and success rate of Extracorporeal Shockwave Lithotripsy (ESWL) for proximal ureteral stones vary from 63.9% to 91.5%, and appear mainly to depend on the different models of lithotripters used in each clinical series and in different stone characteristics. The first-generation Dornier HM3 lithotripter, with its large focal area and small ellipsoid aperture, delivered relatively more energy to the stones and resulted in excellent stone fragmentation and clearance rates<sup>1,2</sup>.

In recent years, ESWL has proved a safe and easily reproducible method for treatment of calculi in upper urinary tract particularly above iliac crest. In 1999, AUA (American Urological Association) guidelines for the management of upper ureteric stones- ESWL are considered as the primary treatment modality<sup>3</sup>. These guidelines were based on series demonstrating success rates of 50% to 80% depending on stone size and type of the lithotripter used. To increase patient comfort and eliminate the need for regional or general anesthesia, certain modifications were made and different principles of shock wave generation (electromagnetic and piezoelectric) were applied. (In our setup we have used electrohydraulic lithotripter). With these modifications, several studies reported that ESWL with these low-cost second- and third-generation lithotripters seemed to be less effective, and the re-treatment rate was as high as 45% when compared with first-generation lithotripters<sup>4</sup>.

Nevertheless, because of its minimally invasive nature and it being an outpatient procedure, ESWL is still generally considered to be the first-line therapy for patients with ureteral stones, although the results greatly depend on the type of ESWL machine used, irrespective of the expertise of the urologist who provides the treatment. It is very useful for the local viability of the services to treat the upper ureteric stone.

In the last decade, technical advancements in fiber optic imaging and the development of semi-rigid and flexible ureteroscopy (URS) have dramatically increased the success rates and safety of performing invasive procedures in the ureter. Simultaneously, a variety of intracorporeal lithotripter devices have also been invented to enhance the efficacy of stone fragmentation. Despite these improvements, the optimal treatment of ureteral stones, especially with large proximal ureteral stones, remains controversial. Indeed, the 2007 Guidelines for the Management of Ureteral Calculi AUA/EAU (European Urological Association) recommends that patients be informed that URS (Ureterorenoscopy) is associated with

a better chance of becoming stone free with a single procedure. (5)

Since then advances have been made in ureteroscopes and holium: yttrium-aluminum-garnet (HO: YAG) laser for the upper ureteric stones management as well as for the intra renal stones surgeries (RIRS). It is also necessary to consider the financial implications that different treatment options pose. In this developing nation like Nepal where per capita income is less than 46,000 Rs per year, healthcare provider has to take in to consideration.

In this study, we are comparing the efficiency of ESWL to URS with pneumatic lithotripter in our set-up. Objective is to compare the success rates, and efficiency of ureteroscopy with intracorporeal pneumatic lithotripsy (URS/ICPL) and (ESWL) for the proximal ureteric stones.

## Methods

This is a prospective observational randomized Study with 78 patients included since October 2011 to November 2012

Treatment modality was determined by alternate randomization (time bound). Patients were categorized on the basis of the initial procedure used to treat proximal ureteric stones.

Inclusion criteria were radiopaque, solitary symptomatic stone located between the ureteropelvic junction and sacroiliac joint (above Iliac crest) of the size between 5mm to 20 mm without evident Urinary tract infection (UTI)

In URS/ICPL Group: 7.5fr semi-rigid ureteroscope with Pneumatic lithotripter (Storz, Germany) was used to treat the ureteric stones. Study was conducted in Om hospital and research center, Chabahil, and HAMS hospital, Budha Nagar, Kathmandu, Nepal.

In ESWL Group: ESWL with Direx Medical System,

Compact Tripter, Ellipsoid reflector with shockwave coupling of water cushion.

(Electrohydraulic lithotripsy) C-arm Digiscope RX2 was used. Study was carried out in Blue Cross Nursing Home, Tripureshwor, Kathmandu, Nepal.

- Pre-operative IVU and Ultrasound were done on both groups
- Stone sizes were measured on the control film of IVU, ultrasonography and non-contrast computerized tomogram (CT Scan) with maximum diameter.

- Stone disintegration and clearance were assessed doing KUB immediately after in URS /ICPL group and 3weeks later in ESWL group
  - Statistical analysis was done using SPSS 13.0 with chi-square test and Fischer exact test
  - Efficiency Quotient was calculated using
- % stone free

\_\_\_\_\_X100

100%+retreatment + % auxiliary procedures

## Results

**Table 1: Gender distribution**

Sex	ESWL	URS	Total
Female	16	17	33
	34.8%	53.1%	42.3%
Male	30	15	45
	65.2%	46.9%	57.7%
	46	32	78
			P=0.107

Site of the stones (Table-2)

	ESWL	URS	Total
Left	26	18	44
	56.50%	56.30%	56.4%
Right	20	14	34
	43.50%	43.80%	43.65
Total	46	32	78

**Table 3: Sizeof the stones**

	ESWL	URS	Total
10-20mm	42	28	70
	91.3%	87.5%	89.7%
5-10mm	4	4	8
	8.7%	12.5%	10.3%
Total	46	32	78
	100%	100%	100%
			p=0.710

Mean age: ESWL= 32.72  
URS/ICPL = 37.31

**Table 4: Age distribution**

Age(yrs)	ESWL	URS/ICPL
10-19	3 (6.5%)	1 (3.1%)
20-29	16 (34.8%)	8 (25.0%)
30-39	16 (34.8%)	11(34.4%)
40-49	8 (17.4%)	6 (18.8%)
50-59	2 (4.3%)	3 (9.4%)
60-69	1 (2.2%)	2 (6.3%)
70-79	0	1 (3.1%)
Total	46 (100%)	32 (100%)

## Outcome of the procedures

- In URS Group (n=32)
- Disintegration of stone 25 (78.1%)
- Dislodgement of stone 7 (21.9%)
- DJ Stenting 24 ( 75.0%)
- Re-treatment needed 2 ( 6.2%)
- Auxiliary services needed 5 (15.6%)

In ESWL group (n=46) Session needed to disintegrate the stone

- Single session 38 (82.6%)
- Two sessions needed 5 (10.9%)
- Three sessions needed 2 (4.3%)
- Auxiliary service needed 1 (2.2%)
- Shocks needed Minimum 2000
- Maximum 9500
- (Mean) 4690

## Complications

- URS/ICPL
  - Fever with hematuria 4 (12.5%)
  - Severe sepsis 1 (3.1%)
  - ESWL
  - Echymosis 28 (60.9%)
- p < 0.0001

Transient hematuria	36	(78.2%)
Fever/UTI	1	(2.2%)
Efficiency Quotient		
• ESWL	31.8%	(n=46)
• URS/ICPL	18.2%	(n=32)
p value	0.18	(insignificant)

## Discussion

Shock wave lithotripsy (SWL) is the least Invasive treatment for upper urinary tract calculi and is recommended as first line therapy<sup>3</sup> Stone clearance after SWL is variable and influenced by stone size, location and composition. The results of treatment for proximal ureteral calculi either in situ or after stent placement range from 57 to 96% with a high retreatment rate of 5 to 60%<sup>3,6-9</sup>. Since Chaussy *et al.* reported the application of ESWL with an HM-3 lithotripter manufactured by Dornier Co., Ltd. in clinical practice in the 1980s, various models of ESWL equipment have been developed and improved. Shock wave generators have been developed, starting with the underwater spark gap type, followed by the electromagnetic conversion type and the piezoelectric element type. ESWL is now the first-line treatment for upper urinary tract stones<sup>10</sup>. Though newer techniques has taken over the ESWL for the management of upper ureteric stone management, its' role cannot be under looked in present era. The role of shock-wave lithotripsy (SWL) in the management of ureteral calculi has been challenged following the development of more minimally invasive ureteroscopic techniques. Evidence, however, suggests that equivalent stone clearance rates are achieved using ESWL without routine retrograde manipulation and stenting, and thus patient morbidity and cost may be less with this therapy. Patient positioning may be modified to permit optimal treatment of mid- and distal ureteral stones. Predictive factors for single-treatment stone clearance, including stone size and density, obesity and stone location, may be assessed using nomograms. Clearance rates after ESWL tend to be higher for ureteral than renal calculi, and higher for proximal than distal ureteral stones. The use of medical expulsive therapy can also improve stone-fragment clearance, though this is not the part of the study. Little conclusive evidence exists to suggest long-term metabolic consequences of ESWL for ureteral calculi. ESWL remains a central option in the management of ureteral calculi<sup>11</sup>.

In this study, male to female were 57.7% to 42.3% respectively on both groups of ESWL & URS/ICPL (p-0.107).(Table-1) Regarding the site, left sided stones were more than right side on ESWL group as well as in URS

group bearing 56.50% and 56.30% respectively.(Table-2) Size of the stone (10-20mm) were on ESWL (n-42) and URS/ICPL(n-28) whereas in 5-10mm size ESWL(n-4) and URS/ICPL(n-4) p-0.710. (Table-3)

In this study, ESWL group (n-46) single session needed to disintegrate the stone (82.6%)n=38, two sessions and three sessions needed for 10.9%(n-5) and 4.3%(n-2) respectively. Auxiliary service in the form of URS done in one patient.

In URS/ICPL group (n=32), disintegration and clearance of stones was found to have 78.1%(n=25) with dislodgement of stone were 21%(n=7). Retreatment needed in two cases (6.2%)with auxiliary services needed in 5(15.6%) cases. Double J stenting were placed in 75.0% cases particularly with larger stone burden in order to prevent the "steinstrasse" and ureteric colic.

Complications were noted in 5 cases on URS/ICPL group whereas ecchymosis at the site of shockwave was found on ESWL group (60.9%, n=28,p-0.0001). Transient hematuria experienced in 36patients(70.2%). Both the SWL and URS groups in this study had low overall complication rates, consistent with other reports<sup>3,12</sup>.

The two groups were similar in complication rates except for greater "steinstrasse" in the ESWL group. We believe that both treatment modalities can be performed without major complications in most proximal ureteral stones.

Efficiency Quotient between ESWL and URS/ICPL group was insignificant (p-0.18). Our results for patient satisfaction in the subgroups with  $\geq 10$  mm proximal ureteral stones indicate that despite preoperative explanation of possible upward migration of stone fragments during URS/ICPL with large stones, expectation of stone-free status may be greater in patients undergoing URS/ICPL surgery than in those undergoing ESWL. In addition, unless the possible necessity of ancillary procedures after URS for large proximal ureteral stones is explained, patient satisfaction may be much lower despite rapid symptomatic relief, compared with that of patients undergoing ESWL. In this context, surgeons should be aware of high patient expectations for treatment success and reluctant patient attitudes toward ancillary treatment after surgery<sup>13</sup>.

Role of ESWL in our setup is considered as least invasive; having acceptable success rate but it is limited by stone size & composition. For small unobstructed upper ureteric stone free rate (SFR)is 85%-96%.

Role of URS/ICPL: there are newer innovations with flexible ureteroscope and new lasers (holmium lasers).Immediate decompression of obstruction could be achieved with the ureteroscopic procedure with higher stone disintegration

and clearance. Its' use has been limited by accessibility & failure to reach stone and different access sheath related complications.

Role of PCNL vs URS vs ESWL is there for the upper ureteric obstructive stones. We have to consider for the invasiveness vs complications vs success. Cost is the important factor in our part of the world and it is still controversial.

## Conclusion

ESWL and URS/ICPL can be offered to patient for treatment of upper ureteric stone with minimal and acceptable complications. ESWL can be done on daycare basis whereas URS/ICPL needed to be admitted in hospital, if procedure done under spinal anaesthesia. ESWL has good result for stone less than one cm and confounding factors are machine dependent ESWL, stone composition, upper ureteric location with impacted stone and associated hydronephrosis.

**Conflict of interest:** None declared

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