

## Role of Extra Corporeal Shock Wave Lithotripsy (ESWL) in Management of Upper Ureteric Stone

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### Abstract

**Introduction:** Genitourinary stone disease is an important health problem due to an estimated prevalence in the general population of 2-3% and a lifetime recurrence rate of about 50%. There are multiple factors influencing the choice of the treatment, such as stone characteristics (expected stone composition, location and size), symptoms (urinary tract infections, pain, and hematuria), patient factors (age, co-morbidities), particular contraindications or anatomic characteristics and availability of technical expertise. ESWL is an attractive option for management of renal and upper ureteric stone of less than 2 cm. It is noninvasive in nature and associated with low complication rates. **Methods:** From September 2017 to December 2019, in the present study, in a series of 100 patients of upper ureteric stone who were managed by ESWL. All data were collected from medical records, which contained the clinical, laboratory evaluation and diagnostic imaging. Patients were underwent plain X-ray KUB at 2 weeks after each ESWL session to check for stone fragmentation. Clinically insignificant stones with size of stones less than 5 millimeter not causing symptoms and not associated with infection after ESWL were considered as success of treatment. Patients were followed at 2 weeks, 1 month, 2 month and 3 months. Patient had undergone X ray KUB and USG KUB during follow up. **Results:** The average age of patients in our study ranged from 2 - 70 years. stone size ranged from 5 to 20 mm; of which 36 (36 %) patients were of  $\leq 10$  mm stone size, 64 (64 %) patients were of 11-20 mm stone size. patients presented with multiple symptoms with most common presentation being flank pain in 83 patients. 20 (20%) patients had stone attenuation value less than 1000 HU, 50 (50%) had a stone attenuation value of 1000 HU – 1200 HU and 30 (30%) patient had stone attenuation between 1200 – 1500 HU minor complications like UTI (9), post procedural pain (51 %) mild Hematuria (26%) steinstrasse (5%) were seen which were managed accordingly. Out of 5 patients with steinstrasse following ESWL 3 patients managed by retrograde ureteroscopy and 2 patients were managed conservatively. In the present study, of 100 patients who were treated by ESWL, 92 (92%) patients were completely cleared of stone and were regarded as success of procedure at 3 months follow up whereas 8 (8 %) patients required auxiliary procedure URS and were regarded as failure of ESWL. **Conclusions:** Upper ureteric stone patients can be easily managed with eswl procedure in appropriately selected patients. ESWL is a non-invasive, cost effective, OPD procedure which can be safely performed without anesthesia even in the cases of upper ureteric stone having risk for invasive treatment with several advantages over other treatment modalities like RIRS and PCNL. Overall ESWL is associated with less significant complications, faster convalescence and greater patient acceptance.

**Keywords:** Upper Ureteric Stone, ESWL (Extra Corporeal Shock Wave Lithotripsy), Genitourinary Urothithiasis.

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### Introduction

Genitourinary stone disease is an important health problem due to an estimated prevalence in the general population of 2-3% and a lifetime recurrence rate of about 50% [1,3,7]. Management of urinary stone forms the bulk of the urological practice in India. Improved diagnostic modality like USG, CT scan lead to increase in to detection of symptomatic as well asymptomatic urinary stone nowadays. There are multiple factors influencing the choice of the treatment, such as stone characteristics (expected stone composition, location and size) [2-8], symptoms (urinary tract infections, pain, and hematuria), patient factors (age, co-morbidities), particular contraindications or anatomic characteristics and availability of technical expertise. Management of the renal stone has undergone dramatic change from the era of open surgery to extracorporeal shock-wave lithotripsy (ESWL) as well as minimally invasive procedures like ureterorenoscopic or percutaneous interventions. ESWL is an attractive option for management of renal and upper ureteric stone of less than 2 cm. [5,12-15]. ESWL is noninvasive in nature and associated with low complication rates. Extracorporeal Shock wave Lithotripsy (ESWL) was first introduced by Chaussy and his co-

workers in 1980. The outcome is influenced by potential predictor factors with reference to the characteristics of the stone, renal anatomy, patient habitus, etc. The success rate of this treatment modality is in the range of 60- 90% in various series [4,11] This study was aimed to evaluate the role of extracorporeal shockwave lithotripsy (ESWL) in management of upper ureteric stone

### Materials and methods

This prospective study included one hundred patients having upper ureteric stone sized 6 to 2 cm between September 2017 to December 2019 at B J Medical College, Ahmedabad. In this study patients were having urosepsis, uncontrolled coagulopathy, pregnancy, stone size > 2 cm, or stone secondary to any anatomical obstruction were excluded. All patients were evaluated in form of complete haemogram, RBS, PT/INR, BUN, and S. Creatinine [9-12]

Urine routine/ & microscopy and urine culture & sensitivity. In addition to this X-ray KUB, USG KUB, CT scan were used for imaging studies. The study protocol was explained to the patients with a full discussion of success, possible complications, need for auxiliary procedure. Written and informed consent was taken from all patients before each sitting of ESWL. ESWL to all patients was given by same person and same machine. The procedure was performed without any type of anesthesia or sedation. Each sitting provided 2500 - 3000 shocks to patient, initially at 10 kV, which was gradually increased to 24 kV within 500 initial shocks. Regular monitoring of target point was done with fluoroscopy, during the procedure. On completion of the procedure, every patient was given a

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course of antibiotics for 7-10 days. Patients were given treatment with tablet aqazide 10 mg once a day, Tablet Alfuzosin 10 mg bedtime and urinary alkalinizer syrup three times a day post ESWL for 21 days except in patient with altered renal function. Patients were undergoing plain X-ray KUB at 2 weeks after each ESWL session to check for stone fragmentation, if stone was not fragmented or residual fragment size > 5 mm size another ESWL session were given. After 3 months, end point evaluation in form of x-Ray and usg KUB were done for success rate. If no breakage of the stone had occurred after 3 sessions and stone size more than 5 mm then case was considered an ESWL failure, and the patient underwent Ureterorenoscopy (URS), retrograde intrarenal surgery (RIRS) or observation. Clinically insignificant stones with size of stones less than 5 millimeter not causing symptoms and not associated with infection after ESWL were considered as success of treatment[13-16].

**Follow-up:** Patients were followed at 2 weeks, 1 month, 2 month and 3 months. Patient had undergone X ray KUB and USG KUB during followup.

### Results

In this study, 100 patients with upper ureteric stone were included. The following observations were made.

1. **Age and Sex:** The age of patients in our study ranged from 2 - 70 years. Of the 100 patients, 5 (5 %) patients were less than 20 years and 49 (49%) patients were in the age group 21-40 years, 38 (38%) patients were of age group 41-60 years. Most of the patients were in the 21-40 age group. Mean age in our study is 39.58 years. In this study 73 patients were male and 27 patients were females.

2. **Stone Size:** In our study, stone size ranged from 5 to 20 mm; of which 36 (36 %) patients were of ≤10 mm stone size, 64 (64 %) patients were of 11-20 mm stone size.

3. **Clinical Presentations:** Of the 100 patients included in the study, patients presented with multiple symptoms with most common presentation being flank pain in 83 patients, followed by Nausea in 44 patients, burning micturition in 30 patients and hematuria in 11 patients. 14 patients were incidentally diagnosed with stone. Out of 100 patients who underwent ESWL, 86 patients had normal serum creatinine and 14 patients had altered serum creatinine

4. **Stone Attenuation Value (Hounsfield Units) with Stone Laterality:** Patients were grouped according to stone attenuation value as group 1-less than 1000 HU, group 2-1000 HU – 1200 and group 1200 – 1500 HU, 20 (20%) patients had stone attenuation value less than 1000 HU, 50 (50%) had a stone attenuation value of 1000 HU – 1200 HU and 30 (30%) patient had stone attenuation between 1200 – 1500 HU. Table shows the distribution of the patients according to stone attenuation value included in the study. In the present study 47 (47%) patients had right sided stones whereas 53 (53%) patients had left sided stones.

5. **Post-operative Complications:** Of the 100 patients who were managed by ESWL, patients had some minor complications not requiring hospital stay; No major complications occurred to any patient in our study of the 100 patients who were managed by ESWL; minor complications like UTI (9), post procedural pain (51) mild Hematuria (26) steinstrasse (5) were seen which were managed accordingly. Out of 5 patients with steinstrasse following ESWL 3 patients managed by retrograde ureteroscopy and 2 patients were managed conservatively patients.

6. **Clearance rate:** In this study at 3 months of follow up, of the 100 patients undergoing ESWL, 92 (92%) had successful complete clearance and the patients with stone attenuation value less than 1000 Hounsfield units had clearance rate of 95.23% and patients with stone attenuation value between 1001-1200 Hounsfield units had clearance rate of 82.46 %. Patients with stone attenuation value between 1200-1500 Hounsfield units had clearance rate of 96.29 %. In present study the patients with stone size 0.5 – 1 cm had clearance rate of 98.46 % and patients with stone size 1- 2 cm had clearance rate of 83.80 %. In present study, of 100 patients who were treated by ESWL, 66(66%) patients had complete clearance in single session of eswl while 15(15%) patients required 2 sessions and 3(3%) patients were cleared in 3 sessions of eswl. 8(8.34%) patients had unsuccessful clearance and were managed by other auxiliary procedures (URS).

7. **Success of ESWL:** In the present study, of 100 patients who were treated by ESWL, 92 (92%) patients were completely cleared of stone and were regarded as success of procedure at 3 month follow up whereas 8 (8 %) patients required auxiliary procedure URS and were regarded as failure of ESWL.

**Table 1: Distribution of patients according to stone attenuation value**

Stone attenuation value	Patients	Percentage
Less than 1000 HU	21	21 %
1000 HU – 1200 HU	52	52%
1200HU - 1500HU	27	27%

**Table 2: Complications of ESWL.**

Complication	No of patients
UTI	9
Hematuria	26
Post procedural pain	51
Steinstrasse	5

**Table 3: Stone Clearance According Stone Size**

Stone size	Patients with complete clearance	Clearance
0.5- 1 cm(36)	35	97.22 %
1- 2 cm(64)	57	89.0

### Discussion

The efficacy and outcome of ESWL is measured in terms of fragmentation and clearance of the calculus fragments. Fragmentation of a calculus largely depends on its size and composition, and the ability to predict stone composition would help to increase the efficiency of ESWL. The success rate of ESWL depends on stone size, location, and density (Hounsfield unit) of the stones.

**Age and Sex:** Of the 100 patients 5(5%) patients were less than 20 years and 49 (49%) patients were in the age group 21-40 years, 38 (38%) patients were of age group 41-60 years. Most of the patients were in the 21-40 age group. Mean age of the patients in present study was 39.58 years which is comparable to the Gupta et al. Study.

In the present study 73 (73%) patients were male and 27 (27%) patients were female, which is comparable to the previous studies.

**Stone Size, Side and Location:** In present study patients with urinary stone size ranging from 5 mm to 20 mm which were 62(62%) patients had stone located in the upper ureter close to pelviureteric junction i.e., within 5 cm of the PUJ while 38(54%) patients had stone more than 5 cm from the pelviureteric junction. In the present study 47(47%) patients had right sided stones and 53(53%) patients had left sided stones. Which is comparable to Gupta et al and Ouzaid et al study.

**Stone Attenuation Value (Hounsfield Units):** In present study the patients with stone attenuation value less than 1000 Hounsfield units

had clearance rate of 95.23% and patients with stone attenuation value between 1001-1200 Hounsfield units had clearance rate of 82.46 %. Patients with stone attenuation value between 1200-1500 Hounsfield units had clearance rate of 96.29%. The results of this study supports the previous studies in that stone density has an inverse relation with the ESWL success rate, and CT stone density has a positive correlation with the number of shockwaves needed for fragmentation and number of sessions required for stone clearance. Also, the result of this study concurs with the results of previous studies.

**Stone Clearance According Stone Size:** In present study the patients with stone size 0.5 – 1 cm had clearance rate of 97.22 % and patients with stone size 1- 2 cm had clearance rate of 89 %. Tarawneh et al study concluded that success rate was 92 % with 0-10 mm stones whereas patients with stone size 11- 20 mm had clearance rate of 74 %. Results of Tarawneh et al study is comparable with our study. Lingeman et al performed a meta-analysis of 13 studies published on the management of renal calyceal stone with ESWL. They reported a stone-free rate of 59% in a meta- analysis of 2927 patients. When classified according to stone size, the stone free rates for stones smaller than 10 mm and 11 to 20 mm were reported to be 74% and 56% respectively. In our study, size of the stone was one of the most important factors determining success of ESWL. The mean number of sessions required for successful fragmentation of the stones increased with increase in size

**Auxiliary Procedure:** In the present study 8 (8%) patients needed auxiliary procedure. All patients underwent ureteroscopy. In Ouzaid et al. study 8% patients needed auxiliary procedure with one patient underwent RIRS and three patients underwent rigid ureteroscopy, which is comparable to the present study. In Amr M. Massoud et al

study 0.98 % patients needed auxiliary procedure with three patients underwent rigid ureteroscopy.

**Complications:** In the present study 13% patients had complication of which 9(9%) patients had urinary tract infection and 5 (5%) patients had steinstrasse of this one patient had both UTI and steinstrasse. In Amr M. Massoud et al study 5.2 % patients had complication in the form of fever and steinstrasse. The results of the present study is comparable to the Amr M. Massoud et al study.

**Comparison of Complication of Various Management with Respect to ESWL:** Overall, of the 100 patients included in the study 13(13%) had some minor complications which were managed accordingly. No major complications occurred to any patient. When compared to other studies complication with RIRS were higher which included major complications like ureteric stricture(2%), sepsis (3%) and ureteric injury(2%) and When compared to other studies complication with PCNL were higher which included major complications like blood loss(need for blood transfusion)(3%), sepsis (3%) and ureteric injury(2%) and When compared to other studies complication with ureterolithotomy were higher which included major complications like urinary leak(1%), and ureteric stricture(0.5%) [17-19].

#### Conclusion

ESWL is very good option for the management of upper ureteric stone when an appropriate consideration given to stone size, stone attenuation value and stone density. ESWL is a non- invasive, cost effective, OPD procedure which can be safely performed without anesthesia even in the cases of upper ureteric stone having risk for invasive treatment with several advantages over other treatment modalities like RIRS and PCNL. Overall ESWL is associated with less significant complications, faster convalescence and greater patient acceptance

**Table 4: Stone Size Distribution**

Study	Stone size
Tarawneh et al.	5-30 mm
Ouzaid et al.	5-22 mm
Gupta et al.	5- 20 mm
Perks et al.	5- 20 mm
Joseph et al.	Upto 20 mm
Amr M. Massoud et al	Upto 30 mm
Sultan M. et al	5- 20 mm
Kartik Shah et al	5- 20 mm
Present study	5-20 mm

**Table 5: Clearance according to Stone attenuation value**

Study	Clearance according to Stone attenuation value			Overall
Tarawneh et al.	Less than 500	501-1000 HU	> 1000 HU	
	94%	76%	42%	71%
Ouzaid et al.	Less than 970	more than 970		
	96%	38%		76%
Gupta et al.	Less than 750	more than 750		
	88%	60%		76%
Perks et al.	Less than 900	more than 900		
	91%	41%		66%
Joseph et al.	Less than 500	501-1000HU	> 1000HU	
	100%	85.7%	54.5%	80.06%
Amr M. Massoud et al	Less than 500	501-1000HU	> 1000HU	
	100%	95.7%	44.6%	83 %
Sultan M. et al	Less than 500	501-1000HU	> 1000HU	
	100%	95.7%	0%	65.23%
Kartik Shah et al	Less than 1200	More than 1200		
	88.1%	82.5%		85.3%
Present study	Less than 1000	1001-1200HU	1200 -1500HU	
	95.23%	82.46%	96..29%	92%

**Table 6: Auxiliary procedure**

Study	Auxiliary procedure(Percentage)	Procedure (No of patients)	
Ouzaid et al.	8%	RIRS - 1	URS - 3
Amr M. Massoud et al	0.98%	URS - 3	
Present study	8 %	URS-8	

**Table 7: Complication**

Study	Complication
Yuruk et al.	6.5 %
Resorlu B. et al.	7.6 %
Amr M. Massoud et al	Total – 5.2%(Fever- 1.6%, Steinstrasse -3.6%)
Present study	Total – 13 % (Urinary tract infection - 9 %, Steinstrasse - 5 %)

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