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Role of ESWL in the management of renal and upper ureteric stone more than 15mm in the current era of RIRS and Mini-PCNL: A retrospective study

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I. INTRODUCTION

The primary goal while treating renal stones is to achieve maximum clearance of stone, while causing minimal morbidity to the patient. Various minimally invasive modalities are described for this, like shockwave lithotripsy (SWL), percutaneous nephrolithotomy (PCNL), and retrograde intrarenal surgery (RIRS)[1-2].Extracorporeal shock wave lithotripsy (ESWL) became the most common treatment modality with its safe and successful results in renal as well as ureteral stones. However, failure of ESWL may cause unnecessary exposure of the treated kidney and neighbouring organs to high energy shock waves which may result in tissue damage. Identification and the use of these predictive factors in clinical setting will both increase the efficacy and decrease the cost by reducing the number of unnecessary treatment sessions as well as hospital visits[3-4]. The preferred approach for stones <1 cm is ESWL, whereas for stones >2 cm, it is PCNL, but the management of stones of 1-2 cm is still controversial [5].

In this study we aimed to find out the efficacy of ESWL in the management of stone size greater than 15mm with favourable anatomy.

II. PATIENTS AND METHODS

The study was done in the Department of Urology,Civil hospital, Ahmedabad from January2021 to April 2023. The study design comprised of 80 cases of different demographic profile.

Inclusion criteria:

1. Stone in upper ureter, renal pelvis, upper and middle calyx
2. Stone size 10 to 20 mm.

Exclusion Criteria:

1. Patients with urosepsis
2. Uncontrolled coagulopathy
3. Pregnancy
4. Stone size more than 2 cm
5. Stone secondary to anatomical obstruction and lower calyceal stone

Pre procedural evaluation was done using baseline blood investigation, routine urine examination, X-KUB, CT-IVP.

Post procedural evaluation was done using X-KUB,USG KUB for any complication.

ESWL technique:

All ESWL treatment was performed as an outpatient procedure using Dornier Sigma only.

ESWL to all patients was done by same technician. Maximum of three sittings of ESWL were given, each of approximately 3000 - 3500 shocks at the rate of 60-70 shocks per minute, at an interval of 2 to 4 weeks, depending upon the fragmentation seen at the end of ESWL session on fluoroscopy. A maximum of 4,500 shocks were delivered for each session or until complete fragmentation of the stone had occurred.The procedure was performed without any type of anaesthesia 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. All patients were stented before ESWL session.

On completion of the procedure, every patient was given a course of antibiotics for 7-10days.

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Patients were given treatment with tablet Hydrochlorthiazide10 mg once a day, and tablet Alfuzosin10 mg bedtime and urinary alkalizer syrup three times a day post ESWL for 21 days except in patient with altered renal function.

Patients underwent plain X-ray KUB 2 weeks after each ESWL session to reassess the calculi if any, for their number, size and location and to determine if there is no stone fragmentation or if there are significant residual fragments (≥ 5mm) which warrants another ESWL session. The endpoint evaluation at 3 months was done with x-ray KUB and ultrasonography KUB to categorize the patients into success or failure group. DJ stent was removed after 3 months of first ESWL session whether patient had success or failure.

III. RESULTS

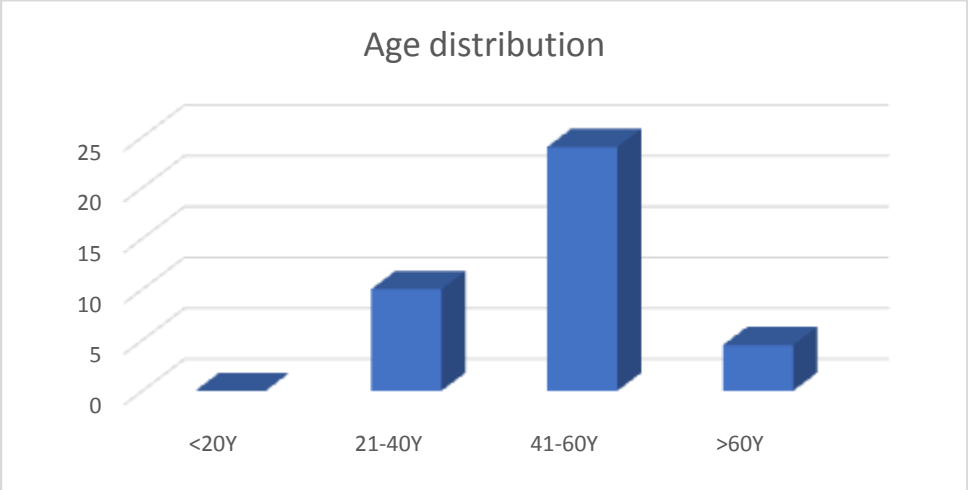
In the present study, 80 patients with upper tract stone were included. The following observations were made.

1. Age and sex

The age of patients in our study ranged from 20- 70 years. Of the 80 patients, nopatients were less than 20 years and 20 patients were in the age group 21-40 years, 48patients were of age group 41-60 years, 12 patients were more than 60 years. Table 1 shows the age wise distribution of thepatients included in the study. Most of the patients were in the 41-60 age group. Mean age inour study is 49 years.

Table 1: Age distribution

Age groups	No. of patients	Percentage
< 20 years	0	
21 – 40 years	20	25%
41-60 years	48	60%
> 60 years	12	15%



In this study 64 patients were male and 16 patients were females. Table 2 shows the sex wise distribution of the patients included in the study.

Table 2: Sex distribution

Sex	Patients	Percentage
Male	64	80%
Female	16	20%

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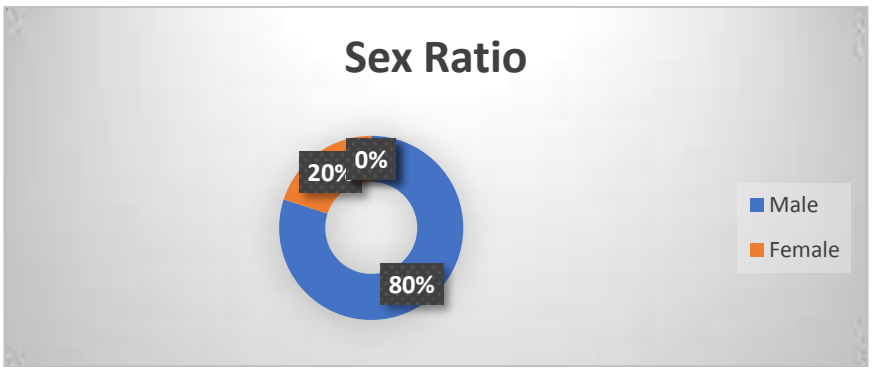
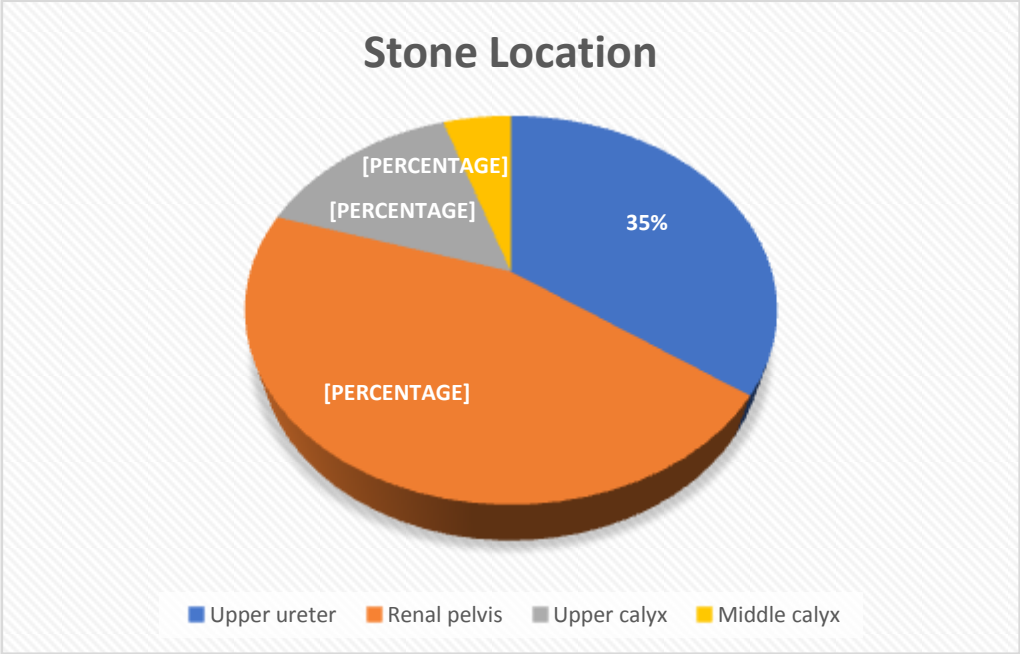


2. Stone location:

Of the 80 patients included in the study, 28(35%) patients had stone in theupperureter, 36(45%) patients had stone in renal pelvis, 12(15%) had stone in upper calyx and 4(5%) had stone in middle calyx

Table 3: Distribution of patients according to stone location

Stone location	Patients	Percentage
Upper ureter	28	35%
Renal pelvis	36	45%
Upper calyx	12	15%
Middle calyx	4	05%



3.Stone laterality:

In the present study 36 (45%) patients had right sided stones whereas 44 (55%) patients had left sided stones.

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Table 4:Shows the distribution of the patients according to stone laterality included in the study.

Stone laterality	Patients	Percentage
Right	**36**	**45%**
Left	**44**	**55%**

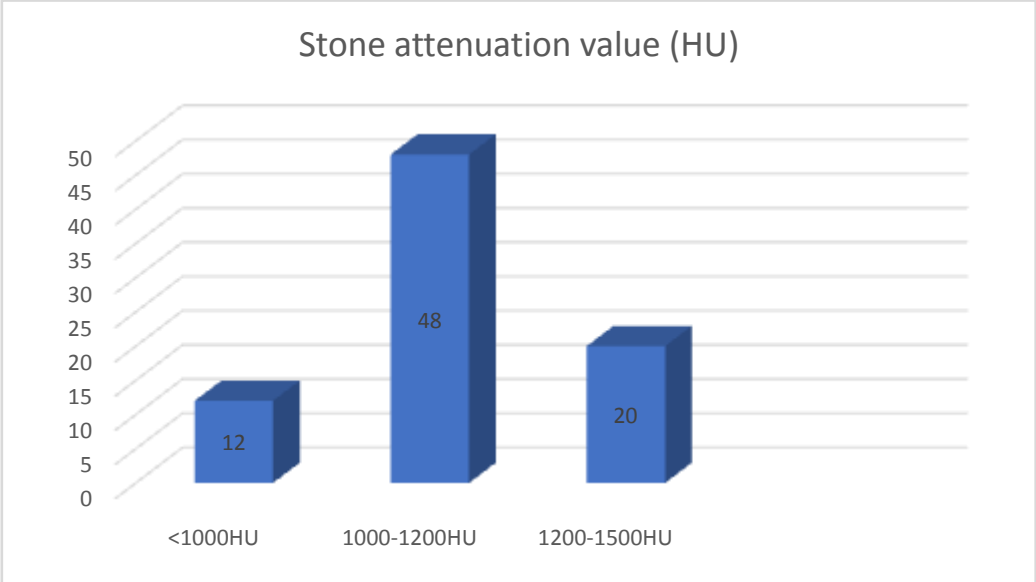
4.Stone attenuation value (Hounsfield units)

Patients were grouped according to stone attenuation value as group 1: less than 1000HU, group 2: 1000 to 1200 HU and group 3: 1200 to 1500 HU, 12 (15%) patients had stoneattenuation value less than 1000 HU, 48 (60%) had a stone attenuation value of 1000HU – 1200 HU and 20 (25%) patient had stone attenuation between 1200 – 1500 HU.

Table 5 shows the distribution of the patients according to stone attenuation valueincluded in the study.

Table 5: Distribution of patients according to stone attenuation value

Stone attenuation value	Patients	Percentage
Less than 1000 HU	**12**	**15%**
1000 HU – 1200 HU	**48**	**60%**
1200HU - 1500HU	**20**	**25%**



5.Post- ESWL Complications:

Of the 80 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 the80 patients who were managed by ESWL; minor complications like UTI (7), postprocedural pain (31) mild haematuria (6) steinstrasse (5) and perinephric hematoma (1) were seen which were managedaccordingly.

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Out of 5 patients with steinstrasse following ESWL 3 patients managed by retrogradeureteroscopy and 2 patients were managed conservatively. Patient with perinephric hematoma was managed conservatively.

Table 6: Complications of ESWL.

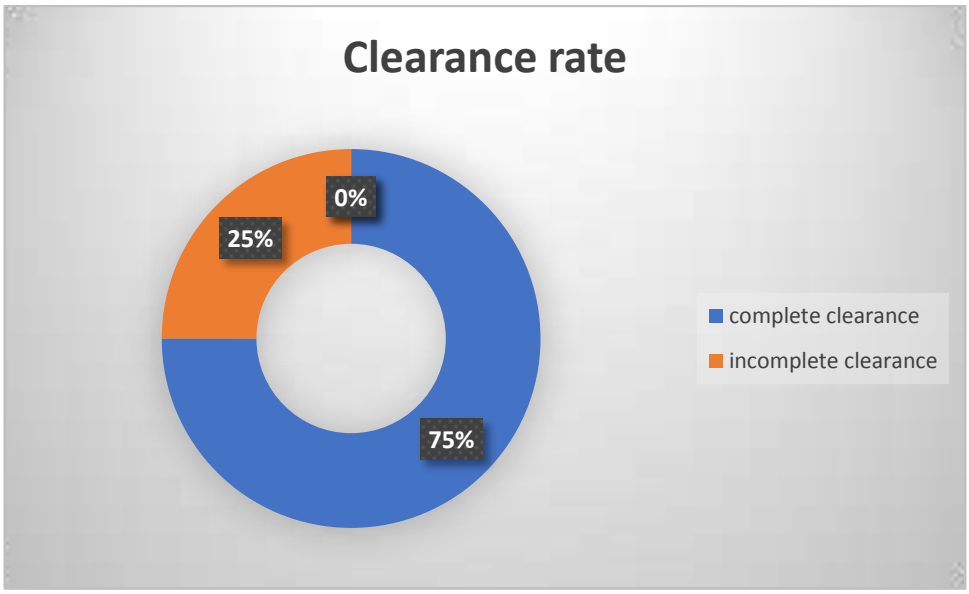
Complication ESWL	Patients
UTI	**7(17.5%)**
Haematuria	**6(15%)**
Post procedural pain	**31(77.5%)**
Steinstrasse	**4(10%)**
Perinephric hematoma	**1 (1.25%)**

6.Clearance rate

In present study at 3 months of follow up, of the 80 patients undergoing ESWL, 60 (75%) had successful complete clearance.

Table 7: Clearance rate of ESWL.

Clearance Rate	Patients	Percentage
Complete clearance	60	75%
Incomplete clearance	20	25%



7.Stone clearance according to stone attenuation value (Hounsfield units):

In the present study, the patients with stone attenuation value less than 1000 Hounsfield units hadclearance rate of 83.33% and patients with stone attenuation value between 1001-1200Hounsfield units had clearance rate of 79.16 %. Patients with stone attenuationvalue between1200-1500 Hounsfield units had clearance rate of 75 %.

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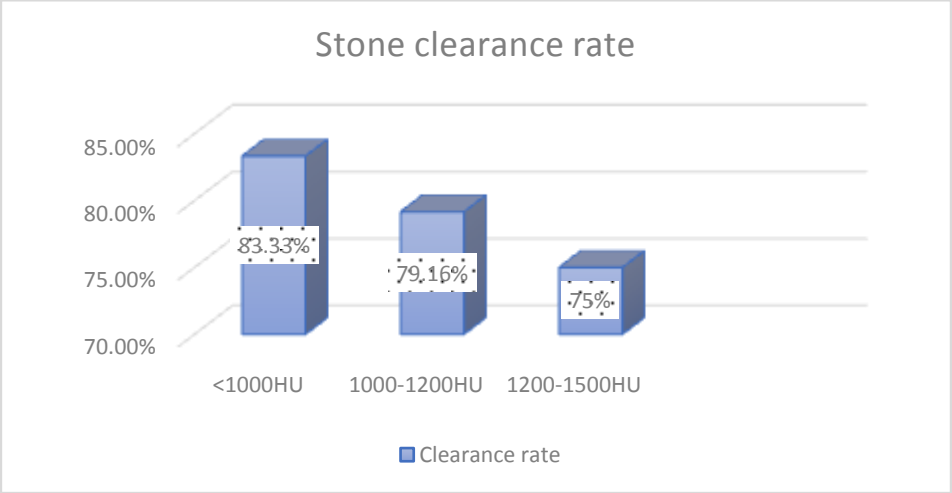
Table 8: Clearance rate of ESWL according to stone attenuation value

Stone attenuation value	Patients	Clearance Rate
Less than 1000 HU	24	83.33%
1000 HU – 1200 HU	48	79.16%
1200HU - 1500HU	8	75%



8.Auxiliary procedure:

In the present study, of the 80 patients who were treated by ESWL, total 20(25%) patientsrequired auxiliary procedure in the form of URS(14), and Mini PCNL(6). Table 9 shows thedistribution of thepatients who required auxiliary procedure.

Table 9: Distribution of patients managed by auxiliary procedures

Procedures	Patients	Percentage
URS	14	17.5%
Mini PCNL	6	7.5%
Total	20	25%

IV. DISCUSSION

ESWL became the treatment of choice in the majority of urinary stones with safe and effective results both in adults and children[6].ESWL has revolutionised the management of urolithiasis, with further decreases in morbidity andmortality rates . The overall success rate of ESWL for treating upper urinary tract stones is 60–95%.[7]

The age distribution of present study is 20(25%) patients were in the age group 21-40 years, 48(60%) patients were of age group 41-60 years, 12(15%) patients were more than 60 years of age. Mean age of the patients in present study was 49 years which is comparable to the **Gupta et al.**[8]study.In the present study male and female distribution of cases are 80% and 20% respectively which is comparable with Previously reported **Tarawneh etal.**[9]**Amr M. Massoud et al**[10]**, Ouzaid et al.**[11]studies.

Of the 80 patients included in the study, 36(45%) patients had stone in the renal

pelvis,28(35%) patients had stone in upper ureter, 12(15%) had stone in upper calyx and 4(5%) had stone in middle calyx. Previous studies are comparable with the present study as shown in following chart.

Study	UC/MC/PELVIC	LC	Upper ureteric
Tarawneh et. al[9]	42 (64.61%)	17 (26.15%)	6 (9.2%)
Gupta et. al[8]	67(62.03%)	22(20.37%)	19 (17.59)
Massoud et. al [10]	193(63.27%)	73(23.9%)	39(12.8%)
Present study	52(65%)	-	28(35%)

In the present study 36 (45%) patients had right sided stones and 44(55%) patients had leftsided stones. Which is comparable to **Gupta et al** and **Ouzaid et al[11]**study.

Study	Right	left
Ouzaid et al.[11]	27(54%)	23(46%)
Gupta et al.[8]	57(52.77%)	51(47.22%)
Present study	36(45%)	44(55%)

In the present study the patients with stone attenuation value less than 1000 Hounsfield units hadclearance rate of 83.33% and patients with stone attenuation value between 1001-1200Hounsfield units had clearance rate of 79.16 %. patients with stone attenuation value between1200-1500 Hounsfield units had clearance rate of 75 %.**Tarawneh et al.[9]**evaluated 65 patients undergoing SWL treatment.Low-density group: patients with stone densities of less than 500 HU, medium-densitygroup: patients with stone densities of 500–1000, and high-density group: patients with stonedensities of more than 1000. SWL treatment outcomes, according to stone density levels,showed a high success rate in the low-density group (94%) and patients with stone densitiesmore than 1000 HU have a 42 % clearance rate. **Ouzaid et al.[11]**prospectively evaluated 50patients with urinary calculi of 5–22 mm undergoing extracorporeal SWL.The stone-freerate for stones of < 970 HU was 96% vs 38% for stones of ≥ 970 HU. A linear relationshipbetween the calculus density and the success rate of ESWL was identified.**Perks et al[12]** study included 111 patients with renal stone 5- 20 mm in size who underwentESWL. Patients with calculi of < 900 HU and 91% had complete clearance. Patients withcalculi of > 900 HU and clearance rate was only 41%.**Kartik Shah et al[13]** study included 99 patients with solitary renal and upper ureteric stone.Clearance rate in-group A (stones of attenuation value < 1200 HU) was 88.1%, whereas ingroup B (stones of attenuation value > 1200 HU) it was 82.5%.

The results of this study supportthe previous studies in that stone density has an inverse relationship with the ESWL success rate.In the present study 20(25%) patients needed auxiliary procedure. Out of 10 patients 14 patients underwent ureteroscopy and 6 patients underwent PCNL.**In Ouzaid et al.[11]**study 8% patients needed auxiliary procedure with one patient underwentRIRS and three patients underwent rigid ureteroscopy, which is comparable to the presentstudy.In Amr M. Massoud et al[10] study 0.98 % patients needed auxiliary procedure with threepatients underwent rigid ureteroscopy.

Comparing stone clearance with other modalities:

In the present study; of the 80patients who were treated by ESWL,60 (75 %) patients had successful clearance at 3months; studies showed that clearance rate with PCNL and Lap ureterolithotomy werehigher than ESWL, and were lower in URS/RIRS.

Table: Comparing stone clearance with other modalities

STUDY	ESWL	URS/RIRS	PCNL	LAP URL
Grasso et al [14]	62%	97%	-	-
Goel et al [15]	-	-	98.5 %	
Wu et al 61% 92%[16]	61%	92%	-	--
Present study	75%	-	-	-

In the present study, most common complication faced by the patients was post procedural pain77.5%, 17.5% patients had urinary tract Infection, 15% had haematuria and 10%patients had steinstrasse, of thesetwo patients had both UTI and steinstrasse and 1 patient had perinephric hematoma.In **Amr M. Massoud et al[10]** study 5.2 % patients had complication in the form of fever andsteinstrasse.The results of the present study is comparable to the **Amr M. Massoud et al[10].**

V. CONCLUSION

ESWL has several advantages over other endourologic modalities in terms of less invasiveness, no use of anaesthesia, out-patient procedure. Stone size and stone attenuation value(HU) are the most important predictors for success of ESWL. There is inverse relationship between Hounsfield unit and stone clearance rate.Because of non-invasive nature and very minimal post procedural complications, patient acceptance level is high. ESWL should be advised to patients with less than 20 mm upper tract stone with low CT attenuation value with favourable anatomy.

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