

## Extracorporeal shock wave lithotripsy in the management of upper urinary tract stone: a single institute experience

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### ABSTRACT

**Introduction:** The aim of the study was to observe the success rate of extracorporeal shock wave lithotripsy (ESWL) in the management of upper urinary tract stones.

**Materials and Methods:** This retrospective study was conducted in Pokhara Kidney stone Centre, Pokhara, Kaski, Nepal from January 2017 to January 2018. Seventy nine patients were selected in this study with upper urinary tract stone, size less than 20mm.

**Results:** Seventy four (93.67%) patients were successfully treated in initial use of shock wave and 5 (6.32%) patients required repetition.

**Conclusion:** Overall satisfactory success rate was observed using ESWL for the upper urinary tract stone. Careful selection of patient, stone size and Hounsfield unit (HU) is advisable.

**Keywords:** ESWL, upper urinary tract stone, Stone size, Hounsfield Unit

### INTRODUCTION

With the modern advancement in the field of urology, the treatment of renal stone has changed dramatically over the span of a short period of time. Minimal invasive procedures have replaced the open surgeries for renal stones. Since the introduction of Extracorporeal Shock Wave Lithotripsy (ESWL) in 1980s in Germany, the HM1 (Human Model 1, Dornier, Germany; now Dornier MedTech America, Inc., Kennesaw, GA, USA), it has become urologist's armamentarium for the treatment for renal stone all over the world because of its noninvasive nature, low costs, high efficiency of stone disintegration, less/no exposure to anesthesia and fewer complications. Lithotriptors produce a powerful acoustic field that results in two mechanical forces on stones and tissue: (1) direct stress associated with the high amplitude shock wave and (2) stresses and microjets associated with the growth and violent collapse of cavitation bubbles.<sup>1</sup> ESWL is a well established management for nephrolithiasis and it is suggested as first line treatment together with retrograde intrarenal surgery (RIRS) for stones smaller than 20 mm in the upper & middle calyx, renal pelvis or proximal ureter according to European Association

of Urology (EAU) guidelines.<sup>2,3</sup> As the incidence of renal stones is on the rise, the demand of ESWL is also increasing. The Stone Free Rate (SFR) of ESWL depends upon various factors such as efficacy of the lithotripter, size of the stone, location of the stone, and composition/hardness of the stones.<sup>4,5,6</sup> Recent Report from high volume centers with static machines have suggested encouraging SFR.

### MATERIALS AND METHODS

This retrospective study was conducted in Pokhara Kidney stone Centre, Pokhara, Kaski, Nepal from January 2017 to January 2018. Seventy nine patients were selected in this study with upper urinary tract stone, size less than 20mm. All patient clinical history, laboratory investigation and imaging were study thoroughly. The procedure was done on outpatient service basis. Patients were selected according to size of stone and Hounsfield unit (HU <1000HU).

The patients with urinary tract infection, renal insufficiency or renal failure, distal obstruction, large stone burden, radiolucent stones, pregnancy, bleeding disorders, and coagulopathy under medication were excluded.

ESWL was performed with Allenger(TM) Lithotripter. Treatment was initiated with 5 kV depending on the tolerance of the patient, location of the stone and the nature of the stone. Maximum of 3000 shocks were delivered in one setting. All the procedures were done by well trained, a fixed radiology technician in the same setting. Informed written consent was taken prior to the procedure. All patients were given intramuscular analgesic (Diclofenac sodium 75mg) 30 minutes prior to the therapy. The procedure was done in supine position. Post procedure, all patients received tablet Tamsulosin 0.4mg for 14 days and also tablet ciprofloxacin and ketorolac for 5 days. Follow-up was done twice on 7th and 14th day after the treatment and stone free status was confirmed by ultrasonography and plain KUB x-ray. Patients were considered stone free if radiology report confirmed stone clearance or the persistence of fragments smaller than 2 mm in maximum diameter. The treating policy towards ESWL was liberal, and there was no maximum fixed number of ESWL attempts as long as progress was observed. Data collection and statistical analysis were done using SPSS 22.0. The different study variables were analyzed using descriptive statistics.

## RESULT

Out of seventy nine patients fifty were male (mean age 35.32±10.94 years) and twenty nine were female (mean age 36.68±14.98 years). The numbers of patients with stone in the renal, PUJ and proximal ureter were 37 (46.83%), 33 (41.77%) and 9 (11.39%) respectively. Thirty eight (48.10%) patients had stone size ≤10 mm with mean size of 8.73±1.13 mm and 41 (51.89%) patients had stone size >10mm to 20mm with mean size of 14.78±3.37 mm.

Overall 93.68% (74/79) were treated successfully with the initial ESWL. 6.32% (5/79) patients required repetition for steinstrasse whose initial mean size was 17±1.73 mm and 962±41.27 HU. Stone clearance was seen in 38 patients in the stone size ≤10 mm with mean HU of 611±108.40, and in 36 patients in the stone size >10-20 mm with mean HU of 857±172.83. The success rate was found to be high in the stone size less than 10 mm.

The common adverse effect encountered after procedure was flank pain/ discomfort and microscopic hematuria which was alleviate by adequate hydration and analgesic, in out-patient basis. No any major complications were observed. The overall efficacy of

the procedure was very encouraging and satisfactory.

**Table 1.** Patient characteristics and stone features

S.No.	Details	N=79 (mean ± SD)
1	Age in year	35.82 ±12.50
	Male	50 (35.32±10.94)
	Female	29 (36.68±14.98)
2	Location	
	Renal	37 (46.83%)
	PUJ	33 (41.77%)
	Proximal Ureter	9 (11.39%)
3	Stone size (length)	
	≤10 mm	38 (48.10%) (8.73±1.13)
	>10-20 mm	41 (51.89%) (14.78±3.37)
4	Success rate	74 (93.68%)
	≤10 mm	38 (HU 611±108.40)
	>10-20 mm	36 (HU 857±172.83)
5	Repeated	5 (6.32%) (all >10 mm; for steinstrasse)

## DISCUSSION

With the introduction of modern and minimal assess procedures such as ESWL, Ureterscopy, Percutaneous Nephrolithotomy (PCNL) and Retrograde Intra Renal Surgery (RIRS), open surgery for renal stones has drastically decreased. Among all the minimal invasive procedure, ESWL is still considered safe and first line of treatment among all the procedures in preferred case.<sup>3,7,8,9</sup>

The ESWL technology was first discovered by Germans in early 1980s by Chaussy et al, and has revolutionized the treatment of urinary tract stone. This happened during the investigation of the supersonic aircraft when Dornie, the German airline, found that shock waves coming from passing debris into the atmosphere could to break something solid, and came to the conclusion that the body that collided with another body, whose movement velocity greater than the speed of sound, resulting shock or vibration waves.<sup>9,10</sup> ESWL is comprised of shattering forces produced by an external power source called lithotripter, which produces high intensity and low frequency acoustic waves. All lithotripsy machines consist of 4 components: an energy source, a focusing system, localization unit, and a coupling machine. The shock waves are concentrated directly onto the stone. The mechanism of fragmentation relies on cavitation, shear, and spalling. Cavitation is considered to be the most important force responsible for fragmentation of

the stones into smaller pieces.<sup>9,10</sup>

To these date only few literatures has been published by domestic authors about the efficacy of ESWL in Nepalese population. Hamal BK et al reported overall stone free rate was 73.52% in 710 patients, and according to stone sites it was reported 85.94%, 90.20% and 50.52% for upper, middle, and lower calyx respectively.<sup>11</sup> Similarly Shrestha B et al has reported 93% in which 7% required invasive intervention including open surgery in 3%.<sup>12</sup> Ghimire P et al reported 91.1% SFR in 112 patients.<sup>13</sup> Joshi HN reported overall SFR in first session was 79.3% and in three months of follow up after receiving three sessions was increased to 96.3%.<sup>14</sup> Sharma UK et al reported 73.6 % in 91 patients.<sup>15</sup> And also Wu H. et al reported SFR up to 89%<sup>6</sup> and Nielsen TK et al reported up to 93%.<sup>7</sup> In our study overall 93.68% (74/79) were treated successfully with the initial ESWL. 6.32% (5/79) patients required

repetition for steinstrasse.

Limitations of study: Small population, Single centre study, Retrospective study and Short duration of follow-up. Large multi center prospective study is mandatory.

### CONCLUSION

ESWL can be chosen as first line option in the treatment of upper urinary tract stone in selected cases. Careful selection of patient, stone size and Hounsfield unit is advisable to achieve higher efficacy/ success rate.

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### CONFLICT OF INTEREST

None

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