

EVALUATION OF FACTORS INFLUENCING OUTCOME OF EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY (ESWL) FOR RENAL STONE IN ADULT

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Abstract

Background: Renal stone disease is a common disorder with a prevalence ranging from 4-15% in different parts of the world. Modalities of kidney stone management includes drug therapy, extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL), Retrograde intrarenal surgery ureteroscopy (RIRS) and open surgery. ESWL is an acceptable technique and widely used because it is a non-invasive treatment and does not require anesthesia and usually done on an outpatient basis. Generally, ESWL is the treatment of choice for kidney stones <1 cm. However, not all ESWL treatments are successful. The success rate has been reported to be between 50%-87%, depending on various factors. This study was conducted in order to evaluate the factors affecting renal stones treatment by extracorporeal shock wave lithotripsy (ESWL). On the basis of different variables and factors affecting the renal stones treatment by ESWL was evaluated.

Objectives: To evaluate the factors affecting the outcome of Extracorporeal Shock Wave Lithotripsy (ESWL) in the treatment of renal stone in adults. To assess the success and failure rate by using ESWL for treatment of renal stone, to determine the effects of stone related factors to correlate the success rate with characteristics of the patients condition of the urinary tract and stone features; to observe the patient groups most likely to benefit from or fail an initial intervention with ESWL and to evaluate the post ESWL complications.

Materials and methods: This is a prospective observational and analytical, hospital based study. Total 500 patients with single or multiple radio-opaque renal stones were treated with ESWL monotherapy using Siemens MODULARIS Variostar lithotripter. This study was carried out in the Department of Urology, Combined Military Hospital, Dhaka for a period of two years between 01 July 2015 to 31 July 2017. The results of treatment were evaluated after 3 months of follow-up. Treatment success was defined as complete clearance of the stones or presence of clinically insignificant residual fragments (<3mm). The results of treatment were correlated with the patient characteristics (age, sex, body mass index) and stone features (size, site, number & radio density).

Results: At 3-months follow-up, the overall success rate is 87.6%. Among them, repeated ESWL sessions were required in 266 patients (53.2%). Post-ESWL complications were recorded in 62 patients (12.4%). Using the chi-square test, only four factors have a significant impact on the success rate, namely stone site, size (the largest diameter of the stone), stone number, BMI (body mass index) of the patient. The success rate is

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highest for stones located in the upper calyx (136/136; 100%) and lowest for those located in lower calyx 104/78; 75%) ($p=0.001$). Stone with a largest diameter of <10mm are associated with a success rate of 93.6% (307/328), compared to 76.2% (131/172) for those with a diameter of >10mm ($p=0.001$). The success rate was also higher for single stone (396/437; 90.6%) than multiple stones (42/63; 66.7%) ($p=.001$). Patients with lower BMI (<24) have a better success than higher BMI (>25) ($p=.001$). Other factors including age, sex and stone radio density compared to ipsilateral 12th rib have no significant impact on the success rate.

Conclusion: The success rate of ESWL for the treatment of renal stones can be predicted by stone size, location, number, and patients BMI.

Key Word: Renal stone, ESWL.

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Introduction

Urolithiasis is a problem that has confronted clinicians since the time of Hippocrates and the prevalence of urolithiasis is approximately 4 to 15 percent in general population and the estimated lifetime risk of developing a kidney stone is about 12 percent for white males. Approximately 50 percent of patient with urinary calculi have a recurrence within 10 years[1].

Renal stones are common approximately 50% of patient between the ages of 30 to 50 years. The male-female ratio is 4:3. Calculi smaller than 0.5 cm, usually pass spontaneously unless they are impacted. Any surgical intervention carries risk of complication and needless intervention should be avoided. Small renal calculi may cause symptoms by obstructing a calyx or acting as a focus for secondary infection. However most can be safely observed until they pass[2]. The development of endourological and extracorporeal lithotripsy techniques led to an increasing number of options for the management of renal calculi. Each of the methods available needs to be evaluated in terms of its stone clearance rate, potential morbidity and cost effectiveness. Extracorporeal shock wave lithotripsy (ESWL) is an effective, well established method for treatment of renal calculi[3,4]. Chaussy et al in 1980 was the first to report the clinical application of shock wave lithotripsy in the management of kidney stones and then the management of nephrolithiasis has undergone a complete revolution[5]. The goal of renal stones treatment is to achieve maximal stone clearance with minimal morbidity to patient. Multiple options are available including extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL), retrograde intrarenal surgery (RIRS), and in selected cases open stone surgery. ESWL has

revolutionized in the treatment of renal stone disease and a significant number of renal calculi can be treated satisfactorily with ESWL[6,7]. For renal stones 15mm or greater and stag horn calculi treatment switched from ESWL to PCNL as primary treatment, as stone free rate were higher and the ancillary procedures and retreatment rates were lower with PCNL. Holmium laser lithotripsy is now considered as a primary treatment modality for intra corporeal lithotripsy[8]. The success rate of ESWL depends on stone size, location, number, renal morphology, congenital anomalies and stone composition[1,4]. 'ESWL results for stone up to 10mm in size are satisfactory independent of their location in kidney, whereas the stone free rate for stones 11 - 20mm in size is lower, particularly for lower pole calculi for which it ranges from 41% to 73%[9,10]. Other researchers like Sampio et al. examined lower caliceal anatomy as a predictor of success of ESWL for lower caliceal stones[11]. Stone radio density, a useful parameter for predicting outcome of ESWL for stone >20mm. Mina S suggests that for stones <20mm within renal pelvis, the value of radiographic appearance of a stone alone in determining treatment outcome on the doli machine is somewhat limited. There seems to be tendency for a worse outcome for stone 11- 20mm that have a radio density greater than 12thrib[12].

Treatment outcome after lithotripsy depends on several factors. The type of lithotripter, stone characteristics (number, size, composition and location), patient characteristics and renal anatomy and function are important factors for determining treatment characteristics and outcome. Although the role of shock wave lithotripsy for management of lower pole nephrolithiasis has been questioned in some studies[1]. Overall stone free rates after ESWL vary from 50% to

87%, depending on many factors affecting the overall success rate[13]. On the other hand, shock wave lithotripsy is not without complications and renal trauma from treatment in time may lead to hypertension and renal insufficiency. Factors associated with increased renal damage due to shock wave lithotripsy include high shock wave number & energy[14].

Materials and methods

This is a prospective observational study which was conducted in the Department of Urology, Combined Military Hospital (CMH), Dhaka, during the period of July 2015 to July 2017. Patients who underwent ESWL for renal stone in CMH Dhaka within the study period were included. This hospital based prospective experimental study was conducted on the patients with renal stone (≥ 15 mm), in OPD basis in the Department of Urology, Combined Military Hospital, Dhaka to evaluate the factors that affect the success rate of Extracorporeal Shock Wave Lithotripsy (ESWL) for treatment of renal stones. Decision of procedure was taken as per the standard protocol.

All patients were evaluated by detailed history, physical examination and relevant investigations. Urinalysis, urine culture and sensitivity, complete blood count (CBC), blood urea nitrogen (BUN), serum Creatinine, coagulation profile and plain X-Ray KUB region, ultrasonography of KUB region, IVU or Non contrast CT Scan of KUB region were done. Patient with documented urinary tract infection were treated with appropriate antibiotic before the procedure.

Patients selected for ESWL in OPD undergo ESWL using the Siemens MODULARIS Variostar (German). All the patients were in nothing per oral from morning and given intravenous fluid with diclofenac sodium suppository and injection pethidine 75mg IM given 30 minutes before ESWL. In a single session, maximum 4000 shock waves were given. All patients were treated with same lithotripter Siemens MODULARIS Variostar (German). This lithotripter uses electromagnetic wave for shock wave generator, water cushion for coupling, membrane for shock wave focusing and fluoroscopy for stone localization. Gut preparation were done by Enema Simplex and laxena before operation. Routinely all patients were fasting over night before the day of ESWL. Anticoagulants, aspirin and aspirin like compounds were stopped 05 days prior to start the ESWL procedure. Diclofenac suppository was used routinely as an analgesic prior to start the ESWL for analgesia. A prophylactic broad spectrum antibiotics

and intravenous line started just before the start of ESWL.

All patients were treated in supine position on treatment table depending upon the side of the stone (right or left side). ESWL therapy was started at low voltage (0-5kv) until the patient accustoms to the shock and the voltage was then gradually increased to maximum of 6.5kv. Maximum 4000 shock waves were used until x-ray shows adequate pulverization in each patient. The shock waves were delivered at rates 120/min in all patients. The stone was positioned in the focus of the shock wave by using fluoroscopy imaging. The shock tube is then pressed and "coupled" with some gel-like material. Treatment time was varied according to the size and hardness of the stone. Progress of the treatment was determined by fluoroscopy. After treatment, in order to assist passage of the particles, inj. frusemide was given to all patients and were advised to drink large quantities of water. The patients were discharged on the next day.

Patients were reviewed after 24 hours of ESWL session to assess fragmentation and the presence of renal obstruction by plain X-ray KUB and USG of KUB region. After four weeks repeat treatment was carried out if there was inadequate fragmentation of the stone. If there was no response or presence of residual fragments >4 mm after three session, the case was considered as ESWL failure.

Follow-up was continued every 4 weeks until there was complete stone clearance by plain x-ray of KUB region. Highest three session were given in each patient at every 4 weeks intervals. All the follow-up data analyzed after 3 months visit. Treatment success was defined as a complete stone clearance or clinically presence of insignificant residual fragments (CIRFs) stone size <3 mm. Failure was defined as presence of significant residual (SRFs) after 3rd month. Statistical analysis was done with the data of all 500 patients from the master data sheet. The success rate was correlated with characteristics of the patients and stone feature with chi square test by using SPSS program version 22. A p value <0.05 was considered as statistically significant.

Results

Stone clearance rate

At 3 months follow-up of 500 cases complete stone free were observed in 354 patients (70.8%), clinically insignificant residual fragments (CIRFs) were observed in patients 84(16.8%) and significant

residual fragments (SRFs) were observed in 62 patients (12.4%). Stone clearance rate is summarized in Table-1 and Fig-1.

Table-1

Distribution of the study patients by stone clearance rate (n=500)

Parameters	No of patients	Percentage (%)
Success		
Stone-free	354	70.8
CIRFs	84	16.8
Failure		
SRFs	62	12.4
Total	500	100.0

CIRFs, clinically insignificant residual fragments;
SRFs, significant residual fragments;

In this study treatment success was defined as a complete stone clearance or clinically presence of insignificant residual fragments (CIRFs; stone size <3 mm). Failure was defined as presence of significant residual fragment (SRFs; stone size >3mm) after 3rd month.

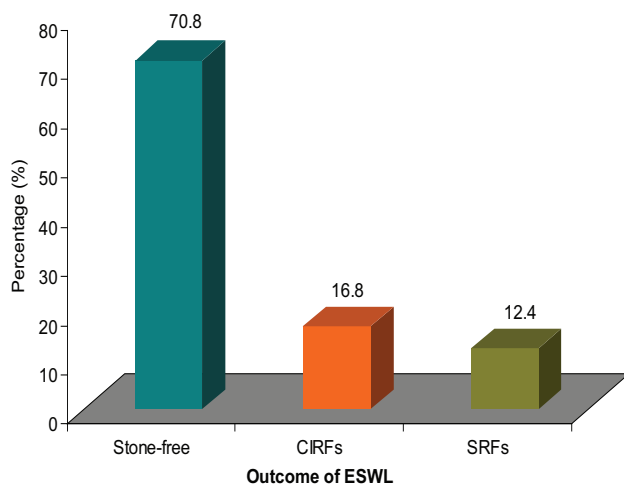
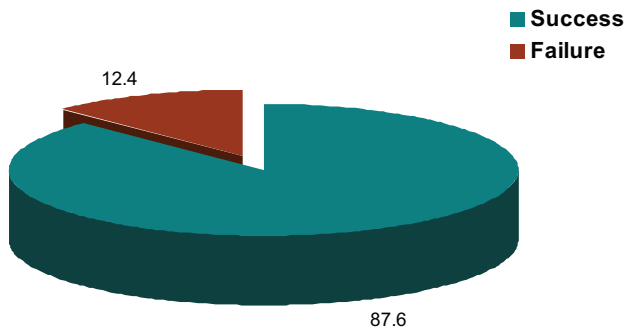


Fig. 1: Bar diagram of stone clearance rate after ESWL monotherapy of 500 renal calculi after 3rd month showing stone free cases 354(70.8%), CIRFs 84(16.8%) and SRFs 62(12.4%).

So at 3 months follow-up, overall success were 438(87.6%) and failure were 62(12.4%) shown in Fig-2. Among 500 cases, 234 patients (46.8%) needed single sessions of ESWL for success. Repeated session was needed in 266 patients (53.2%). Among



Success 438(87.6%), failure 62(12.4%).

Here success means stone free plus CIRFs & failure means SRFs.

Fig-2: Pie chart of overall success & failure after 3rd month.

the re-treatment group 148 patients (55.6%) were needed two and or three sessions of ESWL to ensure success. The mean number of shocks per patient was 4883±2382.

In this study, the success rate was correlated with characteristics of the patients and stone features using the chi-square test. Here seven factors were studied, among them four factors had significant impact on success rate, namely stone size, site, number & patient BMI. On the other hand patient age sex & radiodensity had no significant impact on success rate.

Age of the patient:

The mean age of 500 patients was 38.6±10.28 years (ranging from 20 to 60). Out of 500 patients age within 20-30 years were found in 116(23.2%), among them success were 99(85.3%), age within 31-40 years 145(29.0%) patients were found, among them success 129(89.0%); age within 41-50 years 157(31.4%) were found, among them success were 142(90.4%) patients. The p value was >0.05, that was not statistically significant. So age of the patient had no significant impact on success rate of ESWL.

Table II
Age and stone features in correlation with success rate (n=500)

Age (years)	No. of pts	%	No. of success rate	% success rate	P-value
20-30	116	23.2	99	85.3	0.370ns
31-40	145	29.0	129	89.0	
41-50	157	31.4	142	90.4	
51-60	48	9.6	41	85.4	
>60	34	6.8	27	79.4	

Data were expressed as frequency and percentage

Data were analyzed by Chi-square test, ns= not significant

Sex of the patient:

In total 500 cases, males were 283(56.6%), among them no. of success were 242(85.5%). The series also include 217 females (43.4%), among them no. of success were 196(90.3%). A p value was >0.05 that was not statistically significant. So sex of the patient had no significant impact on success rate.

BM1 of the patients:

Among the 500 patients mean height of the patients was 1.56 m (1.56±0.073). Minimum height was 1.40 m. and maximum was 1.70 m. The mean weight of the patient was 57.45 kg (57.35+6.8). The minimum weight

was 42 kg & maximum was 70 kg. The mean BMI of 500 patients was 23.27 ± 1.68 (ranging from 19.78 to 26.22). The no. of patient BMI <24 (ranging from 19 to 24) were 349 (69.8%), among them no. of success were 339(97.1%) and patient BMI >24 (ranging from 24 to 27) were 151(30.2%), among them no. of success were 99(65.6%). So the success rate were decreased from 97.1% to 65.6% for patient BMI (19 - 24) to (>24 - 27) respectively. A p value was <0.001, that was statistically significant. So, in this study the ESWL success rate were gradually decreased with increasing the patients BMI.

Table III
Sex distribution and stone features in correlation with success rate (n=500)

Sex	No. of pts	%	No. of success Rate	% success rate	P-value
Male	283	56.6	242	85.5	0.106ns
Female	217	43.4	196	90.3	

Data were expressed as frequency and percentage

Data were analyzed by Chi-square test, ns= not significant

Table IV
BMI (kg/m²) and stone features in correlation with success rate (n=500)

BMI (kg/m ²)	No. of pts	%	No. of success Rate	% success rate	P-value
= 24 (19-24)	349	69.8	339	97.1	0.001*
>24(24.01-27)	151	30.2	99	65.6	

Data were expressed as frequency and percentage

Data were analyzed by Chi-square test, *= significant

3.5 Stone size (along its largest diameter):

The mean stone size of 500 patients was 5.21 mm (5.21± 1.61). The smallest stone size was 5mm & largest stone size 10mm. The sizes of the stones were divided into two groups. In one group the no. of stones <6mm (ranging >4mm to 6mm) were 328(65.6%), among them no. of success were 172(93.6%) and another group the no. of stones size >5mm (ranging 5 mm to 10 mm) were 172(34.4%), among them no. of success were 131(76.2%). So in this study, the success rate for stones <6mm was 93.6%, while it was 76.2% for stone >6mm (p=0.001). That was statistically highly significant. So, with increasing size of the stones the success rate of ESWL was gradually decreased.

Stone site:

The series included the number of stones in the upper calyx were 136(27.2%), middle calyx were 146(29.2%), lower calyx were 104(20.8%) and renal pelvis were 114(22.8%), where the no. of success were 129(94.9%), 121(82.9%), 79(76.0%) and 109(95.6%) respectively. In this study, the success rate was decreased from 94.9% to 95.6% for upper calyx and renal pelvis, respectively. It was also decreased from

76.0% to 82.9% for stones lower calyx and middle calyx, respectively (p<0.001). That was statistically significant. So location of the stone had a significant impact on success rate of ESWL.

Stone number:

In this study patients with single stone were 437(87.4%), among them no. of success were 396(90.6%). On the other hand, patients with multiple stones were 63(12.6%), among them no. of success were 42(66.7%) (p=0.001). That was statistically significant. So, ESWL success was better in single renal stone than multiple ones.

Radiodensity of the stone:

In this study, radiodensity of the renal stones were ipsilateral 12th rib. The no. of stones radiodensity <12m rib were 294(58.8%) equal to 12th rib were 113(22.6%) and >12ih rib were 93(18.6%), among them no. of success were 265(90.1%), 93(82.3%) and 80(86.2%) respectively. Here success rate was gradually increasing with decreasing the radiodensity. But p value was >0.05 that was not statistically significant. So, stone radiodensity had no significant impact on ESWL success rate.

Table V
Stone size and stone features in correlation with success rate (n=500)

Stone size	No. of pts	%	No. of success Rate	% success rate	P-value
=6 mm (>5-6)	328	65.6	307	93.6	0.001*
>6 mm (7-10)	172	34.4	131	76.2	

Data were expressed as frequency and percentage
Data were analyzed by Chi-square test, *= significant

Table VI
Stone site and stone features in correlation with success rate (n=500)

Stone site	No. of pts	%	No. of success rate	% success rate	P-value
Upper calyx	136	27.2	129	94.9	<0.001*
Middle calyx	146	29.2	121	82.9	
Lower calyx	104	20.8	79	76.0	
Renal pelvis	114	22.8	109	95.6	

Data were expressed as frequency and percentage
Data were analyzed by Chi-square test, *= significant

Table VII
Number of stone and stone features in correlation with success rate (n=500)

Stone number	No. of pts	%	No. of success rate	% success rate	P-value
Single	437	87.4	396	90.6	0.001*
Multiple	63	12.6	42	66.7	

Data were expressed as frequency and percentage
Data were analyzed by Chi-square test, *= significant

Table VIII

Radiodensity of stone and stone features in correlation with success rate (n=500)

Stone radiodensity	No. of pts	%	No. of success rate	% success rate	P-value
<12th rib	294	58.8	265	90.1	0.087ns
Equal to 12th rib	113	22.6	93	82.3	
>12th rib	93	18.6	80	86.2	

Data were expressed as frequency and percentage

Data were analyzed by Chi-square test, ns= not significant

Table-IX*Distribution of the study patients by post ESWL complication (n=500)*

Complications	No. of patients	Percentages (%)
Loin Pain	52	10.4
Haematuria	10	2.0
Ureteric obstruction with fever	28	5.6
No complications	410	82.0
Total	500	100.0

Complications:

In 500 cases, post-ESWL complications were encountered in 90 patients (18.0%), Among them, 52 patients (10.4%) were loin pain, 10 patients (2.0%) were fever and pain. 28 patients (5.6%) were ureteric obstruction along with haematuria and pain. Pain and haematuria were managed conservatively, ureteric obstruction needed spasmotic and diuretics.

Discussion:

The aim of this present study was to evaluate the factors that affect the success rate of extracorporeal Shock Wave Lithotripsy for treatment of 500 patients of renal stones size d" 20mm at the Department of Urology, Combined Military Hospital, Dhaka from July 2015 – July 2017. Follow-up was continued every 3 weeks interval up to 3rd month of ESWL. After 3-months each patient was reviewed by plain X-ray of KUB region. Highest three ESWL sessions were given at every 3 weeks intervals. All the follow-up data were analyzed after 3 month visit.

At 3-months follow-up, the overall success rate was 87.6%. This result was matching with some similar previous studies that reported stone free rates were 75-85% for treatment of renal stones by ESWL[14, 15].

This study examined only four factors that had a significant impact on the success rate namely stone size, site, number of stone and BMI of the patient. Other factors like age, sex and radiodensity had no significant impact on the success rate.

In this study, stone size was a significant predictor of ESWL outcome. The success rate for stones <10mm was 93.6%, while it was 75.2% for stone >10mm (p=0.001). Al-Ansari et al. (2006)[4] did a prospective study of 427 patients with single or multiple stones (<30mm) underwent ESWL monotherapy using SL20 lithotripter. At 3-months follow-up, the overall success rate was 78%. There 10 prognostic factors were studied, 5 had a significant impact on the success rate namely renal morphology, congenital anomalies, stone size, stone site and number of stone treated. Other factors including age, sex, nationality, stone nature and ureteric stenting had no significant impact on the success rate

In this study, as in others stone size had a significant predictive impact as factor of ESWL outcome.[3,4,5,21] In another study, Lalak et al[22] evaluated the outcome of ESWL of 500 renal calculi using the dornier compact delta lithotripter. Here the authors found the overall stone free rate was 66%, while <10mm in size was 76% at 6 months follow-up. For 10-20mm stones, the success rate was 66%, while the rate for stones >20mm in size was 47%. Here the authors did not recommend ESWL as primary therapy for stones >20mm in size[22]. In another study, Coz et al.(2000) [16] demonstrated that stone size had a significant impact on the success. There the stone-free was 89.7% for stones <15mm and 78% for stones >15mm (p<0.001). This result also similar to present study. Here the authors recommended stone size <15mm was better treated with ESWL than stone size >15mm.

In the present study, the success for stones located in the renal pelvis, upper, middle and lower calyces were 95.6%, 94.9%, 82.98% and 76.0% respectively ($p=0.001$). This finding was supported by similar previous studies, where for upper and lower calyceal stones free rate ranges from 90% to 70% respectively, where as that for lower calyceal and multiple site stones ranges from 70% to 50% respectively. All the studies had shown that better stone clearance rate were in the renal pelvis, upper, & middle calyx than stone in lower calyx[1,4,16,25]. In this study, the success rate for stones located in the lower calyx was 75%. This result in agreement with a study done by Chen (1996) [17] who evaluated the impact of radiological anatomy as predictive factors of lower calyceal stone after ESWL. Here 112 patients with a solitary lower calyceal stone measuring 20mm or less in size were enrolled in that retrospective study. Pretreatment IVU was reviewed for measuring the anatomical predictors, such as lower pole infundibular length (IL), infundibular width (IW) and infundibulopelvic angle (IPA), while the stone location and size were determined on plain abdominal X-ray. All treated with Siemens Lithostar Plus lithotripter and were followed-up for 3-months. Three months after ESWL, only 49(43.7%) patients were stone free. Under multivariate analysis with logistic regression, smaller stone size (10mm or less, $p=0.005$) and greater IW (4mm or more, $P=0.029$) were significant favourable predictors for better stone clearance. Here the authors concluded, in addition to the influence of stone size, lower pole anatomy especially IW, had a significant impact on stone clearance for lower calyceal stone after ESWL, that was similar with other studies[23,24].

But in another study Sorensen CM et al. (2002) [25] examined 246 cases of lower pole renal calculi <20mm in size were treated with the Doli 50 lithotripter. The overall stone free rate was 78%, 73%, 43% and 30% for stones <5, 6-10, 11-15 and 16-20mm in size respectively. Here the authors concluded that stone size rather than lower pole calyceal anatomy was predictive of treatment outcome. In this study lower calyceal anatomy not studied as a predictor of success. However, the treatment for lower pole calculi especially for stones larger than 10mm in size remains controversial. The comparison of stone clearance rate between ESWL and more invasive treatments such as PCNL was done by many authors[1,19].

In the present study, stone number had a significant impact on stone clearance by ESWL. The success rate

for single stone was 90.6% and 66.7% for multiple stones. This result is similar to that of Abdel-Khalek et al. (2004) [1], here the authors did a study under 2954 patients with single or multiple radiopaque renal stones (<30mm) underwent ESWL monotherapy. The results of treatment were evaluated after 3 months of follow up. By a multivariate regression model analysis the authors found that success rate was lower in multiple renal stones than single stone[1]. This agreement was also proved by Jan H. Ruffer et al. (2002) [15], and Al-Ansari et al. (2006) [4]. All the studies the authors examined that, the success rate was lower by ESWL for multiple renal stones than single stone.

In the present study, stone radiodensity alone was not a useful parameter for outcome of Extracorporeal Shock Wave Lithotripsy. This findings was supported by Mina et al. (2005) [18]. The authors studied 211 patients with solitary renal pelvic stones <2cm by Dornier Doli 50 Lithotripter under general anesthesia. The radiodensity was compared to ipsilateral 12th rib. Following after 3 months follow-up they declared that there was no co-relation between stone radiodensity and stone composition. For stone <10mm within renal pelvis, the SFRs were similar (71-74%) regardless of stone radiodensity. For stone between 11 to 20mm, the SFR was 60%, if the stone had a radiodensity >12th rib compared to a SFR of 71%, if the stone radiodensity was <12th rib. However, these differences in SFRs were not statistically significant. In this study, we also had shown that, success rate was gradually decreasing with increasing the radiodensity of stone, but it was not statistically significant ($p=0.087$).

In the present study, success rate was significantly higher (97.1%) in patients with BMI 19 to 24 kg/m² compared to BMI 24 to 27kg/m² (65.6%). This result was also matching with Ackermann et al. (1994) studied that BMI influences the outcome of ESWL. They found that body mass index (BMI) and stone number were the only significant predictors. The authors studied that the best chance of success for ESWL was found in patients with BMI 20 to 28. But Robert et al. (1999) [20] found patients with a BMI >25 had a worse outcome after ESWL that matched with present study. In the present study, it was statistically proved that the ESWL success rate was gradually decreased with increasing the patients BMI ($p<0.001$). In this study, patients age and sex had no significance that affects stone clearance of renal calculi after ESWL. This result was also similar with other study done by Al-Ansari et al. (2006).⁴But

Abdel-Khalek et al. (2004) [1] did a multivariate regression model analysis; here the authors found that age of the patient had a significant impact on renal stone free rate.

Conclusion

The overall success rate of Siemens MODULARIS Variostar(Lithotripter) for treatment of renal stones at the Department of Urology, Combined Military Hospital, Dhaka was 87.6%. The success rate was gradually decreases in relation to increasing size of the stone. Success rate was higher in the upper calyx, pelvis and middle calyx than in the lower calyx and multiple sites of kidney. Success rate was higher for patient BMI <24. Repeated sessions were needed in 53.2% and overall complication rate was 12.6%. Factors that significantly affected the success rate included stone size, stone location, multiple stones and patients BMI.

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