Stone-free rate after extracorporeal shockwave lithotripsy in the management of renal stones in relation to different sizes and locations of the stone

Murooj Mazen Qattan (1)
Nouf M.Alasiri (2)
Hanouf Aljuaid (2)
Naif Saud Alsifiri (3)
Ziyad khalid Saifaddin (4)
Salahadin Hassan Lamy (5)

1 King Abdul-Aziz University, Jeddah, Kingdom of Saudi Arabia
2 Medical intern, Ibn Sina national college for medical studies, Jeddah, Kingdom of Saudi Arabia.
3 Medical student, Ibn Sina national college for medical studies, Jeddah, Kingdom of Saudi Arabia.
4 medical student, King Saud bin Abdulaziz University for health Sciences.
5 Consultant Urology, Renal transplantation Urology Surgery

Corresponding author:
Dr. Nouf M. Alasiri
Medical intern, Ibn Sina national college for medical studies
Jeddah, Kingdom of Saudi Arabia
Tel: 966553025400.
Email: ALASIRI_N@DR.com

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Abstract

Background: Extracorporeal shockwave lithotripsy is one of the outpatient procedures that are used to fragment a kidney or ureteric stone into small pieces to help them to pass through the urinary tract without blocking the ureter.

Aim of the work: Assessment of extracorporeal shockwave lithotripsy (ESWL) in the management of renal stones in relation to different sizes and locations of the stone.

Objectives: To identify the success rate of ESWL in treatment of renal stones according to stone size and location and compare it with untreated ureteric stones.

Method: Retrospective cohort study between 2014 and 2018 carried out by obtaining data from electronic health records and patients' files for all patients who had ESWL in King Abdulaziz Medical City, Jeddah. Analysis was done for multivariables such as stone size, complications, number of sessions used and the need for other procedures. The collected data were analyzed by computer using Statistical Package for Social Science (version 20, SPSS Inc., Chicago, IL).

Results: This study included 88 patients, 64.7% were males and 35.3% were females who complained of having stones. These patients had 124 stones (79 kidney stones and 45 ureteric stones) out of them 67 (54.03%) subjects who went for 1 session, 31 (25%) subjects who went for 2 sessions and 26 (20.97%) subjects who went for 3 sessions. The overall success rate of ESWL was 41.13%, out of 45 subjects who had ureteric stones; 18 (35.29%) subjects had a successful ESWL.

Conclusion:
Future researchers should consider investigating the impact of other factors dually such as success rate, and the following parameters: BMI with age, BMI with gender, BMI with size of the stone, age with gender, age with size of the stone, gender with size of the stone.

Key words: extracorporeal, lithotripsy, stone, location

Introduction

Urolithiasis ranks as the third most common disease that affects the urinary tract system. It depends on many factors such as gender, family history, climate, diet, ethnicity among other genetic factors (1). Its prevalence is estimated to be from 2-3% of the general population (2), and is found to increase in areas with hot climate rather than cold climate (3).

The majority of stones are localized in the kidney and ureter and it represents nearly 97% of all stones, mostly in the ureter and the localization of the stones is affected by many factors such as demographic characteristics (4).

Urolithiasis can be managed either conservatively, by either major or minimally invasive procedures (2). Extracorporeal shockwave lithotripsy (ESWL) is an alternative, non-invasive method that uses shockwaves to disintegrate urinary tract stones (5). Since it was introduced during the 1980s, ESWL quickly became the standard treatment of the majority of urinary tract stones (6).

The study aims to identify the success rate of ESWL in the treatment of renal stones according to their size and location. This will, accord-ingly, guide physicians within the institution to direct patients to the optimal choice of treatment. It will also open a door for further investigations in case the success rate is different than the universal rate. Errors might be due to lack of experience or technical errors.

Patients and methods

Type and site of the study:
This is a retrospective cohort study carried out by obtaining data from electronic health records and patients files (BESTCare system) for all patients who had ESWL in a four year duration from January 2014 to June 2018 in King Abdulaziz Medical City, Jeddah.

Study population:
All adult patients with renal or ureteric stones measuring from 5 to 20 millimeters who underwent ESWL were included in the study while those with undocumented stone size and site were excluded.

Out of 121 patients who had ESWL, the calculated sample size was 88 considering a power of 80% and alpha level of 0.05 with success rate of 79 in kidney stone of vs. 45 in ureteric stones [9].

Study procedure:
The type of ESWL used in King Abdulaziz Medical City is the SIEMENS Lithoscope electromagnetic lithotripter. The lithotripter generates shock waves which can be focused on the stone to result in disintegration of the stone. This process requires generation of shock waves by the lithotripter and coupling mechanism of the lithotripter to the skin of the patient as near as possible to the kidney. These shock waves should be focused on the stones by the help of fluoroscopy. Targeting of stones for SWL is done with the assistance of X-ray.

After the stone is located the lithotripter is directed to it, and it generates shock waves that disintegrate the stone. The maximum number of shock waves delivered in a session is 3,000 to 3,500 shock waves.

Data management:
The collected data were coded, entered, presented, and analyzed by computer using a database software program, Statistical Package for Social Science (version 20, SPSS Inc., Chicago, IL). Chi square test using SPSS version 23 was used for comparing qualitative data in patients who had renal with those with ureteric stone. Subgroup analysis was done based on stone size (5-10 mm vs. 10.1-20 mm). Independent t-sample test was used to find if there is a significant difference in the success rate based on BMI.

Ethical considerations:
Ethical approval for the study was obtained from the ethical review committee of the King Abdulaziz Medical City, Jeddah. Confidentiality of data was ensured and data was only accessed by the researcher.

Results

This study is a retrospective cohort study during the period 2014 to 2018, that included 88 patients; 64.7% were males and 35.3% were females, who complained of having stones. These patients had 124 stones (79 kidney stones and 45 ureteric stones) out of which 67 (54.03%) subjects went for 1 session, 31(25%) subjects went for 2 sessions and 26 (20.97%) subjects went for 3 sessions (Table 1).

Regarding the success rate, the analyzed results showed that the overall success rate of ESWL was 41.13%, out of 45 subjects who had ureteric stones, 18 (35.29%) subjects who had a successful ESWL, while 27 (64.71%) failed. Regarding the renal stones there were 79 subjects, out of whom only 33 (64.71%) subjects had success, while 46(35.29%) failed with no significant difference between them (P value= 0.847) (Table 2).

Regarding the success rate related to size, out of 74 subjects who had stones size between 5 to 10 mm, 28 subjects (54.9%) had success and in 46 subjects (45.1%) had failure. The total number of subjects who had stones between 10.1 to 20 mm was 50 subjects and the success rate was seen in 23 (45.1%) while the failures were seen in 27 (54.9%) with no significant difference between them (P value =0.365) (Table 3).

Table 1: Basic characteristics of the studied participants (n=88)

	Stones		P-value
	Renal stones	Ureteric stones	
Age mean±SD	48.77 ± 14.04	49.04 ± 13.28	NS
Gender			
Male	36	21	NS
Female	18	13	
Total	**54**	**34**	
BMI **mean±SD**	30.46 ± 6.12	30.70 ± 5.98	NS
Size			
5-10mm	46 37.1%	28 22.58%	NS
10-20mm	33 26.6%	17 13.71%	
Total	**79 63.7%**	**45 36.3%**	
Number of sessions			
One	39 31.45%	28 22.58%	
Two	23 18.55%	8 6.45%	NS
Three	17 13.71%	9 7.26%	
Total	**79 63.7%**	**45 36.3%**	
Other intervention			
No	48	21	
PCNL	2	0	
URS	7	9	
Stent	15	7	
PCNL+Stent	1	0	
URS+Stent	6	8	
Total	**79**	**45**	

Table 2: Outcome of ESWL regarding site and size of the stones

	Outcome		P-value
	Success	Failure	
Site			
Ureteric stones	18 (35.29%)	27 (64.71%)	
Renal stones	33 (64.71%)	46 (35.29%)	NS
Size			
5-10mm	28 (54.9%)	46 (45.1%)	NS
10.1-20mm	23 (45.1%)	27 (54.9%)	

Table 3: Outcome of ESWL regarding site and size of the stones

Site	Size		P-value
	5-10mm	10.1-20mm	
Ureteric Stones	14 (27.45%)	4 (7.84%)	0.02*
Renal Stones	14 (27.4%)	19 (37.25%)	0.016*

Discussion

This study is retrospective cohort study that included 88 patients who complained of stones at different sites (kidney and ureteric) and of different sizes, who underwent ESWL.

The study reported that the overall success rate of ESWL was 41.13%.

The success rate among subjects with ureteric stones was (35.29%) while the success rate of those with the renal stones was (64.71%) with no significant difference between them (P value= 0.847). Regarding the success rate related to size, stones (5 to 10 mm), it was (54.9%) while that of stones between 10.1 to 20 mm was (45.1%) with no significant difference between them (P value =0.365). About (54.03%) of subjects needed 1 session, (25%) of them went for 2 sessions while (20.97%) of subjects needed 3 sessions.

Many studies have been conducted and revealed different success rates at different sites and stone sizes. A study conducted on 117 patients who underwent ESWL with their mean age was 38.2 ± 14.1 and where the majority of them (75.2%) were males revealed that the overall frequency of stone clearance after ESWL for renal stones was 70.9%. Regarding number of ESWL sessions, most cases (65.8%) needed 3 ESWL sessions while only (4.3%) of cases needed only one session. About 29.9% needed 2 sessions (7).

A higher success rate was revealed with a study conducted in Jeddah, Saudi Arabia which reported that ESWL for ureteric calculi had a success rate of (88.7%) with only (5.65%) of patients having some residual stone (8).

Another study conducted in Iran included about 138 subjects and reported that the overall success rate of ESWL was 71.7%. The success rates were different at different sizes as (8-10 mm, 11-15 mm, and 16-20 mm) stones success rates were (23.7, 55.7, and 20.6%) respectively. In addition, the success rate of ESWL was measured based on stone location where 68.3% of the renal stones and 81.1% were ureteral stones, with no significant differences in the success rate of lithotripsy between these two locations (9) .

In a study conducted in India in 2017 the results of the efficacy of ESWL in lower ureteric calculus showed that the stone-free rate in stones ≤10 mm was (88%) while it was only in (56.5%) in stones >10 mm 10.

Another study that included 76 patients with mean size of the stone was 1.08 ±0.59 cm reported that the post- ESWL stone-free-rates were different even in different locations in the kidney as it was 47% in lower pole kidney stones, 70.58% in upper and mid pole stones and 68% in renal pelvis stones (11). This may be attributed to the feasibility of the waves to reach the stones and their nature.

A cohort study that was conducted in Sudan including patients with kidney (72.5%) and ureter (27.5%) stones managed by ESWL revealed that the stone free rate was correlated with the number and site of the stones. The overall stone success rate was very high (96.6%). But the rate of complete resolution was not affected by the site of stone impaction (p=0.8) (12).

On the other hand, other studies reported that the success for stone fragmentation and clearance varied greatly regarding stone size, site and composition (13, 14).

It can be reported that ESWL is an effective intervention for managing kidney and ureter stones and it works optimally for kidney stones (4 mm to 2 cm) and stones up to 1 cm in the ureter (15).

Conclusion

Future researchers should consider investigating the impact of the other factors: success rate, and the following parameters: BMI with age, BMI with gender, BMI with size of the stone, age with gender, age with size of the stone, gender with size of the stone.

Also, we recommend for future researchers a prospective study as there were many missing valuable data that we excluded due to poor documentation and vague information.

Many patients did not follow up after the procedure which in our opinion was either because they became symptom free or because they changed the health care facility.

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