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Factors Affecting Fragmentation and Clearance of stones after shock wave lithotripsy

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ABSTRACT

Background:

The applying of ESWL is widely extended from kidney stone to the most of urinary tract stones.

Objective:

the aim of the current study is to find the correlation between the location and the stone size with the efficiency of ESWL.

Materials and Methods:

Data were collected from patients in ESWL unit in urology department in Al-Karkh general hospital for three years, starting December 2017 until December 2020. The number of patient was (174) patient divided into two groups, first group (G1) with average stone size 12 mm while it was 14 mm for the second group (G2). The shocks used of the frequency of 90 shock/minute start up at 9 KV with escalated does increase to 18 KV till fragmentation of stone or till reach of average 3000 shocks for real stone on upper ureteric stone per session up to 3 session.

Results:

the collected data found that the best fragmentation was in the lower stone location (G2) 95.45% followed by the upper location 93.33%, and middle one 85.71%, the same sequence is for G1, 90.00%, 76.47% and 66.66% respectively same finding sequence with the clearance.

Conclusions: ESWL affected with stone size, and location, the larger stone size the better fragmentation and clearance.

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Introduction:

The stone diseases in urinary tract system considered as a very widespread disease all over the world ⁽¹⁾. In general, the kidney stone disease is more familiar in high standard living countries, and recently on 2015, Bouatia and his coworkers reported that this disease has an effect on 13% of Canadians and Americans, and around 7.5 % of Europeans, while it has an effect on 3% of the Asian population. Also it was reported that there is around 50% of the chance of reappearances within 7 years ^(1, 2).

The urinary stone disease usually diagnosed and due to the following causes ^(3, 4):

- Infections.
- Kidney dysfunction
- Lack of fluid
- Eat foods that contain oxalate and salts
- Genetic factors.
- Chronic disease such as diabetes.

There are different methods, techniques that were applied to treat the kidney

stones, among them are: Laparoscopic Surgery, ESWL (Extracorporeal Shock Wave Lithotripsy), Percutaneous Nephrolithotomy, (URL) Ureteroscopic Lithotripsy and medical therapy ^(5, 6).

The most common methods and techniques that extensively used are URL (which used micro telescope to remove the stone from ureter) and ESWL(which use the shock wave to break the stone into pieces). In ESWL the doctors use machine called lithotripter, the disadvantage of this technique is the bleeding that may appear due to kidney damage. The practice and usual insertion of the stents to urethral tract for long period of time can minimize and decrease the risk of renal colic as well as the ureteral obstruction ⁽⁷⁾, this is because the stents can afford the drainage path to the fragments of the stone all the way to the bladder and can recover and cause the improvement simultaneously of the hydronephrosis⁽⁸⁾, application of stents for long time can also promote curing and healing to the mucosal injury that's

appear due to surgeries ^(9, 10). On the other hand there are some disadvantages in implementation of ureteral stents due to some complications that associated with it like discomfort, irritation, stent encrustation, vesico-ureteral reflux as depicted by Chandhoke and his co workers in 2002 ⁽¹¹⁾.

In 2001, Bach and Buchholz ⁽¹²⁾ declared that since 1983 the urolithiasis small stone treatment was changed, generally, the best technique to manage the urinary stone is the ESWL, however stones that made of uric acid and cystine stones are hard to be broken by ESWL ⁽¹³⁾,

However, there are some reasons that may prevent patients from taking the treatment (contraindication) which means anything (including a symptom or medical condition) that is a reason for a person to not receive a particular treatment or procedure because it may be harmful. For example, having a bleeding disorder is a contraindication for taking aspirin because treatment with aspirin may cause excess bleeding,

and there three types of contraindication (medical, local and total) ⁽¹⁴⁾.

The efficiency of ESWL can be easily determined by CT scan by which it can shows the complete disappearance of the stone, however X-ray can also determine the complete removal of the renal stone ⁽¹⁵⁾.

When the size of stone is below 2 cm, however the rate of success in using ESWL may affected with many factors like; renal function, obstruction degree, impaction, stone size and stone location ^(16, 17).

In 2020, Hiller and Ghani⁽¹⁵⁾ find that diuretics cause an increasing in the flow of urine during the SWL particularly in the area surrounding the stone, which leads to improve the occurring phenomena of cavitation ^(6, 18).

In the current study, the research focuses on the complications and benefits of diuretics after breaking up the stones.

Materials and Methods

Data were collected from patients in ESWL unit in urology department in

Al-Karkh general hospital for three years, starting December 2017 until December 2020. Total number of patient was (174) patient and were selected after clinically diagnosed with kidney stones according CT, X-Ray and intravenous urography IVU were clinically diagnosed by the specialists, the patients were divided into two groups according to the size of the stone, first group (G1) the stone size 12 mm while the second group (G2) with stone size 14 mm. The shocks used of the frequency of 90 shock per minute start up at 9 KV, the (ESWL) for renal and ureteric calculi collected from a

prospectively populated database using third generation with escalated does increase to 18 KV till fragmentation of stone or till reach of average 3000 shocks for renal stone on upper ureteric stone per session up to 3 session.

Data Analysis

Each treatment was conducted with three replicates and all of the experiment groups were conducted in triplicates, the dates were showed as mean SD (standard deviation).

Results and Discussion

Table 1 shows the location of the stone, there were renal located, and their sizes were in millimeter and the groups.

Table 1: stone locations, size and group patients

Description	First group (G1)	Second group (G2)
Patients number	86	88
Stone location		
Upper	34	30
Middle	12	14
Lower	40	44
Stone size (Average)	12 mm	14 mm

Generally from table 1, it is clear that the location of the stone in most of the patients

were in the lower renal, followed by upper renal and were very rare in the middle of the renal.

Table 2 shows the calculates results of clearance and fragmentation of the stone

Description	Lower		Middle		Upper	
	G1	G2	G1	G2	G1	G2
Patient's Number	40	44	12	14	34	30
Pulse average (shocks)	3000	3000	3000	3000	3000	3000
Clearance (%)	32 (80.00%)	42 (95.45%)	4 (33.33%)	10 (71.43%)	20 (58.82%)	26 (86.66%)
Fragmentation (%)	36 (90.00%)	42 (95.45%)	8 (66.66%)	12 (85.71%)	26 (76.47%)	28 (93.33%)

However many researchers proposed that the physical properties and characteristics of the stone and its obstruction such as; chemical composition, size, and site may affects the accomplishment of the fragmentation and clearance to the stone ⁽¹⁹⁾.

In the current study it was found that the best fragmentation was in the lower stone location (G2) 95.45% followed by

the upper location 93.33%, and middle one 85.71%, the same sequence is for G1, 90.00%, 76.47% and 66.66% respectively, and this finding match with the finding of Zomorodi et al 2018 ⁽⁶⁾, same sequence with the clearance, and this result match with Hafez et al 2010 ⁽²⁰⁾.

Manipulate cavitation can affect the process of ESWL ⁽²¹⁾, rate of the shock wave pulse can also affect ^(22, 23).

Conclusions

- ESWL affected with stone size and chemical composition (such as oxalate, and cystine stones)
- Stone location also affects the ESWL process, upper, lower and middle of renal.

Further work

The current work did not study some factors that may affect the ESWL, the researchers suggest further studies in:

- Age, weight, and gender of the patients.
- Stone history.
- Session times.
- Shocks number.
- Medication (such as lasimax)

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