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ESWL of Solitary Renal Stones at Different Anatomical Sites with Piezoelectric Lithotripsy. Does it Affect the Results?

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Abstract

Introduction: Kidney stone disease is a common health problem which increasing prevalence in industrialized countries. Extracorporeal Shockwave Lithotripsy (ESWL) is an important, effective, non-invasive, treatment option for kidney stones.

Aims: This study aimed to investigate the effect of stone location within the kidney on the outcome of ESWL in renal solitary stones.

Methods: A single center study that assessed the effect of stone location inside the kidney on the result of treatment with ESWL. It was conducted in the urology department in Ibn Sina teaching hospital – Sirte – Libya in a four year period that extended from January 2010 to December 2013. Results: 129 patients with solitary renal stones were enrolled in the study, of whom 79 males (61%) and 50 females (39%). Patients' age ranged from 5 to 74 years old. Average stone size was 13.2 mm. There were 18 patients (14%) with stones in the upper calyx, 15 (12%) in the middle, 38 (29%) in the lower renal calyx and 58 (45) patients with stones in renal pelvis. Stone free rate was 72% in stones located in upper renal calyx, 80% in middle calyx, 53% in lower calyx and 81% in stones located in renal pelvis. Discussion: the finding of the current study is consistent with growing body of evidence that indicate that ESWL is least effective in case of stones located in the lower renal calyx. Therefore, early stone localization might help in the decision making and selection of the best option for the stones located in sites less responsive to ESWL. Conclusion: patients' selection and stone site localization are important points to help in decision making before ESWL since other treatment options should be considered in patients with lower renal calyceal stones, or any other patients who may not benefit from ESWL.

I) INTRODUCTION:

Kidney stone disease or Nephrolithiasis is a common health problem which showed an increasing prevalence associated with the increase in the prevalence of its modifiable risk factors, such as diabetes mellites, obesity, fatty liver and hypertension (1). It is also a disease that has the potential for recurrence and is associated with the formation of hard mineral deposits inside the urinary tract (2). Treatment of nephrolithiasis widely ranges from lifestyle management and dietary modifications for prevention to more invasive surgical procedures (2).

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Within this wide range of treatment options, Extracorporal shockwave lithothripsy (ESWL) remains an important, effective, non-invasive, commonly used procedure for the treatment of kidney stones (3), it uses high energy shock waves to disintegrate kidney stones (4) and entered clinical practice early in the 1980s (5).

Regardless of many factors those may affect the success of treatment of kidney stones with ESWL, the site of the stone within the kidney itself may play an important role in the success of the procedure (6, 7). Thus, the current study aimed to investigate the effect of stone location within the kidney on the outcome of ESWL in renal solitary stones.

II) Materials and Methods

Study setting: The current study is a prospective single-center interventional study that assessed the effect of stone location inside the kidney on the result of treatment with extracorporeal shock wave (piezoelectric) lithotripsy. The study was conducted in the urology department in Ibn Sina teaching hospital – Sirte – Libya in a four years period that extended from January 2010 to December 2013.
Patients: The study included patients diagnosed with solitary kidney stones who are less than 80 years of age (both adult and pediatric patients) who live in Sirte district, referred for specialist management in the Urology department in Sirte University hospital and required interventional therapy for their kidney stones.
Patients' Preparation: Patients were prepared for the procedure by obtaining informed consent from adult eligible patients and a parents'/carers' informed consent of pediatric and non-eligible patients. All patients were managed without the need for hospital admission (out patients) and received proper reassurance before the procedure. When indicated, double J stent was inserted 1-2 weeks before the procedure.
Interventional Procedures: Analgesia was only given if needed (Diclofenac sodium Intramuscular dose), with no sedation required. Wolf Piezolith lithotripter was used, most stones were localized with fluoroscopy (few stones were localized via ultrasonography). In every session 3000-4000 shocks were given with 16-20 KV energy (average 18KV). Patients were followed up for 1 to 2 weeks with KUB X-ray. Antibiotic as prophylaxis were given to patients whose urin examination was positive even if the patient was asymptomatic and the urine culture was negative. All patients continue to receive treatement in the department as required, even after the study, in order to acheive best possible clinical outcome.

III) Results

During the study period 129 patients were enrolled in the study, of whom 79 males (61%) and 50 females (39%). Patients' age ranged from 5 to 74 years old. A solitary renal stone was localized in all patients. Stone sizes ranged from 5 mm to 20 mm (average 13.2 mm). Renal stones were located at different anatomical sites in the patients' kidneys. Most of the stones were located in the renal pelvis while the middle kidney calyx was the site was the least number of stones were located, Table – 1 summarizes the number of stones detected in every anatomical site.
Each patient received from 1 to 6 sessions of ESWL (average 2.7 sessions per patient). The total number of sessions given to patients throughout the study has reached 354 sessions. As clinically indicated in individual patients' situations, double J stents were inserted in 27 patients prior to sessions.

Stone site	Number	%
Upper Calyx	18	14%
Middle Calyx	15	12%
Lower Calyx	38	29%
Renal Pelvis	58	45%
Total	**129**	

Table – 1 number of stones in every anatomical location

Complete stone free rate was achieved in 92 out of the 129 patients (71.3%), while 37 patients (28.7%) showed minimal to no effect rate was seen in 37 patients (28.7%). The minimal to no effect of ESWL was more frequent in patients with stones located in the lower renal calyx. Table 2 and figure 1 respectively, summarizes and illustrate the relationship between ESWL stone free rate response the location of kidney stones within the kidney.

Stone Site	Number	Stone Free Rate %
Upper Calyx	13/18	72%
Middle Calyx	12/15	80%
Lower Calyx	20/38	53%
Renal Pelvis	47/58	81%
Total	**92/129**	**71%**

Table – 2 Stone free rate in every anatomical location of treated stones

When it comes to complications of ESWL, steinstrasse happened in 22 patients (17%), of whom 8 patients were treated by inserted double J stent while the remaining 14 patients underwent ureteroscopy and lithoclast lithtripsy to treat the impacted ureteral stones and all patients were followed up and treated individually to achieve best possible outcome.

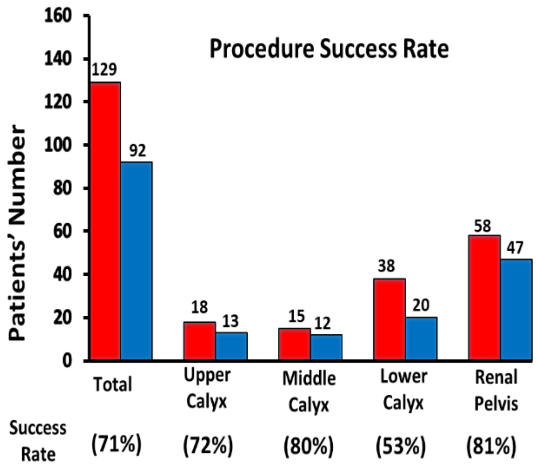

Figure – 1 illustrates the relationship between stone location within the kidney and the ESWL procedure success rate

IV) Discussion:

The results of the current study are consistent with the growing body of evidence that highlights the effect of renal stone location on the success rate of ESWL. Specifically, there studies those reported this effect of renal stone location, in renal pelvis, upper, middle or lower calyx (7).

In the current observation, stones located in the lower renal calyx has the lowest ESWL treatment success rate. Which was the same to what Nirmal et al., (2020) had observed when they carried out their study (8). Reduced success rate in stones located in the lower renal calyx has nothing to do with decreased fragmentation by ESWL, instead, it is related to decreased chance of clearing fragments out of the kidney from their location in the lower renal calyx (9).

This phenomenon is related mainly to the acute infundibulopelvic angle that does not facilitate passage of fragments taking in account the effect of gravity because of the dependent location of the lower pole collecting system, which also embeds fragment expulsion (10).

In addition, results of current study are comparable to those observed by Massoud et al. (2014) (7) and the slight deference could be attributed to differences in the study setting and methods.

Despite the growing body of evidence supporting this observation, there is still no clear approach to improve the success rate of ESWL in managing lower caliceal stones, even though, some experts recommend patients selection and stone site localization before taking the decision to use ESWL (11, 12).

Another important point to mention is that the high incidence of steinstrasse in the current study, which could be explained by the high percentage of Renal pelvic stones among study population which have more tendency to develop steinstrasse (13, 14).

Therefore, the result of the current study highlights the importance early stone localization to help in decision making since other treatment options could be considered for those patients who might not benefit from ESWL. For example, percutaneous nephrolitholapaxy (PCNL) is a minimally invasive procedure that may clear out large or difficult renal stones (15). In addition, flexible ureteroscopy is another possible treatment option for those who may not benefit from ESWL (16).

V) Conclusion:

Extracorporeal shock wave lithotripsy ais a safe and effective in the treatment of renal calculi. However, data in the current study showed low success rate of ESWL in case of lower calyceal stones. Therefore, patients' selection, stone site localization are important to help in decision making before ESWL since other treatment options should be considered in patients with lower renal calyceal stones, or any other patients who may not benefit from ESWL.

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