Superiority of Percutanous Nephrolithotomy over Extra Corporeal Shockwave Lithotripsy In Renal Stones Management ; King Hussein Medical Center Experience.

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ABSTRACT

Objectives: To compare between percutaneous nephrolithotomy (PCNL) and extracorporeal shock wave lithotripsy (ESWL) in renal stone management and persistent bacteria clearance rate after the complete extraction of these stones.

Methods: The medical files of (340) patients who underwent PCNL or ESWL for kidney stone between February 2016 and July 2017 were reviewed retrospectively, Patients with positive urine culture, stone size at 10-45mm, age 23-66 year of both genders, and a normal creatinine were included. Patient with uncontrolled hypertension, pregnant ladies, patients with ureteric obstruction or suspicious renal mass, age younger than 23 years, patients with single or transplanted kidney were excluded. In all, 340 patients were included with a mean (SD, range) age of 40.08 (±10.087, 23-66) years, and followed up from the first day post each procedure till (3 – 8 months). The clearance rate of stone and bacteria, stone size, fever post procedure, duration of antibiotics administration, type of hydronephrosis were compared between both groups.

Results: 178 patients were treated by PCNL and 162 by ESWL. The stone bacteria clearance rate and residual stone and persistent bacteriuria rate for PCNL were (80.3% vs.19.6%, respectively, *P*=0.009), while for ESWL were (53% vs.47%, respectively, p=0.152), so the result showed that the clearance rate of stone and bacteriuria was significantly higher within the PCNL group

Conclusion: PCNL is superior to ESWL regarding stone and bacteria clearance rate.

Keywords: ESWL, PCNL, Persistent bacteriuria, Stones complete clearance, Stone free rate.

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Introduction

Urolithiasis is a common medical illness worldwide, which can cause many complications extending from acute abdominal pain, haematuria, infection and bacteriuria, renal dysfunction and finally to renal failure and maybe death. Treatment options of renal stones were developed to avoid these complications as much as possible[1, 2, 3] Also renal stones serve as fertile An environment for growth of reluctant bacteria, which eventually will cause what is known as the persistent bacteriuria. Whether the persistent bacteriuria was asymptomatic or symptomatic ,treatment of underlying infected stone by complete clearance is mandatory because of recurrent urinary tract infections and the possibility of complications were mentioned above.[4] Treatment of infected stone can be accomplished by noninvasive technique like extracorporeal shock wave lithotripsy or minimally invasive procedure like percutaneous nephrolithotomy.[5,6,7] the aim of this treatment is to achieve complete clearance of infected renal stones so that persistent bacteriuria can be treated by proper antibiotics.[4] However percutaneous nephrolithotomy (PCNL) is more effective than extra corporeal shock wave lithotripsy

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(ESWL) in management of stones sized >2.5 cm and post failure of ESWL treatment, while ESWL is applied for stones less than 2 cm, the hospital stay and period of operation are more prolonged in PCNL than ESWL, because ESWL is done as an outpatient procedure which make it more safe than PCNL and has a less morbidity rate and complication rate. [8, 9, 10, 11] We hypothesize that PCNL has an efficacy over ESWL according to the clearance rate of stone and bacteria.

Methods

There were 476 patients who underwent PCNL or ESWL for kidney stone between February 2016 and July 2017 were reviewed retrospectively at PHOU institute. Their medical files were reviewed retrospectively, Patient with positive urine culture, stone size at 10-45mm, age 23-66 year of both genders, and a normal creatinine were included. Patient with uncontrolled hypertension, pregnant patient, patient with ureteric obstruction or suspicious renal mass, age younger than 23, patient with single or transplanted kidney were excluded. 340 patients were included in our study and 136 patients were excluded, patients who did ESWL for stone more than 2.5 cm or did ESWL despite the stone being radiolucent or did more than 3 sessions of ESWL were excluded due to our protocol violation. Patients were divided by the research assistant that filtered the medical files into two groups: a group of patients who underwent PCNL, and a group of patients who underwent ESWL. The choice of the procedure ESWL or PCNL depends on many factors such as: patients and stone factors, and stone management guidelines. All patient were diagnosed by non contrast renal CT scan, the size, location and the degree of hydronephrosis (which is defined by the dilatation of the pelvicalyceal system in a different degrees (mild, moderate, and severe) were measured. In patients who underwent PCNL (n=178), a prophylactic antibiotic (a third generation cephalosporin ceftriaxone 1gm IV x 2) one day before the procedure, and continued for 48 hours, post the procedure was given for all patients, a flank incision was made by an Interventional radiologist with the patient in a prone position, using multidirectional C-arm fluoroscopic guidance. Alken's coaxial dilators were used for tract dilatation to 30 F. A rigid 26 F nephroscope (Karl Storz Endoscope) was used through an Amplatz sheath. Ultrasonic or pneumatic lithotripters were used for stone disintegration, with forceps being used for stone fragments removal. A 22 F nephrostomy tube was put at the end of the procedure and kept for 24–48 h. Patients were discharged on oral antibiotics (ciprofloxacin 500mg x 2 for 5 days).162 patients underwent ESWL, the electromagnetic Dornier lithotripter S was used. 80shocks/min was given to a maximum of 3000 shocks per session. There were 58 patients with double j catheters were inserted before the procedure because the sizes of stones were above 2 cm or post operations due to signs of obstructive uropathy or urosepsis, whether unilateral double j catheter insertion or bilateral. But here in ESWL procedures, patients were treated with antibiotics as outpatients because the procedure was done without the need for admission except in some cases when urine culture gave sensitivity to I.V antibiotics alone, patients had urosepsis, septicemia or obstructive uropathy, that had been mandated a double j catheter insertion and admission. The Patients were followed from the first day post procedure up to (3-8 months), with a mean follow up period of 3.5months for PCNL patients, and a mean follow up period of 5.5 months for ESWL patients. Patients underwent K.U.B, a non-contrast renal computed tomography scans, and a urine culture two weeks post any procedure, with a patient's temperature being measured during admission. If the patient developed a fever, which is defined as (temperature > 37.5 c° orally), a urine culture was requested, and a proper antibiotic was given according to the culture. Both groups (PCNL and ESWL) were compared regarding: demographic data, Clearance rate of stone and bacteria, stone size, fever post any procedure, duration of antibiotics, duration of follow up, and the type of hydronephrosis. The success rate of the procedure being measured by: complete clearance of stones by a follow up CT scan (which is defined as a single stone sized less

than 3 mm in non enhanced helical CT), a negative urine culture < 10^5, patient a febrile (which defined by temperature less than 37.5 orally by thermometer for 48-72 hours. Statistical analysis in relation to the stone clearance rate and bacteria by using SPSS computer program version 22, the results were expressed as mean ± SD or number, the comparison between the mean values of both groups continuous clinical variables were done by using Mann-Whitney U test. The Comparison between both groups regarding the categorical data (N (%)) was done by chi-square test. P-value < 0.05 was considered statistically significant.

Results

After studying every file of all (340) patients who underwent both procedures (PCNL or ESWL) until an enough period of follow-up that was started from the first day post procedure up to (3 to 8) months for the urine to become free of the bacteria (bacteria < 10^5) in patients who were free of renal stones, while not all patients with residual stones had been found to be free of bacteria, the following results were found: In all, 340 patients were included in this study, with 200 male patients and 140 female patients, the number of male patients who underwent PCNL were 102 and 98 patients underwent ESWL, while the number of females who underwent PCNL were 76 patients and only 64 patients underwent ESWL. The mean (SD, range) age of PCNL patients were 42.7 (±11. 7, 25-66) years. While for ESWL a mean (SD, range) age of 37.22 (± 9.03, 23-56), and for the whole studied groups the mean (SD, range) age of 40.08 (± 10.87, 23-66). (Table I). In all, 178 patients underwent percutaneous nephrolithotomy (PCNL) and 162 patients underwent ESWL forming (52, 3 %), (47.7%), respectively. 143 (80, 3 %) experienced complete renal stone clearance and free from bacteriuria post PCNL, whereas, the number of patients after PCNL who still having residual stones and persistent bacteriuria was 35 patients (19, 6%, *P*-value =0.009). On the other hand only 86 patients were free from renal stones and bacteriuria forming (53 %). While the number of patients post ESWL with persistent bacteriuria due to residual stones was 76 patients, which accounting for (47 %., *P*-value=0.0152). According to the stone size: a mean (SD, range) size of 2.38 (±1.6, 1-4.5 cm) for total patients, while a mean (SD, range) size of 3.095 (± 1.88, 1.8-4.5cm) for PCNL group and a mean (SD, range) size of 1.6 (± 0.5, 1-2.5cm) for ESWL group. The number of patients who had developed fever post PCNL was 23 patients, while 46 patients developed fever post ESWL. The duration of antibiotic use for PCNL group was 10-21 days, while it was 14-33 days for ESWL group. (Table II) ,We found that, there is a correlation between the type of hydronephrosis, and the complete clearance rate of stones and bacteriuria. This correlation becomes obvious, we found that a large proportion of the patients were free from stones post ESWL when they had mild hydronephrosis and when the size of the stone below 2 cm. While in the patients post PCNL, a large proportion of the complete clearance rate in the patients were seen when hydronephrosis was moderate. (Table III)

Table I: Demographic data of study population.

	PCNL(N*=178)	**ESWL(N=162)**
(Age group), mean± SD®	(25-66 years), 42.7 ± 11.7	23-56 years), 37.22 ± 9.03
Number of males	102	98
Number of females	76	64

*The number of the patients, ®Standard Deviation.

Table II: Comparison between PCNL and ESWL in relation to the total number of patients, clearance rate, residual rate, follow up period, size of stone, fever post operations and the duration of antibiotics.

Procedure	**PCNL**	**ESWL**
Total number of the patients for each procedure	178	162
The number of the complete clearance patients	143	86
The number of the patients with residual stones	35	76
Follow up period (mean)	3.5 months	5.5 months
Size of the stone(mean)	3.0 cm	1.6 cm
The number of postoperative febrile patients	23	46
Duration of antibiotics	10-21 days	14-33 days

Table III: Comparison between the 3 types of hydronephrosis in relation to complete clearance of renal stones in both procedures:

Type of hydronephrosis	Post ESWL complete clearance of stones n*=86 (53%).	Post PCNL complete clearance of stones n=143 (80, 3 %).
Mild	N=42 (25, 9 %)	N=14 (8 %)
Moderate	N=36 (22 %)	N=79 (44, 3 %)
Severe	N=8 (5 %)	N=50 (28 %)

*The number of the patients.

Discussion

Our study confirmed the finding that the complete clearance rate of renal stones and eradication of persistent bacteriuria is better in patients who underwent PCNL procedures more than in patients after ESWL procedures according to the size of stone, location and degree of hydronephrosis. Also, the positive relationship between stone free rate and treatment of persistent bacteriuria is confirmed, ESWL is superior treatment of renal and uretric stones as outpatient, non invasive procedure with the least likely for complications, PCNL gives the best results of renal stone management irrespective of stone size and location with high complications rate and period of hospital stay. [12] Despite that PCNL had the better success rate of stone management in a single treatment and ESWL had the lowest rate, but when the second treatment was used for ESWL the success rate was approximately equal to that in PCNL. [13] The stone-free rate in patients with hydronephrosis and multiple stones was lower than that in patients without these conditions, and residual stones rate was higher in patients with hydronephrosis than that in patients without hydronephrosis. [14] PCNL achieved a stone free rate of 96% after the first procedure, then 100% after the second procedure, which means that complete clearance of renal stones in PCNL for stones sized more than 2 cm is very high.[15] While the stone free rate is 93 % in patients who underwent mini PCNL, especially if the size of stone is more than 2 cm. [16] The stone size should be assessed, if the stone is less than 1 cm then ESWL is better to be used for renal stone management, and if the stone size is between 1 and 2 cm we should asses stone composition, if it is composed of calcium oxalate monohydrate, cystine or brushite then PCNL is better, but in other types of stones the location of stone should be assessed, with the preference for PCNL in lower group calyceal stones and for ESWL in renal pelvis, upper and middle calyceal stones, while if the stone size is above 2 cm the preferred procedure is PCNL. [17, 18] For a stone located in the lower group and sized between 10 mm and 40 mm, PCNL achieves a higher clearance rate comparing to ESWL with stone clearance rate being 97.43% and 67.95%, respectively. PCNL is considered more effective in clearing stones and decrease stone complications, while ESWL is less invasive, but with lower clearance rate than PCNL. So PCNL achieves higher stone clearance rate than ESWL regardless of the stone size or location. [19, 20, 21, 22] Even in patients who are on chronic anticoagulant medications who underwent PCNL procedures, the stone free rate may approach 100 %.[23] PCNL is the best modality of treatment for a large stone located in the lower pole of a single kidney in children and the stone free rate was approximately 80%. But when children are cooperative or anesthetized, then maybe ESWL can be a successful option to manage small lower pole stones less than 1 cm. [24]

Conclusion

No correlation between the type of infecting organism and the success rate of eradication of infection, and the most important factor for the clearance of infection was the eradication of all infected fragments, not prolonged use of antibiotics, The success rate of stone of infected stone clearance is not related to previous stones procedures, and PCNL is superior to ESWL regarding complete stone clearance and eradication of bacteriuria regardless the renal location of stones, especially in large stone. We recommended a PCNL as a treatment modality of medium to large size stone (>1.8 cm), especially in the case of moderate to severe hydronephrosis. And It is useful to be

a multi-site or multi-user study with strong study design (RCT) randomized control trial.

Limitations

In our study, we did not consider the stone composition, which is a well known factor affecting the efficacy of ESWL treatment, and this is due to unavailability of the preprocedure lab tests to analyze the stone composition. Also, there is no enough existing data for residual stone patients till being free of bacteria, and a single site study cannot be generalized to the findings.

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