Comparative Study between Outcome of Percutaneous Nephrolithotomy and Extracorporeal Shock Wave Lithotripsy in Patients with Renal Insufficiency

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Abstract:

Background: The incidence of stone formation in patients with renal insufficiency 17.5%, complete clearance of stone in these patients need least invasive procedure with safety of kidney parenchyma and kidney function.

Objectives: To analyze outcomes of percutaneous nephrolithotomy (PNL) and shock wave lithotripsy (SWL) and their effect on kidney function for patients with renal insufficiency.

Materials and methods: 52 renal insufficiency patients with renal stones presented to our department randomized into two groups group A (25 patients) underwent PNL and group B (27 patients) underwent SWL and all results recorded and analyzed with Statistical Package for Social Science® (SPSS) and Microsoft Excel 2010.

Results: Stone free rate was about 84% of patients in group A (25 patients) and about 26.6% of patients in group B with first session, while it`s about 88.9% for all patients in group B (27 patients) with some degree of improvement of kidney function.

Conclusion: This study shows that both PNL and SWL are safe on patients with renal insufficiency with improvement of kidney function.

Keywords: Renal insufficiency, PNL, SWL, outcome and kidney function.

Introduction:

Urolithiasis is a recognized precursor for renal deterioration. Moreover, if untreated, it can lead to renal failure. The prevalence of nephrolithiasis in patients with concomitant renal insufficiency is estimated to be 17.5%, it is a major public health problem and in the surgical setting not only are they at higher risk of anesthetic complications, but at greater risk of post-procedure complications ***(Kellett etal., 1991; Jones et al., 2017)***. In addition to achieving good stone clearance, surgical interventions employed in the treatment of stone disease must try to preserve maximal renal function ***(Kellett et al., 1991; Chandhoke et al1992).***

Management of nephrolithiasis in patients with renal insufficiency is therefore a difficult challenge for the endourologist as well as nephrologists and calls for careful consideration of the risks against the benefits, Multiple modularities can be used for various types of renal stones such as shock wave lithotripsy (SWL), percutaneous nephrolithotomy (PNL), retrograde intrarenal surgery (RIRS) and laparoscopic and/or robotic approaches***(Nasir et al., 2014).***

Gunasekaran et al compared the long-term effects of shock wave lithotripsy (SWL) and percutaneous nephrolithotomy (PNL) on renal function with a solitary kidney and/or

chronic renal insufficiency, SWL known to be dependent upon the type of lithotripter used, total energy and number of shock waves delivered, and focal size of the shock waves. It also can cause hematoma formation, hematuria and residual stones***(Chandhoke etal., 1992)***.PNL depends on number of punctures, type of lithotripter and site and size of stones, PNL can cause parenchymal damage with the hazards of radiation exposure with fluoroscopy, and the risk of bleeding, calyceal or infundibular tear, persistent urine leak***(Jones et al., 2017)*.**

Patients and Methods:

Study design:

This study performed as prospective randomized clinical study for all renal insufficiency patients with renal stones presenting to Urology department, Qena university hospital from January 2018 to January 2020.

Sample size:

We planned to have 52 cases of renal insufficiency patient with renal stones

Patient grouping:

We planned to have two groups each group with at least 25 cases using closed envelope method.

Group A:25patients who underwent PNL.

Group B:27patients who underwent SWL.

Patient selection:

Inclusion criteria:

I. All renal insufficiency patients with renal stones. (S. creatinine 2-4mg/dl)
II. Stone size range (10-30 mm)

Exclusion criteria:

I. Patient on chronic hemodialysis
II. Congenital renal anomalies as pelviureteric junction obstruction (UPJO), ectopic kidney and horseshoe kidney.
III. Uncontrolled coagulopathy.
IV. Patient unfit for general anesthesia

Preoperative evaluation protocol:

1. History taking and physical examination.
2. Laboratory work up:

S. creatinine, Blood urea, Creatinine clearance, estimated glomerular filtration rate (eGFR), Serum electrolyte, Complete blood count, Hematocrit value, Bleeding time, prothrombin time and prothrombin concentration, Random blood sugar.

3. Imaging study:

Pelvi-abdominal U/S, KUB, Non-contrast CT, Radioisotope scan.(If needed).

Post-operative follow up:

1. Hospital stay and complication.
2. Stone free rate (SFR) we define SFR as residual stones less than 4mm.
3. Follow up include:

- Complete blood count and hematocrit value one week later.
- S. creatinine every other day for first week, then after two weeks then after four weeks.
- Pelvi-abdominal U/S two weeks postoperative.
- Serum electrolytes, creatinine clearance and estimated glomerular filtration rate (eGFR) every month for three months.
- Computed tomography (CT) scan, KUB if needed and radioisotope scan if needed after three months.

Results:

This study was conducted at Urology department, Qena University Hospital with about 52 renal insufficiency patients with renal stones randomized into two groups.

The mean age of each group compared, show no statistically significant difference

between two groups in **Table 1** group A ±53.96 years while in group B ±59.04 years. Sex distribution **Table 1** show no statistically significant difference between two groups.

Body mass index between two groups compared **Table 1** show no statistically significant difference between two groups. Mean stone size **Table 2** compared in both group show no statistically significant difference for group A ±23.1 mm and group B ±21.5 mm.

Operation time compared between two groups **Table 3** showed group A with mean time about ±53.04 minutes while group B ±51.22 minutes with no statistically significant difference.

Stone free rate **Table 4** show 84% in group A while it was about 26.6% for patients after first session in group B while it was about 88.9% in all patients in group B.

Pre and post PNL laboratory data compared for group A show improvement in all kidney function test **Table 5**. While pre and post SWL laboratory data compared for group B show improvement in serum creatinine and e GFR with no statistically significant decrease in creatinine clearance **Table 6**.

Postoperative complications **Table 7** show nine cases in group A and fifteen cases in group B with no postoperative complication. Two cases in each group experience fever treated with antipyretic (paracetamol) and antibiotic safe in these cases as (ceftriaxone 1gm). Nine groups A with bleeding from tract of PNL receive blood transfusion and five cases with hematuria in-group B with intravenous fluid and hemostatic hematuria stopped. Only one case in-group A with leakage stopped spontaneously with frequent dressing from tract site two cases with obstruction post SWL in group B, KUB done revealed ureteric stones passed by medical treatment. Four cases with residual stones group A and three cases with residual stones group B need further treatment.

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Table 1.Demographic data

	Group A	**Group B**	***P* value**
Number	25	27	
Age (years) Mean	53.96	59.04	0.04
Male: Female	17:8	15:12	0.623
BMI (kg/m^2)Mean	31.9	31.1	0.089

Table 2.Stone size

	Group A	**Group B**	**P value**
Stone size (mm)	23.1mm ±5.8	21.5mm ±5.1	0.04

Table 3.Operation time

	Group A	**Group B**	***P* value**
Operation time	53.04±7.6	51.22±5.5	0.04

Table 4.Stone free rate

		Group A	**One session SWL**	**Group B**
SFR	**Free**	21 (84%)	8 (26.6%)	24 (88.9%)
	Residual stones	4 (16%)	19 (70.4%)	3 (11.1%)

Table 5.Pre & post group A

	Group A		P value	Percent change
	Pre	post		
S. creat	2.2±0.3	2±0.3	0.001*	9.1%
Creatinine clearance	46.5±11	55±11	0.000*	18.3%
eGFR	47±10	52.8±14	0.003*	12.3%

Table 6.Pre & post group B

	Group B		P value	Percent change
	pre	post		
S. creat	2.3±0.3	2.1±0.3	0.000*	8.7%
Creatinine clearance	48.6±13	47.7±12	0.09	1.9%
eGFR	41.8±8	44.6±8	0.001*	6.7%

Table 7.Complications

Complication	Group A	Group B
No	9 (36%)	15 (55.6%)
Fever	2 (8%)	2 (7.4%)
Bleeding/Hematuria	9 (36%)	5 (18.5%)
Leakage	1 (4%)	0 (0%)
Obstruction	0 (0%)	2 (7.4%)
Residual stones	4 (16%)	3 (11.1%)

Discussion:

Patients with renal insufficiency represent about 0.78-17.5% of patients with urinary stones ***(Yaycioglu et al., 2007).***Urinary stones disease may lead to more deterioration of kidney function by its obstructing effect and infective effect***(Pérez-Fentes et al., 2014).***The treatment of these stones improve renal function, preventing more deterioration and avoid the need for renal dialysis***(Marangella etal., 1990).*** Multiple modalities present for treatment of renal stones includes medical treatment, open surgery, PNL, SWL and RIRS***(Nasir et al., 2014).*** With low morbidity and good stone free ratePNL, SWL and RIRS are more favorable for treatment of renal stones in patients with renal insufficiency as less invasive procedure***(Sinha et al., 2006).***

In this study, we compared the outcome and effect of PNL and SWL for renal stones in patients with renal insufficiency. The data of these patients recorded and analyzed. 52 renal insufficiency patients with renal stones presented to our Urology department complaining mainly from pain and slightly hematuria these patients randomly divided into two groups using closed envelope method group A (25 patients 48.1%) for patient underwent PNL and group B (27 patients 51.9%) underwent SWL. The mean age in our study 53.96 in group A (range 40-65) which not differ from that of group B 59.04 (range 45-72).

In our study, there was no statistically significant difference in both group as group A males 17 (68%) females 8 (32%) while in group B males 15 (55.6) females 12 (44.4%) the overall gender percentage of study males 61.5% and females 38.5% which similar to previous studies***(Zanetti etal., 1992).***

The mean body mass index of patients in our study was comparable in both groups with no statistically significant difference with no impact on results in both groups.

In our study, the mean stone size in both group was 23.1mm in-group A while in-group B 21.5 mm with no statistically significant difference between two groups.

In our study, preoperative laboratory investigation includes (S. creatinine, Creatinine clearance, and eGFR); while for imaging, we use abdominal ultrasound, KUB and CT.

Perez et al uses more blood and urine markers for follow up as laboratory tests***(Pérez-Fentes et al., 2014).***Perez et al and Sinha et al use IVU and ^{99m}Tc DTPA in their

studies***(Sinha et al., 2006; Pérez-Fentes et al., 2014).***

In our study, the operative time recorded and the mean operative in each group compared, mean operative time in-group A 53.04 minutes while in group B 51.22 minutes with no statistically significant difference between two groups but we should consider that in-group B about 19 patients need more than one session.

In our study, the overall stone free rate for group A (PNL) 84% while in group B (SWL) totally 88.9% but when compare stone free rate of group A with patients in group B after first session was about 26.6%, so result in favor of PNL as stone free rate as monotherapy and no need to re-treatment. Deem et al randomized 32 patients to PNL and SWL and followed after 3 months with KUB and CT showing stone free rate PNL superior to SWL (85% vs 33% respectively)***(Deem etal., 2011).***

In Our study, there was statistically significant improvement in both S. creatinine and eGFR similar to other studies as Handa et al and Chandhoke et al**.** ***(Handa et al.,2006;Chandhokeet al., 1992; Johnson et al., 2010).***Ozden et al reviewed 67 patient underwent PNL showing improvement of eGFR as baseline (37.9 ±14.05) while post eGFR (45.1±16.8)***(Mehmet etal., 2015; Ozden etal., 2012).***

In our study, Creatinine clearance show slight deterioration in cases of group B this may be due to exposure to shocks, which affect renal parenchyma and poor drainage post SWL as no catheter for drainage and high incidence of infection. As regard blood loss was more significant in-group A as more susceptible for bleeding during dilatation of tract and manipulation of stones with percentage of loss about 4.8% while in-group B 0.8%present in the form of slight hematuria post session.

In our study, there were some complications recorded ranging from fever, hematuria and residual stones. About 7.7% with fever treated with medical treatment, 26.9% bleeding and hematuria some cases in group A need blood transfusion while other cases improved on medical treatment and about 19.2% with urinary leakage and residual stones which need further treatment as double J stent insertion and endoscopy. Analysis of our complication was similar to previous studies it shows about 46.2% of patients in both groups experience no complication and about 53.8% with mild complication***(Handa et al.,2006; Chandhokeetal., 1992; Johnson etal., 2010).***

Limitation of the study:

The first was the number of patients, which was not high enough to reduce the impact of statistical error during analysis.

The second limitation was inability to do more investigation as radioisotope scan and urine markers for all cases pre and post procedures. The majority of these limitations could not avoid during the study. However, the majority of results analyzed in this study matches with results of previous literature, which indicates that quality of data, and results in our work have not affected by these limitations.

Conclusions:

PNL is safe as SWL in treatment of renal stones in patients with renal insufficiency with high stone freerate, less complication and no or even minimal effect on kidney function.

PNL is more favorable as one session high stone free rates while SWL may need more than one session.

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