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 et al., 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 al.1992).

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 hematomat formation, hematuria and residual stones (Chandhoke et al., 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: 25 patients who underwent PNL.
Group B: 27 patients 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 post-operative.
- 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 eGFR 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.

List of tables

**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/m²) Mean | 31.9    | 31.1    | 0.089   |

**Table 2. Stone size**

|                  | Group A | Group B | P value |
|------------------|---------|---------|---------|
| Stone size (mm)  | 23.1±5.8| 21.5±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 |
|------------------|---------|-----------------|---------|
| Free             | 21      | 8               | 24      |
| (84%)            |         | (26.6%)         | (88.9%) |
| SFR Residual stones | 4      | 19              | 3       |
| (16%)            |         | (70.4%)         | (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±0.3   | 0.000*         | 8.7%            |
| Creatinine clearance | 48.6±1 | 47.7±1  | 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 et al., 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 rate PNL, 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 et al., 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 ingroup 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
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 retreatment. 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 et al., 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; Chandhoke et 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 et al., 2015; Ozden et al., 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; Chandhoke et al., 1992; Johnson et al., 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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