

## RENAL FUNCTIONAL RESPONSE FOLLOWING PERCUTANEOUS NEPHROLITHOTOMY IN PATIENTS OF RENAL STONE DISEASE WITH IMPAIRED RENAL FUNCTION

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### Abstract

**Background :** Urolithiasis is one of the oldest disease known to human beings and has been documented in ancient Greek. Urolithiasis continues to pose a significant health hazard, causing progressive renal impairment, if left untreated. The etiology of renal insufficiency in patients with nephrolithiasis is multifactorial and includes renal obstruction, urinary infection, frequent surgical interventions, and coexisting medical diseases. The purpose of this study is to assess the change in renal function following removal of kidney stones by Percutaneous Nephrolithotomy (PCNL) in patients with associated impaired renal function.

**Materials and methods :** 50 Patients with renal stone disease with associated impaired renal function who were admitted and underwent PCNL in Urology department were selected as per inclusion and exclusion criteria by purposive sampling. Complete clinical evaluation including history, physical examination, relevant examinations & laboratory investigations were performed. All the patients were treated by PCNL monotherapy with Double J stenting. Mean age was 46.63±11.95 years (Age range: 24-72 years). There were 36 males (72%) & 14 females (28%) & male to female ratio was 2.57:1.

**Results :** In this study, a significant fall in mean serum creatinine (0.5 mg%) was demonstrated following the stone removal. The creatinine

value remained unchanged in 12% and improved in 84% patients. In contrast to the improvement of renal function as evident by a decline in the mean serum creatinine values, the mean Glomerular Filtration Rate (GFR) registered a small fall of 1.78 ml/min (Statistically not significant). we have observed that total 12 (24%) patients out of 50 cases experienced different sorts of complications.

**Conclusion:** This study showed that PCNL approach to urolithiasis in patients with impaired renal function significantly improves renal functional status manifested according to the preoperative and postoperative difference of serum creatinine and 99mTc DTPA performance.

### Key words

Impaired renal function; Renal stone; Nephrolithotomy.

### Introduction

Urolithiasis is one of the oldest disease known to human beings and has been documented in ancient Greek<sup>1</sup>. Urolithiasis continue to pose a significant health hazard, causing progressive renal impairment, if left untreated. Patients with renal insufficiency comprise 0.78–17.5% of the cases treated for urinary stone disease<sup>2</sup>. Gupta et al. 1994 reported that 75.8% of urolithiasis patients with mild to moderate renal insufficiency required multiple procedures for treatment including Extracorporeal Shock Wave Lithotripsy (ESWL) percutaneous and ureteroscopic procedures and even open surgery.

One of the major causes for acute and chronic renal failure is the stone formation. Kidney stones result from the precipitation of certain substances within the urine<sup>3</sup>. The etiology of renal insufficiency in patients with nephrolithiasis is multifactorial and includes renal obstruction, urinary infection, frequent surgical interventions, and coexisting medical diseases<sup>4</sup>.

The prevalence of urinary calculus disease in patients on maintenance hemodialysis is reported to

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be 3.2%. On the other hand, 1.9% to 7.7% of patients who undergo Percutaneous Nephrolithotomy (PCNL) have Chronic Kidney Disease (CKD)<sup>5</sup>. Removing obstructive urinary calculi and eradicating urinary infection through a minimally invasive procedure may improve kidney function.

Percutaneous Nephrolithotomy (PCNL) is the gold standard procedure for treating renal stones larger than 2 cm. PCNL has replaced open surgical removal of large or complex calculi at the most institutions. Extracorporeal shockwave lithotripsy has limitations in poorly functioning kidneys. Furthermore, any surgical intervention is complicated in the presence of azotemia and may deteriorate renal parenchymal injury. Percutaneous endourologic procedures seem to be the most suitable option, because of causing minimal morbidity and mortality<sup>6</sup>. Percutaneous nephrolithotomy in patients with CKD provides a high stone-free rate and may also improve kidney function<sup>7</sup>.

#### Materials and methods

This prospective observational study was conducted in the Department of Urology, National Institute of Kidney Diseases & Urology from January 2015 to December 2016. 50 patients with renal stone disease with associated impaired renal function who were admitted and underwent PCNL in Urology department were selected as per inclusion and exclusion criteria by purposive sampling. Inclusion criteria were stone size-1cm or more, impaired renal function (Serum creatinine >1.5 mg/dl), sterile urine culture, normal coagulation studies & radio opaque stones. Exclusion criteria were patient with bleeding disorder, single kidney, pregnant women, renal stone with ureteropelvic junction obstruction, anatomical abnormality that hampers patient positioning, i.e scoliosis & radio-lucent stone.

A detailed history and clinical examination of the patients were done. The calculus burden, anatomy of the renal collecting system, and the degree of hydronephrosis were evaluated using plain radiography, ultrasonography of KUB and non-contrast-enhanced spiral computed tomography. The renal function status was evaluated using biochemical tests (Blood urea, serum creatinine, serum electrolytes). The lowest creatinine value obtained before surgery was accepted as the baseline creatinine

level of the patient. All patients will undergo a dynamic renal radioisotope scan using 99m Tc DTPA to quantify the total and split renal functions and estimate the Glomerular Filtration Rate (GFR). Pre-operative management will include culture-specific antibiotic treatment of those with urinary tract infection, transfusions for those with severe anemia & optimization of blood sugar level where appropriate. Nephrology consultation was obtained for all patients for the control of hypertension as well as the planning of renal replacement therapy before and after surgery as necessary. Stone diameter was taken as the largest diameter of the stone measured in millimeters on a plain radiogram.

All the patients were treated by PCNL monotherapy with Double J stenting. Renal access was achieved under fluoroscopic guidance, preferably through the lower calyx. Tract dilation was performed and a 26 F Amplatz sheath was placed. Pneumatic lithotripter was used for fragmentation of the calculi. Particles were extracted by suction or grasper. Then a 6 F ureteral double-J stent and 24-F nephrostomy were inserted. The nephrostomy tube was removed 24 hours after the operation. Ureteral double-J stent was removed 4 to 6 weeks after the operation. The Foley catheter was removed 48-72 hours after the procedure, once hematuria ceased & patient was discharged from hospital.

Operation time was defined as the time elapsed in minutes from the induction of anesthesia until the patient leaves the operating room. Hospitalization time was defined as the number of days the patient spent at the hospital starting from the day of surgery. A successful outcome was defined when the patients were rendered stone free or had residual fragments smaller than 4 mm after PCNL. Patients having residual fragments larger than 4 mm after PCNL will be regarded as failures.

Postoperative renal function was estimated using serum creatinine, 99mTc DTPA renal scan and GFR estimation, 12 weeks after surgery. Statistical analyses were done using the chi-square, independent and paired samples t tests.

#### Results

Out of 50 patients aximum 56% belonged to the age group 30-49 years & mean age was 46.63±11.95 years (Age range: 24-72 years). There were 36 males (72%) & 14 females (28%) & male to female ratio was 2.57:1.

**Table I :** Age distribution (n=50).

Age group (In years)	Frequency (%)
<30	7 (14%)
30 – 49	28 (56%)
50 – 59	11 (22%)
60 – 69	3 (6%)
≥70	1 (2%)
Mean age	46.63±11.95
Age Range	24 – 72

**Table II :** Distribution of stone parameters (n=50).

Variables	Values (n=50)
Stone size (In mm)	
10 – 14	6 (12%)
15 – 19	19 (38%)
20 – 24	16 (32%)
≥25	9 (18%)
Mean stone size (in mm)	22.84±1.07
Stone Side	
Right	29 (58%)
Left	21 (42%)
Bilateral	0 (0%)
Location of stone	
Calyceal	17 (34%)
Pyelocalyceal	21 (42%)
Pelvic	12 (24%)
Number of stones	
Single	37 (74%)
Multiple	11 (22%)
Staghorn	2 (4%)

**Table III :** Baseline characteristics (n=50).

Variables	Values
Hb (gm/dL)	10.9±1.3
S.creatinine	2.1±0.8
Urine C/S	
Culture positive	37 (74%)
Culture negative	13 (26%)
Urine R/M/E	
RBC present	42 (84%)
RBC absent	8 (16%)
Pus cells plenty	36 (72%)
Pus cells a few	14 (28%)
RBS (gm/dL)	133±11.54

Table III shows that the different hematological and microbiological baseline characteristics of patients.

**Table IV :** Treatment variables (n=50).

Variables	Values
Mean operation time (Min)	175±69
Mean hospitalization (Days)	7.1±4.9
Complications (%) (n=12)	
Transfusion	8%
Fever	12%
Sepsis	2%
Pleural injury	2%
Extravasations/Urine leak	2%
Colonic injury	0%
Mortality	0%

Table IV shows that surgery related variables that proclaims mean operation time and hospitalization as well as different type of PCNL related complications. Fever claimed the highest complications. Some complications jointly manifested in same patients.

**Table V :** Renal function improvement (n=50).

	Preoperative	Postoperative	p-value
S. creatinine	2.1±1.3	1.5±0.8	<0.05 <sup>S</sup>
99m TC DTPA scan	8.11±8.06	20.48±14.73	<0.001
GFR (total) (ml/min)	65.32	63.54	>0.05 <sup>NS</sup>
GFR (Affected kidney) (ml/min)	26.89±15.1	27.57±18.54	

### Discussion

In this study, out of 50 patients 28(56%) were from the age group 30-49 years. The mean age of the respondents was 46.63±11.95 years (Age range: 24-72 years). Our reports were very much similar to study done by Moskovitz B et al, who reported that the mean age of the respondents was 47±16 years<sup>8</sup>.

Renal failure is the worst complication of upper tract stone disease which is potentially recoverable in many cases if obstruction is relieved at an early stage<sup>2</sup>. In our study, a significant fall in mean serum creatinine (0.5 mg%, p= <0.05) was demonstrated following the stone removal. Two patients (One partial and another complete staghorn calculus) (4%) demonstrated a marginal increase in the serum creatinine level. The creatinine value remained unchanged in 12% and improved in 84% patients. Gupta et al had shown an improvement in creatinine clearance and a fall in serum creatinine in 32 of their 33 patients<sup>2</sup>. In follow up of 13 of those patients, 9 had continued to

have stable renal function while 4 had progressed to ESRD. Minocha et al had performed PCNL in 11 patients of CRF, 8 of which showed improvement in renal function with fall in creatinine levels, while 2 patients continued to show deterioration of renal function<sup>9</sup>. In contrast to the improvement of renal function as evident by a decline in the mean serum creatinine values, the mean GFR (Total) registered a small fall of 1.78 ml/min (Statistically not significant). Mean GFR of the affected kidney improved from 26.89±15.1 ml/min to 27.57±18.54ml/min.

In our study, we have observed that total 12 (24%) patients out of 50 cases experienced different sorts of complications. An international multi-center study of 5,803 patients undergoing PCNL reported an overall complication rate of 21.5% that were very much similar to this report. The study, conducted by the Clinical Research of the Endourological Society (CROES) found majority of complications were minor, with rates of 11.1%, 5.3%, 3.6%, 0.5% and 0.03% of for grade I, II, III, IV and V complications, respectively<sup>10</sup>. The most common minor complications included nephrostomy tube leakage (15%) and transient fever (10-30%)<sup>11</sup>. Major complications (Grade III, IV and V) of PNL are often associated with the performance of percutaneous access into the renal collecting system, and may include injury to adjacent organs, violation of the pleural space, bleeding or infection. In this study, 12% grade I,II and almost 10% grade III, IV,V complications observed.

Dynamic renal scanning using 99m Tc DTPA had shown moderate cortical uptake in 32 patients (64%) while the rest 36% had a poor/negligible uptake. Other workers, who had studied renal function in stone disease using 99m Tc DTPA had observed persistence of delayed clearance of the isotope and prolonged transit times for several years after operative stone removal<sup>12</sup>. In their study on stone removal in patients of urolithiasis with severe chronic renal insufficiency, Witherow and Wickham had observed that improvement of function in severely compromised kidneys was occasionally evident after as long as 3 months after surgery.

#### Limitations

It was a cross sectional study. The sample size is very small & study period was very short. Solitary kidney patient with stone was excluded from the

study. So, whether after removal of solitary kidney stone with severely compromised functional status could not be assessed whether improvement or ESRD was obvious after stone removal.

#### Conclusion

This study showed that the significant improvement of renal functional status which was significantly manifested according to the preoperative and postoperative difference of serum creatinine and 99mTc DTPA performance. So, it can be clearly said that PCNL approach to urolithiasis may radically improve the renal functional status.

#### Recommendation

A case control study is advocated with long term study and large sample size. Study including stones with solitary kidney is recommended so that a standard approach of guideline in such condition can be formulated.

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#### Contribution of authors

SMSAK-Conception, design, acquisition of data, drafting & final approval.

IE-Design, acquisition of data, drafting & final approval.

KZR-Acquisition of data, drafting & final approval.

MN-Interpretation of data, critical revision & final approval.

ASA-Data analysis, drafting & final approval.

KRA-Interpretation of data, critical revision & final approval.

#### Disclosure

All the authors declared no competing interest.

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