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## Evaluation of alteration of glomerular filtration rate in operated kidney after percutaneous nephrolithotomy operation

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### Abstract

**Background:** Percutaneous Nephrolithotomy (PCNL) is advanced minimally invasive endoscopic procedure for management of renal stones. There are limited studies showing early changes of renal function following PCNL. Knowledge of the changes of renal function after PCNL may act as a guide during postoperative follow-up, especially those at risk.

**Methods:** From 1<sup>st</sup> November 2016 to 30<sup>th</sup> October 2018, patients were subjected to PCNL under general anaesthesia. A preoperative 99 m Tc DTPA renal scan was performed & repeated on 3<sup>rd</sup> & 14<sup>th</sup> post-operative day.

**Results:** Total 102 patients were divided into 19-32, 33-46 and 47-60 years group. At post-operative day-3 GFR of operated kidney reduced significantly in all 3 age groups ( $p < .05$ ) but at post-operative day-14 changes were not significant ( $p > .05$ ).

**Conclusions:** Nephrotoxic drugs, contrast agents, ESWL etc. has negative influence on renal function. These should be avoided to prevent further trauma of operated kidney in early post-operative period.

**Keywords:** GFR, 99 m Tc DTPA, PCNL, Post-operative

### Introduction

Urolithiasis is one of the important cause of morbidity affecting urinary system like kidney with a lifetime prevalence is 13% and 7%, in male & female respectively <sup>[1]</sup>.

The kidney performs important functions to maintain internal composition of body fluids. It is important to assess the renal function in health as well as in disease condition. The most important parameter is Glomerular Filtration Rate (GFR) measurement determining renal function <sup>[2,3]</sup>.

The long term effects of PCNL on renal function have been evaluated and significant alteration has not been reported yet <sup>[4]</sup>.

There are limited studies showing early changes of renal function following PCNL operation, like in one study GFR significantly decreased upto 2 days after PCNL but at 3<sup>rd</sup> post PCNL day it returned to near pre-operative values in <sup>[5]</sup>. In another study there was a moderate decrease in renal function 1 day post PCNL that returned to near baseline values at 14 days <sup>[6]</sup>, but other study showing estimated GFR during the first few days after standard PCNL. Renal GFR decreased immediately after PCNL, reaching a nadir at 48 h after the operation and then, increases slowly <sup>[7]</sup>.

As the Studies showing changes in kidney functions in the early period after PCNL is limited. This study done for this purpose in which changes in the glomerular filtration rate (GFR) will be evaluated during the early postoperative period.

It is thought that knowledge of the changes that can develop in kidney function after PCNL operation during the early period may act as a guide during postoperative follow-up, especially when managing those at risk and in the selection of drugs.

### Materials and Methods

This is a hospital-based Prospective, Comparative, Analytical study was carried out over a period of 3 years from Between 1<sup>st</sup> November 2016 to 30<sup>th</sup> October 2018. Ethical approval was

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sought and obtained from the ethical committee of the hospital (Memo no-Inst/IEC/2018/258).

**Exclusion criteria**

Patients who did not give their consent to the study or patient presented with medical comorbidities like DM, HTN, and UTI or past history of any previous intervention for renal stone disease, high creatinine level >1.5 mg/dl, and post-operative complications like sepsis, shock.

**Inclusion criteria**

Age ranging from 19-60 years, unilateral renal stone disease, stone size >1.5 cm, single puncture during PCNL operation, complete clearance achieved during operation and absence of post-operative complication were studied.

**Methodology**

All the patients having renal stone disease based on renal imaging like X-ray KUB, CT scan, IVP were studied. Routine standard preoperative work up of all the patients were undertaken. A preoperative 99 m Tc DTPA renal scan was performed for comparison with a postoperative DTPA scan which was done on 3<sup>rd</sup> & 14<sup>th</sup> post-operative day. Informed written consent was taken from the patient to participate in the study. Following inclusion into the study the patients were consecutively recruited for the study groups. The patients in the study group were undergone PCNL under General Anesthesia.

A 5 French open ended ureteral catheter is placed in the ipsilateral ureter using 30 degree lens & 21 French sheath, and is secured to a 16 French Foley’s catheter with 2-0 silk in Lithotomy position. Patients are then placed in the prone position and areas under pressure are protected with pads under fluoroscopic guidance access to desire calyx are achieved using 18 gauge Chiba needle. We pass the terumo guide wire (0.32mm), through the needle and nephrostomy tract is dilated in a sequential manner via fascial sheath (8, 10 & 12) followed by alken metallic dilator up to 28 French. Using a 26 French Olympus Nephroscope and Pneumatic Lithoclast (SWISS lithoclast), target stone is fragmented and removed. A 5.5 French, 26 cm DJ stent is given. An 18 French Nephrostomy tube is placed in renal pelvis and opening side is closed. Instead of discharging that patient on 3<sup>rd</sup> post of day we have performed 99 m Tc DTPA Renal Scan. Along with blood creatinine is measured and urine is sent for culture.

**Statistical analysis**

Statistical Analysis was performed with help of Epi Info (TM) 7.2.2.2. EPI INFO is a trademark of the Centers for Disease Control and Prevention (CDC). Using this software, basic cross-tabulation, inferences and associations were performed.  $\chi^2$  Test was used to test the association of different study variables with the study groups. Z-test (Standard Normal Deviate) was used to test the significant difference between two proportions. T-test was used to compare the means. One way analysis of variance (ANOVA) was used to compare more than two means at a time and also Tukeys test followed by one way ANOVA was used to calculate critical difference (CD) to compare the means pairwise. P < 0.05 was considered statistically significant.

**Results**

Between from 1<sup>st</sup> November 2016 to 30<sup>th</sup> October 2018 total 129 patients were enrolled in this study. Of these enrolled patients, 102 (79.07%) were included in the study, whereas 22 patients were excluded because of multiple puncture (9 patients),

incomplete stone clearance (6 patients), post-operative urinary tract infection with fever & positive urine culture & sensitivity (4 patients) and hematuria with hypotension requiring blood transfusion (3 patients).

The ages of the 129 participating patients ranged from 19 to 60, the mean age (mean  $\pm$  s.d.) of the patients were 40.71 $\pm$ 11.53 years with median was 41 years. Most of the patients (39.2%) were with age between 33 – 47 years which was higher than other age group but it was not significant (Z=0.86;p=0.22).

**General characteristic**

Total 129 patients were enrolled. Refused to Participate, N= 5; mean age = 34.80 years, Median age=28, (19- 57yrs). Participated in the Study N = 124; mean age = 40.61 years, Median-41 years (19-60yrs). Excluded: N = 22; mean age = 41.18 years, Median-41.5 years (19-60yrs). Included in the Study, N = 102; mean age = 40.71 years, median 41 years (19-60yrs). These 102 patients were divided into 3 age groups 19-32 years, 33-46 years, and 47-60 years. The mean age (mean  $\pm$  s.d.) of the patients was 40.85 $\pm$ 11.21 years with range 19 – 60 years and the median age was 41 years. Most of the patients (39.2%) were with age between 33 – 47 years which was higher than other age group but it was not significant (Z=0.86;p=0.22). Thus urolithiasis was mostly prevalent among the patients with age between 33 – 47 years. (Table 1).

**Table 1:** Distribution of age of the patient

Age (in years)	Number	%
19 - 32	28	27.5%
33 - 47	40	39.2%
48 - 60	34	33.3%
Total	102	100.0%
Mean $\pm$ standard deviation.	40.85 $\pm$ 11.21	
Median	41	
Range	19 - 60	

The ratio of male and female (Male: Female) was 1.6:1.0. Test of proportion showed that proportion of males (60.8%) was significantly higher than that of females (39.2%) (Z= 3.05; p<0.0001). Thus males were in significantly higher risk of having renal stone disease than females  $\chi^2=0.53$ ; p=0.76 (Not Significant).

Corrected Chi-square ( $\chi^2$ ) test showed that there was no significant association between age and gender of the patients (p=0.76). Thus the prevalence of urolithiasis was more or less equally distributed over the age of male and female patients (Table-2)

**Table 2:** Distribution of gender of the patients

Gender	Number	%
Male	62	60.8%
Female	40	39.2%
Total	102	100.0%
Male: Female	1.6:1.0	

Though the mean age of males was higher than that of females, t-test showed that there was no significant difference in mean age of males and females (t<sub>100</sub>=0.03; p=0.86). Thus females were at higher risk of having urolithiasis at a younger age than that of

males.

One ANOVA showed that there were significant differences in mean level of DTPA at different time intervals of the patients ( $F_{2,303}=10.50$ ;  $p<0.0001$ ). As per Tukeys critical difference (CD) the mean level of DTPA of the patients decreased significantly at post-operative Day 3 and then increased at post-operative Day 14. However, no significant difference was found between the mean pre-operative level of DTPA and at post-operative Day14 of the patients ( $p>0.05$ ). Thus at post-operative Day14 the mean

level of DTPA was almost equal to pre-operative level of DTPA. At Day3 the level of DTPA of all the patients decreased as compared to pre-operative level of DTPA. However, At Day14 the level of DTPA of 47.1% of the patients increased as compared to pre-operative level of DTPA.

Test of proportion showed that the level of DTPA increased significantly at Day14 (47.1%) as compared to Day3 (0.0%) ( $Z=7.84$ ;  $p<0.001$ ). (Table-3).

**Table 3:** Distribution of Mean GFR at pre-operative period, post-operative day 3 & day-14 in different groups

Age in years	Pre op mean GFR (ml/min)	Mean GFR at day-3 (ml/min)	F-ratio Difference at POD3	p-value Difference at POD3	Mean GFR at Day-14 (ml/min)	F- ratio Difference at POD-14	P-value Difference at POD-14
19-32	38.17	34.08	$F = 4.477$	$P=.038981$ significant	38.43	$F = 0.01796$	$P=.893886$ Not significant.
33-47	36.09	32.80	$F = 6.38066$	$P=.013563$ significant	36.15	$F = 0.00176$	$P=.966659$ . Not significant
48-60	38.03	34.31	$F = 5.92319$	$P=.017658$ . significant	37.14	$F = 0.31939$	$P=.57389$ . Not significant

GFR-glomerular filtration rate, POD- post operative day

The mean duration of surgery (mean  $\pm$  s.d.) was  $104.96\pm 18.28$ , with range 60 – 130 minutes and the median was 105 minutes. For most of the patients the duration of surgery  $\geq 90$  minutes (68.6%) was significantly higher than that the duration of surgery  $< 90$  minutes (31.4%) ( $Z=5.26$ ;  $p<0.001$ ). (Table-4)

**Table 4:** Distribution of duration of surgery of the patients

Duration of surgery (In minutes)	Number	%
$< 90$	32	31.4%
$\geq 90$	70	68.6%
Total	102	100.0%
Mean $\pm$ standard deviation.	$104.96\pm 18.28$	
Median	110	
Range	60 - 130	

At Day3 the level of DTPA of the patients with duration of surgery both  $< 90$  minutes and  $\geq 90$  minutes decreased as compared to pre-operative level of DTPA. However, at Day14 the level of DTPA of the patients with duration of surgery both  $< 90$  minutes increased in significantly higher proportion (53.1%) than that of the patients with duration of surgery both  $\geq 90$  minutes (44.2%) ( $Z=2.06$ ;  $p=0.027$ ).

## Discussion

In this study One ANOVA showed that at post-operative day-3 GFR of diseased kidney reduced significantly in all 3 age groups (19-32,33-47 &48-60 years) ( $p<.05$ ) in comparison to pre operation value but at post-operative day-14 GFR changes are not significant statistically from pre-operative value ( $p>.05$ ).

At Day-3 the level of GFR of all patients decreased as compared to pre-operative level of DTPA. However, At Day-14 the level of GFR of 47.1% of the patients increased to pre-operative value as compared to pre-operative level.

We have found that time is also important factor in relation to operative trauma. At Day3 the level of DTPA of the patients with duration of surgery both  $< 90$  minutes and  $\geq 90$  minutes decreased as compared to pre-operative level of DTPA. However, at Day14 the level of DTPA of the patients with duration of surgery both  $< 90$  minutes increased in significantly higher proportion (53.1%) than that of the patients with duration of surgery both  $\geq 90$  minutes (44.2%) ( $Z=2.06$ ;  $p=0.027$ ).

In a prospective series of 11 patients, Ekelund and associates performed renal scintigraphy using  $^{99m}\text{Tc}$ -DTPA to evaluate overall renal function after unilateral PCNL.<sup>[6]</sup> In these patients, who had non-obstructing and non-infectious stones, there was a

moderate decrease in renal function 1 day postoperatively that returned to near baseline values at 14 days. However, in three patients, there was a 20% decrease in renal function of the treated kidney at 14 days. Similar finding shown by Kuzgunbay B *et.al.* [8].

In his study Saxby assessed creatinine clearance of urine just before, 24 hours after, and 2 weeks after unilateral PCNL but noted no statistical significant differences [9].

Another study by Hosseini S.R. and associate showed that mean GFR pre-operatively was 74.8944 mL/min, after 48 hours was 64.0427 mL/min, and 72 hours was 69.5417 mL/min following PCNL [10].

Functional studies in porcine model also done by Handa and colleagues after unilateral nephrostomy and tract dilatation up to 30 French. Using renal clearance of para-aminohippuric acid (EPAH), GFR and RPF in the treated renal unit measured and it was significantly lower following 1 hour after intervention (55%), but reverted to baseline at 72 hours [11].

Like aforementioned studies in our study also we have found that following PCNL there is statistically significant drop of GFR of operated kidney in post-operative day-3 in all age groups compared to pre-operative value because of operative trauma. But it begin to recover. And at post-operative day 14 operated kidney regain its function towards the pre-operative value as GFR at POD-14 was statistically not significant in comparison to pre-operative value.

So it is advisable to avoid factors that can bear a negative influence on renal function during the early postoperative period such as nephrotoxic drugs, contrast agents, ESWL and Re-PCNL.

## Conclusion

It is thought that knowledge of the changes that can develop in kidney function after PCNL during the early period may act as a guide during postoperative follow-up, especially when managing those at risk and in the selection of drugs.

Nephrotoxic drugs, contrast agents, ESWL and Re-PCNL and UTI etc., has negative influence on renal function. So these should be avoided to prevent further trauma of operated kidney in early post-operative period. If relook-PCNL or ESWL etc. required we should delay to provide adequate time for recovery of operated kidney.

So this study can be helpful in establishing a protocol for management of post-operative patient of PCNL surgery thus further trauma of operated kidney can be minimized.

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