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Effects Of Percutaneous Nephrolithotomy In Chronic Kidney Disease Patients In Our Tertiary Care Center

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ABSTRACT
Introduction: *Chronic kidney disease is defined as a long-standing irreversible impairment of kidney function, causing a major public health problem. Renal stone disease is the leading cause for the deterioration in the kidney function. Renal stone disease has a prevalence of 1.7% to 18% patients with CKD. Management of renal stone in CKD patient is to retain the maximum renal function and to provide pain relief, removing the source of recurrent renal calculi and prevent UTI. Percutaneous nephrolithotomy (PCNL) gives optimum stone clearance in a large stone with poor functioning kidney.*
MATERIALS AND METHODS: *20 patients sufficed inclusion criteria with stone size more than and equal to 1.5 cm. The exclusion criteria in the study included patient with bleeding disorders, pregnancy and poor on follow up. Patients were split into two groups, Group A (GFR ≤30 ml/min/m^2) and Group B (GFR >30 <60 ml/min/m^2). Patients were followed up for a period of 6 months. The pre-PCNL eGFR and eGFR at last follow-up were recorded and analysed.*
RESULTS: *The mean age of the patients was 56 years. The mean eGFR pre-PCNL for Group A was 23.68 ml/min/1.73 m2 and Group B was 47.50ml/min/1.73 m2. At a mean follow-up of 180 days, post-PCNL eGFR was 26.02 mL/min/1.73 m2 in Group A and 54.85 mL/min/1.73 m2 in Group B. Mean stone size was 1.76 cm.*
CONCLUSION: *CKD patients have good clearance rates and good renal functional outcome with PCNL. Patients with high-risk CKD should undergo PCNL with care and full understanding of its complications.*
KEYWORDS: *Chronic kidney diseases, estimated glomerular filtration rate, percutaneous nephrolithotomy*

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I. Introduction

Chronic kidney disease is defined as a long standing irreversible impairment of kidney function, causing a major public health problem.[1] Renal stone disease is the leading cause for the deterioration in the kidney function.[2] Renal stone disease has a prevalence of 1.7% to 18% patients with CKD.[3]CKD patients who undergo surgical procedure have risk of anesthetic and post procedure complications.[4,5] Management of renal stone in CKD patient is to retain the maximum renal function and also to provide pain relief, removing the source of recurrent renal calculi and prevent UTI. The various surgical management of renal stone in CKD patient are percutaneous nephrolithotomy (PCNL), extracorporeal shock wave lithotripsy (ESWL), retrograde intrarenal surgery (RIRS). Percutaneous nephrolithotomy (PCNL) gives optimum stone clearance in a large stone with poor functioning kidney. But the drawback being its complications like bleeding and acute or chronic deterioration of renal function limits its usage. This study is aimed to analyze demography, factors causing renal function impairment, complication and procedure outcomes in patients with Stage III, IV and V CKD undergoing PCNL

II. MATERIALS AND METHODS

A total of 70 consecutive PCNLs were done for renal calculi at our institution from July2020 to July 2022. 20 (28%) patients sufficed inclusion criteria with stone size more than and equal to 1.5 cm. The exclusion criteria in the study included patient with bleeding disorders, pregnancy and poor on follow up. Modification of Diet in Renal Disease (MDRD) equation was used in our study to estimate glomerular filtration rate eGFR of each patient.[6] National Kidney Foundation Kidney Disease Outcome Quality Initiative classification system was used to classify CKD.[7] Patients were split into two groups, Group A (GFR ≤30 ml/min/m^2) and Group B (GFR >30 <60 ml/min/m^2). Patient demographic parameters, kidneys, ureters, bladder (X-KUB), computed tomography (CT) KUB findings, routine blood, and urine analysis reports were recorded. All patients underwent PCNL by standard C-Arm guided approach, using Bull's eye technique.[8] Patients were followed up for a period of 6 months. The pre-PCNL eGFR and eGFR at last follow-up were recorded and analysed.

III. RESULTS

Seven patients were included in Group A, out of which 4 are men and 3 women, while Group B had thirteen patients of which 7 were men and 6 women. Mean age was 60.57 years in Group A and 55 years in Group B.(Table 1) Mean stone size was 1.76 cm. Left-sided (7) PCNL were done more commonly. 7 units had solitary renal calculus as compared to 4 units with multiple calculi and staghorn calculus was present in 1 unit. Comorbidities associated with CKD included diabetes mellitus in 2 patients, hypertension in 7, both diabetes and hypertension in 2 patients. However, no comorbidity except urinary stone disease that might cause CKD was noted in 1 patient.

Table 1: Patient demographics

Patient data	Group A	Group B	Total
CKD stage	IV and V	III	
Number of patients	7	13	20
Mean age(years)	60.57	55	56.95
Female	3	7	10
Male	4	6	10
Side			
Right	3	6	9
Left	4	7	11

The mean eGFR pre-PCNL for Group A was 23.68 ml/min/1.73 m2 and Group B was 47.50ml/min/1.73 m2. Intraoperatively, mean 1.42 sittings were required in Group A as compared to 1.07 sitting in Group B. 2 patients in Group B required blood transfusion where none of the group A patient required blood transfusion.

Total 3 out of 7 renal units had complete clearance in Group A as compared to 12 out of 13 in Group B. Postoperatively, one patient in Group B needed ICU stay as compared to none in Group A. 1 patient in Group A underwent an auxiliary procedure for stone clearance as compared to 2 in Group B. Mean hospital stay was 5 days in Group A as compared to 4 days in Group B. At a mean follow-up of 180 days, post-PCNL eGFR was 26.02 mL/min/1.73 m2 in Group A and 54.85 mL/min/1.73 m2 in Group B. Deterioration of renal function was seen in 5 patients out of which 4 patients were of Group A and 1 in Group B. In either of the groups there was no mortality at a follow-up of 180 days. Patients with CKD who had concomitant disease had improved renal function.

On complications stratification as per CD classification more complications were observed on in Group B falling in the grade of 2and 3 compared to CD Grade 1,2,3 and 4 complications were seen in Group A.

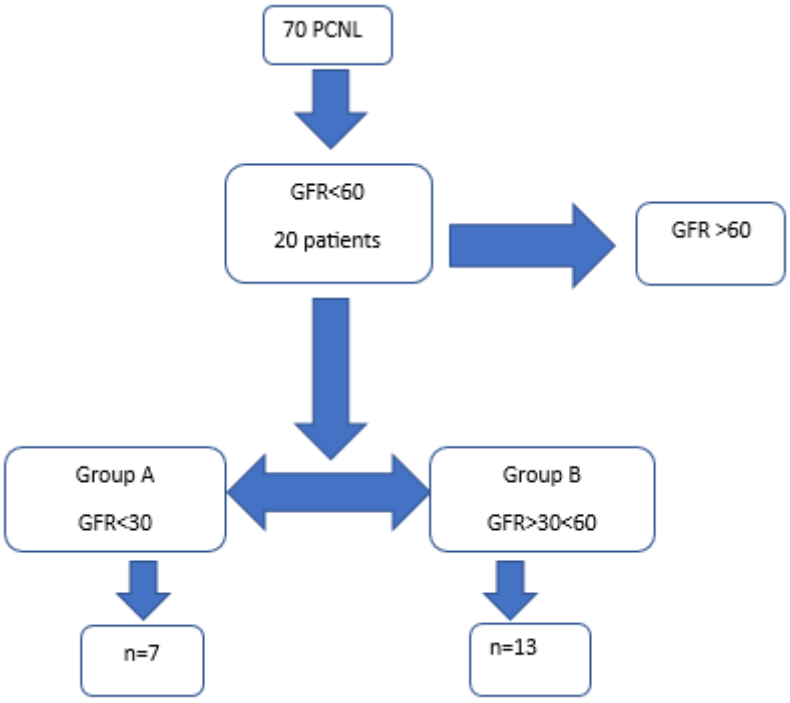

Figure 1: Sample collection

IV. Discussion

CKD presenting with Renal Calculi patients are common in urologic practice. In the present era, wide array of non-invasive and minimally invasive surgical modalities are available for stone management including ESWL, RIRS, PCNL, and laparoscopy. Renal calculi >2 cm is managed by PCNL which is gold standard and its efficacy is well documented in literature. PCNL has highest single step success rate. However, the high success rate tends to have concerns regarding serious complications such as bleeding, need for blood transfusion, anaesthesia-related complications , urinary tract infection, fever, ICU stay, and adjacent organ injury.[9] CKD patients are always associated with some comorbidities such as hypertension or diabetes mellitus, bleeding diathesis. Therefore, they are always at more operative risk compared to general population. In CKD patient the kidney is already compromised due to some degree of kidney parenchymal and bleeding complications especially associated to deranged blood parameters including liver failure, thrombocytopenia.

Pre- and postoperative Indices of patients

Indices	Group A	Group B	Total
Intraoperative complications			
Number of sittings	1.42	1.07	1.24
Need for blood transfusion	1	3	4
Complete clearance (%)	42.85%	92.3%	75%
Postoperative complications			
Need for ICU	0	3	3
Auxiliary procedures	1	2	3
Pre-PCNL GFR (ml/min/m^2)	23.68	47.50	35.59
GFR at follow-up (6 months)	26.02	54.85	40.43
Detoriation of renal function	4	1	5
Mean rise in GFR	2.34	7.34	7.47
Mortality	0	0	0

ICU: Intensive care unit, PCNL: Percutaneous nephrolithotomy, GFR: Glomerular filtration rate

The stone-free rate in our series was 65.8% after one session of PCNL, and it improved to 83% after relook PCNL (2 required relook PCNL) and improved to 90% after auxiliary procedures (1 required ESWL). Which is comparable with other studies in the literature reporting 60%–90% clearance rates.[11-13] In our study, Group A had complete clearance after one session of PCNL was observed in 42.85% as compared to 92.3% in Group B. Our study is comparing the efficacy of PCNL in subgroups of CKD patients making it one of its kind to the best of our knowledge. Patients with higher CKD stage had low clearance rate, which can be due to associated comorbidities, increased stress due to poor functioning kidneys, and bleeding causing poor visualization. As per the literature, our research work has also encountered some postoperative complications. Nearly 35% cases had PCNL related complications. 1 patient in Group A required blood transfusion as compared to 3 in group B. Up to 20% of the CKD patient reported the need for transfusion. Detailed preoperative and intraoperative planning may reduce PCNL associated complications in these patients. When postoperative complications were stratified as per CD grades additional complication were noticed, in which clinically important complications were seen only in CD Grades 4, 3, and 2. Need of ICU stay ,blood transfusion secondary to bleeding, and need of auxiliary procedures for residual stones were the common complications encountered.

In a study by Kurien et al.,[14] 91 patients with CKD undergoing PCNL were studied for factors predicting further renal deterioration. CKD stage deteriorated in 12 patients (13.2%). Eight patients (8.8%) required maintenance hemodialysis or renal transplantation. Among our patients in Group A, four needed dialysis as compared to no one in Group B. The increased need for dialysis in patients in Group A was mainly due to fluid overload leading to pulmonary distress and electrolyte imbalance, which is common in patients with poor renal reserve.

In our study stage of kidney disease was evaluated using 4-variable MDRD formula. In a study by Canes et al., 81 patients with a solitary functioning kidney were evaluated to observe the impact of PCNL on renal function. As compared to other studies that used only serum creatinine as a marker of CKD. In our study, mean eGFR pre-PCNL and peak eGFR at follow-up of 6 months were 35.59 ml/min/1.73 m2 and 40.43 mL/min/1.73 m2, respectively. In Group A GFR increased by 2.34 ml/min/m2 while in Group B, it increased by 7.34 ± 7.2 ml/min/m2. The more rise in GFR in Group B could be attributed to better renal function, more functional nephrons and better functional reserve in patients with lower CKD states. Similarly, a study by Akman et al. demonstrated that CKD patient showed significant improvement in eGFR after PCNL.[11] Canes et al. showed an

increase in mean eGFR from 44.7 ml per minute/1.73 m2 preoperatively to 55.4 ml per minute/1.73 m2 by 1 year after PCNL in their study. Akman et al. demonstrated that renal function improved or stabilized among 90% of cases at more than a 6-month follow-up. Our study showed similar results , and patients in our study had improvement in eGFR and renal function.

Results in our study were consistent with this finding, and most of the cases in our series were associated with betterment in renal function and eGFR.

Comparison with other studies

Variable	Kurien et al.	Kumar et al.	Canes et al.	Our study
Number of patients	117	30	64	20
Mean age	52.5	45	60.7	56.95
Preoperative eGFR	32.1	6.3(sc)	44.7	35.59
Postoperative eGFR	43.3	2.8(sc)	55.4	40.43
Postoperative SFR(%)	83.5	90		87.3
Auxillary procedure (%)	2.5	10	8.7	3
Complications (%)	17	26.6	10.6	7

eGFR: Estimated glomerular filtration rate, SFR: Stone free rate

Use of advance laser and small diameter sheath lead to decreased complication and increase stone clearance. Therefore, our study can help in removing the blind fear that PCNL will lead to long-term disfunction of renal function in patients with CKD. PCNL and ESWL have been documented to cause some renal parenchyma injury,[5] but eGFR does not show any significant alteration. We came across some limitations of our study, which include its usage of mathematical formula for eGFR calculation rather than nuclear renography, retrospective nature and shorter period of follow-up i.e., 6 months. With that, stone-free rate was calculated using USG KUB and X-KUB and rather than a CT KUB. Most studies choose RIRS for the management of calculus in CKD patients, but due to high cost involved in RIRS as compared to PCNL, patients choose PCNL as a method of stone clearance. Additional to that, not many patients who underwent RIRS with CKD were available for comparison. Small fragments and microdust residue after RIRS, lead to increased intrapelvic pressure caused intraoperatively, and PCNL had less infection as compared to RIRS due to incomplete drainage after the procedure, was the other reason to choose PCNL over RIRS.

due to incomplete drainage after RIRS it further aggravated the infection in CKD patients as compared to PCNL which was the reason for selecting PCNL over RIRS.

V. CONCLUSION

CKD patients have good clearance rates and good renal functional outcome with PCNL. Patients with high-risk CKD should undergo PCNL with care and full understanding of its complications.

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