Original Article

Outcome of Mini-Percutaneous-Nephrolithotomy in Solitary Functioning Kidneys, Single Centre Experience

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ABSTRACT

Objective: This study aimed to evaluate the outcomes of (mini-percutaneous-nephrolithotomy) (PCNL) in the treatment of individuals with SFKs who have renal stone disease.

Study Design: A Retrospective Analysis study

Place and Duration of Study: This study was conducted at the Department of Urology Institute of Kidney Diseases Peshawar from January 2021 to September 2023.

Methods: Patients with renal stone disease in solitary functional kidneys (SFKs) who had mini-percutaneous nephrolithotomy (PCNL) had their medical data retrospectively analyzed for this study. The study included individuals with SFKs, whether or not they had renal failure; paediatric patients were not included. Mini PCNLs were carried out under rigorous aseptic conditions while under general anaesthesia. Fluoroscopy was used to confirm the placement of the stone, and the case dictated whether to use a single or double-tract approach. The proper tools were used for stone removal and fragmentation, and a Double-J stent was inserted in each instance. Monitoring blood parameters, imaging for stone clearance, and removal of the Double-J stent as necessary were all part of the postoperative treatment. To find relationships between different elements, statistical analysis was done.

Results: The mean age of the patients was 40.55 years, with a majority being male. PCNL procedures were primarily performed using a single-tract approach. The stone clearance rate achieved was 90.9%, with a low percentage of patients requiring auxiliary treatment. Complications, such as postoperative fever and hematuria, were observed but effectively managed. Statistical analysis revealed correlations between certain factors, including gender, stone size, and complications.

Conclusion: Mini PCNL demonstrated satisfactory outcomes in terms of stone clearance in patients with SFKs.

Key Words: Renal stones, Solitary functioning kidney, percutaneous nephrolithotomy (PCNL), Stone clearance, Complications

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INTRODUCTION

The incidence of urolithiasis is increasing worldwide in all age groups and carries significant morbidity.[1] Management of urolithiasis in SFKs is always a subject of great debate. Stone in SFKs carries a high risk of recurrence, chronic kidney disease (CKD), and end-stage renal disease (ESRD).[2] Literature shows that PCNL in SFKs is associated with a higher risk of renal impairment and lower stone-free rates (SFRs) in comparison to PCNL in patients with bilateral functioning kidneys. The risk of bleeding requiring transfusion is also higher in patients undergoing PCNL for stones in SFKs.[2] Urinary stones should be treated not only because of their immediate clinical manifestations, i.e. recurrent urinary tract infection (UTI), pain, and sepsis, but also for their long-term progression to CKD.[3] Depending on the stone and the patient, the therapy of kidney stones might include open operations, Percutaneous Nephrolithotomy (PCNL), and Extra Corporeal Shockwave Lithotripsy (ESWL). The most often used treatments for renal stones in SFK are PCNL and ESWL. In the most SFR-compliant SFKs, PCNL is safe and effective; nonetheless, there is a significant chance of consequences, including bleeding (11.2–17.5%), urine extravasation (7.2%), colon damage (0.8%), and pleural injury (3.1%).[4] ESWL has fewer complications but lower SFR and needs multiple sessions. Retrograde Intra-Renal Surgery (RIRS) has minimal complications and a high SFR but could be repeated if the stone size is large.[5] PCNL in SFKs with staghorn stone has satisfactory outcomes, but patients with advanced stage CKD need

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dialysis and repeated sessions for complete clearance of stone.[6] Single tract PCNL might have better outcomes for staghorn stones in SFKs as compared to multiple tracts.[7] Though PCNL has high morbidity, its efficacy can be weighed against other minimally invasive modalities. Different risk factors can affect the outcomes of PCNL in SFKs. Preoperative, poorly controlled diabetes and UTI play an essential role in affecting renal function postoperatively.[8] With the advent of PCNL, indications for open surgery have declined and have become the last treatment option that is related to more perioperative and postoperative complications such as renal injuries, gut injuries, major vascular injuries, more blood loss, postoperative pain, wound infections, and more extended hospital stay.[9] The goal of our study was to evaluate the outcomes of mini PCNL for renal stone disease in SFKs in our setup in order to improve patient care.

METHODS

The assessment of the mini PCNL medical data of SFK patients from January 1, 2021, to September, 2023, was granted permission by the hospital's research and ethics council. The study excluded kids under the age of five. However, it did include SFKs with or without renal failure. Every patient's information was entered into an exact form.

To do small PCNLs, general anaesthesia (GA) and meticulous aseptic protocols were used. A ureteric catheter was inserted via cystoscopy into the pelvicalyceal system (PCS) in the lithotomy position, and its placement was verified by fluoroscopy. The ureteric catheter was connected to a bladder catheter. Once prone, the patient was prepared and draped. Using fluoroscopy, we identified the safety triangle and located the stone. Using a ureteric catheter, Urograffin was used to opacify the PCS. Select a calyx and use an 18-gauge needle to puncture it. A guidewire was passed, and then the tract was dilated using Alkin's metallic serial dilators. An 18 French metallic sheath was inserted, and nephroscopy was performed with a 16 French Karl-Storz micro nephroscope. A pneumatic lithoclast broke apart the stone and gathered it.

Fluoroscopy confirmed the removal of the stone in each case, and a Double-J stent (DJS) was inserted. The placement of a nephrostomy tube was investigated if bleeding or infection developed. Every patient received standard postoperative care. On the first postoperative day, patients are allowed to eat and move. On the second postoperative day, after total blood counts, renal function tests, and X-ray KUB, patients were given the option to be released. Four weeks after the therapy, residual stones were checked using ultrasound and X-ray KUB. PCNL, ESWL, or URS were repeated if any residual stones were discovered. Total cleansing got rid of DJS. Proforma data were entered and examined using SPSS 22. Tables, graphs, and other formats were used to display the results. To find correlations between variables, we used Kendall's tau B test and Pearson Chi-Square test. A significant p-value was defined as less than 0.05.

RESULTS

The research had 33 patients in all, whose ages ranged from 18 to 78 years old on average. There were 10 (30.3%) female patients and 23 (69.7%) male patients. Eleven patients (33.3%) had hypertension, while six patients (18.2%) had diabetes. In 24 (72.7%) of the instances, stone illness was the reason for a single kidney; in 9 (27.3%) of the cases, congenital absence was the cause. Of the operations, 26 instances (78.8%) resulted in a single tract, while 7 cases (21.2%) resulted in two tracts. In 17 instances (51.5%), PCNLs were done on the right side and in 16 cases (48.5%) on the left. The average stone size was 27.61 mm (range: 17-50.5), and the average cortical thickness was 11.43 cm (range: 8-15.4). Stone load was measured using Guy's Score, which had a mean score of 2.06. Guy's 1 (n=10, 30.3%), Guy's 2 (n=15, 45.5%), Guy's 3 (n=4, 12.1%), and Guy's 4 (n=4, 12.1%) comprised the distribution of Guy's Score. Preoperative creatinine levels were 1.55 mg/dl (range: 1-4.4 mg/dl), and haemoglobin (Hb) levels were 13.29 gm/dl (range: 9.1-16.7 gm/dl). Table 1 displays the stone properties and preoperative patient information.

Following surgery, the average haemoglobin level was 12.30 gm/dl (9.5–15.6 gm/dl), while the postoperative creatinine level varied depending on the time of day: Days 1 through 3: 1.67 mg/dl (0.9-2.7), 1.4 mg/dl (0.97-2.44), and 1.87 mg/dl (1.60-2.20) respectively. With 28 (84.9%) patients remaining for two days, 4 (12.1%) patients staying for three days, and 1 (3.0%) patient staying for five days, the mean length of hospital stay was 2.2 days. After surgery, none of the patients needed hemodialysis. Ninety-nine per cent of the stones were removed (n = 30). Just three individuals (9.1%) needed further care in the form of ESWL.

Fifteen (45.5%) of the patients had reported postoperative problems. Grade II postoperative fever was seen by two individuals (6.1%); this was treated with intravenous Meropenem. Postoperative hematuria was seen in 13 individuals (39.4%). Five patients (15.2%) had spontaneous resolution of hematuria (grade I), whereas eight patients (24.2%) needed blood transfusions (grade II). Angioembolization was not necessary for any of the patients. There were no significant difficulties noted. Table 2 displays the postoperative parameters.

Multiple associations were found using statistical analysis. Larger stones (p=0.013), a higher Guy's Score (p=0.027), and more significant problems (p=0.05) were all linked to male gender. More residual pieces (p=0.002 and p=0.018, respectively) and a higher number of tracts (p=0.000 and p=0.000, respectively) were needed in cases with more giant stones and higher Guy's Scores. There was no association discovered between the operation's side. The quantity of tracts and

the existence of leftover pieces were correlated (p=0.038). Higher Guy's Score and the number of tracts were linked to blood transfusion rates (p=0.005 and p=0.046, respectively). On the second postoperative day, cortical thickness and creatinine levels were associated (p=0.000).

Table No.1: Preoperative patients' and stone parameters

Variable	Result
Mean Age	40.55 years
Gender • Male • Female	 23 (69.7%) 10 (30.3%)
Mean Preoperative Creatinine	1.55 mg/dl
Mean Preoperative Hemoglobin	13.29 gm/dl
Mean Stone Size	27.61 mm
Stone Side • Right • Left	 17 (51.5%) 16 (48.5%)
Mean Cortical Thickness	11.43 cm
Guy's Score • 1 • 2 • 3 • 4	2.06 10 (30.3%) 15 (45.5%) 4 (12.1%) 4 (12.1%)

Table No.2: Postoperative parameters

Variable	Result
Mean Postoperative Hemoglobin	12.30 gm/dl
Mean Postoperative Creatinine • Day 1 • Day 2 • Day 3	 1.67 mg/dl 1.4 mg/dl 1.87 mg/dl
Mean Hospital Stay	2.2 days
Stone Clearance • Yes • No	 30 (90.9%) 3 (9.1%)
Postoperative Complications Grade I • Transient Hematuria Grade II • Fever • Hematuria requiring Blood Transfusion Grade III Grade IV	15 (45.5%) 5 (15.2%) 2 (6.1%) 8 (24.2%) 0 0

DISCUSSION

Because of the increased risk of recurring disease, CKD, and ESRD, managing urolithiasis in individuals with SFK is complex.[2] When treating renal stones in SFK patients, the primary goal is not just to manage immediate symptoms such as repeated UTIs and discomfort but also to prevent long-term progression to CKD.[3] ESWL, PCNL, and open procedures are among the therapeutic options available and are chosen based on the individual characteristics of the stone and the patient. PCNL has evolved as a popular and effective treatment option with a high SFR. However, it is critical to evaluate the risks of PCNL, such as haemorrhage, urine extravasation, colon injury, and pleural injury.[4] These risks must be carefully balanced against the benefits of stone removal in SFKs.

In this study, we assessed the effectiveness of micro PCNL in treating patients with SFKs who had renal stone disease. Our findings showed that micro PCNL in SFKs produced good stone-clearing results. The research had 33 patients in all, with a mean age of 40.55 years. 69.7% of participants were men, which is in line with the fact that men are more likely than women to have urolithiasis. [10]. Diabetes and hypertension were comorbidities present in a portion of the patient population, highlighting the importance of managing these conditions in relation to protecting renal function postoperatively. The distribution of Guy's Score, which assesses stone burden, revealed a range of scores, with Guy's two being the most common. These findings reflect the varying severity and complexity of renal stone disease in patients with solitary functioning kidneys, where Fabio et al. found that Guy's 2 and 3 were the most common ones.[11]

PCNL was primarily performed using a single tract approach (78.8%). In comparison, a minority of cases required two tracts (21.2%), where a number of tracts and persistent post-op bleeding were independent factors for renal function deterioration[12-13]. The mean preoperative haemoglobin and creatinine levels indicated the baseline health status of the patients. Postoperatively, the mean Hb levels gradually improved, and no patients required postoperative hemodialysis. The overall stone clearance rate achieved with PCNL in our study was 90.9%. Only a tiny percentage of patients (9.1%) required auxiliary treatment, such as ESWL, to address residual fragments. This highlights the effectiveness of PCNL in achieving stone clearance in solitary functioning kidneys.[6]

Although no significant complications were reported, postoperative fever was observed in two patients (6.1%), which resolved with appropriate antibiotic treatment. Hematuria was a common postoperative finding in 39.4% of patients, with eight patients requiring blood transfusions. However, none of the patients required angioembolization, indicating the successful management of postoperative bleeding.[14]

Statistical analysis revealed several interesting correlations. Male gender was associated with larger stones, higher Guy's Score, and a higher incidence of complications. Larger stones and higher Guy's Scores were also associated with more residual fragments and a more significant number of tracts required during the

procedure. Cortical thickness was found to be correlated with creatinine levels on the second postoperative day, emphasizing the importance of assessing renal function postoperatively.

The limitations of our study include its retrospective design and the relatively small sample size. Additionally, the follow-up period was relatively short, and long-term outcomes of PCNL in SFKs should be further investigated.

CONCLUSION

Our study demonstrates that mini PCNL is an effective treatment option for managing renal stone disease in patients with SFKs. It provides a high stone clearance rate while minimizing the need for auxiliary treatments. The observed complications were generally manageable, highlighting the importance of meticulous perioperative care. Further study with larger sample sizes and more extended follow-up periods is warranted to confirm our findings and explore the long-term outcomes of PCNL in this patient population.

Author's Contribution:

Concept & Design of Study:	Akhtar Nawaz
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