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Original Article

# Outcome of Percutaneous Nephrolithotomy in Patients with Renal Stone

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## Abstract

**Introduction:** Renal stone disease is an identified precursor to renal deterioration, and if left untreated, it can deteriorate to renal failure. The surgical benchmark for treating large or complex renal stones is percutaneous nephrolithotomy (PCNL). The PCNL technique has undergone numerous changes since its initiation.

**Methods:** This observational study included 50 adult patients admitted to our hospital with kidney stones. As confirmed by diagnostic imaging, patients over 18 years with a renal stone larger than 2 mm were included in the study. All patients who had a renal stone on ultrasonography or a plain radiograph of the kidney, ureter, and bladder (KUB) were evaluated further with non-contrast computed tomography KUB. All patients in the study underwent PCNL procedure using 26 French Karl-Storz nephroscope and pneumatic lithotripters.

**Results:** The mean age of patients was 49.24 ± 13.18 years. The majority of the stones were located in the pelvis (n=26), followed by the lower calyx (n=10) and upper calyx (n=6). In 16 % (n=8), the liths were located in multiple calyces. Eighteen stones were in a single location, while 32 were multiple. The average stone size was 3.1± 1.5 mm. Fourteen cases noted single puncture access was noted in 44 cases, while 6 required multiple punctures. The average hospitalization was 3.9±1.48 days. One patient required a blood transfusion.

**Conclusion:** The efficacy of percutaneous nephrolithotomy was re-established in this primary study. No major complications were encountered in this study. PCNL can be tailored to the patient's needs due to technological advances.

**Key words:** percutaneous nephrolithotomy, kidney stone, nephrolithiasis, urolithiasis, outcome, renal stone

## INTRODUCTION

The ancient Egyptians described renal stone disease (Nephrolithiasis or Urolithiasis) more than 2000 years ago. It is a disorder which is associated with significant morbidity and healthcare costs. Surgical interventions like Extracorporeal Shock Wave Lithotripsy, retrograde intrarenal surgery, and Percutaneous nephrolithotomy are advocated as treatment options. Percutaneous nephrolithotomy (PCNL) has advanced significantly since Fernstrom and Johansson first removed a renal calculus through a nephrostomy tract in 1976. Today, percutaneous nephrolithotomy is a well-established urologic treatment option for large and complex calculi. It entails the removal of the renal stone in its entirety or fragments via a specially designed tract between the skin surface and the kidney. Compared to open pyelolithotomy, it has a lower morbidity rate, a shorter length of stay, and a lower cost.[1-3]

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Indication for PCNL includes large stones, hard liths, lower calyceal stones, those stones leading to obstruction and infection, stones where there is the certainty of the final result, extracorporeal shock wave lithotripsy failure, contraindication to extracorporeal shock wave lithotripsy and anatomic variations.[2] PCNL has a success rate greater than 90%, but at the expense of higher complication rates (greater than 10 percent).[4]

This study was performed to evaluate the outcomes of percutaneous nephrolithotomy in patients with renal stones in terms of patient and stone characteristics, stone clearance, and complications in treating renal stones at our hospital.

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## MATERIALS AND METHODS

This observational study included 50 adult patients with confirmed by diagnostic imaging, patients over 18 years with a renal stone larger than 2 mm. Patients with a BMI of 30 or higher, co-morbidities, renal failure, a history of pyelonephritis, a preoperative diagnosis of a renal scar, atypical renal anatomy such as ectopic or horseshoe kidneys, and a stone burden greater than 700 $mm^2$ were excluded from the study.

Convenient sample size was chosen. The patients were subjected to a thorough history and physical examination. Complete blood count, kidney function tests, blood sugars, coagulation profile, and urine analysis were performed. All patients who had a renal stone on ultrasonography or a plain radiograph of the kidney, ureter, and bladder (KUB) were evaluated further with non-contrast computed tomography KUB.

All patients in the study underwent PCNL procedure using 26 French Karl-Storz nephroscope and pneumatic lithotripters. All procedures were performed while under general anaesthesia. Under fluoroscopic guidance, a six-Fr ureteric catheter was positioned cystoscopically in the renal collecting system. Retrograde pyelography was performed after the patient was placed in a prone position. Under fluoroscopic guidance, the target calyx was punctured with an 18-gauge needle. Terumo guidewire was passed and directed into the ureter after confirming the puncture. Multiple punctures were made, and wire was passed through them in cases where multiple tracts were expected. The tract was dilated with fascial dilators until 10 Fr, then serially with Alkens telescopic dilators over a central guide rod and fluoroscopy until 24 or 30 Fr. A rigid nephroscope was used to visualize the stones and fragment them with pneumatic lithotripsy.

Patients' demographic information, stone location and complexity, access puncture, procedure time and hospital stay length were recorded. Patients' demographics and characteristics are summarized in Table 1. Data so gathered was analyzed.

## RESULTS

The mean age of patients was 49.24 ± 13.18 years. Thirty-three male and 17 female patients were enrolled in the study. Twenty-nine were located in the right kidney and 21 in the left kidney. The majority of the stones were located in the pelvis (n=26), followed by the lower calyx (n=10) and upper calyx (n=6). In 16 % (n=8), the liths were located in multiple calyces. Eighteen stones were in a single location, while 32 were multiple. The average stone size was 3.1 ± 1.5 mm. Fourteen cases noted single puncture access was noted in 44 cases, while 6 required multiple punctures [Table 1]. The average hospitalization was 3.9 ±1.48 days. The mean procedure time was 68 42 ± 24.17 minutes [Table 2]. One patient required a blood transfusion.

**Table 1: Distribution of patient's clinical parameters**

| Variables | Frequency | Percentage |
|---|---|---|
| Gender | | |
| Male | 33 | 66 |
| Female | 17 | 34 |
| Stone location | | |
| Right kidney | 29 | 58 |
| Left kidney | 21 | 42 |
| Stone located area | | |
| Pelvis | 26 | 52 |
| Upper calyx | 6 | 12 |
| Lower calyx | 10 | 20 |
| Multiple calices | 8 | 16 |
| Stone complexity | | |
| Single | 18 | 36 |
| Multiple | 32 | 64 |
| Access puncture | | |
| Single puncture | 44 | 88 |
| Multiple puncture | 6 | 12 |

**Table 2: Distribution of patients clinical parameters**

| Variables | Mean | SD |
|---|---|---|
| Age (Years) | 49.24 | 13.18 |
| Stone size (mm) | 3.1 | 1.5 |
| Duration of stay (days) | 3.9 | 1.48 |
| Procedure time (mins) | 68.42 | 24.17 |

## DISCUSSION

The prevalence of urinary stone disease ranges from 1% to 15%. The likelihood of developing urolithiasis varies with age, gender, race, and ethnicity. Stone disease is extremely common in India, accounting for nearly 30% of the urology department's caseload. Calcium oxalate accounts for roughly 60% of all stones, with it being 90 % in India. Because of its high success rates and low morbidity, PCNL has become a favoured approach for the treatment of renal stones larger than 2 cm.[5,6]

An observational study of 75 renal calculi patients in Srinagar between July 2014 and June 2016 assessed the operative characteristics and treatment outcome of PCNL. In line with the present study, this study noted a mean age of 42.46 years, with 48 male and 37 female patients. 13 had stones in the upper calyx, 13 in the lower calyx, and six in the middle calyx and mean stone size was 24.56 mm. In 42 patients, the stone was noted on the right side, while in 32, it was on the left side and was bilateral in 11 patients.

In 6 patients, a blood transfusion was required. We did not find any bilateral calculi in our study. The mean operation procedure time was 93.56 ± 9.90 min, which is higher than our study. The mean hospital stay was mean hospital stay was 3.11 ± 1.33 days.[5]

Patients with renal stones larger than 2 cm and who underwent either PCNL or retrograde intrarenal surgery (RIRS) were prospectively analyzed and compared by Srinivasrao and Shasidhar. A total of 50 patients were compared between January 2013 - May 2017. The mean age of patients in the PCNL group was 55.25 years, with 15 males and 10 females. 13 liths were pelvic, 3 in the upper calyx, 5 in the lower calyx and 4 in multiple calices in PCNL. Concerning the PCNL group, the mean stone size was 24.66 mm; the mean operating time was 78±12.75 minutes, mean hospital stay was 4.73±2.11 days. Two patients required blood transfusion in the PCNL group compared to none in the RIRS group.[7]

A study in Nepal retrospectively evaluated 75 pediatric PCNL cases. The mean age of the patient was 14.89 years. The female preponderance and right side dominance were noted. The mean stone length was 2.09 cm. 42 single and 34 multiple cases were noted. Based on anatomic location, 71 were noted in the pelvis, 13 in the upper calyx, 58 in the middle, 32 in the lower, and 4 in the upper ureter. The mean operation time was 58.6±29.7 minutes.[8]

Singh *et al*. documented their experience of PCNL in the solitary functioning kidney in 128 patients, with a median age of 41. The cohorts were grouped into 2 groups based on their chronic kidney disease stage. Blood transfusion was required in 14 patients. The mean operating time and mean hospital stay were on 93.5 minutes, 4.3 days in group 1 and 98.5 minutes, 6.7 days in group 2, respectively.[9]

Another study by Akman *et al*. assessed the outcomes, complications, and early and late postoperative kidney function of percutaneous nephrolithotomy in 47 patients with solitary kidneys. The mean age of patients was 44.1 ± 14.1 years. The mean size of the stone was 816 ±487 mm. The mean operative time and length of hospitalization were 65.12 ±22.83 minutes and 2.87 ±1.57 days, respectively, similar to the present study. Three of the cases required blood transfusions.[3]

The study by Turna *et al*. sought to identify variables that may influence haemorrhage during PCNL. Data of 193 PCNL procedures were retrospectively assessed. The mean age of the patient was 45.7±14.4 years. Male dominance was noted (M: F 134:59). Right kidney dominance was noted in 92 and left in 101 patients. The mean procedure time was 87 minutes. The mean stone surface area was 843.1 ± 830.2 $mm^2$. Pelvic location was noted in 43, Caliceal in 58 and multiple in 42. Blood transfusion requirement was noted in 44 patients.[4]

Another group of researchers in Guwahati assessed the efficacy and safety of PCNL in 50 adult patients with chronic kidney disease. Most patients were males (32) compared to females (18). The mean age was 42.55 years. Bilateral renal stones were noted in 32 patients, while 18 had unilateral renal stones. The mean stone burden was 352.38± 140.10 $mm^2$. The renal pelvis was the most common location, followed by the lower calyx. Thirty-four patients received single-access PCNL, while the remaining 16 received multitract PCNL. Mean hospitalization was 4±0.86 days. In seven cases, blood transfusions were required.[10]

Bai *et al*. compositely evaluated PCNL and retrograde intrarenal surgery (RIRS) treatment outcomes in One hundred sixteen patients with solitary kidneys and stones larger than 2 cm. Clinical data of PCNL cases showed a mean age of 52.22±10.56, 44 male, 16 female with left laterality in 33 cases. The mean stone size was 29.6±5.7 mm, with 10 in the pelvis, 15 in the lower calyx, 1 in the middle calyx, 1 in the upper calyx and 33 in multiple locations. PCNL group had a lesser operating time (78.95±29.81min) but significantly longer hospitalisation.[11]

Neto *et al*. documented their experience with 88 PCNL in the supine position. The procedure was recommended for patients who had large or complex staghorn stones. Ten patients had concurrent ureteral stones that were treated without changing patient position. The remaining patients had PNL with a modification to the original position. The patient was supine with the legs extended, and the ipsilateral leg was crossed over using a cushion beneath the ipsilateral leg and the contralateral leg flank to achieve a $30^o$ inclination. Despite the procedures, no colonic or thoracic injuries occurred, despite the procedures and 8 % required blood transfusion.[12]

Manohar *et al*. recorded the outcome of PCNL in 62 patients in the supine position. They demonstrated that the supine position can be used even in morbidly obese patients, for whom it may be an excellent indication due to the difficulties in placing them in a prone position.[13]

A systematic review and network meta-analysis of stone-free rates after RIRS, extracorporeal shock wave lithotripsy (ESWL), and PCNL for renal stones were conducted for literature before 2016. According to network meta-analyses, the stone-free rates of RIRS and ESWL were lower than those of PCNL. In the rank-probability test, PCNL was ranked first.[14]

A literature search was executed using the MEDLINE database on PCNL between 1980 and 2004 by Skolarikos *et al*. They noted that PCNL in the horseshoe kidney, malrotation and pelvic kidneys, and transplanted kidneys were safe and efficacious, particularly in the presence of large stones or ureteropelvic junction obstruction. They inferred that PCNL achieved 67% - 100 % stone-free rates and is an effective procedure for the removal of large renal calculi.[2]

Atamaca *et al*. analyzed the data of 170 patients to compare the outcomes of PCNL in patients with kidney malformations and normal subjects with similar stone characteristics. Group 1 (n =18) had Patients with kidney malformations, while group 2 (n = 152) had patients with normal kidneys. The mean age was 45.6 ±16.6 and 45.4 ±13.4; M: F 14:4 and 94:58; stone burden on average was 449 and 444; pure pelvic (3 vs. 22), pure caliceal (11 vs. 108) and complex (5 vs. 28); mean operation time 103 ± 44.8 and 96.9 ± 41.2 in group 1 and 2 respectively. They concluded that safe as well as effective procedure in patients with kidney malformations.[15]

Notwithstanding the salient features of this study, limitations do exist. A larger cohort with the inclusion of more variables like co-morbidities, anomalous morphology and prolonged follow-up would have contributed significant data and enabled better understanding.

## CONCLUSION

Renal stone disease is a known risk factor for kidney failure. If left unaddressed, it can result in renal failure. The surgical gold standard for treating large or complex renal stones is percutaneous nephrolithotomy. Community studies have yielded a wealth of data on patient outcomes following PCNL. Compared to treatment alternatives such as ESWL and open surgery, this procedure is safe, has a higher stone clearance rate, and is more cost-effective. In addition, modern PCNL, with its advanced techniques and technology, enables personalized stone management.

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