Original Article

Treatment Outcome of Percutaneous Nephrolithotomy: The Initial Experience from a Tertiary Care Center

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Abstract

Introduction: The purpose of the study was to assess the operative characteristics and treatment outcome of percutaneous nephrolithotomy (PCNL) for the treatment of renal calculi at our hospital. **Materials and Methods:** Patients with significant size symptomatic renal calculi not manageable by conservative management and those with calculi resistant to extracorporeal shock wave lithotripsy (ESWL) were included in the study. Patients excluded from the study were those with significant coagulopathy, active upper urinary tract infection, and renal calculi in ectopic kidneys. **Results:** Our study group had a mean age of 42.46 ± 11.29 years. Nearly 60% of stones in our study were of size 21–30 mm in the longest diameter with mean stone diameter of 24.56 ± 7.809 mm. Mean hemoglobin drop following the procedure was 1.35 ± 0.843 g/dl. Mean operative time was 93.56 ± 9.90 min. We had an overall success rate of 83.5% in our study. Fourteen failure cases were managed by ESWL (ten cases), second look PCNL (three cases), and by open surgery (one case). **Conclusion:** Although we find a higher frequency of minor complications such as transient mild hematuria (37.6%), mild puncture site pain (55.3%), or low-grade fever (24.7%), no major or long-term side effects were observed in our series.

Keywords: Kidney, nephrolithiasis, percutaneous nephrolithotomy

Introduction

Urinary stone disease has a prevalence of 1%–15%. The probability of developing urolithiasis varies with age, sex, racial, and ethnic differences.[1,2] With changing trends in global culture, the site of calculi formation has also changed with an increased involvement of the upper urinary tract.[1] Women show a bimodal distribution of urolithiasis, with second peak corresponding to onset of menopause.[3] The incidence of renal calculi shows an increasing trend in pediatric population,[4] with only 9%–24% having an identifiable underlying cause.[5] Genetic, dietary factors, and body mass index also influence the formation of urinary stones.[1,6] Calcium oxalate constitutes about 60% of all stones. In India, 90% of stones are calcium oxalate.[7]

Ultrasonography (USG) is the initial investigation of choice for the evaluation of urolithiasis, especially for children and pregnant women,[8] as it is free of radiation exposure and does not require intravenous contrast administration. It is not affected by the renal functions[9] and has sensitivity of 91%–98% for nephrolithiasis.[10] Intravenous pyelography (IVP) was the gold standard until the advent of computed tomography (CT). IVP has a sensitivity of 64%–87%.[11] It also provides function and anomalies of the contralateral kidney. As compared to CT, intravenous urography is more time consuming and is unable to offer alternative diagnosis.[12]

Stable patients with nonobstructive urinary calculi and those with recurrent calculi formation are candidates for medical management.[13] The development of minimally invasive techniques (extracorporeal shock wave lithotripsy [ESWL], percutaneous nephrolithotomy [PCNL], ureteroscopy, and laparoscopic stone surgery) has revolutionized the

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management of urolithiasis and has led to decrease in open surgical techniques for treating urinary stones.[14] Most patients harboring simple renal calculi can be treated satisfactorily with ESWL.[15] Parameters of poor stone clearance in ESWL include: large calculi, calculi within dependent or obstructed parts of the collecting system, and obesity.[16] PCNL allows a convenient approach to address both problems simultaneously for patients with concomitant renal stones and ureteropelvic junction narrowing.[14] Lower pole stones of size 1 cm or greater are most efficiently treated with PCNL. It is the preferred method of treatment for partial or complete staghorn calculi.[17]

Objectives

The objective of the study was to assess the operative characteristics and treatment outcome of PCNL for renal calculi at our hospital.

Materials and Methods

Study design

This study was an observational study including all patients as per inclusion criteria, treated with standard PCNL as well as mini PCNL. The sample size in our study was 85.

Ethics statement

The study protocol was approved by the institutional ethical committee of the institute under protocol number: IEC/SKIMS Protocol #78/2015.

Exclusion criteria

Patients with significant coagulopathy, active urinary tract infection, and renal calculi in ectopic kidneys were excluded from the study.

This study was conducted in the department of Urology, SKIMS, Srinagar, between July 2014 and June 2016. All patients with significant size renal calculi not manageable by conservative management or resistant to ESWL were included in the study. All patients were evaluated on an outpatient basis, and an informed consent was taken after proper counseling about the technique including the relative benefits and risks as well as the information about alternative treatment modalities available. Besides routine investigations, urinalysis and urine culture-sensitivity were done. IVP and USG were done in all patients. CT abdomen and radioisotope scan were done only if necessary. The stone size was assessed by measuring its largest dimension on plain X-ray film and USG, while the degree of hydronephrosis was determined by excretory urography or USG.

An X-ray kidney, ureter, and bladder (KUB) was done before surgery to know the preoperative status of calculus. Prophylactic antibiotic dose was given 30 min before surgery. After cystoscopy in lithotomy position, the position was changed to the prone position with table flexed 30°–40° to increase space between 12th rib and iliac crest. Generous padding was done to prevent pressure injury and to facilitate ventilation. PCNL was done using rigid nephroscope and Swiss Lithoclast. Pain in the postoperative period was assessed using visual analog scale. Patients were prescribed α-blocker for 1 week and were followed at 1 week, 3 weeks, and 3 months. Double-J (DJ) stent was removed at 3 weeks. At 1 week, a follow-up KUB was done to know status of residual stone fragments. At 3 weeks, X-ray KUB and abdominal USG were obtained to determine the success rate. At 3 months, patients were assessed with USG for the development of any delayed complications. IBM SPSS Statistics for Windows, Version 20. Armonk, NY, USA : IBM Corp. was used to analyze the data.

Observations and Results

A total of 85 patients in the age range of 16–68 years (mean age 42.46 years) with renal calculi underwent PCNL. Thirty-nine (45.9%) patients were in the age group of 21–40 years of age. Forty-eight (56.5%) patients were males and 37 females with male-to-female ratio of 1.2:1. The majority of patients (90.5%) had flank pain as the presenting complaint. Dysuria was present in 32.9% and hematuria in 21.1% of patients. Nineteen (22.3%) patients had other symptoms such as nausea and vomiting. Three (3.5%) patients were asymptomatic and had incidentally detected renal calculi. Mean stone size in our study group was 24.56 mm, with a majority (60%) of patients having stone size of 21–30 mm. Out of 85 patients, 13 had stones in the upper calyx, 13 patients in the lower calyx, and six patients in middle calyx. In eight patients, stones were present in more than one calyx, and 29 patients had pelvic stones. Sixteen patients had staghorn stones, of which ten were partial and six were complete staghorn stones. Forty-two patients had stone on the right side, 32 on the left side, and 11 patients had bilateral renal stones. Hydronephrosis was present in 71 of 85 (83.5%) patients. The pelvicalyceal system was approached through upper calyx in 60 (70.6%) patients, middle calyx in 11 (13%) patients, and through lower calyx in 14 (16.4%) patients.

The average drop in the hemoglobin levels was 1.35 g/dl with a standard deviation of 0.843 (minimum: 0.5 mg/dl and maximum 5.0 g/dl). Of 85 cases performed, DJ stent alone (tubeless PCNL) was put in for postoperative drainage in 54 patients (Figures 3-4b), nephrostomy tube in 13 patients, whereas in 18 patients, DJ stent with nephrostomy tube was put in (Figure 4c). The mean operation time was found to be 93.56 ± 9.90 min (range 78–125 min). Postoperatively, four (9.5%) patients had severe hematuria. Seventy-eight (91.7%) patients had mild-to=moderate puncture site pain, and seven (8.2%) patients had severe pain requiring opioids. Twenty-one (24.7%) patients developed low-grade fever. Seven (8.2%) patients developed urine leak. Urosepsis developed in two cases (2.4%). Hydrothorax occurred in three cases (3.5%). Six (7.1%) patients required blood transfusion. There was no bowel injury. All these complications [Figure 1] were managed conservatively except hydrothorax which was managed by putting intercostal chest tube drain. At 3-month follow-up, none of the patients had any significant complication. The mean hospital stay in our study patients was 3.11 ± 1.33 days with majority (94.1%) of patients discharged within 5

days of procedure. Patients on nephrostomy tube had a mean postoperative hospital stay of 4.69 ± 1.40 days. Patients with DJ stent alone (tubeless PCNL) had shorter mean postoperative hospital stay as compared to those with nephrostomy alone or both nephrostomy and DJ stent [Figure 2].

The success of PCNL was determined at 3 weeks using X-ray KUB/USG. The presence of residual stone fragments >4 mm was considered failure. PCNL was successful in 71 (83.5%) patients. In 14 (16.5%) patients, the residual stone burden was >4 mm. There was no significant difference of postoperative drainage method on the success rate (*P*: 0.338). Of 14 failed cases in our study, ten patients were successfully treated with ESWL, three patients required a second look PCNL, and one patient required open surgery.

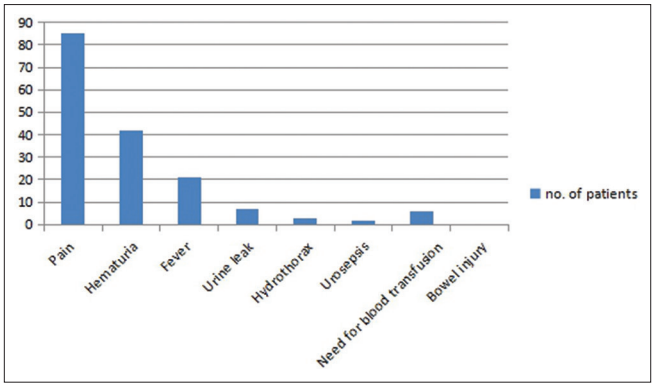

Figure 1: Complications in our study

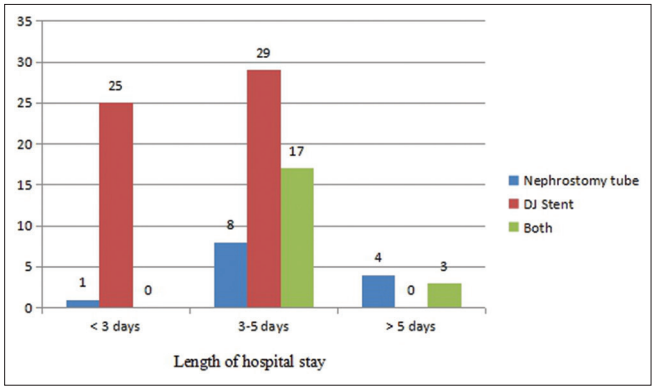

Figure 2: Length of hospital stay with respect to postoperative drainage methods

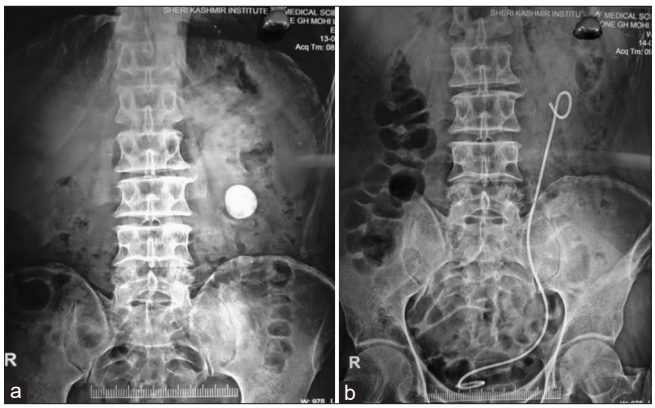

Figure 3: (a) Preoperative X-ray showing left renal calculus. (b) Postoperative X-ray of patient as in (a) with Double-J stent *in situ*

Discussion

The management of renal calculi had changed dramatically due to improvement in endourological armamentarium. PCNL is a minimally invasive procedure for stone removal from the kidney by a small puncture wound. Being a superior approach than open surgery for stone removal in terms of morbidity and cost, it has replaced open surgical removal of large or complex calculi at many centers.[18] The age distribution in our patients (mean age: 42.46 years) was comparable to study conducted by Atmaca *et al*.[19] (mean age: 45.6 ± 16.6). Flank pain was most common complaint, present in 77 (90.6%) patients. Other symptoms were dysuria, hematuria, fever, nausea, vomiting, and low backache. Three patients were asymptomatic (3.5%) and were detected on routine USG for other reasons. This is the usual presentation seen in patients with nephrolithiasis.[20] The stone size in our study ranged from 15 mm to 50 mm (mean size: 24.56 mm). The mean stone size in our study was comparable to study conducted by Ali *et al*.[21] (mean stone size: 25 mm). In our study of 85 patients, 42 patients (49.4%) had stone on the right side, 32 patients (37.6%) had stone on the left side, while 11 patients (12.9%) had bilateral renal calculi. In a study by Barfa *et al*.[22] 70% of the patients had right-sided calculi, 20% had left-sided calculi, and 10% had bilateral calculi.

In our study, stones were purely pelvic in 29 (34.1%) cases. There were 16 staghorn stones, of which ten (11.8%) were partial and six (7.1%) were complete. In this respect, our study had fairly comparable results with a study conducted by Barfa *et al*.[22] (30% of the patients had pelvic stones and 55% of the patients had calyceal stones). In our study, sixty patients (70.6%) were approached through upper calyx. The mean drop in hemoglobin level in our study was 1.35 g/dl ± 0.84. Although there are more chances of pulmonary complications with the puncture of superior calyx, these can be minimized in experienced hands. In a study by Reddy and Shaik,[23] who analyzed the efficacy of PCNL, the average drop in hemoglobin levels was 1.24 ± 0.54 g/dl. These results are comparable to our results.

In our study, the mean operation time was 93.56 ± 9.90 min, ranging from 78 to 125 min. Thirty-eight (44.7%) patients had operation time 60–90 min, and in 47 (55.3%) patients, operative time exceeded >90 min. In this respect, our study was comparable to study conducted by Ali *et al*.[21] who noticed a mean operative time of 90 ± 60.2 min with a range of 40–120 min. Barfa *et al*.[22] had an average operative time of 100 min. In our study, males had a mean operation time of 92.56 min, whereas females had 94.86 min.

In our study, complications encountered included mild hematuria in 32 (37.6%), moderate hematuria in six (7.1%), and

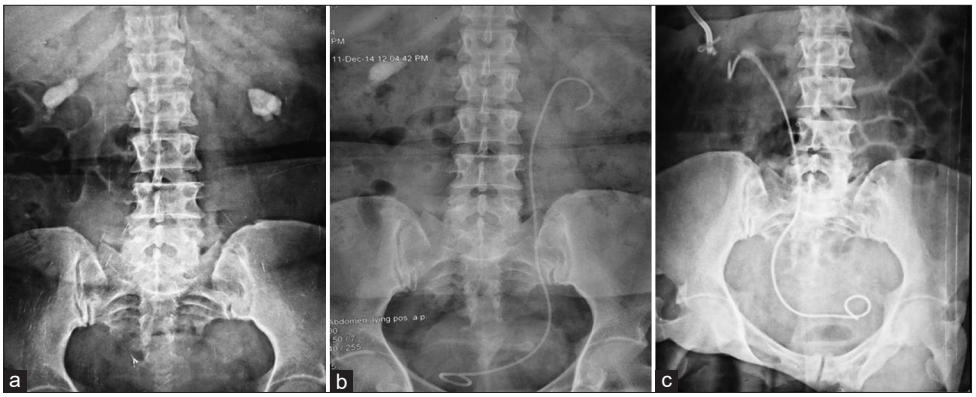

Figure 4: (a) Preoperative X-ray showing bilateral renal calculi. (b) Postoperative X-ray after left percutaneous nephrolithotomy with Double-J stent in place and untreated right renal calculus. (c) Postoperative X-ray of the same patient after right percutaneous nephrolithotomy with both Double-J stent and nephrostomy tube *in situ*

severe hematuria in four (4.7%) of patients. Mild postoperative pain/colic was seen in 47 patients (55.3%), whereas moderate pain was present in 31 (36.5%) patients. Severe postoperative pain was present in seven (8.2%) patients. Patients undergoing tubeless PCNL had significantly lesser pain as compared to patients undergoing standard PCNL (P – 0.006). Low-grade fever occurred in 21 (24.7%) patients while urosepsis developed in two (2.4%) patients. Seven (8.2%) patients developed postoperative urine leak from the puncture site. The presence of urine leak was significantly dependent on the presence of preoperative hydronephrosis ($P \leq 0.001$). This findings were comparable to study conducted by Dirim *et al*.[24] Three (3.5%) patients developed hydrothorax. Six patients (7.1%) were transfused with blood. There was no major complication such as bowel injury or vascular injury in our study. Most of the complications were managed conservatively or by minimally invasive techniques (e.g., intercostal chest tube drainage). Most of our results are fairly comparable with other studies. Michel *et al*.[25] had an overall complication rate of around 83% including extravasation in 7.2% of cases, blood transfusion in 11.2%–17.5%, and fever in 21.0%–32.1%, whereas major complications such as septicemia (0.3%–4.7%), colonic injury (0.2%–0.8%), or pleural injury (0%–3.1%) were rare. In a study by Ali *et al*.,[21] intraoperative bleeding occurred in 8.57% of patients, transient fever in 55.43% of patients, urinary leakage in 8.57% of patients, urinary tract infection in 5.14% of patients, colonic injury in one patient (0.57%), and nephrectomy was done in one patient due to severe bleeding. Shah *et al*.[26] compared the outcome and complications of tubeless and standard PCNL and found that the postoperative pain in tubeless PCNL was less as compared to standard PCNL.

In our study, the mean total hospital stay was 3.11 ± 1.33 days. The mean hospital stay in patients in whom DJ stent alone was put in tubeless was significantly lower, i.e., 2.54 ± 1.34 days ($P < 0.05$). These findings were comparable to a study conducted by Barfa *et al*.[22] (mean hospital stay 6.17 days). We had an overall success of 83.5% in our study. There were no significant differences in the success rates of tubeless and standard PCNL ($P = 0.34$). The results of our study were comparable with other studies done previously by Cortellini *et al*.[27] (success rate of 60%) and Ali *et al*.[21] (stone-free rate: 80.57%). In a study by Viville,[28] the stone-free rate immediately after PCNL was 77.6% but approached to 82.8% after spontaneous elimination of the calculi. In a study by de la Rosette *et al*.,[29] the success rate was 84.5%. Of those cases who failed the primary procedure in our study, ESWL was done in ten patients, repeat PCNL was done in three patients, while one patient required open surgery.

PCNL is a well-established procedure for the treatment of renal calculi. Tubeless PCNL is gaining popularity over standard PCNL due to less postoperative hospital stay, less morbidity, and comparable success rate.

Conclusion

PCNL is a safe procedure for the management of nephrolithiasis with the advantages of excellent outcome, lower morbidity, and shorter hospital stay. Although we find a higher frequency of minor complications such as transient mild hematuria (37.6%), mild pain (55.3%), or low-grade fever (24.7%), no major or long-term side effects were observed in our series.

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Conflicts of interest

There are no conflicts of interest.

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