



# Comparative Study of Supine Versus Prone Percutaneous Nephrolithotomy

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## ABSTRACT

### Background

Percutaneous nephrolithotomy (PCNL) performed in the prone position is known for its high success rate and low morbidity. However, the supine position offers notable advantages, leading to a debate over the preferred position for PCNL. This study aimed to compare the efficacy and safety profiles of PCNL to determine if one position is superior to the other.

### Methods

A prospective comparative study was conducted in Kathmandu Medical College and Teaching Hospital, Kathmandu, involving 60 patients over a six months period from January, 2024 to July, 2024, who underwent PCNL. All patients were divided into 2 groups, in which group 1 underwent PCNL in supine position and group 2 underwent PCNL in prone position. We have evaluated the two approaches in terms of operative time, stone clearance rate, drop in hemoglobin, hospital stay and complications.

### Results

The stone free rate was slightly higher in supine group (86%) compared to the prone group (82%), though this difference was not statistically significant (p-value 0.12). Mean operative time was significantly shorter for supine PCNL (74.63±12.42 min) than prone PCNL (90.02±12.67 min) (p-value <0.0001). Overall complication rates were 15% in supine group and 25% in prone group, with no statistically significant difference (p-value = 0.51). Patients in the prone PCNL group had a significantly longer hospital stay (3.20±0.92 days) compared to the supine group (2.40±0.74 days) (p-value <0.001).

### Conclusions

Supine PCNL is as effective and safe as prone PCNL, while having significantly shorter operative time.

**Keywords:** PCNL; supine position; prone position; operative time; stone free rate; complications.

## INTRODUCTION

Percutaneous nephrolithotomy (PCNL) performed in the prone position has a high success rate and low morbidity.<sup>1</sup> The prone position offers several advantages, including larger surface area for puncture, better site selection and easier anatomical identification.<sup>2</sup> However, this approach has limitations, particularly for obese patients and those with cardiac conditions. Additionally, the need for patient repositioning for ureteral catheter (UC) insertion is a significant drawback.<sup>3</sup> The supine position provides several benefits: it reduces cardiopulmonary risks,

eliminates the need for repositioning, minimizes radiation exposure to the operator, and allows for concurrent ureteroscopy during the procedure.<sup>4</sup> This raises the question of which position is preferable for PCNL - prone or supine. While numerous international studies have examined this comparison, there is a scarcity of research from Nepal investigating the efficacy and safety of prone versus supine PCNL. This study aims to compare these two approaches to determine if one offers superior outcomes.

## METHODS

This is a prospective non randomized comparative

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study conducted at the Department of Urology, Kathmandu Medical College and Teaching Hospital (KMCTH), Kathmandu, Nepal, over a six months period from January 19, 2024 to July 20, 2024 following ethical approval from Institutional Review Board of KMCTH. Sample size calculation was done using prevalence rate of renal stone in Asian population from study by Yu Liu et al.<sup>5</sup> as 1-8%. For this study, a prevalence of 4% was assumed and the sample size formula,  $n = z^2pq/e^2$  was used. Considering  $p = 0.5$  (50%);  $z = 1.96$  at 95% confidence level;  $q = 1-p$ ; and  $e = 0.05$  at 5% margin of error, the sample size calculated was 59. Total 60 patients of age group between 16 years and 70 years, with stone size  $>1.5\text{cm}$  in CT scan, with American Society of Anesthesiologists. (ASA) status 1 and 2, who were undergoing PCNL were enrolled in the study. Exclusion criteria were paediatric age below 16 years, active urinary tract infection, simultaneous bilateral procedures, second stage PCNL, patients with percutaneous nephrostomy (PCN) tube in situ and patients not reporting with X-ray KUB and ultrasound (USG) after 1 month. All patients underwent preoperative investigations, including blood counts, renal function tests, and imaging (either non-contrast CT of the kidney, ureter, and bladder or CT urography). Preoperative urine cultures were performed for all patients. If bacterial growth was detected, patients were started on culture-specific antibiotics before surgery. PCNL procedure was performed by two experienced consultant urologist according to the standard techniques. Patient who have undergone PCNL on the odd days of the calendar were assigned to supine PCNL group, and the patients undergoing PCNL on the even days of the calendar were assigned to prone PCNL group. Prophylactic antibiotic (Inj Ceftriaxone 1 gm) was given intravenously 30 mins before the anesthesia. Both supine and prone procedures were performed in general anesthesia.

### Surgery steps

#### Supine Position

The 12th rib, iliac crest, and posterior axillary line were marked on the skin after anesthesia was given.

The patient was placed in a Barts flank-free modified supine position, ipsilateral leg of the patient was placed straight on the stirrup and the contralateral leg was flexed and abducted. The patient was tilted 15 degree in contralateral side with the help of two bolsters, one under the hip and the other under the chest, to raise and free the flank for better access to kidney (Figure 1).



**Figure 1. Barts flank-free modified supine position for PCNL.**

Initially, ureteral catheter (UC) of 5 Fr was placed in pelvicalyceal system and a 18G needle was used for the initial puncture using triangulation technique under fluoroscopic guidance. A guide wire (0.035") was passed through the needle after successful puncture and serial dilatation was performed from 16 Fr to 24 Fr depending on stone site and burden. Stone was fragmented with a pneumatic lithoclast and then stone fragments recovered using an alligator forceps. In some cases, additional punctures were required to achieve clearance. In each instance, a double J stent of size 5 Fr was inserted via antegrade fashion after looking for stone clearance intraoperatively.

#### Prone Position

Prone PCNL was done by the same set of surgeons and same preoperative and peroperative protocol was followed. After inserting the UC in lithotomy position, patient was turned into prone position carefully protecting the spine and airway. Puncture was done using triangulation or Bull's eye technique using 18G needle. Rest of the procedure was similar to supine PCNL and all the intraoperative and postoperative parameters were recorded.

Patients were kept in the observation area for four hours and shifted to ward after they were stable.

Injection paracetamol was administered as an analgesic. Antibiotics were given for 48 hours. PCNL tube if kept was removed on second postoperative day and catheter was removed on second or third day. Patients were called for follow-up after one week and DJ stent removed 3 weeks after surgery. X-ray KUB and USG KUB were done in all the patients before stent removal and any residual calculi >4 mm was considered as significant residual fragment.

## RESULTS

A total of 60 patients were enrolled in the study with no one lost to follow up. Among them 28 patients in supine group and 32 patients in prone group. Patient demographic data were comparable between the two groups (Table 1).

Characteristics	Supine PCNL (n=32)	Prone PCNL (n=28)	p-value
Age	39.7±12.93	36.8±13.95	0.416
Gender			
Male	19	18	0.901
Female	13	10	
BMI	24.9±2.3	23.5±2.2	0.02
Stone Size (mm)	2.4±0.8	2.9±0.9	0.02
Creatinine (mg/dl)	1.0±0.5	1.1±0.64	0.51
Laterality (Right:Left)	15:17	13:15	0.58

The number of additional accesses required for stone clearance were not significant in both the groups. (p-value 0.305) Mean operative time was significantly less in the supine position (74.63±12.42 min) as compared to prone position (90.02±12.67) (p-value <0.001). Drop in haemoglobin were similar in both the groups (p-value=0.22) whereas length of hospital stay was less in supine PCNL group (2.40±0.74 days) as compared to prone PCNL group (3.20±0.92 days). (p-value<0.001) Also stone free rate was marginally higher in supine PCNL (86%) as compared to prone (82%) but not statistically significant (Table 2).

Fever was the most common post-operative complication seen in 7(11.66%) patients. Overall complications were 15% in supine group and 25% in prone group, which were similar in both the groups. (p value 0.51) (Table 3).

Variables	Supine PCNL (n=32)	Prone PCNL (n=28)	p-value
Number of Puncture			
Single	29	25	0.59
Multiple	3	3	
Operative time (min)	76.63±12.42	90.02±12.67	<0.001
Drop in Haemoglobin (mg/dl)	1.02±0.55	1.27±0.94	0.22
Hospital stay (days)	2.40±0.74	3.20±0.92	<0.001
Stone free rate (%)	86	82	0.12

Variables	Supine PCNL (n=32)	Prone PCNL (n=28)	p-value
Post-operative Fever	3	4	0.69
Sepsis	0	1	0.46
Bleeding Requiring blood Transfusion	1	0	0.53
Retroperitoneal Hematoma	1	1	0.71
Pleural Effusion	0	1	0.46
Total	5(15.62%)	7 (25%)	0.51

## DISCUSSION

PCNL has been the gold standard treatment for renal calculi larger than 2 cm.<sup>4</sup> It is a good alternative even in smaller stones. In our study, we compared the outcomes of patients undergoing PCNL in supine and prone positions. There were no significant differences between the two groups in terms of gender, age, body mass index (BMI), stone size or serum creatinine levels. Operative time was significantly shorter in supine group (76.63±12.42 minutes) than that of prone group (90.02±12.67 minutes) with a mean difference of 16 minutes. This finding is similar with other various studies as well.<sup>6,7</sup> The shorter operative time in supine group can be due to lack of need to reposition the patient from lithotomy to prone position. In supine PCNL, there is no need to change the position of the patient, UC insertion and rest surgery is done in same position. Further no patient disinfection and re-draping is needed. For doctors and surgical nurses, there is also no need for re-scrubbing and use of repeated surgery clothes. In supine PCNL, the installation of UC and kidney puncture can be done simultaneously, which further saves time. There is no need to re-position if

ureteroscopy is needed while undergoing PCNL, if the surgery is done in a supine position.<sup>8</sup> This result was comparable to the study of Satyagraha et al., which revealed that the mean operative time was approximately 21 minutes shorter in the supine group compared to the prone group ( $p$ -value = 0.001).<sup>9</sup> In our study, the stone-free rate was slightly higher in the supine group (86%) compared to the prone group (82%), although the difference was not statistically significant ( $p > 0.05$ ). Similarly, Desoky et al. found no statistically significant difference in stone-free rates between the two positions, with 89.3% in the supine group and 88.9% in the prone group ( $p > 0.05$ ).<sup>10</sup> In comparison, Rehan M et al. also reported similar stone clearance rates across both groups, with 82% in the supine group and 80% in the prone group, and a non-significant difference ( $p = 0.856$ ).<sup>11</sup> However, Valdivia et al. reported higher stone-free rates in the prone group (77.0% versus 70.2%).<sup>12</sup> This discrepancy may be attributed to the early experience with supine PCNL in Valdivia's study. Patients in the prone PCNL group had a significantly longer hospital stay ( $3.20 \pm 0.74$  days) compared to the supine group ( $2.40 \pm 0.74$  days). This finding is consistent with the results of Jones et al., who also observed a longer hospital stay in the prone group.<sup>13</sup> Overall complication rates were slightly lower in the supine PCNL group (15.62%) compared to the prone PCNL group (25%), although this difference was not

statistically significant ( $p = 0.51$ ). These findings are consistent with those of De Sio et al., who reported complication rates of 20.5% in the supine group and 13.9% in the prone group. Similarly, Falahatkar et al. observed overall complication rates of 27.5% in the supine group and 30% in the prone group.<sup>8,14</sup> No bowel injury was seen in our study. Other studies have reported a 0.2-0.3% incidence of colonic perforation; but this was noted mainly in cases of complex anatomy like horseshoe kidney which was excluded in our study.<sup>15</sup>

Some limitations in our study were that follow-up for stone clearance was done with X-ray KUB and not computed tomography considering the radiation exposure and cost burden involved to the patients. In addition, we did not adjust for stone characteristics such as hardness (stone composition), multiplicity (single or multiple stones), locations (renal pelvis, upper calyx, and lower calyx) while analyzing on operation time. Also small sample size, non-randomization of the groups were research constrains.

## CONCLUSIONS

PCNL in supine position has the same effectiveness and safety as PCNL in prone position, while having significantly lesser operative time.

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