ORIGINAL ARTICLE

COMPARISON BETWEEN SUPINE POSITION VERSUS PRONE POSITION IN PERCUTANEOUS NEPHROLITHOTOMY: A SINGLE CENTERED ANALYSIS OF 623 CASES

Muhammad Nasir Jamil[1], Faheem ul Haq[1], Ehsan ul Islam[1], Robina Shaheen[2], Umer Farooq[3]

[1]Department of Urology, [2]Department of Anatomy, Ayub Medical College, Abbottabad, [3]King Abdullah teaching hospital Mansehra-Pakistan

Background: The ideal urological method for treating complex, large renal calculi is Percutaneous nephrolithotomy (PCNL). Its instruments, surgical techniques, and positions have all been adjusted as a result of its ever-changing nature. In PCNL, the supine position is advantageous compared to the prone position due to its several advantages, including the absence of cardiopulmonary risks, fewer post operative complications and shorter operative time. This study was designed for comparison of PCNL in prone and supine positions. **Methods:** After receiving ethical and research committee approval, this retrospective review from secondary data was conducted from April 2015 to December 2021. Out of 623 patients, PCNL in prone position was performed on 258 patients and365 patients inmodifiedsupine position. The patients' demographics, stone size and location, number of tracts, operating time, hospital stay, stone clearance rate, and post-operative complications were all compared. **Results:** The gender and age of the patients, the size and number of tracts, and location of the stones were all comparable (p>0.05). Operative time for prone position was 82 min ±2.49 SD VS 65 min ±2.95 SD, for modified supine position, p<0.001), hospital stay was 58 hrs. ±1.66 SD for prone VS 51 Hrs. ±1.65 SD, for modified supine position, p<0.01) and analgesia requirements for prone position was 41% VS 23% for modified supine position, p<0.001). The stone clearance rate was 87% in supine position and 89% in the prone positioning group (p=0.47). Urinary leakage from tract site was 0.38% in prone vs. 0% in supine position and temperature >99 °F was 12.4% in prone vs. 11.3% in supine position were the most common post-operative complications. Angioembolization was not observed in either group. Blood transfusions were given to 4.26% in prone position and in 3.58% of cases in supine PCNL. **Conclusion:** Percutaneous nephrolithotomy in the supine position had a short operating time, short hospital stays, and less analgesia requirements than PCNL in the prone position. In view of the above findings, supine PCNL is easy, quick to perform and having less complications rate as compare to Prone PCNL.

Keywords: Supine position; Prone position; Percutaneous nephrolithotomy (PCNL)

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INTRODUCTION

For complex and big upper urinary tract calculi, such as stag horn stones, SWL-resistant stones, or calculi growing in kidneys with aberrant pathology, PCNL is the ideal treatment option.[1,2] Prone position is the standard position for PCNL, because it is more familiar to urologists and allows for more percutaneous access and instrument manipulation. It does, however, have major disadvantages, particularly in obese, cardiac, and elderly patients, and it is unsuccessful in people with bone abnormalities.[3,4] It may exacerbate anaesthesia-related events such as position-related ventilatory and hemodynamic issues.[4] Other drawbacks include patient turnover during surgery and the risk of peripheral, and spinal nerve injury, as well as the inability to combine PCNL with other ureteroscopic procedures.

In 1998, Valdivia and colleagues published a study that demonstrated the effectiveness and safety of performing PCNL in the supine position.[5] All of the disadvantages of PCNL conducted in the prone position are eliminated when performed in the supine position, such as the ability to perform PCNL concurrently with other ureteroscopic procedures, accessing the upper pole of kidney through lower pole puncture, lack of respiratory and cardiovascular risks, and other common prone position issues, specifically in patients with obesity.[6,7] The disadvantages of PCNL in the supine position include a lack of space for renal puncture, relatively lower stone free rate(statistically insignificant) and difficulties holding the nephroscope.

When the advantages and disadvantages of these two procedures are weighed, more questions arise about how to choose an appropriate posture for PCNL. Several studies comparing these two positions for PCNL are done. The goal of this study is to provide a more accurate assessment of the safety and effectiveness of PCNL in prone and supine positions in patients having renal calculi.

MATERIAL AND METHODS

From April 2015 to December 2021, we conducted retrospective review from secondary data. A single urologist collected data of 623patients who underwent PCNL in prone or supine positions. Ethical approval was taken from the hospital's ethical and research committee. Patients with stones greater than 2 centimeter in diameter or who had failed SWL therapies were considered for inclusion in the study. Patients with uncorrectable coagulation problems, pregnancy, and current urinary tract infections were excluded. The follow-up visit was completed by 623 patients. Out of them, prone PCNL was performed in 258 patients and 365 patients underwent PCNLin supine positions. All patients signed written and informed consent form, and the surgeon's preference was used to establish the surgical position. Prior to surgery, all of the patients were assessed, which included a thorough medical history followed by physical examination, and laboratory tests (full blood count, bio chemistry investigations for evaluating renal functions, coagulation profile, viral serology, urine analysis, urine C/S for exclusion of any active infection in the urinary tract). Imaging including ultrasonography for the kidney, ureter, and bladder and CT urography was performed in all patients. Preoperatively, all patients were given antibiotics prophylactically and a sterile urine culture was ensured as well. Operative time of the procedure was recorded after anaesthesia completion and it included patient positioning as well as a PCNL technique including the placement of double J. Stents.

For prone PCNL, under general anaesthesia, cystoscopy was performed followed by placement of ureteral catheter in the ipsilateral pelvi-calyceal system under fluoroscopic guidance, followed by a Foley's catheter insertion. Patient was then rolled over to a prone position (shoulders, iliac bones, knee joints, ankles, and feet were padded, supported, as well as secured).

In supine PCNL patient was positioned in a supine position, with the contralateral lower limb in a relaxed lithotomy position and the ipsilateral lower limb stretched in line with the trunk. No bridge/bolsters were used to elevate shoulder, flank or buttock. Cystoscopy was performed followed by placement of ureteral catheter in the ipsilateral pelvi-calyceal system under fluoroscopic guidance, followed by a Foley's catheter placement.

Patients in both groups underwent the identical technique after placement and insertion of the ureteral catheter. Following the retrograde pyelogram, a target calyx was punctured under fluoroscopic guidance with 16G LP needle or Chiba needle in case of obese patients. On obtaining clear urine, a sensor wire was passed and placed into collecting system preferably into upper ureter. Alken dilators were used for serial dilatation in all cases. The location and size of stones determined the number of punctures. A 24 rigid French (Richard Wolf) nephroscope was used for nephroscopy. A pneumatic lithotripter was used for breakage and fragmentation of stones. Irrigation pumps or forceps were used to clean away or remove small stones. In all cases, double J stents were placed for 7 days, but nephrostomy tubes were placed in selected cases.

SPSS version 22.0 was used to analyze the data. For quantitative variables, the mean and standard deviation were computed, while for qualitative variables, frequencies and percentages were calculated. When comparing quantitative variables, the student T test was applied, while for comparison of qualitative variables, the Chi square test was applied. $p<0.05$ was chosen as the statistical significance level. To eliminate confounding factors or bias, exclusion criteria were strictly observed.

RESULTS

A total of 623 patients were included in this study. There were 258 patients in the prone group (Group A) and 365 patients in the supine group (Group B). Gender, age, stone size, number of stones, number of tracts of stones, and stone position all had no statistically significant differences ($p>0.05$) (Table-1, Figure-1)

In terms of mean operative time ($p<0.001$), analgesia during procedure ($p<0.001$), and hospital stay ($p<0.01$), there was a statistically significant difference between the two groups (Table-2). The stone clearance rate in the prone position was 89% and in the supine position was 87%, which was statistically insignificant ($p=0.47$) (Figure-2).

Post operatively, nephrostomy site urinary leakage was noted on one patient (0.38%) in prone position group, fever >99 in 12.4% in prone position versus 11.3% in supine position, while Angioembolization was not required in any of the patients in these groups. Eleven pints of blood were transfused in prone position group and 13 pints in supine group (Table-3)

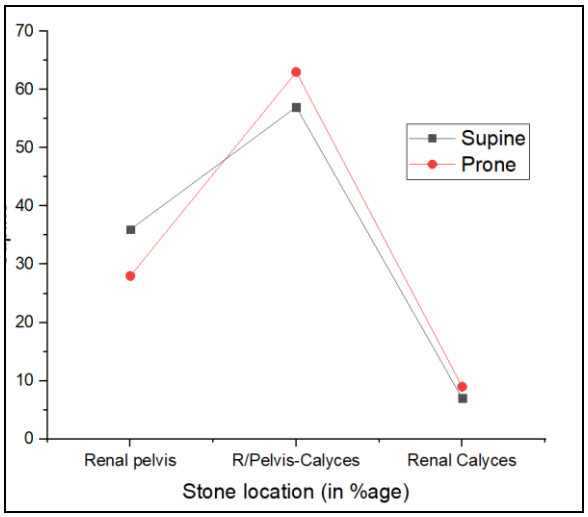

Figure-1: Stone location (*p*=0.08)

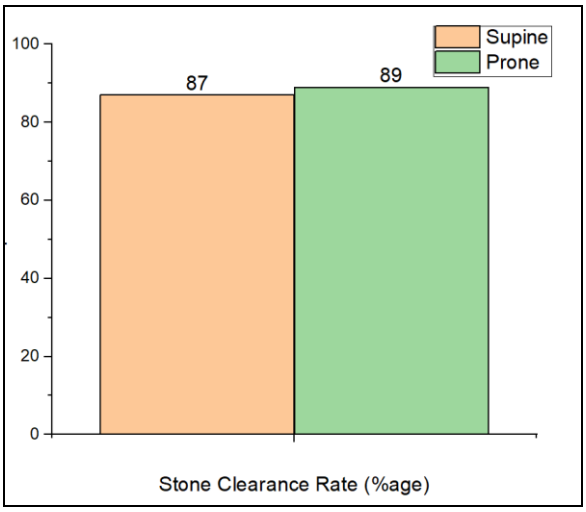

Figure-2: Stone clearance rate in PCNL (supine vs. prone position)

Figure-1: Supine position for PCNL (A) Illustrating surgeon's workstation for supine PCNL (B)

Table-1: Clinical Characteristics of patients (n=623)

	Prone position (A) (n=258)	**Supine position** (B) (n=365)	***p*-value**
Patients	258	365	
Gender	Male 165 (64%)	Male 242 (66.3%)	0.46
	Female 93 (36%)	Female 123 (33.7%)	
Age (years)	45.17 ± 10.87 SD	47.80 ± 10.46 SD	0.06
Size of stone (cm)	3.53 ± 0.97 SD	3.39 ± 1.04 SD	0.09
Number of stones	Single 96 (37.2%)	Single 156 (42.7%)	0.17
	Multiple 162 (62.8%)	Multiple 209 (57.3%)	
No of tracts	Single 202 (78%)	Single 304 (83.3%)	0.28
	Double 49 (19.3)	Double 54 (14.7%)	
	>2 tract 9 (2.7%)	> 2 tract 7 (2%)	

Table-2: Characteristics of patients in prone VS supine position PCNL (n=623)

	Prone position (n=258)	**Supine position (n=365)**	**P-value**
Mean operative time (min)	82 ± 2.49 SD	65 ± 2.95 SD	<0.001
Analgesia during procedure	41%	23%	<0.001
Stay in hospital (Hours)	58 ± 1.66 SD	51 ± 1.65 SD	<0.01

Table-3: Post-operative Complications (n=623)

Complication	Prone position (n=258)	Supine position (n=365)	*p*- value
Urinary leakage	1 (0.38%)	0 (0%)	-
Blood transfusion	11(4.26%)	13 (3.56%)	0.08
Fever >99°F	32 (12.4%)	41(11.3%)	0.045
Angioembolization	0 (0%)	0 (0%)	-
Total	17%	14.7%	0.065

DISCUSSION

Since its introduction, PCNL has been the favoured procedure for treating renal calculi, including stag horn stones. Although the posture of the patient during PCNL is still debatable, the most common position is prone, which was initially reported by Fernstrom and Johansson in 1976.[8] Since then, the strategy has been modified in terms of positioning stone clearing rate, and complication reduction. Despite the fact that more than two decades ago, supine position was established for PCNL, the prone position is still popular among urologists and is used in more than 80% of the world's centers [9]. In several South American cities, PCNL is frequently performed in the supine position.[9] The supine position has been declared safe and effective in the literature.[10–13] The position was mostly determined by surgeon's preference in this study. Supine position was advocated for PCNL in 58.6 percent of patients in our study.

The supine positioning considerably lowers surgical time because the patient does not have to be rolled over during the procedure.[14] The supine group in our study had a significantly shorter operating time than the prone group (82 minutes ±2.49 SD versus 65 minutes ±2.95 SD, $p<0.001$). In addition, Chapagain A *et al*[15] and Wang Y *et al*[16] found a statistically significant difference in prone and supine operational periods (44.63 minutes ±12.44 SD VS 53.02 minutes ±12.67 SD, P <0.04) and (78 minutes versus 88 min, $p<0.05$). Furthermore; Falahatkar S[16] established a statistically significant difference ($p<0.05$) between PCNL supine and prone positioning in terms of operating time, with the supine position consuming less time. In their meta-analyses, Wu P *et al*[18] and Liu L *et al*[19] revealed that supine PCNL had a significantly ($p<0.05$) shorter operational time.

In our study, in the supine PCNL group, stone clearance rates were found to be lower while the stone clearance rate in the prone position was shown to be high (89% VS 87%, $p=0.47$). In their study, De Sio M *et al* reported comparable results (91% versus 89%).[20] In another study, Falahatkar S *et al*.[17] and Wang Y *et al*.[16] concluded that the supine position had a lower stone clearance rate (77% versus 80%) and (73.3% versus 88.7%) than the prone position, which is consistent with our findings. According to Wang *et al*.[16], the stone-free rate was 88.7% in the supine position against 73.3% in the prone position. Yuan D *et al*[21] found that the overall rate of stone clearance was lower in the supine position than in the prone PCNL position (77.3% vs. 74.3%). In their review study, Patel RM *et al*[22] found that in supine and prone position PCNL, stone clearance rates were 82.6% and 84.8%, respectively. As a result, the proposed benefits of supine PCNL group in terms of clearance rate for stone have not been achieved.

The hospital stay was considerably shorter in the supine position (51±1.65 SD vs. 58±1.66 SD, $p<0.01$) in our study. Al-Dessoukey *et al* (49.8 Hrs. 81.2 Hrs. $p<0.02$)[23] obtained similar results. The mean hospital stays of patients in supine and prone postures differed numerically but statistically insignificantly, according to Valdivia JG *et al* (4.2 days vs. 4.3 days, $p=0.42$).[24]

The group that was in the prone position had more postoperative issues (17% vs. 14.5%) in our study. Similarly, Mazzucchi E and Chapagain A *et al* (16.2% vs. 15.7%)[15] found that the prone position group had a greater risk of post-operative complications (12.5% vs. 3.1%) [25]. In our study, we found urinary leakage (0.38 % vs. 0%) in the prone and supine positions respectively. Al-Dessoukey *et al* reported an increased number of urine leakage in the prone position group (4.9 % vs. 3%)[23], and Chapagain A *et al*.[15] reported one case of urinary leakage in the prone PCNL group, which validates the findings of our study.Fever >99 °F was found to be more common in the prone position group (12.4% vs. 11.3%). Shoma AM *et al* (5% vs. 4%)[26], Valdivia JG *et al* (11.1% vs. 7.6%)[24], and Al-Dessoukey AA (5.9% vs. 5%)[23] also found similar results of greater cases of fever in the patients operated in prone position. Blood transfusion rate was lower in the supine PCNL (3.56%vs. 4.24%) in this study. Valdivia JG *et al* (6.1% vs. 4.3%)[24] and Al-Dessoukey AA *et al* (6.1% vs. 4.3%) both reported similar results demonstrating higher blood transfusion (2.9% vs. 1%).

CONCLUSION

Our research has found that supine PCNL had a number of statistical advantages over prone PCNL, including a significantly shorter mean operative time, reduced analgesia requirement, and a shorter hospital

stay. There were a number of benefits identified, including lower blood transfusion rate as well lower cases of fever and urine leakages. In patients with renal calculi undergoing PCNL, supine position has a higher safety profile and positive outcome when all other factors are equal. PCNL in the supine posture is suggested for patients with renal stones.

AUTHORS' CONTRIBUTION

MNJ, FUH: Conceptualization of the study design, Literature search. FUH, EUI, RS, UF: Data collection, data interpretation, proof reading.

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Address for Correspondence:

Faheem ul Haq, Department of Urology, Ayub Medical College, Abbottabad-Pakistan
Email: faheem_123@hotmail.com