

Our experience of Prone Versus Supine Percutaneous Nephrolithotomy

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Prone Versus
Supine
Percutaneous
Nephrolithotomy

ABSTRACT

Objective: To compare the effectiveness of percutaneous nephrolithotomy (PCNL) performed in prone and supine positions.

Study Design: Randomized clinical trial study.

Place and Duration of Study: This study was conducted at the Urology department of Bakhtawar Amin Medical and Dental Collage, Multan, Pakistan from 1st July 2022 to 30th June 2024.

Methods: A total of 200 patients who underwent PCNL in either prone or supine positions were enrolled. Patients with stones larger than 2 centimeters or those who had failed shock wave lithotripsy (SWL) therapies Follow-up was completed by 200 patients, among whom 100 underwent prone PCNL and 100 underwent supine PCNL, with the surgical position determined by the surgeon's preference.

Results: The mean operative time of Group A was greater than Group B, 77.63 ± 3.66 minutes and 72.47 ± 12.87 minutes, respectively. ($p < 0.001$). Analgesia during procedure was given 43 (43.0%) to Group A and 29 (29.0%) to Group B, ($p = 0.039$). The mean length of hospital stays of Group A was greater than the Group B, 62.13 ± 3.69 hours and 52.96 ± 10.36 hours, respectively, ($p < 0.001$).

Conclusion: Performing PCNL in the supine position offers several advantages over the traditional prone position. Supine PCNL leads to shorter operating times, decreased hospital stays, and reduced analgesia requirements compared to prone PCNL.

Key Words: Nephrolithotomy, Prone position, Supine position, Pain, Hospital stay

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INTRODUCTION

In 1976, the successful removal of a kidney stone through a nephrostomy tract was accomplished for the first time¹. Since the day of PCNL has been introduced as a treatment of choice for complicated renal stones, taking place of open surgical technique². PCNL is usually performed in a prone position as it is to access diseased parts and easy to puncture the calyx posteriorly through Brodel's avascular plane, thereby reducing the risk of peritoneal breach and renal hemorrhage³. Prone position hinders pulmonary capacity by reducing abdominal pressure, especially for obese patients or those who have moderate to severe lung disease (unable to tolerate procedure)⁴.

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In 1987, Valdivia Uria introduced the supine PCNL technique, highlighting its advantages due to its simplified approach⁵. The supine position minimally affects circulation and the pulmonary system, facilitating patient monitoring and potentially reducing the required dose of anesthetics⁶. This technique is particularly beneficial for pediatric, geriatric, obese or overweight patients, those with spinal deformities, and debilitated individuals⁷.

The benefits for the surgeon include keeping their hands out of the fluoroscopic field, facilitating easier kidney puncture, and enabling endo-vision-assisted kidney puncture and renal tract dilation⁸. In addition, improved maneuverability and injury to the large bowel (colon). Thus, the main disadvantage of this technique is kidneys can easily be displaced or bent forward with facial dilators or puncture needles which can result in deeper channels^{9,10}.

Despite the extensive debate over positions of percutaneous nephrolithotomy (PCNL) approaches, no study has yet been conducted at our center. We assessed complications of techniques, safety profile, stone clearance, success rate, and time of surgery so that better techniques can be adopted for better patient care and to fulfill the local reference gap in the literature.

METHODS

A randomized controlled trial was completed in the department of Urology was conducted at the Urology department of Bakhtawar Amin Medical and Dental Collage, Multan, Pakistan from 1st July 2022 to 30th June 2024. A total of 200 patients who were admitted for elective percutaneous nephrolithotomy (PCNL) either in a supine or prone position were enrolled in the study. The study was approved by the hospital board of ethics. Patients who had failed shock wave lithotripsy, stone size above 2cm, pregnant women, active urinary tract infection, and deranged coagulation profile were excluded. Patients were randomized into two groups, 100 patients were operative in the supine position technique and 100 were operative with the prone position technique. Randomization was done by using the lottery method.

All patients underwent a brief preoperative assessment of physical examination, complete medical and surgical history, laboratory investigation including renal function test, complete urine examination, and imaging studies were also conducted as per surgeon requirement. Preoperative antibiotic prophylaxis was also given and operative in both positions of patients and follow-up measurements were also recorded.

In both positions (prone and supine) PCNL procedures performed under general anesthesia, cystoscopy was performed after the insertion of the catheter in urethra into the ipsilateral pelvicalyceal system visualized by fluoroscopic guidance, along with placement of a Foley's catheter; patients have positioned accordingly, with the prone position featuring adequate padding and support, and supine position involves stretched ipsilateral lower limb and lithotomy position of contralateral lower limb; subsequent steps involved identical techniques such as puncturing a target calyx under fluoroscopy, inserting a sensor wire into the collecting system, serial dilatation using Alken dilators, nephroscopy with a 24 rigid French nephroscope, stone fragmentation with a pneumatic lithotripter, and removal of stones using irrigation pumps or forceps; stents (Double J) were universally placed for 7 days, with nephrostomy tubes added in selected cases. Data analysis was conducted with SPSS version 27, all numerical and categorical variables were categorized and after test of significance p values below 0.05 was taken as significant.

RESULTS

Of the 200 patients, 100 were included in the Prone Position (Group A) and 100 were included in Supine Position (Group B). In terms of demographic and clinical profile, both the study groups were almost equal, ($p>0.050$). (Table. I).

The mean operative time of Group A was greater than Group B, 77.63 ± 3.66 minutes and 72.47 ± 12.87 minutes, respectively. ($p<0.001$).

Table No. 1: Comparison of demographic and clinical profile between the groups

Variable	Prone	Supine	p-value
Age (years)	47.51±7.84	49.16±7.95	0.184
Sex			
Male	65 (65.0)	60 (60.0)	0.465
Female	35 (35.0)	40 (40.0)	
BMI (kg/m ²)	25.19±1.23	25.10±1.59	0.640
Stone size (mm)	3.65±0.59	3.53±0.52	0.120
No. of stones			
1	28 (28.0)	39 (39.0)	0.099
>2	72 (72.0)	61 (60.0)	
No. of tracts			
1	72 (72.0)	66 (66.0)	0.166
2	20 (20.0)	30 (30.0)	
>2	8 (8.0)	4 (4.0)	
Stone location			
Renal pelvis	28 (28.0)	29 (29.0)	0.684
Pelvis cycles	48 (48.0)	52 (52.0)	
Renal cycles	24 (24.0)	19 (19.0)	
Stone clearance rate			
Yes	80 (80.0)	76 (76.0)	0.495
No	20 (20.0)	24 (24.0)	
Mean ± standard deviation, n (%)			

Table No. 2: Comparison of demographic and clinical profile between the groups

Variable	Prone	Supine	p-value
Operative time (min)	77.63 $\pm$ 3.66	72.47 $\pm$ 12.87	<0.001
Analgesia during procedure	43 (43.0)	29 (29.0)	0.039
Hospital stays (hours)	62.13 $\pm$ 3.69	52.96 $\pm$ 10.36	<0.001
Mean $\pm$ standard deviation, n (%)			

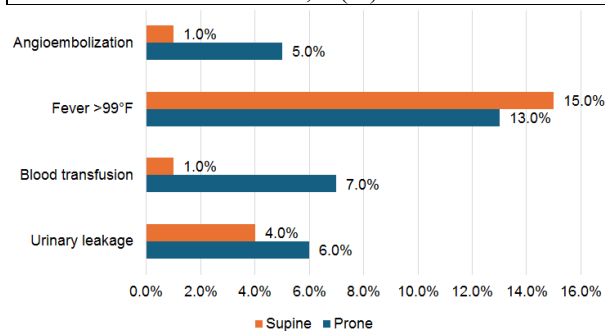


Figure No. 1: Postoperative complications between the groups

Analgesia during the procedure was given 43 (43.0%) to Group A and 29 (29.0%) to Group B, ($p=0.039$). The mean length of hospital stays of Group A was greater than that of Group B, 62.13 ± 3.69 hours and 52.96 ± 10.36 hours, respectively, ($p<0.001$). (Table. II). The presence of postoperative complications was depicted in the figure. I. Fever $>990F$ was the most common complication, with 13 (13.0%) in Group A and 15 (15.0%) in Group B, ($p=0.684$). (Figure. I).

DISCUSSION

PCNL is the most usual surgical procedure and is graded as the treatment of choice adopted for the management of kidney stones (urolithiasis), especially in large-size stones (above 2cm) either partial staghorn or staghorn. However, it is also a suitable option for smaller stones¹¹.

The mean operative time of Group A was greater than Group B, 77.63 ± 3.66 minutes and 72.47 ± 12.87 minutes, respectively. ($p<0.001$). Additionally, Wang Y et al¹³ observed average operating times of 78 minutes for the supine group compared to 88 minutes for the prone group, the difference ($p<0.05$). Similarly, research by Chapagain A et al¹² found a clear difference in operational periods between prone and supine positioning, reporting average times of 53.02 minutes (± 12.67 SD) for the supine group versus 44.63 minutes (± 12.44 SD) for the prone group ($p<0.04$).

Falahatkar et al¹⁴ noted a difference in operating time between the supine and prone positions for PCNL, with the supine position requiring less time. Additionally, a meta-analysis conducted by Liu L et al¹⁵ corroborated these findings, revealing that PCNL in the supine position had a significantly shorter operational time ($p<0.05$) compared to the PCNL prone position.

In our study, we observed that the stone clearance rates were lower in the supine PCNL group compared to the prone position group, with the latter demonstrating a higher clearance rate (76% versus 80%, $p = 0.47$). This finding aligns with the results reported by De Sio M et al¹⁶, who also found comparable stone clearance rates between the two positions (91% versus 89%).

Yuan et al¹⁷ found stone clearance rate in PCNL was lower in the supine position compared to the prone position, with rates of 74.3% and 77.3%, respectively. In a review study, Patel et al¹⁸ reported stone clearance rates of 82.6% for the supine position and 84.8% for the prone position. Consequently, these findings suggest that the anticipated advantages of the supine PCNL position in terms of the clearance rate of stone have not been realized.

In our study, the hospital stay was significantly shorter for patients in the supine position compared to those in the prone position, with durations of 52.96 ± 10.36 hours versus 62.13 ± 3.69 hours, respectively ($p<0.01$). Similarly, Al-Dessoukey et al¹⁹, found mean hospital stays of 49.8 hours for the supine position and 81.2

hours for the prone position, with a statistical significance of $p<0.02$. However, Valdivia JG et al²⁰ observed a numerical difference in the mean hospital stays in both positions, with durations of 4.2 days and 4.3 days, respectively, ($p=0.42$).

The presence of postoperative complications was depicted in the figure. I. Fever $>990F$ was the most common complication, with 13 (13.0%) in Group A and 15 (15.0%) in Group B, ($p=0.684$). This finding aligns with research conducted by Mazzucchi et al²¹, where they also found a greater risk of post-operative complications among patients in the prone position group, with rates of 16.2% versus 15.7% in the non-prone group. Specifically, they noted a higher incidence of complications at 12.5% in the prone group compared to 3.1% in the non-prone group. These results suggest that the prone position during surgery may be associated with a slightly increased risk of postoperative complications, highlighting the importance of careful consideration and monitoring during surgical procedures involving this position.

CONCLUSION

Performing percutaneous nephrolithotomy (PCNL) in the supine position offers several advantages over the traditional prone position. Supine PCNL leads to shorter operating times, decreased hospital stays, and reduced analgesia requirements compared to prone PCNL. These benefits underscore the ease and efficiency of supine PCNL, making it a favorable option with lower complication rates than prone PCNL.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Ibrar Ahmad, Muhammad Adnan, Saifullah
Drafting or Revising Critically:	Muhammad Muzammil, Kiran Areej, Muhammad Arbaz Hanif Khan
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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