**Original Article**

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# Comparison Between Supine Position Versus Prone Position in Percutaneous Nephrolithotomy

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Author`s Contribution

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**ABSTRACT**

**Objective:** To compare and evaluate the efficacy and safety of percutaneous nephrolithotomy (PCNL) performed in prone and supine positions.

**Methodology:** This prospective randomized trial study was conducted at the Urology department of Nishtar Hospital Multan from January 2023 to December 2023. A total of 174 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 174 patients, among whom 87 underwent prone PCNL (Group A) and 87 underwent supine PCNL (Group B), with the surgical position determined by the surgeon's preference. Chi-square test was applied to check the significance of categorical variables and student t test was applied to check significance the difference between two means. One way ANOVA was applied to the significant difference between more than two means. p values below 0.05 was taken as significant.

**Results:** The mean operative time of Group A (prone position) was greater than the Group B (supine position), 77.60±3.76 minutes and 71.61±13.58 minutes, respectively. Analgesia during procedure was given 42.5% to Group A (prone position) and 27.6% to Group B, (p=0.039). The mean length of hospital stay of Group A (prone position) was greater than the Group B, 62.00±3.72 hours and 51.62±10.41 hours, respectively. The presence of postoperative complications urinary leakage was 5.7% in Group A and 3.7% in group B, blood transfusion was 6.9 and 1.1 in Group A and group B, angioembolization was 4.6 and 0.0% in Group A and group B, fever >990F was the most common complication, 12.6% in Group A and 17.2% in Group B.

**Conclusion:** Both procedures have equal efficacy and safety as PCNL in supine position is associated with advantages of shorter operating time, less analgesia requirement and shorter hospital stay and prone position PCNL associated with better stone clearance rate and less complication of fever.

**Keywords:** Nephrolithotomy, Supine position, Prone position, pain.

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## Introduction

Since the pioneering successful removal of a renal calculus via a nephrostomy tract in 1976, percutaneous nephrolithotomy (PCNL) has firmly established itself as the preferred technique for managing patients with large or complex kidney stones.[1] Traditionally, PCNL is performed with the patient in a prone position, which offers numerous surgical advantages, such as a broad field for kidney puncture, reduced risk of abdominal visceral injury, and a direct, short puncture pathway.[2] This position enables multiple access routes and facilitates C-arm fluoroscopy, allowing optimal vertical positioning during the puncture process.[3]

Importantly, prone positioning allows accessing kidneys posteriorly to the collecting system, theoretically enabling surgeons to puncture a posterior calyx via Brodel's avascular plane, thereby minimizing bleeding from parenchyma and the risk of peritoneal perforation.[4] However, the prone position has drawbacks.[5] For instance, it can elevate abdominal pressure, reduce end-

expiratory lung volume and overall lung capacity, compromise respiratory function, and limit the patient's tolerance for prolonged surgery.[6] These respiratory changes make the prone position less suitable for patients with morbid obesity or certain respiratory conditions, in which this positioning could pose significant risks.[7]

The supine position for PCNL involves placing the patient in a supine position with either a water bag positioned under the flank to improve access to the kidney[8]. This position offers several benefits, beginning with enhanced comfort, which minimizes the impact on the patient's circulatory and respiratory systems[9]. Additionally, this arrangement provides the anesthetist with better access to the patient for monitoring purposes and may allow for a reduced dosage of anesthetic agents due to the patient's stability.[10] The modified supine position for high-risk patients allows for easy adaptation to endotracheal intubation anesthesia if necessary.[10]

Another key advantage is the more favorable angle created between the horizon and the surgical access channel, which can aid in efficiently removing stone fragments. This position also enables the simultaneous use of a ureteroscope, making it possible to combine PCNL with ureteroscopic interventions, a benefit precious in treating complex stone diseases.[11] However, a notable drawback of the supine position is that the kidney is more prone to shifting forward when subjected to the pressure of the puncture needle and fascial dilators, potentially requiring the creation of a deeper access channel[12].

The choice of position either prone or supine during percutaneous nephrolithotomy is under debate. De Sio et al[13] found similar stone clearance rates between supine and prone positions in PCNL, with a lower incidence of respiratory issues in the supine position. Liu et al[14] reported shorter operative times and more stable anesthesia in the supine position, particularly in high-risk patients. Rassweiler et al[15] noted that, while the prone position allows better access in complex cases, the supine position's reduced operative time and complication rates often outweigh these advantages. Thus, a well-designed comparative study on the outcomes and safety of supine versus prone PCNL is needed especially in our region where literature-based practice is not trending. This study aimed to compare the outcomes of both positions more extensively and fill the local reference gap in the literature.

# Methodology

This Prospective Randomized Trial was conducted at the Urology department of Nishtar Hospital Multan from January 2023 to December 2023, involving 174 patients who underwent PCNL in either prone or supine positions. Study permission was taken from ethical committee of hospital under number [195/11]. Patients were assigned into two groups A (Prone position) and group B (Supine position) computer generated numbers. Numbers were allocated and enclosed into envelopes. Patients were asked to choose envelop. Odd numbers were assigned to group A and even numbers to group. In group A surgical intervention was done in Prone position and in group B procedure was performed in supine position. Ethical approval was obtained from the hospital's ethical and research committee, with inclusion criteria comprising patients with stones larger than 2 centimeters or those who had failed shock wave lithotripsy (SWL) therapies, while individuals with uncorrectable coagulation issues, pregnancy, or current urinary tract infections were excluded from the study. Follow-up was completed by 174 patients, among whom 87 underwent prone PCNL and 87 underwent supine PCNL, with the surgical position determined by the surgeon's preference.

Preoperatively, patients underwent a thorough assessment, including medical history, physical examination, and various laboratory tests and imaging studies to evaluate renal function and urinary tract health. Antibiotic prophylaxis was administered, and operative time, including patient positioning and PCNL technique, was meticulously recorded throughout the study period.

In PCNL with the prone position, the patient is sedated and then placed in a lithotomy position for disinfection and draping. A 5 Fr open ureter catheter (UC) is inserted into the ureter on the target side using a cystoscope. The UC allows injection of contrast to visualize the kidney's pelvicalyceal system (PCS) under fluoroscopy during puncture and dilation. The UC is guided with the C-ARM to the ureteropelvic junction (UPJ) or below the obstructing stone. If access to the kidney is complex, URS is performed to advance into the PCS, where a guidewire is left. The UC is then inserted over the guidewire with C-ARM guidance. Once positioned correctly, the UC is secured to the urethral catheter. The patient is then repositioned to prone, and re-disinfection and draping are done.

Using C-ARM fluoroscopy guidance, an 18 Gauge nephrostomy trocar punctures the target site. After trocar

insertion, a guide wire is placed, followed by gradual dilation up to 28 or 30 Fr am Platz. A 25 Fr nephroscope is then inserted. Small stones are removed directly with forceps, while larger stones are fragmented using a pneumatic lithotripter, with fragments extracted by forceps. In the end, a decision is made on whether to place a nephrostomy tube or DJ stent, depending on the presence of large perforations, significant bleeding, or large residual stones.

In the supine PCNL procedure, the patient is given anesthesia and positioned in a semi-lithotomy, with one leg in lithotomy and the other slightly lower. The patient is supported with two 1-liter infusion bottles placed under the chest and pelvis. After disinfection and draping, UC insertion is performed via cystoscopy. If UC advancement to the kidney is difficult, URS is used, as with the prone position procedure. Once UC placement is confirmed, kidney puncture is done under C-ARM guidance, followed by the same technique used in the prone position.

Data analysis was conducted with SPSS version 27, all numerical and categorical variables were categorized. Chi-square test was applied to check the significance of categorical variables and student t test was applied to check significance the difference between two means. One way ANOVA was applied to the significant difference between more than two means. p values below 0.05 was taken as significant.

# Results

Out of 174 patients, 87 were included in Prone Position (Group A) and 87 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 the Group B, 77.60±3.76 minutes and 71.61±13.58 minutes, respectively. (p<0.001). Analgesia during procedure was given 37 (42.5%) to Group A and 24 (27.6%) to Group B, (p=0.039). The mean length of hospital stay of Group A was greater than the Group B, 62.00±3.72 hours and 51.62±10.41 hours, respectively, (p<0.001). (Table. II).

The presence of postoperative complications was depicted in figure. I. Fever >99$^0$F was the most common complication, 11 (12.6%) in Group A and 15 (17.2%) in Group B, (p=0.395). (Figure. I).

**Table I: Comparison of demographic and clinical profile between the groups.**

| Variable | Group A (Prone position) | Group B (Supine position) | p-value |
|---|---|---|---|
| **Age (years)** | 47.40±7.72 | 49.16±7.87 | 0.139 |
| **Sex** | | | |
| **Male** | 55 (63.2) | 50 (57.5) | 0.438 |
| **Female** | 32 (36.8) | 37 (42.5) | |
| **BMI (kg/m$^2$)** | 25.15±1.21 | 24.16±1.53 | 0.978 |
| **Stone size (mm)** | 3.61±0.58 | 3.55±0.52 | 0.492 |
| **No. of stones** | | | |
| **1** | 25 (28.7) | 36 (41.4) | 0.081 |
| **>2** | 62 (71.3) | 51 (58.6) | |
| **No. of tracts** | | | |
| **1** | 62 (71.3) | 59 (67.8) | 0.872 |
| **2** | 21 (24.1) | 24 (27.6) | |
| **>2** | 4 (4.6) | 4 (4.6) | |
| **Stone location** | | | |
| **Renal pelvis** | 25 (28.7) | 24 (27.6) | 0.974 |
| **Pelvis cycles** | 47 (54.0) | 47 (54.0) | |
| **Renal cycles** | 15 (17.2) | 16 (18.4) | |
| **Stone clearance rate** | | | |
| **Yes** | 69 (79.3) | 65 (74.7) | 0.471 |
| **No** | 18 (20.7) | 22 (25.3) | |

Mean ± standard deviation, n (%)

**Table II: Comparison of clinical profile between the groups.**

| Variable | Group A (Prone position) | Group B (Supine position) | p-value |
|---|---|---|---|
| **Operative time (min)** | 77.60±3.76 | 71.61±13.58 | <0.001 |
| **Analgesia during procedure** | 37 (42.5) | 24 (27.6) | 0.039 |
| **Hospital stay (hours)** | 62.00±3.72 | 51.62±10.41 | <0.001 |

Mean±SD, N (%)

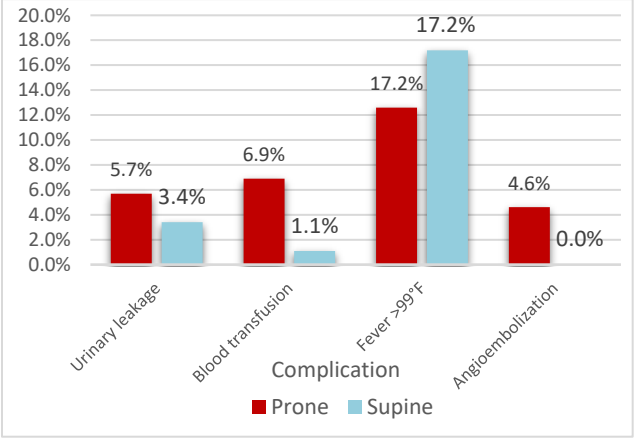


**Figure I. Postoperative complications between the groups**

There was a significant association between stone clearance rate and stone size (p=0.020), stone clearance rate and stone location (p=0.004). (Table. III).

There was a significant association between complications rates and BMI, number of stone, and location of stone, (p<0.001). (Table IV)

**Table III**: **Association of stone clearance rate with BMI, size of stones, and number of stones and location of stones.**

| Variable | Stone clearance rate | | p-value |
|---|---|---|---|
| | **Yes** | **No** | |
| **B.M.I** | | | |
| **≤ 27.5 kg/m²** | 151 | 40 | 0.096 |
| **> 27.5 kg/m²** | 5 | 4 | |
| **Stone size (mm)** | 3.04±0.56 | 3.42±0.52 | 0.020 |
| **No. of stones** | | | |
| **1** | 53 | 14 | 0.789 |
| **>2** | 103 | 30 | |
| **Stone location** | | | |
| **Renal pelvis** | 47 | 10 | 0.004 |
| **Pelvis cycles** | 69 | 31 | |
| **Renal cycles** | 40 | 3 | |

In this study size of stones was almost equal in both groups but prone position group had a large number of stones in large quantity. Although, the number of stones is large in quantity better stone clearance was observed in the prone position. A study was conducted by Mulay et al[19] and reported similar findings that stone size was almost equal in both groups 2.43cm in the supine position and 2.60cm in the prone position group. The stone clearance rate was better in the prone position.

BMI of patients was higher in the prone position group 25.15±1.21kg/m2 than supine position 24.16±1.53 kg/m2 but statistically insignificant results (p=0.978). It was also observed higher BMI was associated with more incidences of urinary leakage and blood transfusion rate. Results from previous studies validate findings; Al-Dessoukey et al[20] reported 4.9% urinary leakage in the prone group as compared to 3% in the supine position.

**Table IV: Association of complications rates with BMI, size of stones, and number of stones and location of stones.**

| Variable | Complications | | | | p-value |
|---|---|---|---|---|---|
| | **Urinary leakage** | **Blood transfusion** | **Fever >99°F** | **Angioembolization** | |
| **BMI** | | | | | |
| **≤ 27.5 kg/m²** | 0 | 0 | 26 | 6 | <0.001 |
| **> 27.5 kg/m²** | 10 | 8 | 2 | 0 | |
| **Stone size (mm)** | 3.67±0.71 | 3.66±0.31 | 3.68±0.51 | 3.21±0.76 | 0.745 |
| **No. of stones** | | | | | |
| **1** | 1 | 3 | 11 | 1 | <0.001 |
| **>2** | 9 | 5 | 17 | 5 | |
| **Stone location** | | | | | |
| **Renal pelvis** | 1 | 2 | 5 | 3 | <0.001 |
| **Pelvis cycles** | 6 | 6 | 17 | 1 | |
| **Renal cycles** | 3 | 0 | 6 | 2 | |

# Discussion

PCNL has long been regarded as the gold standard treatment for large renal calculi, typically those larger than 2 cm. However, it is also a suitable option for smaller stones.[16]

Our study found that the supine group had a significantly shorter operating time than the prone group, with an average of 77.60±3.76 minutes versus 71.61±13.58 minutes, which was statistically significant (p<0.001). Contrast observations were reported by Chapagain et al.[17] found a statistically significant difference in operation times 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). Additionally, Wang et al.[18] observed average operating times of 78 minutes for the supine group compared to 88 minutes for the prone group, the difference (p<0.05).

Falahatkaret al[21] established a statistically significant difference (p<0.05) in operating time between both groups for PCNL, with the supine position requiring less time. A meta-analysis conducted by Liu et al[14] reported findings similar to our findings that the supine position PCNL was associated with a shorter duration of surgery as compared to the prone position. These findings are consistent with our findings that operative time in the prone position was 77.60±3.76 minutes and in the supine position 71.61±13.58 minutes.

Regarding outcomes of the study stone clearance rate in our study was lower in the supine position PCNL 74.7% as compared to the prone position group 79.3%. These findings align with the findings of a study conducted by De Sio et al[13] who reported 89% stone clearance in the supine position and 91% in the prone position. Yuan et al[22] also found that PCNL in the supine position has a lower stone clearance rate of 74.3% when compared with the prone position of 77.3%.

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 51 ± 1.65 hours versus 58 ± 1.66 hours, respectively ($p<0.01$). This may be due to prolonged surgical time that influences the blood loss and transfusion requirements in prone group. Similar results were reported by Al-Dessoukey et al[20], who found mean hospital stays of 49.8 hours for the supine position and 81.2 hours for the prone position, and operation time of 86.16 and 111.7 minutes with a statistical significance of $p<0.02$. However, Valdivia et al[23] observed a numerical difference in the mean hospital stays of patients in supine and prone postures, with durations of 4.2 days and 4.3 days, respectively, and patients in the prone position required more blood transfusion.

In our study, we observed that the group placed in the prone position during surgery experienced a slightly higher rate of postoperative issues at 17%, compared to 14.5% in the non-prone group. Similar findings were observed by Mazzucchi et al[24], who found that prone position surgery was associated with a greater risk of postoperative complications. In his study complication rate in the prone position was 16.2% which was slightly above non prone or supine positioning group.

# Conclusion

Our findings reveal both procedures have equal efficacy and safety as PCNL in the supine position is associated with the advantages of shorter operating time, less analgesia requirement, and shorter hospital stay and prone position PCNL associated with better stone clearance rate and less complication of fever.

# References


1. DiBianco JM, Ghani KR. Precision stone surgery: current status of miniaturized percutaneous nephrolithotomy. Curr Urol Rep. 2021;22:1-1. https://doi.org/10.1007/s11934-021-01042-0
2. Edwan MA, Abdelaziz AA, El-Assmy AM, Abouelghar MI, Abdel-Baky HA. Impact of Pediatric Urolithiasis and its management on renal growth. J Pharm Negat Results. 2023;4(3):713-26.
3. Bergmann J, Rosenbaum CM, Netsch C, Gross AJ, Becker B. First clinical experience of a novel pulsed solid-state thulium: YAG laser during percutaneous nephrolithotomy. J Clin Med. 2023;12(7):2588. https://doi.org/10.3390/jcm12072588
4. Giusti G, De Lisa A. PCNL in the prone position VS PCNL in the modified supine Double-S position: is there a better position? A prospective randomized trial. Urolithiasis. 2020;48(1):63-9. https://doi.org/10.1007/s00240-018-1088-0
5. Yue G, Lei Y, Karagöz MA, Zhu H, Cheng D, Cai C, Wu X, Li Z, Zhao Y, Liu Y. Comparison of the prone split-leg position with the traditional prone position in percutaneous nephrolithotomy: A propensity score-matching study. J Endourol. 2021;35(9):1333-9. https://doi.org/10.1089/end.2020.0791
6. Ahmed AF, Gomaa A, Daoud A, Solyman A, Abdelazim H, El-Feky M et al. Split-leg modified lateral versus prone position in percutaneous nephrolithotomy: a prospective, randomized trial. World J Urol. 2021;39:1247-56. https://doi.org/10.1007/s00345-020-03285-x
7. Kannan D, Quadri M, Sekaran PG, Paul R, Panneerselvam A, Jain N, Paneerselvam A. Supine versus prone percutaneous nephrolithotomy (PCNL): A single Surgeon's experience. Cureus. 2023;15(7): e41944. https://doi.org/10.7759/cureus.41944
8. Giusti G, Pavia MP, Rico L, Proietti S. Percutaneous nephrolithotomy: which position? Supine position!. European Urology Open Science. 2022;35:1-3. https://doi.org/10.1016/j.euros.2021.10.005
9. Kucukyangoz M, Gucuk A. Which position is more advantageous for percutaneous nephrolithotomy: supine or prone?. Urolithiasis. 2023;51(1):p102. https://doi.org/10.1007/s00240-023-01474-y
10. Birowo P, Tendi W, Widyahening IS, Rasyid N, Atmoko W. Supine versus prone position in percutaneous nephrolithotomy: a systematic review and meta-analysis. F1000Research. 2020;2(9):p231. https://doi.org/10.12688/f1000research.22940.1
11. Li P, Ma Y, Liao B, Jin X, Xiang L, Li H, et al. Comparison of safety and efficacy of different positions in percutaneous nephrolithotomy: a network meta-analysis. International Journal of Surgery. 2024;110(4):2411-20. https://doi.org/10.1097/JS9.0000000000001130
12. Chapagain A, Basnet RB, Shah C, Shah AK, Shrestha PM, Shrestha A. Comparative Study of Percutaneous Nephrolithotomy in Supine and Prone Positions. J Nepal health Res Counc 2021;19(1):154-7. https://doi.org/10.33314/jnhrc.v19i1.3346
13. De Sio M, Autorino R, Quarto G, Calabro F, Damiano R, Giugliano F et al. Modified supine versus prone position in percutaneous nephrolithotomy for renal stones treatable with a single percutaneous access: a prospective randomized trial. european urology. 2008 Jul 1;54(1):196-203. https://doi.org/10.1016/j.eururo.2008.01.067
14. Liu L, Zheng S, Xu Y, Wei Q. Systematic review and meta-analysis of percutaneous nephrolithotomy for

patients in the supine versus prone position. J Endourol 2010;24(12):1941-6.
https://doi.org/10.1089/end.2010.0292

15. Rassweiler-Seyfried MC, Rassweiler JJ, Weiss C, Müller M, Meinzer HP, Maier-Hein L, et al. iPad-assisted percutaneous nephrolithotomy (PCNL): a matched pair analysis compared to standard PCNL. World journal of urology. 2020;38:447-53.
https://doi.org/10.1007/s00345-019-02801-y
16. Jamil MN, Haq F, Islam E, Shaheen R, Farooq U. Comparison between supine position versus prone position in percutaneous nephrolithotomy: Asingle centered analysis of 623 cases. J Ayub Med Coll Abbottabad 2022;34(4 Suppl1):1003-7.
https://doi.org/10.55519/JAMC-04-S4-11259
17. Chapagain A, Basnet RB, Shah C, Shah AK, Shrestha PM, Shrestha A. Comparative Study of Percutaneous Nephrolithotomy in Supine and Prone Positions. J Nepal health Res Counc 2021;19(1):154-7.
https://doi.org/10.33314/jnhrc.v19i1.3346
18. Wang Y, Wang Y, Yao Y, Xu N, Zhang H, Chen Q, et al. Prone versus modified supine position in percutaneous nephrolithotomy: a prospective randomized study. Int J Med Sci 2013;10(11):1518-23.
https://doi.org/10.7150/ijms.6305
19. Mulay A, Mane D, Mhaske S, Shah AS, Krishnappa D, Sabale V. Supine versus prone percutaneous nephrolithotomy for renal calculi: Our experience. Curr Urol. 2022 Mar;16(1):25-29.
https://doi.org/10.1097/CU9.0000000000000076
20. Al-Dessoukey AA, Moussa AS, Abdelbary AM, Zayed A, Abdallah R, Elderwy AA, et al. Percutaneous nephrolithotomy in the oblique supine lithotomy position and prone position: a comparative study. J Endourol 2014;28(9):1058-63.
https://doi.org/10.1089/end.2014.0078
21. Falahatkar S, Asli MM, Emadi SA, Enshaei A, Pourhadi H, Allahkhah A. Complete supine percutaneous nephrolithotomy (csPCNL) in patients with and without a history of stone surgery: safety and effectiveness of csPCNL. Urol Res 2011;39(4):295-301.
https://doi.org/10.1007/s00240-010-0341-y
22. Yuan D, Liu Y, Rao H, Cheng T, Sun Z, Wang Y, et al. Supine versus prone position in percutaneous nephrolithotomy for kidney calculi: a meta-analysis. J Endourol. 2016;30(7):754-63.
https://doi.org/10.1089/end.2015.0402
23. Valdivia JG, Scarpa RM, Duvdevani M, Gross AJ, Nadler RB, Nutahara K, et al. Supine versus prone position during percutaneous nephrolithotomy: a report from the clinical researchoffice of the endourological society percutaneous nephrolithotomy global study. J Endourol. 2011;25(10):1619-25.
https://doi.org/10.1089/end.2011.0110
24. Mazzucchi E, Vicentini FC, Marchini GS, Danilovic A, Brito AH, Srougi M. Percutaneous nephrolithotomy in obese patients: comparison between the prone and total supine position. J Endourol. 2012;26(11):1437-42.
https://doi.org/10.1089/end.2012.0257