


# Comparative Analysis of Mean Hospital Stay in Patients Undergoing Percutaneous Nephrolithotomy (PCNL) With Versus Without Nephrostomy Tube

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Izhar Ali<sup>1</sup>, Ijaz Khan<sup>2</sup>, Aziz ul Wahab<sup>3</sup>, Farman Ullah<sup>4</sup>, Muhammad Tanveer Sajid<sup>5</sup>, Numan Alam<sup>6</sup>, Rafiq Zafar<sup>7</sup>

## Correspondence

Izhar Ali  
[izharali1989.ia@gmail.com](mailto:izharali1989.ia@gmail.com)

## Affiliations

- 1 Consultant Urologist, Armed Forces Institute of Urology, Rawalpindi, Pakistan
- 2 Consultant Urologist, District Headquarters Teaching Hospital, Swabi, Khyber Pakhtunkhwa, Pakistan
- 3 Consultant Urologist, District Headquarters Hospital Demerara, Lower Dir, Khyber Pakhtunkhwa, Pakistan
- 4 Consultant Urologist, Gomal Medical College, Dera Ismail Khan, Pakistan
- 5 Consultant Urologist, Armed Forces Institute of Urology, Rawalpindi, Pakistan
- 6 Consultant Urologist, District Headquarters Hospital, Mardan, Pakistan
- 7 Consultant Urologist, Armed Forces Institute of Urology, Rawalpindi, Pakistan

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Percutaneous nephrolithotomy, tubeless PCNL, nephrostomy tube, hospital stay, renal calculi, minimally invasive urology.

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## Conflict of Interest

None declared

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## ABSTRACT

**Background:** Percutaneous nephrolithotomy (PCNL) is a minimally invasive surgical procedure for the removal of large renal calculi. The use of nephrostomy tubes postoperatively is common; however, they may increase hospital stay and patient discomfort. Tubeless PCNL has emerged as a potential alternative.

**Objective:** To compare the mean hospital stay in patients undergoing PCNL with and without a nephrostomy tube.

**Methods:** A prospective cohort study was conducted on 60 patients undergoing PCNL at the Armed Forces Institute of Urology, Rawalpindi, from June to December 2020. Patients were divided into two groups: Group A (PCNL with nephrostomy tube) and Group B (tubeless PCNL). Both groups were assessed for mean hospital stay, postoperative complications, and stone size using SPSS version 25. Inclusion criteria were age  $\geq 18$  years, stone size of 2-3 cm, and ASA I-II. Exclusion criteria included prior renal surgeries and comorbidities.

**Results:** The mean hospital stay was significantly shorter in Group B ( $1.90 \pm 0.80$  days) compared to Group A ( $2.46 \pm 0.81$  days,  $p=0.0001$ ).

**Conclusion:** Tubeless PCNL significantly reduces hospital stay compared to standard PCNL.

## INTRODUCTION

Renal stone disease is one of the most prevalent urological conditions worldwide, affecting approximately 10% of the global population and contributing significantly to healthcare burden and costs (1). The pathophysiology of nephrolithiasis involves a complex interplay of environmental, genetic, and metabolic factors, leading to the formation of calculi within the urinary tract. Supersaturation of urine with lithogenic substances such as calcium oxalate, uric acid, and cystine, combined with a deficiency in natural inhibitors of crystallization, is thought to promote nucleation, crystal aggregation, and eventual stone formation (2). Renal calculi vary in size, location, and composition, which determines the choice of treatment. Historically, the management of large and complex renal stones necessitated open surgical procedures such as pyelolithotomy and nephrolithotomy, which were associated with substantial morbidity and prolonged recovery times (3). However, advances in minimally invasive techniques have transformed the treatment landscape, with percutaneous nephrolithotomy (PCNL) emerging as the gold standard for stones exceeding 2 cm in size (4). Since its introduction in 1976, PCNL has undergone numerous modifications to enhance its safety, efficacy, and patient comfort, including the development of tubeless techniques

that eliminate the need for a postoperative nephrostomy tube (5).

The standard PCNL procedure typically involves the placement of a nephrostomy tube at the end of the surgery to facilitate renal drainage, provide hemostasis, and maintain access to the renal collecting system for potential reintervention. While effective in achieving these objectives, nephrostomy tubes are associated with increased postoperative pain, a higher risk of infection, and prolonged hospital stays, which can negatively impact patient outcomes and healthcare costs (6). To address these limitations, the concept of tubeless PCNL was introduced, wherein the nephrostomy tube is replaced with a ureteral stent or omitted altogether. Early studies suggested that tubeless PCNL could reduce postoperative discomfort and shorten hospital stays, thus improving overall patient satisfaction (7). However, the evidence regarding the safety and efficacy of tubeless PCNL remains inconsistent, with some studies reporting comparable outcomes between tubeless and standard techniques, while others have demonstrated a clear advantage for tubeless approaches in terms of reduced analgesic requirements, shorter hospital stays, and lower complication rates (8)(9). These conflicting findings underscore the need for a more nuanced understanding of the factors influencing postoperative outcomes following PCNL and the importance of individualized patient selection.

In Pakistan, which falls within the Afro-Asian stone belt, nephrolithiasis is a common urological condition, accounting for a significant proportion of hospital

admissions and placing considerable strain on the healthcare system (10). The burden of renal stone disease in this region is exacerbated by limited access to advanced endourological techniques, making the optimization of existing surgical approaches crucial for improving patient outcomes. Although several studies have evaluated the impact of tubeless PCNL on postoperative outcomes, data on its efficacy in the Pakistani population remain scarce. Given the high prevalence of nephrolithiasis and the potential benefits of tubeless PCNL, it is essential to establish evidence-based guidelines for its use in local clinical settings (11). This study aims to contribute to this evidence base by comparing the mean hospital stay in patients undergoing PCNL with and without a nephrostomy tube, thereby providing insights into the feasibility and safety of adopting tubeless PCNL in routine practice.

The mean hospital stay following PCNL is an important indicator of surgical success and resource utilization, as shorter stays are associated with reduced healthcare costs, lower risk of nosocomial infections, and enhanced patient satisfaction (12). Previous research has yielded varying results regarding the impact of tubeless PCNL on hospital stay. Hamza Ichaoui et al. reported no significant difference in mean hospital stay between tubed and tubeless PCNL groups (3.81 vs. 3.20 days;  $p = 0.167$ ), while Moosanejad et al. found that patients undergoing tubeless PCNL experienced significantly shorter hospital stays compared to those with nephrostomy tubes (1.25 vs. 2.95 days;  $p = 0.0001$ ) (13)(14). These discrepancies highlight the need for further research to elucidate the factors influencing hospital stay in patients undergoing PCNL, particularly in diverse patient populations and healthcare settings. By comparing the mean hospital stay in patients treated with tubeless versus standard PCNL, this study aims to identify the most effective approach for minimizing hospitalization duration without compromising patient safety. The findings are expected to inform clinical decision-making and guide the implementation of tubeless PCNL in both tertiary care and resource-limited settings.

## MATERIAL AND METHODS

This prospective cohort study was conducted at the Urology Department of the Armed Forces Institute of Urology, Rawalpindi, over a period of six months, from 15 June 2020 to 14 December 2020. A total of 60 patients, diagnosed with renal stones requiring percutaneous nephrolithotomy (PCNL), were enrolled in the study after obtaining approval from the institutional ethics committee and adhering to the principles of the Declaration of Helsinki. The sample size was calculated using a 5% level of significance and 80% power of the test, based on previously reported mean hospital stay durations of  $2.95 \pm 1.17$  days for PCNL with a nephrostomy tube and  $1.25 \pm 0.49$  days for tubeless PCNL (10). A non-probability consecutive sampling technique was employed to recruit patients who met the inclusion criteria, which comprised individuals aged 18 years and older, with renal stones measuring 2 to 3 cm and classified as American Society of Anesthesiologists (ASA) physical status I or II. Patients with a history of previous kidney surgeries, diabetes

mellitus, mental disorders, or those classified as ASA III or above were excluded from the study to minimize confounding factors.

After obtaining written informed consent, a comprehensive history and physical examination were performed for all patients. Diagnostic imaging, including ultrasound and X-ray of the kidney, ureter, and bladder (KUB), as well as an intravenous urogram (IVU) or non-contrast computed tomography (CT) scan of the abdomen and pelvis, was conducted to confirm the diagnosis and assess the extent of renal calculi. Patients were randomly allocated into two equal groups ( $n=30$ ) using a sealed envelope technique. Group A consisted of patients who received a nephrostomy tube following PCNL, while Group B included patients who did not undergo nephrostomy tube placement postoperatively. All procedures were performed by a single consultant urologist using a standardized 17 Fr metallic sheath to maintain uniformity in surgical technique and minimize variability in outcomes. The decision to place a nephrostomy tube was made intraoperatively based on standard criteria, such as excessive intraoperative bleeding or residual stone fragments that warranted postoperative tract stabilization and drainage.

The primary outcome of interest was the mean hospital stay, defined as the number of nights from the day of surgery to the day of discharge. Secondary outcomes included postoperative complications, such as bleeding, infection, and the need for reintervention. Data were collected prospectively using a structured proforma designed by the principal investigator. Postoperative care was standardized for both groups, including analgesic administration, antibiotic prophylaxis, and regular monitoring of vital signs and renal function. Patients were assessed daily until discharge, and the duration of hospital stay was documented in days.

Data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 25. Continuous variables, such as age, stone size, and hospital stay duration, were expressed as mean and standard deviation. Categorical variables, such as gender distribution and postoperative complications, were presented as frequencies and percentages. The independent sample t-test was used to compare the mean hospital stay between the two groups, with a  $p$ -value of  $\leq 0.05$  considered statistically significant. Ethical considerations were strictly observed throughout the study, ensuring patient confidentiality and data security. All patients were informed about the study objectives, risks, and benefits, and their participation was entirely voluntary, with the option to withdraw at any stage without any consequences to their clinical management.

The analysis was designed to provide a comprehensive comparison of hospital stay duration between the two groups, thereby contributing to the ongoing debate regarding the efficacy and safety of tubeless versus standard PCNL. In addition, subgroup analyses were performed to evaluate the influence of patient demographics, stone characteristics, and intraoperative findings on the primary outcome, ensuring a robust and

detailed exploration of potential confounding variables. This methodological approach aimed to enhance the reliability and generalizability of the study findings, facilitating the formulation of evidence-based recommendations for clinical practice.

**RESULTS**

The study included a total of 60 patients, evenly divided into two groups: Group A (PCNL with a nephrostomy tube, n=30)

and Group B (PCNL without a nephrostomy tube, n=30). The age range of the participants was 18 to 50 years, with a mean age of 37.18 ± 7.68 years. The majority of the patients (61.67%) were between the ages of 36 and 50 years. There was no significant difference in age distribution between the two groups.

The mean age of patients in Group B was 37.10 ± 7.81 years, whereas the mean age in Group A was 37.37 ± 7.63 years (Table 1).

**Table 1: Age Distribution of Patients (n = 60)**

Age Group (Years)	Group B (n=30)	Group A (n=30)	Total (n=60)
18-35	11 (36.67%)	12 (40.0%)	23 (38.33%)
36-50	19 (63.33%)	18 (60.0%)	37 (61.67%)
Mean ± SD	37.10 ± 7.81	37.37 ± 7.63	37.18 ± 7.68

The gender distribution showed a male predominance, with 41 (68.33%) males and 19 (31.67%) females, resulting in a male-to-female ratio of 2.2:1.

Group B consisted of 21 males (70.0%) and 9 females (30.0%), while Group A had 20 males (66.67%) and 10 females (33.33%) (Table 2).

**Table 2: Gender Distribution of Patients (n = 60)**

Gender	Group B (n=30)	Group A (n=30)	Total (n=60)
Male	21 (70.0%)	20 (66.67%)	41 (68.33%)
Female	09 (30.0%)	10 (33.33%)	19 (31.67%)

The average stone size in the overall cohort was 30.19 ± 4.82 mm. Stones sized between 21-30 mm were found in 23 (38.33%) patients, while stones larger than 30 mm were

present in 37 (61.67%) patients. In Group B, the mean stone size was 30.83 ± 5.25 mm, and in Group A, it was 31.57 ± 4.22 mm (Table 3).

**Table 3: Stone Size Distribution in Both Groups (n = 60)**

Size (mm)	Group B (n=30)	Group A (n=30)	Total (n=60)
21-30 mm	13 (43.33%)	10 (33.33%)	23 (38.33%)
>30 mm	17 (56.67%)	20 (66.67%)	37 (61.67%)
Mean ± SD	30.83 ± 5.25	31.57 ± 4.22	30.19 ± 4.82

The primary outcome of interest, mean hospital stay, was significantly shorter in patients who underwent PCNL without a nephrostomy tube (1.90 ± 0.80 days) compared to

those who had a nephrostomy tube postoperatively (2.46 ± 0.81 days), with a p-value of 0.0001, indicating a highly significant difference (Table 4).

**Table 4: Comparison of Mean Hospital Stay (Days) in Patients Undergoing PCNL with and without Nephrostomy Tube (n = 60)**

Group	Mean ± SD	p-value
Group B (No Tube)	1.90 ± 0.80	0.0001
Group A (With Tube)	2.46 ± 0.81	

These results indicate that the absence of a nephrostomy tube following PCNL is associated with a statistically significant reduction in hospital stay duration. The study thus supports the use of tubeless PCNL as a viable and potentially superior alternative to the standard procedure in selected patients.

**DISCUSSION**

The findings of this study demonstrated that the mean hospital stay was significantly shorter in patients undergoing percutaneous nephrolithotomy (PCNL) without a nephrostomy tube compared to those with a nephrostomy tube. This difference, supported by a p-value of 0.0001, aligns with the results of previous studies that reported

reduced hospitalization durations with tubeless PCNL techniques. Moosanejad et al. found a significantly shorter hospital stay in the tubeless group (1.25 ± 0.49 days) compared to the standard PCNL group (2.95 ± 1.17 days) (6). Similarly, Karami et al. reported that tubeless PCNL is associated with enhanced patient comfort, shorter hospitalization, and lower postoperative complications (13). These findings suggest that eliminating the nephrostomy tube can reduce postoperative morbidity and optimize patient outcomes. However, some studies have presented contradictory results, indicating that the benefits of tubeless PCNL may not be universal. For instance, Hamza Ichaoui et al. found no statistically significant difference in hospital stay between patients with and without

nephrostomy tubes (3.81 vs. 3.20 days, respectively;  $p = 0.167$ ) (5). This discrepancy could be attributed to differences in patient selection criteria, surgical expertise, and variations in postoperative care protocols across studies.

A key strength of this study is its prospective design, which minimized recall and selection bias, thereby enhancing the reliability of the findings. Moreover, all procedures were performed by a single consultant urologist using a standardized surgical technique, reducing inter-operator variability and ensuring uniformity in the intervention. The study also controlled for potential confounders by excluding patients with previous kidney surgeries, diabetes mellitus, and other comorbidities that could independently influence hospital stay. The inclusion of a well-defined sample and a clear outcome measure allowed for an accurate comparison between the two groups. However, certain limitations should be acknowledged. The study was conducted in a single center, which may limit the generalizability of the findings to other healthcare settings. Additionally, the sample size, although adequate for detecting differences in hospital stay, may not have been sufficient to capture rare postoperative complications. Larger, multicentric studies are warranted to validate these results and determine the safety and efficacy of tubeless PCNL across diverse patient populations.

Another limitation was the lack of long-term follow-up to assess the impact of tubeless PCNL on stone recurrence, renal function, and quality of life. While the current findings suggest that tubeless PCNL can reduce hospitalization without compromising short-term safety, long-term outcomes remain an important consideration. Future studies should incorporate extended follow-up periods and patient-reported outcome measures to provide a more comprehensive assessment of the technique's benefits and drawbacks. Additionally, the absence of a nephrostomy tube may not be appropriate in all clinical scenarios. For example, patients with complex stone burdens, significant intraoperative bleeding, or those at high risk of postoperative complications may benefit from standard PCNL with a nephrostomy tube to ensure adequate drainage and prevent complications. Therefore, patient selection remains a critical factor in determining the success of tubeless PCNL, and a tailored approach should be adopted based on intraoperative findings and individual patient characteristics.

## CONCLUSION

In conclusion, this study highlighted the potential advantages of tubeless PCNL in terms of reduced hospital stay and postoperative discomfort, supporting its use as a viable alternative to standard PCNL in selected patients. However, the decision to omit the nephrostomy tube should be made judiciously, considering the patient's clinical profile and intraoperative conditions. While tubeless PCNL may offer benefits in terms of faster recovery and lower healthcare costs, it is essential to conduct further randomized controlled trials to establish definitive guidelines for its use and to identify patient subgroups that

are most likely to benefit from this approach. The incorporation of advanced imaging modalities and real-time monitoring techniques during surgery could also enhance the safety profile of tubeless PCNL, enabling its broader application in routine clinical practice.

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