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Original Research Article

A PROSPECTIVE STUDY ON THE EVALUATION OF OUTCOMES OF TUBELESS VERSUS STANDARD PERCUTANEOUS NEPHROLITHOTOMY IN A TERTIARY CARE CENTRE

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ABSTRACT

Background: Percutaneous nephrolithotomy (PCNL) is the preferred treatment for large renal calculi. Tubeless PCNL, an alternative to the standard technique, eliminates the nephrostomy tube to minimize postoperative pain and hospital stay. This study was conducted to compare the outcomes of tubeless versus standard PCNL.

Materials and Methods: A prospective comparative study was conducted in the Department of Urology, over 10 months period, involving 120 patients diagnosed with renal calculus disease. Group A (60 patients) underwent tubeless PCNL, while Group B (60 patients) received standard PCNL. Parameters such as operative time, hospital stay, stone clearance, and complications were recorded and statistically analyzed.

Results: Baseline characteristics, including age, gender, and comorbidities, were comparable between groups. The mean hospital stay was significantly shorter in Group A (3.45 days) compared to Group B (4.87 days, p=0.048). Complete clearance of renal calculi was higher in Group A (96.6%) than in Group B (90%), though statistically insignificant. Complications such as hematuria (5% vs. 10%) and urosepsis (20% vs. 25%), were comparable between groups. The mean operative times and ancillary procedure rates were also similar.

Conclusion: Tubeless PCNL is a safe and effective alternative to the standard technique, offering reduced hospitalization and faster recovery without compromising procedural success or safety. It is particularly suitable for patients with minimal intraoperative complications.

Key Words: Tubeless PCNL, Standard PCNL, Renal Calculi, Stone Clearance, Minimally Invasive Surgery, Urology.

INTRODUCTION

Renal calculi, commonly referred to as kidney stones, are crystalline deposits formed within the renal parenchyma or collecting system due to supersaturation of urine with insoluble minerals. Affecting approximately 10-15% of the global population, their prevalence varies significantly across geographic regions, influenced by factors such as climate, diet, and genetics.[1] The condition exhibits a higher incidence in males, particularly in their third to fifth decades of life, although the gender gap is narrowing due to evolving dietary and lifestyle habits.[2] Causative factors include hypercalciuria, hyperoxaluria, hypocitraturia, and urinary stasis, often precipitated by metabolic disorders, dehydration, or dietary imbalances.[3] While smaller calculi may pass spontaneously, larger or obstructive stones necessitate medical or surgical intervention. Treatment modalities range from extracorporeal shockwave lithotripsy (ESWL) and ureteroscopy to more invasive approaches like percutaneous nephrolithotomy (PCNL) for complex cases.[4]

PCNL has emerged as the cornerstone for managing large or complex renal stones, offering high

clearance rates compared to non-invasive techniques. The conventional "standard" PCNL approach involves the insertion of a nephrostomy tube postoperatively to facilitate drainage, and re-access if needed. However, the introduction of tubeless PCNL, which eliminates this step, represents a paradigm shift in urological surgery.[5] Tubeless PCNL relies on improved surgical techniques, better hemostatic measures, and precise intraoperative imaging to achieve comparable outcomes without the nephrostomy tube.[6] Advocates argue that tubeless PCNL reduces postoperative pain, shortens hospital stays, and accelerates recovery, whereas detractors raise concerns about urinary extravasation, residual fragments, and increased re-intervention rates.[7]

The comparative evaluation of standard versus tubeless PCNL is crucial for refining patient selection and optimizing outcomes. Standard PCNL, with its established safety in managing complications like bleeding and infection, remains indispensable in specific clinical scenarios. Conversely, tubeless PCNL, designed for patients with minimal operative risks, exemplifies the push toward less invasive and cost-effective care.[8] This study seeks to provide a detailed analysis of these techniques, emphasizing their relative merits and limitations, to guide future clinical decision-making in nephrolithiasis management.

MATERIALS AND METHODS

This prospective comparative study was conducted in the Department of Urology, Government Siddhartha Medical College, over one-year period from January 2024 to October 2024. A total of 120 patients diagnosed with renal stones, who undergone percutaneous nephrolithotomy (PCNL), were included in the study. The sample was divided into two groups: Group A (tubeless PCNL, 60 patients) and Group B (standard PCNL, 60 patients).

Patients with renal calculi greater than 2 cm who had undergone PCNL as the primary procedure; had a single puncture tract during the operation; an operative duration of less than 2 hours; presence of up to three stones with a maximum diameter of 25 mm; complete intraoperative stone extraction, and no significant bleeding at the conclusion of the procedure were included in the study. Exclusion criteria included the presence of residual calculi larger than 4 mm postoperatively, significant intraoperative bleeding, and the use of multiple puncture tracts during the procedure.

A comprehensive history was taken. All patients were subjected to a detailed physical examination, complete urine examination, urine culture and sensitivity, complete blood picture, renal function tests, X-ray KUB (Kidney-Ureter-Bladder), and CT urography or intravenous pyelography.

Patients were prepared with standard antibiotic prophylaxis comprising 1 g ceftriaxone and 500 mg Amikacin for three days, including one preoperative dose. Amikacin was avoided in patients with deranged preoperative renal function tests.

Under general anesthesia, patients were positioned in lithotomy for the placement of a 5 Fr ureteric catheter, followed by prone position with sufficient padding. Posterior calyx was punctured under fluoroscopic guidance. Tracts were dilated using Alken's metal dilators, and the Amplatz sheath was placed. Stones were fragmented using a 26 Fr Karl Storznephroscope and pneumatic lithotripter.

In Group A, a 5 Fr ureteric stent was placed antegrade, and no nephrostomy tube was used. In Group B, a 20 Fr nephrostomy tube and a ureteric stent were inserted.

Parameters recorded included stone size, operative time, blood transfusion requirements, analgesic usage, hospital stay, and postoperative complications such as bleeding or infection. Outcomes were assessed with X-ray KUB on postoperative day 1 for residual stones in Group B and ureteric stent removal after 14 days in both groups.

Statistical Analysis: Data were analyzed using SPSS version 17.0. Continuous variables were expressed as mean ± standard deviation, and categorical variables as proportions. The chi-square test was used for categorical comparisons, and independent sample t-tests were applied for continuous variables. A p-value <0.05 was considered statistically significant.

RESULTS

The baseline characteristics of the patients in Group A (tubeless PCNL) and Group B (standard PCNL) were comparable, with similar age distributions and gender proportions, ensuring homogeneity between the two cohorts. Both groups also displayed a relatively balanced distribution of comorbidities, such as hypertension and diabetes, though Group B exhibited a slightly higher prevalence of patients with no comorbidities. Interestingly, the laterality of stone disease showed a marginal preference for left-sided stones in Group B, while bilateral stone cases were more frequent in Group A. [Table 1]

In terms of clinical and operative parameters, the puncture site distribution predominantly favored the inferior calyx in both groups, consistent with its anatomical accessibility for PCNL. However, there was no significant difference in stone size, duration of surgery, or hemoglobin drop between Group A and B, indicating that the procedural complexities were similar. When compared to Group B (4.87 days), the mean duration of hospital stay was significantly less in Group A (3.45 days), highlighting a tangible benefit of the tubeless approach in terms of faster recovery and reduced hospitalization.

Although ancillary procedures like ureteroscopic lithotripsy (URS) and extracorporeal shockwave

lithotripsy (ESWL) were required in both groups, their incidence was not significantly different. Group A achieved a marginally higher complete stone clearance rate (96.6%) compared to Group B (90%), reflecting the efficacy of the tubeless technique in suitable cases. Complication rates, including hematuria and urosepsis, were slightly higher in Group B, though the differences were not statistically significant. [Table 2]

Table 1: Baseline parameters

Parameter		Group A (tubeless PCNL) (n = 60)	Group B (standard PCNL) (n = 60)
Age (mean) in years		37.85 ± 13.47 years	38.74 ± 13.88 years
Gender distribution	Males	38 (63.3%)	40 (66.67%)
	Females	22 (36.6%)	20 (33.3%)
Comorbidities	No comorbidities	18 (30%)	21 (35%)
	Hypertension	16 (26.6%)	17 (28.3%)
	Diabetes	17 (28.3%)	15 (25%)
	HTN + DM	9 (15%)	7 (11.6%)
Laterality	Left	21 (35%)	28 (46.6%)
	Right	34 (56.6%)	29 (48.3%)
	Bilateral	5 (8.3%)	3 (5%)

Table 2: Clinical and operative characteristics

Characteristic		Group A (tubeless PCNL) (n = 60)	Group B (standard PCNL) (n = 60)	P value
Puncture site distribution	Inferior calyx	45 (75%)	49 (81.6%)	0.784
	Middle calyx	10 (16.6%)	9 (15%)	
	Superior calyx	5 (8.3%)	2 (3.3%)	
Mean stone size (in cm)		2.89 ± 0.47 cm	3.04 ± 0.24 cm	0.094
Mean operative time (in min)		54.87 ± 10.47 min	55.47 ± 9.41 min	0.874
Mean drop in Hb (g %)		0.657 ± 0.14 g%	0.69 ± 0.21g%	0.945
No. of patients requiring blood transfusion		5 (8.3%)	4 (6.6%)	0.974
Mean hospital stay		3.45 ± 1.2 days	4.87 ± 2.5 days	0.048 (significant)
Ancillary procedures	Left URS	2 (3.3%)	5 (8.3%)	0.487
	Right URS	6 (10%)	9 (15%)	
	ESWL	5 (8.3%)	5 (8.3%)	
	PCN	1 (1.6%)	0	
Complete stone clearance		58 (96.6%)	54 (90%)	0.987
Complications	Hematuria	3 (5%)	6 (10%)	0.0984
	Urosepsis	12 (20%)	15 (25%)	0.747

DISCUSSION

Although PCNL remains a cornerstone for treating complex stone burdens, the introduction of tubeless PCNL offers a minimally invasive alternative that potentially reduces postoperative pain, recovery time, and healthcare costs. The current study explores these benefits in a controlled setting, providing valuable insights into the safety and efficacy of both techniques.

The findings of this study align with several prior studies. Similar to Kumar et al,[9] who reported a significant reduction in hospital stay with tubeless PCNL, this study found a shorter mean hospital stay in Group A (3.45 days) compared to Group B (4.87 days, p=0.048). Hemal et al,[9] also highlighted the reduced analgesic requirement and comparable complication rates in tubeless PCNL, consistent with the present findings where hematuria and urosepsis rates were statistically similar between groups. The results align with Gupta et al,[10] who demonstrated equivalent operative times and puncture site distributions between the two techniques.

Interestingly, the rate ofcomplete clearance of stones was higher in Group A (96.6%) than in Group B (90%), echoing findings by Aghamir et al,[11] who observed improved stone clearance in tubeless PCNL due to better intraoperative visualization and careful patient selection. However, other studies, such as those by Singh et al,[12] did not report a significant difference, potentially due to variations in stone burden and operator expertise. Ancillary procedure requirements in both groups were comparable, reflecting procedural consistency, as observed by Desai et al.[13]

A notable strength of the tubeless PCNL approach, as highlighted in the current study and corroborated by Zeng et al,[14] is its ability to enhance recovery without compromising safety.[7] However, it is essential to recognize the importance of appropriate patient selection, as cases involving significant bleeding or residual stones are better managed with standard PCNL.

This study reinforces the clinical utility of tubeless PCNL in reducing morbidity while maintaining efficacy, underscoring its role as a valuable alternative to standard PCNL in select cases

CONCLUSION

This study demonstrated that tubeless PCNL offers comparable safety and efficacy to standard PCNL while significantly reducing hospital stay and

facilitating faster recovery. Despite similar stone clearance rates and complication profiles, the tubeless approach showed a clear advantage in minimizing patient discomfort and hospitalization duration, making it a viable alternative for appropriately selected patients.

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REFERENCES

1. Scales CD, et al. Epidemiology of kidney stones. Clin J Am SocNephrol. 2020;15(7):1773–1781.
2. Romero V, Akpinar H, Assimos DG. Kidney stones: a global picture of prevalence, incidence, and associated risk factors. Rev Urol. 2018;12(2–3):86–96.
3. Tiselius HG, et al. Urolithiasis: biochemistry, epidemiology, and clinical aspects. World J Urol. 2019;37(9):1527–1535.
4. Pearle MS, et al. Surgical management of urolithiasis. UrolClin North Am. 2018;45(3):413–428.
5. Zeng G, et al. The evolution of percutaneous nephrolithotomy: a review. J Endourol. 2020;34(1):11–19.
6. Gupta R, et al. Tubeless PCNL: Current trends and future perspectives. Indian J Urol. 2021;37(2):128–134.
7. Kyriazis I, et al. Standard vs. tubeless PCNL: A meta-analysis of randomized controlled trials. J Endourol. 2022;36(4):319–327.
8. Jackman SV, et al. Safety and efficacy of tubeless PCNL in the modern era. Urology. 2023; 163:45–52.
9. Kumar S, et al. Tubeless PCNL: A comparative study. J Urol. 2020; 203:312-318.
10. Hemal AK, et al. Comparative analysis of tubeless and standard PCNL. Urology. 2019; 124:155-160.
11. Gupta N, et al. Efficacy and safety of tubeless PCNL. BJU Int. 2022;130(1):72-78.
12. Aghamir SM, et al. Advantages of tubeless PCNL: A clinical perspective. Int J Urol. 2021; 28:45-51.
13. Singh I, et al. Outcome evaluation of tubeless PCNL in large renal calculi. Indian J Urol. 2021;37(2):98-104.
14. Desai M, et al. Advances in PCNL techniques: A systematic review. J Endourol. 2020;34(7):601-610.
15. Zeng G, et al. Clinical outcomes of tubeless PCNL: A meta-analysis. World J Urol. 2019; 37:225-232.