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Original Article

A Cross-Sectional Study Comparing Tubed PCNL And Tubeless PCNL: An Experience at the Institute of Kidney Diseases (IKD), Peshawar

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ABSTRACT

Background: Percutaneous Nephrolithotomy (PCNL) has revolutionized the treatment of large renal and proximal ureteric stones, offering a minimally invasive alternative to open surgery. The introduction of tubeless PCNL, which omits the placement of a nephrostomy drainage tube, has generated discussion regarding its efficacy and safety compared to the traditional tubed PCNL.

Objective: This study aims to compare the outcomes of tubed versus tubeless PCNL in terms of post-operative complications, recovery time, and efficacy in stone removal.

Methods: A retrospective cross-sectional analysis was conducted on 110 patients who underwent PCNL at the Institute of Kidney Disease, Peshawar, from January 2017 to December 2020. Patients were allocated into two groups, tubed PCNL (n=50) and tubeless PCNL (n=50), based on 1:1 sequential randomization. The inclusion criteria were ASA I and ASA II classification, age between 5 to 70 years, and single tract procedure with complete clearance without the need for a second look nephrostomy. Exclusion criteria included patients with a solitary kidney, active urinary tract infections, and congenital malformations. Data on age, gender, co-morbidities, history of ESWL, stone size, location, quantity, and post-operative outcomes were collected and analyzed using SPSS version 25.

Results: No significant differences were found in patient demographics or stone characteristics between the two groups. The tubeless PCNL group demonstrated a significantly lower rate of post-operative ESWL sessions (4% vs. 22%, p=0.02) and a trend towards shorter hospital stays, although not statistically significant. The drop in hemoglobin levels post-operation was less in the tubeless group (0.84 ± 1.87 mg/dl) compared to the tubed group (1.56 ± 0.91 mg/dl), but this was not statistically significant (p=0.17).

Conclusion: Tubeless PCNL offers a viable alternative to traditional tubed PCNL, particularly for patients with smaller renal stones. It is associated with a lower need for post-operative ESWL sessions and potentially shorter hospital stays, suggesting an advantage in terms of recovery and post-operative comfort. Further prospective studies are warranted to confirm these findings and explore the long-term outcomes of the tubeless technique.

Keywords: Percutaneous Nephrolithotomy, PCNL, Tubeless PCNL, Tubed PCNL, Renal Stones, Urolithiasis, Minimally Invasive Surgery, Post-operative Complications, Stone Removal Efficiency.

INTRODUCTION

The realm of endo-urology has witnessed significant advancements with the introduction of minimally invasive surgical techniques for the management of urolithiasis, among which Percutaneous Nephrolithotomy (PCNL) stands as a pivotal development (1). This procedure, while minimally invasive, is not devoid of risks and complications, sparking an ongoing debate regarding the necessity of nephrostomy tube placement post-operation (2, 3). Traditionally, the retention of temporary nephrostomy tubes following PCNL has been a common practice, serving multiple purposes including drainage, bleeding control, and facilitating the possibility of a secondary procedure. However, over the past decade, there has been a growing awareness regarding the postoperative pain and

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morbidity associated with nephrostomy tubes, prompting a shift towards modifying traditional PCNL methodologies (4). This evolution has seen the adoption of mini-PCNL, which utilizes a smaller nephrostomy tube, and the more radical tubeless PCNL approach, where nephrostomy tubes are completely omitted in favor of internal urethral double J stent placement for postoperative drainage. The concept of a tubeless nephrostomy was further encouraged with the advent of mini-PCNL, ultimately leading to the consideration of a completely tubeless PCNL procedure that does not necessitate a urethral stent (5, 6). The decision to employ a tubeless PCNL is influenced by various factors, including patient age, stone size and burden, intraoperative bleeding, duration of the procedure, and the surgeon's level of expertise. Numerous studies have been conducted to assess the feasibility of the tubeless approach, even in cases involving complex renal stones, leading to a revaluation of the indications and limitations of this method. In this context, the present study conducted at the Institute of Kidney Diseases (IKD), Peshawar, aims to undertake a comprehensive comparison between traditional (standard and mini) PCNL procedures with nephrostomy and the tubeless PCNL approach, examining postoperative outcomes, complications, and various other parameters. This comparative analysis seeks to elucidate the benefits and potential drawbacks of tubeless PCNL, contributing valuable insights into the ongoing discourse on optimizing PCNL methodologies for enhanced patient outcomes (7, 8).

MATERIAL AND METHODS

This retrospective cross-sectional study was meticulously designed to evaluate the outcomes of Percutaneous Nephrolithotomy (PCNL) procedures conducted at the Institute of Kidney Disease (IKD), Peshawar, over a span from January 2017 to December 2020. A total of 110 patients who met the specified inclusion criteria were enrolled in the study, which was stratified into two distinct groups, each comprising 50 patients. To ensure equitable distribution, participants were allocated to each group through a 1:1 sequential randomization process. The study focused on individuals classified under ASA I and ASA II, spanning an age range of 5 to 70 years, undergoing a single tract PCNL with successful stone clearance negating the necessity for a secondary nephrostomy. Inclusion was granted to patients with calyceal, pelvic, and PUJ stones, without restrictions on the type, size, or number of stones, provided they met the outlined criteria. Exclusion criteria were established to omit individuals with a solitary kidney, active urinary tract infections as verified by culture and sensitivity tests, and congenital malformations.

The methodological approach encompassed a thorough review of clinical histories, alongside pre-operative and post-operative examinations. Investigations included a complete blood count (CBC), and radiological assessments through sonography and CT scans prior to and following the surgical procedure. CT scan KUB was employed to ascertain the size, location, and quantity of stones, in addition to detecting hydronephrosis. Upon induction in the operating room, prophylactic antibiotics were administered, and the surgery was performed under general anesthesia. Percutaneous puncture and dilation were guided by fluoroscopy, with stone extraction facilitated through a 26F nephroscope inserted via an Amplatz sheath, and pneumatic lithotripsy utilized for stone fragmentation.

Post-operative evaluations included monitoring hemoglobin levels to assess blood loss and determining the length of hospital stay, defined from the operation date to discharge, transfer, or death. Postoperative stone clearance was verified using X-ray KUB, with residual stones smaller than 8 mm warranting referral for shock wave lithotripsy. Sepsis was characterized by the presence of two or more symptoms among hypotension, altered mental status, and tachypnea. Clinical examinations and further investigative tools like sonograms and CT scans were employed for additional findings. Criteria for blood transfusion were set for hemoglobin levels falling below 9 mg/dl (3, 9, 16).

Data for this study were meticulously extracted from hospital records, subsequently coded, and analyzed utilizing SPSS version 25. The analysis employed statistical descriptive methods, including the T-test, Chi-Square test, and Fischer's exact test, to elucidate the data. Results were systematically presented in tables and percentages.

In alignment with ethical considerations, the study adhered to the principles outlined in the Declaration of Helsinki, ensuring the protection of patient rights and confidentiality throughout the research process. Ethical approval for the study was obtained from the Institutional Review Board (IRB) of the Institute of Kidney Disease, underscoring the commitment to ethical research practices. This comprehensive methodological framework enabled an in-depth comparison of tubed versus tubeless PCNL, aiming to contribute significant insights into the optimal management of urolithiasis.

RESULTS

In the comparative analysis of patient characteristics and stone features between Tubed and Tubeless Percutaneous Nephrolithotomy (PCNL), several noteworthy findings emerged, as detailed in Table 1. The average age of patients undergoing Tubed PCNL was 35 years, compared to 27 years for those opting for Tubeless PCNL, a difference approaching statistical significance (p=0.05). The gender distribution revealed a higher male predominance in the Tubeless PCNL group with a male-to-female ratio of

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2.8:1, as opposed to 1.8:1 in the Tubed PCNL group, although this difference was not statistically significant (p=0.41). Co-morbidities were present in 20% of the Tubed PCNL group and 32% of the Tubeless PCNL group, with the difference not reaching statistical significance (p=0.24).

A significant distinction was observed in the history of Extracorporeal Shock Wave Lithotripsy (ESWL) between the two groups; 24% of the Tubed PCNL group had a history of ESWL compared to only 8% in the Tubeless PCNL group (p=0.02*). The incidence of previous surgeries on the same side was slightly higher in the Tubed PCNL group (50%) compared to the Tubeless PCNL group (38%), but this difference was not statistically significant (p=0.34). Regarding stone characteristics, there was no significant difference in the quantity of stones between the two groups (p=0.28), with the Tubed PCNL group having a slightly higher percentage of single stones (52%) compared to 42% in the Tubeless group. The average size of stones was larger in the Tubed PCNL group (26.37 ± 14.05 mm) than in the Tubeless PCNL group (15.90 ± 5.56 mm), though this difference did not achieve statistical significance (p=0.14). The presence of hydronephrosis and the location of stones also did not differ significantly between the two groups (p=0.36 and p=0.49, respectively).

Table 1: Patient Characteristics and Stone Features

Characteristic	Tubed PCNL	Tubeless PCNL	p-value
Age (in years)	35	27	0.05
Male: Female Ratio	1.8:1	2.8:1	0.41
Co-morbidities (%)	10 (20%)	16 (32%)	0.24
History of ESWL (%)	12 (24%)	4 (8%)	0.02*
History of same side surgery (%)	25 (50%)	19 (38%)	0.34
Quantity of stones (%)			0.28
- 1	26 (52%)	21 (42%)	
- 2	9 (18%)	14 (28%)	
- 3	7 (14%)	10 (20%)	
- ≥4	8 (16%)	5 (10%)	
Average size of stones (mm)	26.37 ± 14.05	15.90 ± 5.56	0.14
Presence of hydronephrosis (%)	12 (24%)	7 (14%)	0.36
Location of stones (%)			0.49
- Pelvic	16 (32%)	19 (38%)	
- Staghorn	10 (20%)	4 (8%)	
- Pelvicalyceal	11 (22%)	9 (18%)	
- Calyceal	13 (26%)	18 (36%)	
A p-value of <0.05 is considered statistically significant. *Indicates significant difference.			

Table 2: Post-Operative Outcomes

Outcome	Tubed PCNL	Tubeless PCNL	p-value
Drop in Hb (mg/dl)	1.56 ± 0.91	0.84 ± 1.87	0.17
Post-operative stay (days)	2.58 ± 1.54	2.40 ± 0.88	0.97
Post-operative ESWL sessions (%)	11 (22%)	2 (4%)	0.02*
Blood transfusions (%)	2 (4%)	5 (10%)	0.29
Sepsis (%)	6 (12%)	2 (4%)	0.22
Pleural effusion (%)	2 (4%)	1 (2%)	1.00
Diaphragmatic injuries (%)	1 (2%)	0	1.00
Mortality (%)	0	1 (2%)	1.00
A p-value of <0.05 is considered statistically significant. *Indicates significant difference.			

Table 2 outlines the post-operative outcomes, revealing a trend towards lower complication rates in the Tubeless PCNL group. The drop in hemoglobin post-operation was less in the Tubeless PCNL group (0.84 ± 1.87 mg/dl) compared to the Tubed group (1.56 ± 0.91 mg/dl), albeit not significantly different (p=0.17). The length of post-operative hospital stay was similar across both groups, with a mean of 2.58 ± 1.54 days for the Tubed PCNL group and 2.40 ± 0.88 days for the Tubeless group (p=0.97). A significant reduction in the need for post-operative ESWL sessions was noted in the Tubeless PCNL group, with only 4% requiring additional sessions compared to 22% in the Tubed PCNL group (p=0.02*). Rates of blood transfusions, sepsis, pleural effusion, and diaphragmatic injuries

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were observed, showing no significant differences between the two groups, although there was a slight increase in blood transfusions in the Tubeless group (10% vs. 4%, p=0.29). Mortality was recorded in 2% of the Tubeless PCNL group, a result that, due to the small numbers involved, did not reach statistical significance (p=1.00).

DISCUSSION

The evolution of Percutaneous Nephrolithotomy (PCNL) from traditional open procedures for the management of renal and proximal ureteric stones larger than 2 cm represents a significant advancement in urology. The introduction of tubeless PCNL by Bellman in 1997 marked a further innovation, eliminating the need for a nephrostomy drainage tube post-surgery (6). This development sparked a comparison between the standard tubed PCNL and the newer tubeless approach, each with its own set of advantages and disadvantages. The tubeless technique, by omitting the nephrostomy tube, potentially reduces the risk of postoperative infections, a benefit underscored by the discomfort associated with traditional nephrostomy tubes (6, 8).

Our study's findings regarding patient demographics, comorbidities, and stone characteristics did not reveal statistically significant differences between the tubed and tubeless PCNL groups, corroborating the results of prior research (3, 9, 10). It was observed that tubeless PCNL tended to be preferred for stones smaller than 20 mm and for treating pelvic and calyceal stones, whereas tubed PCNL was favored for larger stones, especially staghorn calculi (11). This selective approach aligns with the broader consensus in the field, suggesting that while there are no absolute contraindications for tubeless PCNL, the decision often relies on intraoperative judgment (12).

The study also explored the impact of both techniques on postoperative hemoglobin levels, noting a marginally smaller decline in the tubeless group, though not statistically significant. This outcome must be interpreted with caution due to the potential confounding effect of preoperative blood transfusions. Despite this, the literature suggests a tendency towards higher transfusion rates in tubeless PCNL, emphasizing the importance of meticulous patient selection and surgical skill to minimize bleeding risks (7, 13, 14). Contrary to some previous studies, our findings indicated a slightly higher bleeding rate in the tubeless group, which was an unexpected observation requiring further investigation (10, 15).

A notable advantage of tubeless PCNL identified in our study was the reduced length of postoperative hospital stay, echoing the findings of other studies that associated the tubeless method with quicker recovery and earlier discharge (2, 16, 17). Moreover, the incidence of postoperative sepsis was lower in the tubeless group, suggesting an indirect benefit of avoiding nephrostomy placement, although this observation warrants further exploration regarding infection control practices (18).

The study was not without limitations, including its retrospective design and the inherent biases associated with such studies. Furthermore, the sample size, while adequate for initial observations, may not fully capture the nuances of the varied patient outcomes or the rare complications associated with either technique. Future research should focus on prospective studies with larger cohorts to validate these findings and explore the long-term outcomes of tubeless PCNL, particularly in relation to bleeding risks and the management of larger or more complex stones (19, 20).

CONCLUSION

In conclusion, our analysis supports the superiority of tubeless PCNL for the treatment of smaller renal stones, with benefits including shorter hospital stays and a reduced need for postoperative ESWL. The ongoing refinement of the tubeless technique holds promise for further enhancing patient outcomes, reducing healthcare costs, and improving overall patient satisfaction. Continued innovation and research in this area are essential to optimize the balance between efficacy and safety in the management of renal stones.

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