

Comparison of Postoperative Outcomes in Standard Versus Tubeless Percutaneous Nephrolithotomy

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Abstract

Objective: To compare the outcomes of tubeless percutaneous nephrolithotomy (PCNL) over standard PCNL in terms of postoperative pain and rescue analgesia needed.

Study type, settings & duration: This comparative randomized controlled study was done at Department of Urology, Pakistan Institute of Medical Sciences, Islamabad from September 2022 to February 2023.

Methodology: Total 112 adult patients of either gender between age 18-65 years were enrolled. The patients had radiographic findings of ≥ 1 cm kidney stones. Enrolled patients were allocated randomly into two treatment groups. Patients of Group-A underwent tubeless PCNL procedure in which nephrostomy tube was not inserted and a double J (DJ) stent was placed. Patients of Group-B underwent PCNL with placement of nephrostomy tube for drainage and DJ stent was not inserted. Postoperative pain was assessed in both groups. The hospital stay mean was also estimated in the groups.

Results: Patients mean age was 35.3 ± 12.7 years. Stone size mean in group-A was 1.82 ± 0.61 cm and in group-B was 2.15 ± 0.64 cm. Mean VAS score was estimated at different time intervals. At 24 hours after the surgery, mean VAS was 2.09 ± 1.24 in group-A and it was 3.69 ± 1.41 in group-B ($p = 0.001$). In group-A, mean number of rescue injections used in 24 hours after surgery was 2.18 ± 1.18 and in group-B it was 3.51 ± 0.66 ($p = 0.001$). The hospital stay mean was also estimated in both groups. In group-A, mean was 1.44 ± 0.51 days and in group-B it was 2.86 ± 0.75 ($p = 0.001$).

Conclusion: The VAS mean was found to be significantly lower at 24 hours after the surgery, and mean hospital stay was significant shorter in patients underwent tubeless PCNL as compared to those underwent PCNL with tube.

Key words: Kidney calculi, nephrostomy, nephrolithotomy, percutaneous, stent.

Introduction

In 1976, PCNL was first introduced and has widely replaced the open surgery for intervention

of kidney stones. The PCNL is now preformed as gold-standard intervention of large and even complex kidney stones and is favored over open nephrolithotomy because of its lower morbidity.¹ PCNL is also intervention of choice in patients having stones in ectopic pelvic kidney, horseshoe kidney and in kidneys having anteriorly lying renal pelvis. The PCNL is also suitable treatment modality in children and for very obese patients.²

Since its inception, various modifications and changes have been made to attain maximal stone removing while reducing patient morbidity, postoperative analgesia requirements, and hospital stay.³ Some of these changes include small sheath tubeless PCNL, use of nephron space with total tubeless PCNL, injection of hemostatic fluid into the nephrostomy channel, and using local anesthesia

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Authors Contribution

HK & MA conceptualized the project and did the data collection. HK, MA & MJ did the literature search. EH & RH performed the statistical analysis. Drafting, revision & writing of manuscript were done by HK, MA & OD.

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for PCNL.⁴ In standard PCNL, after removal of stone fragments through the access tract, nephrostomy tube is placed in access tract at the end of process. Placing the nephrostomy tube is advantageous in several ways which include providing tamponade effect for bleeding, adequate pelvicalyceal system drainage, preventing the urinary extravasation while also allowing for a second-look or staged PCNL procedures.⁵ However, placing the nephrostomy tube at the end of process may cause postoperative pain, urine leakage and increased duration of hospital stay.⁶

To reduce the post-operative pain and morbidity, Bellman et al presented the idea of tubeless PCNL, in which no nephrostomy tube is placed after the surgery. Tubeless PCNL is a preferred option for some surgeons especially when they are performing the procedure on outdoor patient basis and published reports suggest that it is associated with lesser degree of postoperative pain.⁷ There are two types of tubeless PCNL; one in which DJ stent is inserted into the ureter or ureteral catheter is left in-situ for the drainage and nephrostomy tube is not placed, and other in which neither DJ stent/ureteral catheter nor nephrostomy tube is used (total tubeless PCNL).⁸

Postoperative pain after PCNL is a frequently encountered phenomenon and is quite worrisome for patients. Keeping in view it is necessary to determine the superior interventional method for kidney stones larger than 1 cm by comparing postoperative pain and analgesic requirements in local population. The aim of this study was to compare outcomes of tubeless PCNL over standard PCNL in terms of postoperative pain and rescue analgesia needed.

Methodology

This comparative randomized controlled trial was done at Urology Department of Pakistan Institute of Medical Sciences, Islamabad from September 2022 to February 2023. A written consent from patients to participate voluntarily in this study. A sample size of 112 patients was statistically calculated by using anticipated mean VAS) scores of tubeless and standard PCNL⁹, aged 18-65 years, male and female patients with radiographic and ultrasonographic evidence of renal stones larger than 1 cm who underwent PCNL with or without a nephrostomy tube were included through non-probability consecutive sampling. Patients were excluded if they had coagulopathy (elevated PT/APTT above the reference range or platelet count $\leq 50,000/\text{ml}$) due to the risk of bleeding during surgery, unwillingness to undergo

the procedure, horseshoe kidney (identified on ultrasound) as it increases procedural risk, positive urine cultures due to the risk of urosepsis, pregnancy, or morbid obesity ($\text{BMI} \geq 30 \text{ kg/m}^2$).

Patients were allocated randomly in two interventions groups by lottery method ($n = 56$, each group). Patients of Group-A underwent tubeless PCNL procedure in which nephrostomy tube was not placed and a DJ stent was inserted, and patients of Group-B underwent PCNL with placement of nephrostomy tube for drainage and DJ stent was not inserted. In both groups, a 26 Fr nephro-scope with a 28 Fr Amplatz sheath was used.

The demographics of patients and preoperative data e.g., age, sex, stone size and laterality were recorded on predesigned proforma. Residual stone status was assessed on X-rays or ultrasonography (USG KUB) at 24 hours after the surgery in both groups. Postoperative pain was assessed in both groups using VAS at 24 hours and number of rescue analgesic injections (intravenous ketorolac 30mg IV) needed in first 24 hours after the surgery in both the groups were measured and analyzed. The hospital stay mean was also estimated in the groups.

The data was entered and analyzed in SPSS v 23. Mean and SD was measured for numerical data e.g., age, stone size, operative time and hospital stay, VAS at 24 hours and number of rescue analgesic injections needed in 24 hours. Frequency and percentage were calculated for qualitative data e.g., gender, laterality and residual stone status. Chi square statistical test was applied to compare residual stone status in both groups. Independent sample t-test was applied to compare operative time, hospital stays, postoperative pain and number of rescue analgesic injections used in both groups at 24 hours. Effect modifiers e.g., age, sex, stone size and laterality were controlled by stratification. A probability p -value ≤ 0.05 was measured as significance.

The ethical approval was obtained from the Institutional Board of Islamabad Hospital, Pakistan Institute of Medical Sciences, Islamabad vide letter no. 09/PIMS/IRB-2022.

Results

There was total of 112 adult patients underwent PCNL with or without nephrostomy tube included. Patients mean age was 35.3 ± 12.7 years. Demographic details of both groups such as ages of patients, gender, size of stone, laterality, and residual stone status were studied and analyzed (Table-1). Mean VAS score was estimated at

different time intervals (Table-2). Mean VAS was found to be significantly lower at all time intervals and at 24 hours after the surgery in patients underwent tubeless PCNL (group-A) as compared to those underwent PCNL with tube (group-B).

Table 1: Descriptive statistics of demographics of both groups. (n=112)

	PCNL Tubeless (Group-A)	PCNL with Tube (Group-B)
Ages in year (Mean)	33.6±11.3	36.9±14.1
Sex		
Male	39 (69.6%)	34 (60.7%)
Female	17 (30.4%)	22 (39.3%)
Stone size in cm (Mean)	1.82±0.61	2.15±0.64
Laterality		
Right	25 (44.6%)	29 (51.8%)
Left	31 (55.4%)	27 (48.2%)
Residual stone status on X-rays or USG KUB (24 hrs)	7 (12.5%)	6 (10.7%)

Residual stone status was found similar in both intervention groups ($p=0.768$).

Table 2: Mean VAS at different time intervals in both groups. (n=112)

VAS Score	PCNL Tubeless (Group-A)	PCNL with Tube (Group-B)	p-value
At 3 hours	5.55±1.46	6.89±0.71	0.001
At 6 hours	4.31±1.28	5.86±1.03	0.001
At 12 hours	3.32±1.25	5.02±1.19	0.001
At 24 hours	2.09±1.24	3.69±1.41	0.001

Mean number of rescue analgesic injections used in 24 hours, and hospital stay were estimated in both groups (Table-3). It was found significantly lower in patients underwent tubeless PCNL (group-A) as compared to those underwent PCNL with tube (group-B). The VAS at 24 hours, number of rescue analgesic injections used in 24 hours, and hospital stay were stratified for effect modifier e.g., age, sex, stone size and side. Similar trend was observed with insignificantly found in residual stone status in both groups ($p \geq 0.05$ in all cases). Mean VAS at 24 hours was lower, mean number of rescue analgesic injections used in 24 hours was lesser and mean hospital stay was less in patients underwent tubeless PCNL (group-A) as compared to those underwent PCNL with tube (group-B).

Table 3: Mean number of rescue analgesic injections used in 24 hours, and hospital stay in groups. (n=112)

	PCNL Tubeless (Group-A)	PCNL with Tube (Group-B)	p-value
Rescue analgesic injections	2.18±1.18	3.51±0.66	.001
Hospital stays (days)	1.44±0.51	2.86±0.75	.001

Discussion

This study findings are same with other studies cited in the previous studies. In a similar study, Tyagi et al evaluated efficacy of tubeless PCNL and reported as 94.4%. Postoperative pain score was seen in 4.8 ± 1.2 .¹⁰ In another study, Lai et al determined the efficacy of tubeless PCNL. They reported efficacy in 78.3% patients.¹¹ In present study, the mean VAS score was 2.09 ± 1.24 at 24 hours post-surgery.

Xun et al study analyzed the efficacy and safety of PCNL. Pooled results showed that tubeless PCNL was statistically significant and less associated with postoperative pain ($p \leq 0.001$) and analgesia needs ($p \leq 0.001$), when compared with standard PCNL.¹²

In a study conducted by Bhuiyan et al., the outcomes of PCNL with a nephrostomy tube and DJ stent for kidney stone treatment in specific cases in Bangladesh were evaluated. They reported that patients undergoing tubeless PCNL had a shorter hospital stay and lower analgesic requirements.¹³ Moosanejad compare absolute tubeless PCNL with standard PCNL in kidney stone and reported that tubeless procedure was associated with decreased pain, analgesia requirements, operative time, and hospital time.¹⁴ Isac et al found that the pain score on first postoperative day was 2.7 vs 4.3 ($p=0.014$) less in tubeless group, and postoperative narcotics were less in the 70 mg morphine tubeless group equal to 149 ($p=0.001$).⁹ Present study results showed that mean VAS was found to be significantly lower at 24 hours after the surgery, mean number of rescue analgesic injections used in 24 hours was found to be significantly lesser and mean hospital stay was measured significant shorter in patients underwent tubeless PCNL as compared to those underwent PCNL with tube.

Several authors compared external ureteric catheter (EUC) and DJ stent within tubeless PCNL. Zhou et al demonstrated the symptom of stent-related was found in 19.6% of patients in the EUC group and 60.4% of patients in the double J stent ($p=0.001$). There was insignificant mean difference in pain (2.80 vs 2.92, $p=0.408$), urine leakage (7.1% vs 9.4%, $p=0.931$) and hospital stay (5.70 vs 5.72 days, $p=0.961$) in both groups.¹⁵ Joshi et al reported that a total of 64% symptoms of stent related were noted in DJ stent, however in EUC it was 28% in such complications.¹⁶ In the present study, we used DJ stents in all patients. However, we suggest further studies comparing DJ stent and EUC in patients undergoing tubeless PCNL.

The procedure was found safe and associated with lesser degree of postoperative pain, shorter durations hospital when compared with

standard PCNL. We recommend further studies comparing tubeless PCNL with conventional PCNL taking larger sample size to extend the results of present study to the general population. We also recommend future studies comparing DJ stent and EUC in patients undergoing tubeless PCNL.

The mean VAS was found to be significantly lower at 24 hours after the surgery, mean number of rescue analgesic injections used in 24 hours was found to be significantly lesser and mean length of hospital stay was found to be significantly shorter in patients underwent tubeless PCNL as compared to those underwent PCNL with tube.

Conflict of interest: None declared.

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