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A retrospective study: Is nephrostomy tube necessary after uncomplicated PCNL

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ABSTRACT

Introduction: PCNL is widely used to treat upper urinary tract calculi. An indwelling large bore nephrostomy tube is left at the conclusion of the procedure to tamponade the bleeding site made during the access tract. In recent times, the introduction of tubeless PCNL has led to a decrease in post-operative pain, urinary leakage, and hospital stay duration.

Objective: The aim of this study is to find the difference between standard PCNL and tubeless PCNL with regard to postoperative pain, duration of hospital stay and analgesic requirement.

Methodology: 233 patients who had undergone PCNL were divided into two groups. Group A - 125 patients with nephrostomy tube placement postoperatively along with Double-J stent and Group B - 108 patients with antegrade placement of a DJ stent without nephrostomy. The two groups were compared for age and sex, postoperative pain (VAH score), analgesia requirement, blood loss, postoperative morbidity (urinary leakage, pyrexia), and length of hospitalization.

Results: All patients had an uneventful postoperative recovery. The mean age and preoperative hemoglobin values were not significantly different between the two groups. Postoperatively, postoperative pain ($p< 0.01$), analgesia requirement ($p< 0.01$), and length of hospitalization ($p< 0.01$) were significantly lower in the tubeless PCNL group. At the same time, the incidence of urine leakage, pyrexia and blood transfusion were were not statistically significant with p value of 0.387, 0.38 and 0.102 respectively.

Conclusion: In cases of PCNL without complication, the practice of keeping the nephrostomy tube is not required. Need of further prospective study with proper randomization will further validate this result.

INTRODUCTION

Worldwide prevalence of urolithiasis is 5-15% which is increasing rapidly.[1] In the seventies, the first percutaneous nephrolithotomy (PCNL) was performed. Since then, it is widely used to treat upper urinary tract calculi.[2]

An indwelling large bore nephrostomy tube was left after the procedure to tamponade the bleeding site made during the access tract, maximize drainage from the collecting system, and have a secure access tract for further re-manipulation, like a second look nephroscopy.[3]

In the late nineties, Bellman introduced tubeless PCNL i.e. placement of ureteric stent without nephrostomy tube.[3] There are many studies suggesting that the use of tubeless PCNL has decreased the postoperative morbidity.[6] Initially the acceptance of tubeless PCNL was for single access procedure, less intraoperative blood loss, no injury to the collecting system, and no further intervention planned.[7]

Many authors have suggested that Tubeless PCNL resulted in a much shorter operating time, hospital stay, and time to return to routine activities. In addition, the tubeless PCNL group had lower postoperative pain levels and required less analgesics. The postoperative haemoglobin drop and stone-free rate were not significantly different between the two groups.[1-4] limitation of tubeless PCNL most DJ related discomfort, additional drawback of tubeless PCNL is that it may interfere with a subsequent routine second-look procedure required to clear the residual stone fragments.[5] Realizing all these morbidities, urologists switched form large-bore nephrostomy tube to small-caliber tube without increasing the risk of complication.[5]

To provide a comprehensive view of PCNL indication, technique, and outcome in "real-life" clinical practice, the Clinical Research Office of the Endourological Society (CROES) conducted the PCNL Global Study, which prospectively gathered data on patients receiving PCNL treatment. The Tubeless method was used in just 1.7% of the 5,803 patients treated globally in the PCNL Global Study, despite being shown to be safe and effective enough to be suggested as a safe substitute for NT placement (grade A evidence) in the European Association of Urology guidelines in 2011.[8] A DJ stent may result in a somewhat inferior quality of life than a short-term nephrostomy tube following PCNL, as discussed in the section above on the drainage of an infected or obstructed system. [9]

The aim of this study is to find the difference between standard PCNL and tubeless PCNL with regard to postoperative pain, duration of hospital stay and analgesic requirement.

METHODOLOGY

A retrospective comparative study was conducted at College of Medical Sciences, Bharatpur, Chitwan, in the Department of Urology in patients who had undergone PCNL from October 2016 to March 2020. Inclusion criteria were age 15–70 years, normal renal function serious bleeding or perforation in the collecting system during the procedure, patients with no more than one access, and residual stone burden not needing a second-stage nephroscopy. Exclusion criteria were the presence of a solitary kidney, congenital urinary tract anomaly, and a history of open urinary operations because they have potential to influence the outcome. The sample size was calculated

Where, σ^2= combined SD of two groups = 15.37, Zα= Z- score value at 95% CI =1.96, Zβ= power of study at 80%=0.84, d= efficient size= 6 taking reference from the study conducted by MS Agrawal in 2008.[10]

After antibiotic prophylaxis preoperatively, procedure was performed mostly under spinal anesthesia and sometimes in general anesthesia. Initially patient was kept in lithotomy position and ureteric catheter was placed. Then patient was switched to prone position and C-arm fluoroscopy guided percutaneous puncture was made. This was followed by guidewire placement and sequential dilatation. Stone lithotripsy and removal were done using a 20French (20F) sheathless nephroscope through Amplatz sheath depending on the size of the stone. In our center, ballistic (pneumatic) method was used for lithotripsy. At the end of the procedure, a 20F nephrostomy tube was placed through the PCNL tract after keeping a 6F DJ stent. The nephrostomy tube was usually removed after 48-72 hours after performing a plain radiograph. In the other group, only DJ stent was placed which was 6F and 26 centimeters in length. Discharge criterial were stable vital, adequate pain control, proper urinary drainage and resolved and minimal hematuria.

During postoperative period, pain was assessed on postoperative day 1 by a questionnaire using the linear 100-mm (range 0–100) visual analogue scale (VAS) (0 no pain, 100 maximum intolerable pain).

For postoperative pain, 1 gram of acetaminophen was given 8-hourly and a bolus of fentanyl 25 µgram was given on demand. The amount of fentanyl given intravenously was calculated as a total requirement of analgesic use. Urine leakage was defined as the leakage of urine from the access site. Length of hospitalization was defined by the total days of admission after the surgery. Pyrexia was defined when the temperature was >38°C (>100.4°F). The difference between hematocrit levels before and after the operative procedure was labeled as a drop in hematocrit.

The collected data was initially entered in MS Excel. After necessary data cleaning, data was imported to EZR version 1.36

where final analysis was done. Mean and standard deviation for continuous variables and frequency and percentage for categorical variables was used for descriptive analyses. Student's t-test, chi-square test (for cell count more than 5) and Fisher exact test (for cell count less than 5) were used for inferential analyses, as per the requirement of the collected data.

RESULTS

		Standard PCNL (%)	Tubeless PCNL(%)	Chi Square Test/ Fisher's exact test	P value
No. of cases	Total	125	108		
Sex	Female	62 (56.9)	47 (43.1)	0.861	0.35
	Male	63(50.8)	61(49.2)		
Urine Leakage	No	105(49.29)	108(50.70)	16.91	<0.01
	Yes	20(100)	-		
Pyrexia	No	105(52.5)	95(47.5)	0.748	0.38
	Yes	20(60.6)	13(39.4)		
Length	<5	114(61)	73(39)	20.37	<0.05
	>5	11(23.9)	35(76.1)		
Blood transfusion	No	120(55)	98(4.5)	2.66	0.102
	Yes	5(33.3)	10(66.7)		

The age and sex profile between the two groups were similar. Patients in groups A and B had mean ages of 31 (range 21–57) and 33 (range 18–55) years, respectively.

In the first group, male to female ratio was roughly 1:1, and in the second, it was roughly 3:4. Compared to 20 out of 125 patients in group A, none of the 108 patients in group B experienced temporary urine leakage from the nephrostomy site (P = <0.01). Within one to five days of the nephrostomy tube removal, all patients experienced a spontaneous cessation of leaking.

Of the 125 patients in group A, 20 had a post-operative fever, while the remaining 100 did not. Out of the 108 patients in group B, only 13 suffered from fever. Using the chi square test, the pvalue was computed. The result was 0.38, which was not statistically significant.

Five patients out of 125 in group A and ten patients out of 108 in group B, respectively, needed blood transfusions. The chi square test was employed once more, and the resulting p value was 0.102, which was not statistically significant.

	Standard PCNL	Tubeless PCNL	Student T-test	P value
Post-Operative pain (VAS in mm)	55.15±13.46	31.92±8.83	15.31	<0.01
Post-Operative Analgesia (µmg fentanyl)	112.991±20.30	77.57±17.92	14.01	<0.01
Pre-Operative Hb	12.51±1.40	12.39±1.31	0.67	0.50
Post-Operative Hb	12.006±1.55	11.97±1.40	0.184	0.85
Hospital stay (days)	4.95±1.42	3.50±1.19	8.37	<0.01

The mean±SD VAS pain score for group A patients (standard PCNL) was 55.15±13.46, while group B patients (tubeless PCNL) had a score of 31.92±8.83. The student t-test was used to determine the p-value, and the result was less than <0.01.

Throughout the postoperative period, group A's mean analgesic demand was 112.991 µmg of fentanyl, while group B required 77.57 µmg. This revealed a significant difference between the groups (P < 0.01).

A blood transfusion was necessary for 5 patients in group A and 10 patients in group B. Group A's average preoperative hemoglobin was 12.51±1.40 g%, while that of group B was 12.39±1.31 g%. A p-value of 0.50 indicated that there was no discernible difference between the two groups. Group A's average postoperative hemoglobin was 12.006±1.55 g%, whereas group B's was 11.97±1.40 g%, with a p-value of 0.85 indicating no statistical difference. The average hospital stay in the standard PCNL group was 4.95 days, which was significantly shorter than that for the tubeless PCNL group (3.50 days) (P < 0.01).

DISCUSSION

PCNL is now the mainstay of treatment for patients with renal calculi used to remove a variety of stones, including stones resistant to management with shock wave lithotripsy (SWL) and in patients who cannot undergo SWL.[11, 12]

Traditionally wide bore nephrostomy tube drainage after PCNL had been advocated for several reasons. It provides reliable urinary drainage, hemostatic tamponade to the fresh percutaneous renal tract, and continuing access to the renal collecting system should a secondary percutaneous procedure be required. Despite these obvious and important advantages, large nephrostomy tubes, especially in the vicinity of a rib, are

thought to contribute to postoperative pain and morbidity. As a result, certain investigators have proposed tubeless PCNL to avoid nephrostomy tube drainage after uncomplicated, straightforward percutaneous procedures. In this approach, the nephrostomy tube is replaced by internal Double-J ureteral stent drainage.[13]

The tubeless variation appears to be feasible and can be performed safely in this selected group of patients undergoing PCNL, as there was no evidence of increased risk of major bleeding or any other complication in the tubeless group. This study provides evidence that the tubeless PCNL technique is associated with a significant decrease in the length of hospital stay, primarily as a result of decreased postoperative analgesia requirement, no evidence of active bleeding, and complete endoscopic and fluoroscopic clearance of residual fragments <4 mm. Using visual analog scales, quality of life data, and comparing analgesic requirements, it has been shown that smaller nephrostomy tubes decrease patient discomfort after PCNL. Prospective randomized studies indicate that postoperative pain scores are significantly greater with larger diameter nephrostomy tubes. In most studies, inclusion criteria for this technique were a single puncture tract, procedure lasting less than 2 hours, less than three stones with a diameter <25 mm, complete extraction of all the stones, and no significant bleeding at the end of the operation.[14, 15]

A randomized controlled study conducted by Huiming Jiang et al. suggested that the drainage after PCNL using either only a nephrostomy tube or a DJ stent or an open-ended ureteral catheter was equally safe and effective. However, patients who received a nephrostomy tube or an open-ended ureteral catheter had better health-related quality of life than those who had DJ stent placed because the patients with DJ had to visit a hospital for the second time to undergo DJ stent removal.[16] The above study concluded that repeated intervention decreases the quality of life. In our study, both the groups had a DJ stent placed, one group also had a nephrostomy tube placed and the other did not. The drawback of our study was that we did not estimate the impact of procedures on patient's quality of life.

Moosanejad N et al. reported less blood loss in the conventional PCNL group than the tubeless PCNL group (1.51±1.89 mg/dL and 2.27±3.88 mg/dL in the standard PCNL and totally tubeless PCNL groups, respectively), but we found no differences between our two groups in postoperative decline of serum hemoglobin. According to author, in Standard PCNL a nephrostomy catheter and ureteral catheter were used after PCNL and in tubeless PCNL, at the end of the operation, if there was no perforation of the renal pelvis, the Amplatz sheath was removed. After 4 or 5 hours, the ureteral catheter was removed in the totally tubeless PCNL group. The operation time was significantly lower in the totally tubeless PCNL group than in the standard PCNL group (P=0.005). Shorter hospital stays and decreased pain directly resulted in better patient compliance for regular follow up probably because of decreased financial burden and psychological stimulation of better treatment provided. Pethidine requirements were significantly higher in the standard PCNL group than in the totally tubeless PCNL group (P=0.007).[6] Similar finding was observed in our study though in our study we did only tubeless PCNL. In case of standard PCNL reason for longer hospital stay may be post operative pain which further delayed mobilization, need of wound care. Furthermore, the straightforward surgery with tubeless PCNL resulted in a shorter hospital stay and reduced pain.

Winfield et al. pointed out extravasation of urine as another obstacle that limits the adoption of tubeless PCNL. When tubeless PCNL was first proposed, two cases of serious extravasation of urine with fistula were reported wherein both patients with ureteral stent were not placed in normal positions, resulting in prolonged hospital stays.[18] Agrawal et al. compared conventional and tubeless PCNL in 2008 and reported that the rate of extravasation of urine was higher in the conventional group (7 out of 101) than in the tubeless group (none of 101). Similarly, our data of higher urinary leakage was observed in nephrostomy cases, though the result was not statistically significant. Agrawal et al. found extravasation of urine in 20 out of 108 patients of tubeless PCNL and none of the 125 patients undergoing conventional PCNL. Urinary Leakage in our study in standard PCNL might have been due to the existing tract of the puncture site, tear of collecting system, ureteral obstruction, large stone burden and infection and inflammation all of these factors are not properly addressed in this study further exploration of these factor is essential but the reason for no urinary leakage in Agrawal et al. was not mentioned.[10]

The surgical outcomes of conventional and tubeless PCNL reflected that recovery was quicker in the tubeless group patients as they took 5 to 7 days for complete convalescence whereas standard PCNL patients recovered in 8 to 10 days. The length of hospitalization was shorter i.e., 21.8 +/- 3.9 hours for tubeless PCNL group compared to 54.2 +/- 5 hours for standard PCNL group. Total cost was also lower in the tubeless group. Our results harmonize with those of Agrawal et al. and have added additional evidence that patients treated with tubeless PCNL have shorter hospital stays (3.5 days in tubeless PCNL vs 4.95 days in standard PCNL) and lesser back pain.

A recent review study by Zilberman et al. reported comparable complication rates between tubeless and standard percutaneous nephrolithotomy in 50 published reports. However, the tubeless procedure had impressive advantages such as less pain, less debilitation, lower cost, and shorter hospital stays. Similar findings were observed in our study.[19]

Limitation of this study as this study is retrospective in nature, many data were missing or incomplete, which means that confounding factors such as stone burden, infection status, surgeon experience, anatomical variation, puncture pole, and access tract size may affect the results. Due to selection bias and the fact that the data are frequently based on pre-existing records, the study population might not be representative of the overall population. The results of a prospective research with appropriate matching might be better.

CONCLUSION

Our data suggests statistically significant advantages of tubeless PCNL over conventional PCNL in terms of postoperative discomfort and morbidity, hospital stay in uncomplicated procedure. Hence, the traditional use of a nephrostomy tube for every case is not justified. Complicated cases such as those involving calyces tear or with suspicion of UTI or when relook PCNL is required may however require a nephrostomy tube. Further prospective studies with proper randomization are needed to validate this result.

CONFLICT OF INTEREST None

FINALCIAL DISCLOSURE None

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