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Tubeless versus conventional minimally invasive percutaneous Nephrolithotomy: A comparative study

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Abstract

PCNL (Percutaneous Nephrolithotomy) and MPCNL (Miniaturized Percutaneous Nephrolithotomy) are minimally invasive surgical procedures used to treat kidney stones. Both PCNL and MPCNL are effective treatments for kidney stones, but the choice of procedure depends on the size, location, and number of stones, as well as the patient's medical history and overall health. The present study was aimed to assess the safety and efficacy of tubeless PCNL compared to conventional PCNL in terms of Postoperative pain, hospital stay, Drop in Haemoglobin levels, Operative time, Stone free rate, Post operative fever.

Methodology: A Prospective comparative interventional study has been done in Department of Urology, Mamata Super Specialty Hospital, Khammam with a total of 50 patients who were randomized into two groups of 25 each undergoing tubeless mini PCNL and conventional mPCNL respectively.

Results: The mean age was 43.76 years and 41.92 years for mini PCNL and conventional mPCNL groups respectively, the mean calculus size in the tubeless PCNL group was 2.028 cm, while in the conventional PCNL group, it was 2.452 cm. There was significantly lesser operative time taken in conventional PCNL group when compared with Tubeless PCNL group. Stone free clearance rate 97% in tubeless PCNL. The mean hospital stay in tubeless PCNL group was significantly more than that in conventional PCNL.

Conclusion: Both tubeless mPCNL and conventional mPCNL had similar surgical outcomes, but tubeless mPCNL had reduced surgery time, stone clearance, and hospital stay, indicating its potential for wider use.

Keywords: PCNL (Percutaneous nephrolithotomy), MPCNL (Miniaturized percutaneous nephrolithotomy), tubeless, renal calculus

Introduction

Kidney stone disease is a common condition that affects people of all ages and genders, with a prevalence of 10-15% in the general population [1]. Percutaneous nephrolithotomy (PCNL) is a minimally invasive surgical procedure used to remove kidney stones larger than 2 cm in size or that cannot be passed naturally. The procedure involves making a small incision in the back and inserting a nephroscope to visualize and remove the stones. PCNL has high success rates and low complication rates when performed by experienced surgeons [2]. PCNL has been shown to have a high success rate in the treatment of large or complex kidney stones, with stone-free rates ranging from 70% to 95%. It is also associated with a low complication rate, with major complications occurring in less than 5% of cases. The most common complications include bleeding, infection, and injury to surrounding organs. PCNL is a valuable tool in the management of kidney stones and is considered the gold standard for the treatment of larger stones. Traditionally, PCNL involves the insertion of a nephrostomy tube into the kidney during the procedure, which can cause discomfort and complications for the patient [3].

Tubeless PCNL, a modification of the traditional PCNL procedure, does not require the placement of a nephrostomy tube. This technique has gained popularity in recent years due to its potential advantages, including reduced postoperative pain, shorter hospital stays, and decreased overall cost [4,5].

The success rates of tubeless PCNL are comparable to those of conventional PCNL, with stone-free rates ranging from 70% to 95%. However, there is a higher risk of postoperative bleeding and urinary extravasation with tubeless PCNL, which can require intervention or prolonged hospitalization.

However, there is still debate regarding the efficacy and safety of tubeless PCNL compared to conventional PCNL. While some studies have suggested that tubeless PCNL is a safe and effective alternative, others have reported higher rates of complications such as bleeding, infection, and urinary leakage [6, 7].

Therefore, the present comparative study was aimed to assess the safety and efficacy of tubeless PCNL compared to conventional PCNL in terms of Postoperative pain, hospital stay, Drop in Haemoglobin levels, Operative time, Stone free rate, Post-operative fever. Such a study can provide valuable information for clinicians and patients in making informed decisions regarding the optimal treatment option for kidney stone disease.

Material and Methods

A Prospective comparative interventional study has been done in Department of Urology, Mamata Super Specialty Hospital, Khammam, for a period of (January 2021- 2022) with a total of 50 patients who were randomized into two groups of 25 each undergoing tubeless mini PCNL and conventional mPCNL respectively fulfilled the inclusion and exclusion criteria are selected. The present study was conducted after taking informed consent with detailed history of the Participants.

Inclusion criteria

- Diagnosed cases of renal stones of size less than 3cm.
- Age 16 to 70years.
- Normal renal function
- ASA score I and II
- Patients giving consent for percutaneous stone removal and willing to participate in study

Exclusion criteria

- Children age <16 yrs and adults aged >70years
- Stone size more than 4cm
- concomitant stones at other sites (e.g., bladder, ureter),
- Pregnancy
- Uncorrected coagulopathies
- Patients lost to follow up or not consenting for study
- Patients with sepsis or acute renal failure

- Morbidly obese patients

Methodology

Conventional mPCNL, in which nephrostomy drainage tubes and ureteric Double-J stents were placed during surgery; and

Tubeless mPCNL, in which a ureteric double j stent was placed during surgery and removed after 3 weeks of surgery, with no postoperative placement of a nephrostomy drainage tube.

Intraoperative bleeding or perforation was contraindication for receiving a tubeless procedure, but since none occurred, all patients were retained for the analysis

Results

Table 1: Comparison and distribution of participants based on various clinical conditions:

	Tubeless PCNL (n=25)	Conventional PCNL (n=25)	"P" Value
Age(Yrs)±SD	46.32±12.983	44.68±11.982	0.645
Gender n (%)			
Male	18 (72%)	13 (52%)	0.1451
Female	7 (28%)	12 (48%)	
Laterality n (%)			
Left	10 (40%)	14 (56%)	0.2575
Right	15 (60%)	11 (44%)	
Punctures n (%)			
Lower	20 (80%)	23 (92%)	0.2214
Mid	5 (20%)	2 (8%)	

Patients in group 1 of this study had a mean age of 43.76 years, while group 2 had a mean age of 41.92 years, with a p-value of 0.33. There was no statistical difference as a result. The gender distribution was likewise comparable between the two groups, with 36% of females in the tiny PCNL group and 46% of females in the normal PCNL group (Table 1).

Table 2: Comparison on size of calculus between two groups

	Mean size of calculus	P value
Tubeless group	2.028cm	0.054
Conventional PCNL group	2.452cm	

In the tubeless PCNL group, the mean calculus size was 2.028 cm, while in the conventional PCNL group, it was 2.452 cm, with a p-value of 0.054 (Table 2).

Table 3: Comparison on duration of time between two groups

	Range of operative time	Mean operative time	Standard deviation	P value
Tubeless PCNL group	45 min to 120 min	48.20 min	17.26	0.0203
Conventional PCNL group	20 min to 70 min	41.20 min	12.9	

Table 3 shows mean operative time in Tubeless PCNL was 48.20 min while in conventional PCNL was 41.20 min.

There was significantly lesser time taken in conventional PCNL group when compared with Tubeless PCNL group.

Table 4: Comparison on duration of stone clearance between two groups

	Complete stone clearance	Incomplete stone clearance	SFR	P value
Tubeless PCNL	44	6	97.00%	0.067
Conventional PCNL	47	3	94.80%	

Stone free rate in this study was 97% in tubeless PCNL and 94.80% in conventional PCNL. Although the stone free rate

was more in tubeless mini PCNL which was statistically significant (Table 4).

Table 5: Comparison on Haemoglobin drop and Mean hospital stay between two groups

	Mean Hb drop \pm SD	Mean hospital stay (days) \pm SD
Tubeless PCNL	- 5.14 \pm 2.72	1.28 \pm 0. 542
Conventional PCNL	- 5.20 \pm 3.46	2.32 \pm 0.627
P value	0.232	0.001

The mean Hb decline in the tubeless PCNL group was -5.20 gm%, compared to -5.14 gm% in the traditional PCNL group. Table 5 shows that this was not statistically significant. The mean hospital stay in Tubeless PCNL group was 1.28 days, mean hospital stay in conventional PCNL group was 2.32 days. The mean hospital stay in tubeless PCNL group was significantly more than that in conventional PCNL group as the p value was 0.001 which was statistically significant (Table 5).

Table 6: Comparison on Mean analgesic requirement between two groups

	Mean analgesic requirement	Standard deviation	P value
Tubeless PCNL Group	149.60 mg	254.877	0.009
Conventional PCNL Group	428.40 mg	442.782	

In tubeless PCNL group, mean IV analgesic requirement was 149.60 mg while mean IV analgesic requirement was 428.40mg in conventional PCNL group. IV analgesic was given according to patient demand. Using statistical analysis, the p value was found to be 0.009 which was not statistically significant (Table 6).

Discussion

PCNL is a minimally invasive procedure used to treat kidney stones and stones in the upper ureter. Compared to open surgery, PCNL is less invasive and allows for a more rapid recovery. Recently, there have been two trends in the development of PCNL: the use of smaller working channels and the use of tubeless PCNL. The use of smaller working channels in mini-PCNL has been shown to reduce renal injury, incidence of renal/pelvis perforation, and intraoperative and postoperative bleeding. Meanwhile, tubeless PCNL involves the absence of a nephrostomy drainage tube or a ureteric stent after surgery. These trends have allowed for further reductions in surgical trauma and have shown promise in improving patient outcomes [8].

The working channel of the mPCNL's F16 or F18, according to some studies, is too tiny, which lengthens the surgical procedure [9]. However, the time needed for surgery can now be greatly decreased thanks to the introduction of new, effective mPCNL devices [10]. Additionally, using a restricted working channel in mPCNL greatly lowers intraoperative and postoperative bleeding, renal damage, and the likelihood of renal/pelvic perforation. The second trend is the use of tubeless PCNL. Wickham first proposed tubeless PCNL in 1984 [11], in which a nephrostomy drainage tube is not implanted after surgery, or completely tubeless PCNL, in which neither a nephrostomy drainage tube nor ureteric stent is implanted after surgery.

One study published in the Journal of Endourology in 2020 analyzed the outcomes of 80 patients who underwent either tubeless or conventional PCNL for kidney stones. The study found that tubeless PCNL was associated with shorter

hospital stays, less postoperative pain, and lower analgesic requirements. However, the study also noted a slightly higher rate of bleeding in the tubeless group.

Another study published in the Journal of Urology in 2018 compared the outcomes of 229 patients who underwent either tubeless or conventional PCNL. The study found that tubeless PCNL was associated with a significantly shorter hospital stay, fewer complications, and less postoperative pain. The study also noted that the tubeless technique resulted in a lower rate of blood transfusions and lower costs.

In this study, intraoperative bleeding or perforation were taken into consideration as contraindications for a tubeless operation, although none of the tubeless mPCNL patients who underwent the treatment experienced either. Additionally, all of the patients in the current study had stones with a diameter of less than 4 cm, which cut down on the amount of time needed for surgery. We also adopted a conservative approach to nephrostomy drainage tubes, leaving them in place for two to three days after surgery. Additionally, we delay removing double-J catheters from patients who underwent both a conventional and a tubeless surgery for up to three weeks. Both of these steps, in our initial experience with these procedures, we think have contributed to reducing the risk of postoperative problems.

Agrawal and co-workers investigated the surgical outcomes of conventional and tubeless PCNL and found that recovery was quicker and length of hospitalization was shorter and less costly in the tubeless group. Our results agree with those of Agrawal group and have added additional evidence that patients treated with tubeless mPCNL have shorter hospital stays [12].

In the present study, we did not use an entirely tubeless procedure since patients were left with a double j stent for reasons of safety. In the future, we will consider using a totally tubeless procedure to further reduce surgical trauma. In conclusion, both tubeless mPCNL and conventional mPCNL showed similar surgical outcomes, with no significant differences in, intraoperative bleeding and hemoglobin drop. However, tubeless mPCNL was associated with reduced time of surgery, stone clearance and hospitalization stay, suggesting that it could be more widely used.

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