

## A Prospective Observational Study on Tubeless Percutaneous Nephrolithotomy

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Received: 20-05-2023 / Revised: 11-06-2023 / Accepted: 05-07-2023

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Conflict of interest: Nil

### Abstract:

**Aim:** Aim of this study is to evaluate outcomes and complications with tubeless PCNL. This study also compared the outcomes of tubeless PCNL with standard PCNL.

**Method:** A total number of 36 cases with renal and/or upper uretric calculi of >1.5cm to ≤ 3.0cms for PCNL were selected. Patients and stone characters and operative and postoperative data was analysed.

**Results:** A total of 36 patients were included in the study that underwent tubeless PCNL during June 2021 to May 2023. There were 23 were male and 13 female patients. The mean age in was 44.6 years. There were 10 cases have stone size from 2.6 to 3.0 cm with mean stone burden of 2.24 cms. In 21(58.3%) cases lower calyceal puncture done, 9(25%) patients underwent upper calyceal puncture and for 6(16.6%) cases middle calyceal puncture done for patients. The mean duration of surgery was 56.4 minutes. The mean VAS score in 6<sup>th</sup> hour of surgery was 6.4±1.6 and after 24<sup>th</sup> hour of surgery mean VAS score was 4.8±1.2. The Mean analgesic requirement was 90.0 mg of Diclofenac. Mean duration of hospital stay was 2.5 days. The mean time to return daily activities in tubeless PCNL is 6.2 days.

**Conclusion:** Study demonstrated that in Tubeless PCNL, Nephrostomy can be avoided in selected cases and is equally safe and effective to Standard PCNL and is better tolerated with less post-operative analgesic requirement and decreased post-operative morbidity with shorter hospital stay without any compromise in results when compared with Standard PCNL.

**Keywords:** Tubeless percutaneous nephrolithotomy, Renal stones.

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### Introduction

Kidney stones are one of the most prevalent surgical problem encountered in general population. In the past patients had to undergo invasive surgery with long recovery period. Until the last 3 decades, open surgery for kidney stones was a must. Heineke, in 1879, first described a pyelotomy incision for the extraction of calculi. In 1880, Henry Morris of England was the first to remove a stone from an otherwise healthy kidney by nephrolithotomy extracting a 31gm mulberry calculus from the kidney of a young woman.[1]

Fernstrom and Johansson (1976) first reported the formation of percutaneous track for the specific purpose of subsequently removing an intrarenal stone[2]. This technique was rapidly taken up by other centres, with Alken et al[3] and Wickham et al[4] further demonstrating the effectiveness and safety of the procedure in disintegrating and clearing stones in renal pelvis. Percutaneous

nephrolithotomy (PCNL) is the preferred treatment for large (> 2 cm) renal or staghorn renal stones now a days. In recent years, PCNL has been used widely for urinary stone disease instead of open surgery. PCNL is minimally invasive, having high success rate and low-morbidity. The standard PCNL procedure consists of a tiny percutaneous access to the kidney and the formation of a working tract connecting the flank surface with the intrarenal collecting system to allow endoscopic stone disintegration and removal. A temporary nephrostomy tube is usually left in place at the end of the procedure to allow drainage, tamponade of bleeding, and delayed second-look nephroscopy, along with a DJ Stent.

Studies have shown that the placement of nephrostomy tube in patients undergoing standard PCNL procedure can cause postoperative discomfort, analgesic requirement, and prolonged

hospital stay and increased cost of the procedure. Thus standard PCNL has been modified to PCNL without postoperative nephrostomy tube/DJ stent (Tubeless PCNL). A tubeless percutaneous procedure-one that omits the postoperative nephrostomy tube-was initially proposed by Wickham and colleagues (1984).[4] The concept was revived by Bellman and colleagues (1997)[5], with the addition of an internal ureteral stent left in place for a week or two. Tubeless PCNL is mainly two types i.e. Tubeless with ureteral stent and totally tubeless PCNL.

Aim of this study is to evaluate outcomes and complications with tubeless PCNL. This study also compared the outcomes of tubeless PCNL with standard PCNL.

### Material and Methods

This was a prospective observational study, conducted in the Department of Urology, Rangaraya Medical College, Kakinada, and Andhra Pradesh for a period of 24 months from June 2021 to May 2023. A total number of 36 cases of tubeless PCNL were studied data collected and results analyzed. Results of study group are compared with the parameters of traditional PCNL of our hospital.

#### Inclusion criteria:

Patients with renal and/or upper uretric calculi of greater than 1.5cm, less than equal to 3.0cms, negative urine culture and no coagulopathy.

#### Exclusion criteria:

In those patients with solitary kidney, more than 2 percutaneous accesses, significant perforation of the collecting system and significant intraoperative bleeding and patients with raised creatinine, patients with ectopic, malrotation and fused kidneys were excluded.

Pre-operative assessment included indication for surgery and patient's complete history and physical examination. Important laboratory parameters such as urine analysis and culture/sensitivity, haemoglobin, electrolytes and urea/creatinine, coagulation profile were checked before the surgery. Hb%, serum electrolytes, creatinine and urea repeated after surgery. Pre-operative intravenous urography (IVU), plain CT KUB, X-ray KUB was performed in all cases. Intra op stone Free State demonstrated at the end by endoscopy. Ultrasound and/or X-ray KUB were repeated 24 hours after surgery. Mean stone burden was calculated in each case by the horizontal and

vertical dimensions of the stone, as seen on IVU. The surgical technique was carried out under general anaesthesia. A 5F transurethral ureteric catheter was placed. Percutaneous access was created in all cases under fluoroscopic guidance with the patient in prone position. The nephrostomy tract was dilated with metal dilators and Amplatz sheath was left in situ. A 26 Fr angled Storz nephroscope was used and calculus disintegration was performed using lithoclast.

On completion of procedure, a 4.5 Fr / 26cms DJ Stent was placed in antegrade fashion from renal pelvis to bladder, the Amplatz sheath was removed. The wound was stitched with Prolene 4/0 mattress suture. A Foley's catheter was left in the bladder at the end of the procedure. After surgery fluoroscopy and endoscopy were used to assess stone free status. In post-operative period all patients were given IM diclofenac 50mg whenever they complained pain. The level of pain was recorded on visual analog scale.

Patients data such as age, stone size, stone site, type of puncture, duration of surgery, hemoglobin, complication rate, analgesic need, type of analgesic, dose of analgesic, degree of pain, duration of hospitalization and total cost of the procedure were collected. Total collected data was entered in to excel spread sheet and results were analyzed.

### Results

A total of 36 patients were included in the study who underwent tubeless PCNL during the study period. Among these 36 cases, 23 were male and 13 female patients. Male to female ratio was 1.77:1. The mean age in was 44.6 years with a range of 20 to 65 years. Majority of the patients were of 41- 50 years of age which accounts 15. Among 36 cases 19.4% (7) have hypertension, 13.8%(5) have diabetes mellitus, 2 patient have COPDs, 1 patient had hypothyroidism. Mean stone burden is 2.24 cms with the smallest stone of 1.5cm to largest stone of size 3.0 cms. There were 10 cases have stone size from 2.6 to 3.0 cm. In 21(58.3%) cases lower calyceal puncture done, 9(25%) patients underwent upper calyceal puncture and for 6(16.6%) cases middle calyceal puncture done for patients. Single tract access was successful in all cases. The mean duration of surgery i.e from induction of anesthesia till the patient shifted from operation theatre was 56.4 minutes. The mean VAS score in 6<sup>th</sup> hour of surgery was 6.4±1.6 and after 24<sup>th</sup> hour of surgery mean VAS score was 4.8±1.2 (Table 1).

**Table 1: Patients and stone characters, operative and mean VAS score**

	Frequency (n)
<b>Stone size (cms)</b>	
1.5-2.0	15
2.1-2.5	11
<b>Type of puncture</b>	
Lower calyx	21
Middle calyx	6
Upper calyx	9
<b>Duration of surgery (min)</b>	
31-40	3
41-50	9
51-60	12
61-70	7
>70	5
<b>Time of VAS</b>	
<b>Mean VAS</b>	
At 6th hour	6.4±1.6
At 24th hour	4.8±1.2

The Mean analgesic requirement throughout the hospital course is 90.0 mg of Diclofenac. In addition, complications included high fever and urine leak in tubeless PCNL patients. Mean duration of hospital stay was 2.5 days for tubeless PCNL group. The mean time to return daily activities in tubeless PCNL is 6.2 days (Table 2).

**Table 2: Operative parameters**

Parameter	Measurement
Mean duration of procedure (minutes)	56.4
Mean Length of hospitalization (days)	2.5
Mean analgesic requirement (Diclofenac)	100.0 (mg)
Stone free rate	35 (97.2%)
Time to return of daily life activities (days)	6.2
Mean drop in Haemoglobin	0.7gms
Other complications	Fever 1; Urine leak 1

**Table 3: Reference studies- intra operative parameters**

Reference study	N	Mean stone burden	Postoperative drainage	Analgesia requirement	Average Hb drop Gm/dl	Stone free rates (%)
Agarwal et al <sup>16</sup>	101	3.8cm <sup>2</sup>	JJs	81.7mg MP	0.36gm%	100
Desai et al <sup>17</sup>	10	2.5cm <sup>2</sup>	JJs	87.5mg D	4.2gm%	-
Feng et al <sup>18</sup>	8	4.4cm <sup>2</sup>	JJs	5.25mg M	-	85.7
Singh et al <sup>19</sup>	30	250mm	JJs	6mg M, 415mg D	1.2gm%	100
Limb & Bellman <sup>7</sup>	112	3.3cm <sup>2</sup>	JJs	-	-	93
Goh & Wolf <sup>20</sup>	10	1.8cm	EUC, JJs	-	-	80
Karami et al <sup>21</sup>	201	3cm	EUC	-	-	91.04
Yang et al <sup>22</sup>	138	-	JJs	6.4mg M	-	94.5

N-number of patients, JJs-Double J stents, MP-Meperadine, M-morphine sulphate, D-diclofenac

**Table 4: Reference studies-Surgical outcome**

Reference study	N	Length of hospital stay(days)	Stone free rates (%)	Transfusion rates	complications
Wickham et al <sup>4</sup>	100	2	94	NA	Bleeding (22%) infection (10%)
Winfield et al <sup>23</sup>	2	9	-	-	Not significant
Bdesha et al <sup>24</sup>	32	2	86	-	Not significant
Karami et al <sup>21</sup>	30	1.5	90	0	Infection
Aghamir et al <sup>25</sup>	43	1.6	100	0	Not significant
Gupta et al <sup>26</sup>	96	1.8	-	1.04	Not significant
Crook et al <sup>27</sup>	100	2.9	76	1	1 hydrothorax, 1 sepsis

## Discussion

With advances in instrumentations and techniques, PCNL has become a safe procedure to perform with decreased post-operative complications, reduced pain and decreased hospital stay. As a standard of care, nephrostomy tube is placed post-operatively in all patients to provide an effective tamponade to nephrostomy tract. Despite these obvious advantages, the nephrostomy tube is associated with significant post-operative discomfort and pain. One of the clinically tested modifications is the mini-perc approach that was first reported in pediatric patients. This version of PCNL uses 13-20 Fr working sheaths and was soon adopted for adults. It did not, however, obviate the need for the placement of nephrostomy tubes. Pietrow et al used a narrower tube (10 Fr instead 22 Fr) and noted greater comfort in the immediate postoperative period without sacrificing safety.[6]

The concept of a tubeless technique represents a novel alternative in the search to miniaturize the procedure. Bellman et al. reported their initial experience with a series of 50 patients who underwent various percutaneous procedures. Later Limb and Bellman completed 112 successful tubeless procedures, representing almost one-third of all their percutaneous procedures.[7] Prospective randomized studies designed to compare tubeless vs. mini vs. standard PCNL confirmed the superiority of the tubeless PCNL in terms of reduced postoperative patient discomfort, shorter hospitalization and fast recovery.

In our present study, we evaluated the effectiveness and safety of tubeless PCNL for operative time, postoperative analgesia, hospital stay, and stone-free rate and the results were compared with the parameters of Standard PCNL in our hospital. There was no significant difference between the age and sex of patients, mean stone size, stone side and location when compared with Standard PCNL. This minimized the effect of any of them on the outcomes of the procedures.

There was no significant difference in Mean operative time between the Tubeless and Standard PCNL groups. Hospital stay plays an important role in the evaluation of a technique, in our present study it was lower in Tubeless PCNL group [2.5 versus 5.9 days] when compared with the Standard PCNL of our hospital; this difference was statistically significant. This result was similar to other published studies, such as in the study of Khairy Salem et al. in which the mean (range) hospital stay was 1.7 (1-4) days in the tubeless PCNL group and 2.8 (3-4) days in the Standard PCNL.[8] In a study conducted at AIIMS, New Delhi the Mean hospital stay was 2.9 days in Standard PCNL group and 1.8 days for Tubeless PCNL group of Kara et al., the mean of hospital

stay was 1.5 days for Tubeless PCNL and 3.2 days for Standard PCNL.[9] Bilen et al[10] reported that the mean hospital stay was longer in Standard PCNL versus the Tubeless PCNL group (4.9 versus days) and Etemadian et al[11] in their study showed a significant shorter hospital stay in the tubeless PCNL group.

In our present study, the postoperative analgesic requirement (Diclofenac) was less than that of the patient who underwent Standard PCNL at our hospital [mean 100 versus 150mg, respectively]. This is advantage of tubeless PCNL and has also been reported in other studies, such as that of Zhong et al[12] as their overall results indicated that the tubeless PCNL group had a lesser analgesic requirement.

In our study, the Mean VAS pain score after 6th hour of surgery and after 24 hrs of surgery was 6.4 and 4.8 in Tubeless PCNL patients, where in it was 7.5 and 5.9 in case of Standard PCNL of our hospital. Mean VAS score is significantly reduced at 6th hour and 24th hour after Tubeless PCNL compared with standard PCNL. In the present study, there was no significant difference in the stone-free rate between the study group when compared with the patient undergoing Standard PCNL in our hospital, (i.e 97.2% in Tubeless PCNL patients and 95.4% in Standard PCNL patients). This result is also similar to other published studies such as that of Ni et al[13] who reported no significant differences between tubeless and standard PCNL.

The incidence of complications was not significant between the study group and the patients of Standard PCNL of the hospital. Of the patients in the study group had prolonged fever which subsided with Culture Sensitivity Antibiotics, one had post-operatively urine leak from PCNL site which subsided on per urethral catheterization. Of five comparative articles reporting post-operative pyrexia, incidences were generally lower in tubeless groups, illustrated best by Shah et al[14] (11.4 versus 5.79%). These however were not statistically significant. The mean drop in Haemoglobin was 0.7gms % in the study group and 0.6gms % in Standard PCNL patients of our hospital which was not significant. The results were similar to other published studies such as in the study of Khan A et al.[15]

The mean time to return daily activities in our study group is 6.2 days and for standard PCNL it is 10.5 days. Zhong et al. reported that the time for return to normal activity in the Tubeless group was significantly lower than the Standard PCNL group.

## Conclusion

Our Study demonstrated that in Tubeless PCNL, Nephrostomy can be avoided in selected cases and is equally safe and effective to Standard PCNL and

is better tolerated with less post-operative analgesic requirement and decreased post-operative morbidity with shorter hospital stay without any compromise in results when compared with Standard PCNL. However, PCNL should be carried out in the standard fashion, leaving a nephrostomy tube in place in certain situations like

- Intraoperative uncertainty regarding residual stones
- Solitary functioning kidney
- significant bleeding or perforation occurs
- Other major complications are suspected (e.g., hydrothorax, injury to adjacent organs).

We believe that this study will contribute to the further popularization of the tubeless technique for the benefit of the patient, the medical team, and the health care system.

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