

## Original Research Article

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# Prospective study on standard and totally tubeless percutaneous nephrolithotomy

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## ABSTRACT

**Background:** With the improvement of instrumentation and experience of percutaneous nephrolithotomy (PCNL), several modifications to the procedure have taken place in order to reduce the morbidity and early return to normal lifestyle. This study aimed to compare the totally tubeless percutaneous nephrolithotomy and standard percutaneous nephrolithotomy techniques.

**Methods:** It is a prospective randomized, clinical trial done on 60 patients (patients older than 20 years and younger than 60 years who were chosen for elective surgery of kidney stones via the PCNL technique). Patients were divided into two groups, standard PCNL (with a nephrostomy tube) and totally tubeless PCNL (no ureter stents or ureteric catheters).

**Results:** Demographic data is matched in two groups of patients. The mean operation time was slightly longer in the standard group (108 minutes) than in the totally tubeless group (102 minutes), but there was no statistically significant difference. There was no significant difference between the two groups with regard to serum creatinine change or blood loss. Haemoglobin drop, hospital stay, Pain score and analgesia requirement was significantly less in the totally tubeless group. 4 patients in each group had bleeding postoperatively. Only five patients developed pyrexia in the postoperative period. The differences in the need for blood transfusion and postoperative pyrexia were not found to be statistically significant. 19 in standard group and 2 patients in totally tubeless group developed urine leak, found to be statistically significant.

**Conclusions:** Author can conclude that the tubeless procedure has fewer complications, improved postoperative patient comfort, shorter hospitalization, and a reduced need for analgesics.

**Keywords:** Percutaneous nephrolithotomy, Nephrostomy tube, Complications

## INTRODUCTION

Kidney stones are a common disease that affects at least 10% of people. A total of 70% of people who are affected by kidney stones experience recurring kidney stones.<sup>1</sup> Various non-invasive, minimally invasive, and invasive methods have been reported as a treatment for kidney stones, including medicinal treatment, extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL), and open renal surgery. In the past 2 decades PCNL as a minimally invasive method has

been an effective treatment for large stones located in the kidney and upper ureter. PCNL is a more effective treatment for stones <2 cm compared with the ESWL method with the improvement of instrumentation and experience of PCNL, several modifications to the procedure have taken place in order to reduce the morbidity and early return to normal lifestyle. First described by Wickham et al, another technical variation of tubeless PCNL is totally tubeless approach. They concluded that if the operated kidney was stone-free, collecting system was intact and there wasn't any

excessive bleeding, there was no need for nephrostomy drainage.<sup>2,3</sup>

In most tubeless procedures, internal drainage is provided with a double-J stent or temporary ureteral catheter. In those cases, patients must undergo the uncomfortable procedure for removal of the stent. However, in totally tubeless procedures, internal drainage is not provided. The aim of this study is to compare standard and totally tubeless PCNL with concern to safety and efficacy.

## METHODS

This randomized controlled study done at Kamineni Academy of Medical Sciences and Research Centre; Hyderabad in Department of Urology underwent PCNL at our hospital for a period of 18 months December 2017 to May 2019. 60 patients planned for PCNL and who gave informed written consent were included in the study. Patients were divided into two groups, standard PCNL (with a nephrostomy tube) and totally tubeless PCNL (no ureter stents or ureteric catheters).

### Inclusion criteria

- Age >20 and <60 years both males and females, stones size <3 cm, single puncture tract, PCNL lasting <2 h, complete clearance of stones as ensured by fluoroscopy and endoscopy, no significant bleeding, and intact pelvicalyceal system at the end of procedure.

### Exclusion criteria

- Patients with renal anatomical abnormalities, staghorn calculus, active urinary tract infections, serious bleeding, perforation in the collecting system, and previously operated kidneys, coagulopathy, and those who are unfit for general anesthesia.

Preoperatively, all the patients were evaluated with blood and urine routine examinations, renal function studies, urine culture, coagulation profile, and computed tomography (CT) scan. Under aseptic precaution, a ureteral catheter was introduced into the renal pelvis. The patient was then turned prone, and percutaneous access into the corresponding pelvicalyceal system was achieved under image intensification using an 18-gauge needle. The tract was then dilated using a single-step 30 F Amplatz dilator. Renal stones were fragmented using ballistic lithotripsy.

In patients with supra-costal access tract, chest x-ray was performed postoperatively to rule out significant pneumothorax. In totally tubeless, on completion of the procedure, the Amplatz sheath was removed and the wound was stitched with a mattress suture. The wound was closed with nylon suture. "Stone-free" was defined as complete removal of all stones as evaluated by a postoperative kidney, ureter, and bladder (KUB) film or

computerized tomography. Hemoglobin level was checked in patients experienced severe bleeding during or after the operation, blood transfusion was given in patients have their hemoglobin level <10 g/dl or patients with unstable vital signs. Renal ultrasound was performed in each patient 1-2 weeks after the operation. Clinical data concerning patients' age, stone size, operation time, length of postoperative hospital stay, infection rate, and transfusion rate were analyzed by postoperative chart review.

A comparison was made between the two groups in clinical values, such as patients' characteristics, stone characteristics, operation time, blood loss, changes in serum creatinine levels, change in hemoglobin levels, length of hospitalization, and analgesia requirements. Statistical analysis was performed using SPSS software and student's t test.

## RESULTS

Number of patients involved in 2 groups are same in number. Age, side of involvement and stone location are not significant on comparison between 2 groups (Table 1).

**Table 1: Demographic data and stone characteristics of patients.**

Variables	Standard group	Tubeless group	P value
<b>Number of patients</b>	30	30	NS
<b>Gender (male/female)</b>	18/12	20/10	NS
<b>Age groups, N (%)</b>			
20-40 years	14 (46.6%)	19 (63.4%)	NS
41-60 years	16 (53.4%)	11 (36.6%)	
<b>Side, N (%)</b>			
Right	17 (56.6%)	14 (46.6%)	NS
Left	13 (43.4%)	16 (53.4%)	NS
<b>Stone location</b>			
Renal pelvis	12	13	NS
Lower calyx	7	8	
Middle calyx	6	5	
Upper calyx	5	4	

NS: p>0.05); S: p<0.05.

The mean operation time was slightly longer in the standard group (108 minutes) than in the totally tubeless group (102 minutes), but there was no statistically significant difference. There was no significant difference between the two groups with regard to serum creatinine change or blood loss.

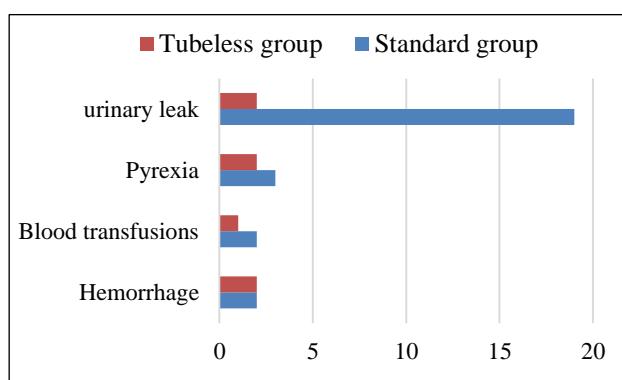
However, Hemoglobin drop, hospital stay, Pain score and analgesia requirement was significantly less in the totally tubeless group (Table 2).

Out of the 60 patients, 4 patients in each group had bleeding postoperatively. Among these, 3 patients required blood transfusion and one patient in tubeless group was managed without blood transfusion. Only five patients developed pyrexia in the postoperative period. The differences in the need for blood transfusion and postoperative pyrexia were not found to be statistically significant. 19 in standard group and 2 patients in totally tubeless group developed urine leak through the wound postoperatively. Residual stones were not detected on plain CT scan of abdomen in these patients. The urine leak lasted for 2-14 days and resolved spontaneously. The difference was found to be statistically significant (Figure 1).

**Table 2: Comparison of operative and post-operative data of both groups.**

Variables	Standard group	Tubeless group	P value
<b>Operative time(mins)</b>	108±23.3	102±24.4	NS
<b>Hemoglobin drop (g%)</b>	1.45 (1.01)	1.02 (0.45)	S
<b>Creatinine (immediate)</b>	0.8±0.2	1.0±0.3	NS
<b>Hospital stay</b>	7.43±2.98	3.44±1.76	S
<b>Pain score</b>	6.54 (1.5)	4.85 (1.1)	S
<b>Analgesic requirement (tramadol in mg)</b>	387 (156)	165 (82)	S

NS: p>0.05; S: p<0.05.



**Figure 1: Complication associated with surgery in both groups.**

## DISCUSSION

Totally tubeless PCNL was first described by Wickham et al, in 1984.<sup>4</sup> Winfield et al, in 1986 also reported two cases of totally tubeless PCNL.<sup>5</sup> However, due to prolonged hospitalization, increased analgesic requirement, and significant inconveniences to the patients, this practice was given up. In a recent study, Aghamir et al, assessed the outcome and safety of the totally tubeless PCNL in patients with renal stones in the upper pole of the kidney and subcostal access.<sup>6</sup> Seventy

patients with upper pole renal stones were enrolled in this study. Stone sizes were over 1.5 cm. All the stones were extracted through successful subcostal accesses. They stated that totally tubeless PCNL for the upper pole renal stone via subcostal access was accompanied by decreased hospital stay and analgesics use and a rapid return to normal activity.

The role of the nephrostomy tube placement after PCNL for haemostasis was challenged by several reports.<sup>7</sup> These studies reported no difference in the haemoglobin change. Findings of our study also goes in accordance with the literature.

In present study mean operation time was slightly longer in the standard group (108 minutes) than in the totally tubeless group (102 minutes), but there was no statistically significant difference. There was no significant difference between the two groups with regard to serum creatinine change or blood loss.

Bellman et al, in 1997 first described “tubeless” PCNL which involved placement of a ureteric stent without nephrostomy.<sup>8</sup> Goh and Wolf in 1999 proposed almost totally tubeless PCNL wherein an externalized ureteric catheter was retained for 1-2 days and they concluded that PCNL without nephrostomy is effective, safe, and reduced the morbidity.<sup>9</sup> Several studies in the recent years have reported the success and advantages of totally tubeless PCNL.<sup>6,10</sup>

Visual analog scale was used for pain assessment 24 h after surgery. The mean pain score in standard and tubeless groups was 6.54, 4.85, respectively, in this study with a statistically significant difference between the groups (p=0.001). A significant difference was also noted in pain scores between tubeless and totally tubeless groups (p=0.001). In a study by Agrawal et al, the mean pain score was 5.9 and 3.1 in standard and tubeless groups, respectively (p≤0.01).<sup>11</sup>

The mean opioid analgesic requirement (tramadol in milligram) was in favor of tubeless and totally tubeless groups compared to standard group and the difference was statistically significant (p=0.001). Agrawal et al, showed mean opioid analgesic requirement with significant difference between standard and tubeless groups (p=0.001).<sup>11</sup> The mean duration of hospital stay in standard and tubeless the difference was statistically significant (p=0.001). The meta-analysis by Borges et al, noted a significant reduction in duration of hospital stay in tubeless PCNL compared to the standard group (p=0.00001).<sup>12</sup> Crook et al, showed mean duration of hospital stay in standard and tubeless groups to be 80.64 and 55.66 h, respectively (p=0.05).<sup>13</sup> The duration of hospital stay did not show a statistical difference in a study by Abbott et al.<sup>14</sup> In a study by Mandhani et al, the analgesic requirement and duration of hospital stay were comparable between the tubeless and totally tubeless groups and concluded that PCNL without nephrostomy or

ureteric stent was a safe procedure in selected patients.<sup>15</sup> A study by Moosanejad et al, showed that totally tubeless PCNL is a safe and effective technique and is associated with decreased pain, analgesic need, and length of hospitalization.<sup>16</sup>

Hemorrhage is the most significant complication of PCNL requiring blood transfusion in 3%-12% of cases.<sup>17</sup> A total of 4 patients had postoperative bleeding and 3 patients were managed with blood transfusion and spontaneous resolution occurred in one patient. Single-step totally tubeless PCNL did not lead to significant hemorrhagic complications compared to other groups. A meta-analysis of standard versus tubeless PCNL by Borges et al, showed that there was no difference in Hb drop between tubeless and standard PCNL ( $p=0.09$ ).<sup>12</sup> In the study by Tefekli et al, the mean Hb drop (g%) in standard and tubeless PCNL was 1.3 and 1.7, respectively.<sup>18</sup> In this study, the difference in mean Hb drop in standard, tubeless, and totally tubeless groups was not found to be statistically significant.

Fever following PCNL is a significant complication. Fever which is mostly seen on the first or second postoperative days has a low risk of progressing to a life-threatening condition. In our study, five patients had fever in the postoperative period out of which 2 were from tubeless and the other 3 were from the standard group. None of the patients in totally tubeless group had fever and the difference was statistically insignificant. In the meta-analysis of six trials by Borges et al., postoperative fever did not attain any statistical difference between the groups.<sup>12</sup> However, a study by Jou et al, showed that postoperative fever was common in those patients with residual fragments. Stone burden, composition and duration of surgery did not produce increased incidence of fever in these patients who underwent PCNL.<sup>19</sup> A study by Aghdas et al, found the incidence of postoperative fever to be more in patients with nephrostomy.<sup>20</sup>

In this study, all 19 patients in the standard PCNL group had postoperative urinary leak following removal of nephrostomy. Only 2 patients in the totally tubeless group had postoperative urinary leak. The difference was found to be statistically significant ( $p=0.001$ ). The urine leak may be due to the temporary edema at the pelviureteric junction due to the trauma of lithotripsy or may be due to the maturation of tissues and establishing an anomalous tract.<sup>12</sup> Urinary leak is not an uncommon problem following PCNL and varied from 0% to 11.1%.<sup>12</sup> This could be due to retained fragments, blood clots, infundibular narrowing, mucosal edema, etc., Though it is difficult to quantify, urine leak persisting 48 h following nephrostomy removal is considered as prolonged urine leakage. The important risk factors for urine leak persisting for 48 h or more depend on stone complexity, severity of hydronephrosis, thickness of renal parenchyma, intraparenchymal renal pelvis, multiple punctures, surgeon's experience, and residual stones.

Most of these subside over a period of time. The meta-analysis by Borges et al, reported urine leak to be lower in tubeless group compared to standard group ( $p=0.0002$ ).<sup>12</sup>

## CONCLUSION

Author can conclude that the tubeless procedure has fewer complications, improved postoperative patient comfort, shorter hospitalization, and a reduced need for analgesics. These differences might make tubeless PCNL the new standard. In suitable cases, the tubeless procedure can be safely used as the standard for PCNL.

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