

# Tubeless Percutaneous Nephrolithotomy with Externalized Ureteral catheter, a Single Centre Experience

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## ABSTRACT

**Background:** Percutaneous Nephrolithotomy (PCNL) has become the preferred method for management of renal stone more than 20 mm. Over the decades, PCNL has undergone various modifications resulting in emergence of procedures like Tubeless PCNL, Miniperc, Ultra-mini PCNL, Micro PCNL etc. Tubeless PCNL (TPCNL) is a technique where instead of nephrostomy tube, an internal indwelling Double J stent or externalized ureteral catheter is placed following stone fragmentation and extraction. Objectives: The Aim of this article is to share our experience of Tubeless PCNL using an externalized ureteric catheter. **Methods:** Patients undergoing tubeless PCNL using externalized ureteric catheter were included in the study. Inclusion criteria were Renal and Proximal ureteric stones of size 15mm or more, complete or partial staghorn calculus, bilateral renal stones, stones in Solitary and anomalous kidneys. Study parameters included are baseline patient and stone characteristics such as stone size, location and associated renal anomaly. Intra-operative parameters included nature of access, duration of surgery, stone clearance rate, intra-operative complications, if any. Postoperative parameters were blood loss (mean drop in hemoglobin), analgesia requirement, duration of hospital stay and complications such as fever, hematuria, urine leak and hydrothorax/hemothorax. **Results:** Mean operative time was 22 minutes (10-122), complete stone clearance rate was 97.3% (219 out of 222). Single access with infracostal and inferior calyceal puncture was most commonly employed. Supracostal puncture was done in 28 cases. Multiple puncture and access was required in 41 (double puncture in 32 and triple puncture in 9 cases). Major bleeding requiring intra-operative transfusion was very low (0.5%). Pleural injury occurred in 6 cases (4 required intercostal tube drainage and other two managed with aspiration. Mean change in hemoglobin and serum creatinine in the post-operative period was 1.62 gm/dl (range 0-3.5) and 0.42 mg/dl (range 0-1.5) respectively. Mean analgesia requirement was 330 mg of Tramadol or equivalent (range 100-1600 mg). Mean VAS (visual analog score) was 3.4 (range 1-6). Blood transfusion rate was 1.5%. **Conclusion:** TPCNL provides distinct advantage over conventional PCNL by avoiding nephrostomy tube related complication and there by post-op pain period and hospital stay is reduced. TPCNL with externalized ureteral catheter instead of DJ stent gives added advantage by avoiding stent related symptoms and second procedure for stent removal.

**Keywords:** TPCNL, Externalized ureteric catheter.

## INTRODUCTION

Since the introduction in early 1980, percutaneous nephrolithotomy (PCNL) has become the preferred method for management of renal stone more than 2 cm. Conventionally PCNL is performed with a nephrostomy tube placed at the end of the procedure. Nephrostomy tube often causes urine leakage from the tract following removal, increased analgesics requirement resulting in prolonged hospitalization and recovery time.<sup>[1]</sup> Over the decades with improvement of technology and surgical skill, PCNL has undergone various modifications resulting in emergence of procedures like Tubeless PCNL, Miniperc, Ultra-mini PCNL, Micro PCNL and so on.<sup>[2-6]</sup> All these modifications were aimed to reduce morbidity and hospital stay associated with standard /conventional PCNL.

Tubeless PCNL (TPCNL) is a technique where instead of nephrostomy tube, an internal indwelling Double J stent or externalized ureteral catheter is placed following stone fragmentation and extraction. The DJ stent is left indwelling and removed after two while the external isedureteral catheter is removed on the second or third post op day if complete stone clearance is ensured. Hence the post-operative morbidities due to nephrostomy tube like postoperative pain, urine leakage and long hospital stay are avoided. Bellman introduced the concept of tubeless PCNL in 1997.<sup>[2]</sup> In a comparative study between 50 patients of standard PCNL with 50 tubeless PCNL, Bellman and colleagues proved safety and efficacy of TPCNL over standard PCNL. Since then many studies have confirmed the same. Over the last decade, there have been several modifications in Tubeless PCNL. First, the inclusion criteria for Tubeless PCNL have been expanded i.e. large stone burden, anomalous kidneys, multiple puncture / access, past history of renal stone surgery, pediatric population, bilateral simultaneous PCNL, are no more contraindications for tubeless PCNL.<sup>7</sup> Second, tubeless PCNL using an externalized

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ureteric catheter instead of Double J stent for drainage.<sup>[8]</sup> Third, a totally tubeless PCNL (where neither nephrostomy tube nor double J stent/ureteric catheter is used for drainage) in selected cases.<sup>[9]</sup>

Most of the reported literatures on TPCNL have used double J stent for internal drainage.<sup>[3-5]</sup> In these patients, although the hospital stay is uneventful, many of them developed stent related discomfort like flank pain, hematuria, fever, UTI etc. In addition a second procedure i.e. cystoscopic removal of stent is required. Alternatively, an externalized ureteral catheter can be kept for 1-2 days. Few studies have reported the advantage of externalized ureteral catheter over internal DJ stent.<sup>[9,10]</sup> In a randomized study by Muratogonen et al, it was found that tubeless PCNL with externalized ureteral catheter is as feasible as Double J stent.<sup>[9]</sup>

We conducted a Prospective randomized study to share our experience with externalized ureteric catheter. Initially, we used to perform standard PCNL at our institution. But in last three years we have switched over to Tubeless PCNL in majority of cases. Our preference in tubeless PCNL is external ureteric catheter over a Double J stent.

The Aim of this article is to share our experience of Tubeless PCNL using an externalized ureteric catheter.

## MATERIALS AND METHODS

A prospective study was carried out at our institution from March 2013 to July 2016. Patients undergoing tubeless PCNL using external ureteric catheter were included in the study. Inclusion criteria were Renal and Proximal ureteric stones of size 15mm or more, complete or partial staghorn calculus, bilateral renal stones, stones in Solitary and anomalous kidneys, previous history of procedure for stone disease like PCNL, pyelolithotomy, ESWL on the same side were. Children younger than 12 years, uncontrolled bleeding coagulopathy, chronic renal failure, placement of double j stent, Multiple punctures/tracts (more than three) and relook PCNL were excluded from the study.

### Brief Methodology:

Preoperative evaluation included complete blood count, urine analysis and culture sensitivity, coagulation profile, blood urea and serum creatinine. IVP or CECT KUB was done to assess the stone characteristics. Stone size was calculated on X-ray KUB/CECT by measuring maximum length and breadth. After taking informed consent, patients were subjected for PCNL (majority under regional anesthesia). All the procedures were performed by a single Surgeon. After confirmation of endoscopic and fluoroscopic stone clearance on table, only externalized ureteral catheter was left at the end of the procedure. Double J stent and nephrostomy tube was given only when deemed necessary and they were excluded from the study. Ureteric catheter was

removed on 2<sup>nd</sup> or 3<sup>rd</sup> postoperative day. A check X-ray KUB was performed before discharge.

Study parameters included are baseline patient and stone characteristics such as stone size, location and associated renal anomaly. Intra-operative parameters include nature of access (supracostal/ infracostal), number of punctures, duration of surgery, stone clearance rate, intra-operative complications if any. Postoperative parameters were blood loss (mean drop in hemoglobin), analgesia requirement, duration of hospital stay and complications such as fever, hematuria, urine leak and hydrothorax/hemothorax.

## RESULTS

A total of 212 patients (Male=143 & Female=89) underwent tubeless PCNL using ureteral catheter over 3 year period. Simultaneous bilateral PCNL was carried out in 20 patients. Regional anesthesia was used in most of the cases. Mean age of patients are 34.5 years (range 13-82 years). Associated renal anomalies were present in 25 cases (Crossed fused ectopia=2, horse shoe kidney=6, pelvic ectopic kidney =2, duplex system =11 and ADPKD =4). Past history of intervention in the same renal unit was noted in 49 cases (pyelolithotomy/nephrolithotomy=37, PCNL in 6 and ESWL in 8 patients). Baseline patient and stone characteristics is shown in [Table 1].

**Table 1: Baseline patient and stone characteristics**

Patient characteristics		Mean	Range
Age (years)		34.5	13-82
Body mass index kg/m <sup>2</sup> (BMI)		26.32	18.34-40.56
Baseline Hb level (gm/dl)		12.8	9.6-15.8
Pre op Urea level (mg/dl)		25.5	11-43
Pre op Creatinine (mg/dl)		1.4	0.9-1.7
Stone characteristics			
Stone size	Stone length (mm)	31.25	15-59
	Stone breadth (mm)	11.2	6-48
Laterality	Right =88	Left=104	Bilateral=20
Stone location		Sup calyx=18, mid calyx=24, inf calyx=36, pelvis and calyceal=2,	partial staghorn=16, complete staghorn=11
Pelvis=59, proximal ureter=21,			

Mean operative time was 22 minutes (10-122). Complete stone clearance rate was 97.3% (219 out of 222). Single access with infracostal and inferior calyceal puncture was most commonly employed. Supracostal (Supra 11th) puncture was done in 28 cases. Multiple puncture and access was required in 41 (double puncture in 32 and triple puncture in 9

cases). Major bleeding requiring intraoperative transfusion was very low (0.5%). Pleural injury occurred in 6 cases (4 required intercostal tube drainage and other two managed with aspiration).

Mean change in hemoglobin and serum creatinine in the post-operative period was 1.62gm/dl and 0.42 mg/dl respectively. Mean analgesia requirement was 330 mg of Tramadol or equivalent (range 100-1600 mg). Mean VAS (visual analog score) was 3.4 (range 1-6). Blood transfusion rate was 1.5 %. 13 patients developed persistent hematuria (lasting more than 3 days). Out of which, 11 managed conservative and haematuria subsided. In rest 2 patients hematuria persisted and were subjected to CT angiography. CT showed pseudo aneurysm and they were referred to higher center for Angioembolization. Mean duration of hospital stay was 3 days (range 1-6). Intra-op and post-operative parameters are depicted in [Table 2].

**Table 2: Intra-Operative and Post-Operative Parameters**

Mean operative Time	22 minutes	10-122
Stone clearance rate	97.3 %	
Supracostal (supra 11 <sup>th</sup> )	28 cases	
Multiple puncture	41 cases Double puncture in 32 Triple puncture in 9 cases	
Mean Change in Hemoglobin	1.62 gm/dl	0.0-3.5
Mean change in creatinine	0.42 mg/dl	0.0-1.5
Mean analgesia requirement	330 mg tramadol or equivalent	100-1600 mg
Mean VAS (visual Analog Score)	3.4	1-6

## DISCUSSION

Over the decade, the challenge to make PCNL more comfortable with minimal morbidity and to make it a true day care procedure has been well taken. Switching from conventional PCNL to miniport and ultra mini PCNL and from tubeless to totally tubeless has really created a remarkable difference in morbidity associated with PCNL.

Wickham et al introduced the concept of totally tubeless PCNL in 1984 which they termed as single stage PCNL.<sup>[9]</sup> However, it was not popularized because this study excluded patients with multiple stones, stones requiring fragmentation, high lying kidney and non-dilated collecting system. In 1977 Bellman and colleagues introduced tubeless PCNL. In their study, they compared 50 patients undergoing tubeless PCNL with internal double J stent with 50 patients of conventional PCNL. The hospitalization time, analgesia requirements, time to return to normal activity were significantly less with tubeless PCNL.

Since then, various studies have been carried out to assess safety, patient comfort and morbidity following Tubeless PCNL. In the initial phase,

tubeless PCNL was performed only in patients with minimal stone burden, kidney with normal anatomy, dilated pelvicalyceal system. However, over the time the inclusion criteria have been expanded.

A meta-analysis by Agarwal et al concluded that Tubeless PCNL can be used with favorable outcome in selected patients (stone less than 3 cm, single access, no significant residual fragments/pelvic injury, minimal bleeding with complete clearance) with advantage of decreased postoperative pain, less analgesic requirement and hospital stay.<sup>[11]</sup>

Shah et al in their study with 454 patients of tubeless PCNL with antegrade internal stenting under general anesthesia, concluded that feasibility of tubeless PCNL can be extended to patients with solitary kidney, previously operated kidney, stones with renal failure, supra costal puncture and synchronous bilateral PCNL. However patients with pyonephrosis, matrix calculi, residual stones, multiple access, significant bleeding were excluded.<sup>[12]</sup>

Mario safer et al reported a series of 281 patients undergoing PCNL. Out of them 200 underwent tubeless PCNL and conventional PCNL in 81 cases. Stone burden (mean =424 mm<sup>2</sup>) anomalous kidney, intra-operative time (45-201 minute) are not criteria against tubeless PCNL. Rather active bleeding 7%, suspected hydrothorax, and extravasation in 7 and 6 cases respectively forced them to adopt standard PCNL in 29 % cases. Patients with tubeless PCNL had a mean hospital stay of one day and time to return to normal activity was 7 days.<sup>[13]</sup>

Yuan H et al conducted a systematic review and meta-analysis involving 14 randomized control trials (776 patients) found statistically significant advantage of tubeless PCNL over standard PCNL with regards to hospital stay, analgesia requirement and urine leakage.<sup>[14]</sup>

Murat Goren in his study analyzed the outcome of TPCNL using 2 different stenting technique in 2 equally divided groups comparable with regard to age, stone burden etc. He found TPCNL with externalized ureteral catheter a better option compared to DJ stenting as stent related symptoms are ruled out. However the surgeon must ensure complete stone clearance.<sup>[15]</sup>

Asraf Abou Ele La et al in their study of 128 cases concluded that TPCNL with an externalized ureteral catheter is a safe procedure suitable for patients who can be rendered completely stone free and without significant intra-op complication.<sup>[16]</sup>

Aghamir in his study found no difference in bleeding complication between single and double access TPCNL.<sup>[17]</sup> H. Ozturk in his study of 52 patients all aged above 65 years underwent TPCNL and compared to standard PCNL had short hospital stay and less analgesic requirement.<sup>[18]</sup>

In our study, we have an expanded selection criteria for TPCNL. We have included patients above 12 yrs, anomalous kidneys, previously operated kidney

(pyelolithotomy, PCNL, ESWL), bilateral renal stones. In most of the studies it has been found that residual stones and significant bleeding are two main potential factors that preclude TPCNL. In our study, our main objective was to have complete stone clearance irrespective of stone burden, type of renal anomaly, no. of access. Our 97 % complete stone clearance rate as demonstrated by intra-op fluoroscopy and nephroscopy and post op imaging has made us confident enough to do away with nephrostomy tube. Portis et al suggested that use of flexible nephroscopy and high magnification rotational fluoroscopy improves intra-operative detection of stone fragments of size 4 mm. We have no access to such facilities and we had only one case where a residual fragment obstructed the ureter in the post-operative period.

Intra operative bleeding evaluation depends upon patient hemodynamic status and surgeon experience. In our study we encountered severe bleeding in 3 cases which forced us to abandon the procedure with nephrostomy tube in place for relook PCNL.

Safer et al reported one quarter of their cases undergone standard PCNL due to surgeon's impression of active bleeding. Shah et al used hemostatic sealants in 62 cases out of 454 patients to control tract bleeding. Tract bleeding after removal of Amplatz sheath had never been a matter of concern for us as experience has taught us this has no clinical significance. In our study we observed that simple closure of tract with parietal suture is good enough for achieving self tamponade. Persistent hematuria was observed only in 13 cases, out of which majority were managed conservatively. In our study we used supracostal access in 28 cases, incidence of chest complications were very low. As ureteral catheter was placed, stent related complications were avoided. Mandhani et al,<sup>[10]</sup> in their study comparing TPCNL with double J stent and external ureteral catheter concluded that external ureteral catheter did not increase post-operative morbidity in selected patients. Our study showed using an externalized ureteral catheter gives more comfort to patients provided complete stone clearance is achieved.

## CONCLUSION

Tubeless PCNL provides distinct advantages i.e. decrease hospital stay, decrease analgesic requirement and urine leak over standard PCNL. With experience it can be used in complex cases such as larger stone burden, multiple tracts, past history of stone surgery, stones in solitary kidney, bilateral renal stones and stones in anomalous kidneys.

In addition, our study demonstrated that tubeless PCNL using a ureteric catheter is a safe and reliable technique. It can reduce the complications associated with double J stent without affecting the efficacy of

the procedure. However, further prospective randomized trials are required to substantiate our results.

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