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Tubeless percutaneous nephrolithotomy (PCNL) as a standard treatment: observations from a tertiary care hospital

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Abstract

Aim: To observe the safety and efficacy of tubeless percutaneous nephrolithotomy (PCNL).

Materials and methods: Since January 2016 to 2019, 210 consecutive tubeless PCNL performed at our hospital were enrolled into this retrospective chart review. The average age of the patients (134 males and 76 females) was 57 ± 11.8 years, and 7 patients were between 8 to 12 years. The stone characteristics were 71 pelvic or calyceal solitary stones, 62 non-complete staghorn kidney stones, 17 ureteral stones, 32 kidney + ureteral stones (concomitant kidney and ureteral stones), and 28 complete staghorn stones. Mean stone size range 3.5 ± 2.8 [range 0.7cm to 11.8 cm]. Patient's position was prone. Tract size varied from 26 F to 30 F and number of tracts varied single tract to 4 tracts.

Results: The average operative time was 85.0 ± 29.4 minutes. Average hospital stay was 21.7 hrs (6 patients had longer stay due to fever) and the blood transfusion rate was 1.4%. Postoperative fever was noted in 19 (9.02%) patients, no urosepsis was noted. No Pulmonary complications and mortality noted. No re exploration was done. No major leak was noted. Angioembolisation rate 0.95%. We did not use any haemoseal ent or cautery in the tracts.

Conclusion: PNT serves purpose of relook PCNL and drainage of urine if there is pyonephrosis or surgeon has doubt about PUJ competency like edema, perforation etc., but other factors like bleeding, fever, sepsis, AV aneurysm, AV fistula, pulmonary complications if puncture is in upper calyx, mortality are comparable to standard PCNL and advantage of tubeless PCNL are reduced post-operative pain which leads to lesser analgesia requirement, less apprehension as no tube is there, therefore more comfort, early discharge and indirectly less hospital expenses, early return to work. Our observation is that Tubeless PCNL is effective and safe. There is limitation of our study that our sample size is small and it is not a case-control study, therefore significance was not established.

Keywords: Tubeless PCNL, nephrolithiasis

Introduction

PCNL has advantage over open stone surgery like lower morbidity and mortality, faster recovery and cost effectiveness ^[1]. In 2005 AUA declared PCNL as a standard treatment in patients with staghorn stones and complex stones ^[2]. Percutaneous nephrostomy tube (PNT) placement in the tract in the pelvicalyceal system was a standard step at the end of procedure. PNT served as haemostatic tamponade for the tract, drain urine and it is a quick access if there is need of re look PCNL. Since 1997 many urologist tried to prove its non essential nature. There are various reports which have confirmed that PCNL without PNT has lower analgesic requirement, faster recovery, with early discharge, less morbidity as well as safe procedure in selected patients ^[3, 5]. Tubeless modification for percutaneous renal surgery has been performed at our institute since 2016 as routine procedure. In this study, we have done a descriptive comparison of our observation of efficacy and safety of tubeless PCNL with other studies and evaluated the factors such as, post-op fever, transfusion rate, angioembolisation, pulmonary complications and mortality, re exploration, nephrectomy, major leak, sepsis, pain score and early discharge.

Material and method: 210 cases of tubeless PCNL which was done during January 2016 to January 2019 were retrospectively reviewed in this study. Indication of PCNL included large stone burden, multiple stones, calyceal stones, upper and middle ureteric stones.

Exclusion Criteria: Single kidney, Pyonephrosis, Non-visualized kidney on IVP, Radiolucent stones, on table residual stones (real time fluoro detected) needs relook PCNL. All the PCNL were performed by single urologist with standard operative method under Spinal or combined spinal epidural (CSE) anesthesia.

With cystoscope both end open ureteric catheter was kept in lithotomy position. If stone present in middle or upper ureter then with ureteroscopy stone pushed into kidney with or without fragmentation in lithotomy position. Renal access tract was obtained with fluoro Bull's eye technique in prone position. Tract size varied from 26F to 30F and single tract to 4 tracts depending on stone burden and renal anatomy. Pneumatic lithotripter was used to fragment the stones. After stone clearance 5 F double J stent was placed in an antegrade fashion for post-operative urinary drainage. Amplatz removed and 5 min hand compression applied on tract site. No cautery or haemostatic gel or foam used. No sutures applied. A Foley's catheter was inserted into every patient for urinary drainage and the catheter was removed in the next morning. Double j stent removed after 3 weeks. Patient's age, stone characteristic, stone size, operative time, post-operative hospital stay, fever, transfusion rate and other complications were recorded and analyzed by retrospective chart reviews. Stone size was measured on a KUB plain film using the longest diameter. Operative time was calculated from the beginning of cystoscopy to the removal of amplatz sheath. Stone free was defined as complete removal of stones on fluoroscopy at operation table. Body temperature above 101 F after the operation during admission or readmission defined as post operative fever. Sepsis was defined as patient with systemic inflammatory response syndrome with suspected infection.

Statistical analysis: All the patients' characteristics were entered in the Microsoft Excel sheet. Descriptive analysis was done in Microsoft Excel 2010. Qualitative data were reported as frequency and percentage where as quantitative data were reported as mean with standard deviation.

Results: The age of the 210 patients ranged from 8 to 78 years (mean age 57.3 ± 11.8). 7 patients were from paediatric age group ranged from 8 to 15 years. PCNL were performed in 134 male and 76 female patients out of 210 cases. Distribution of stone characteristics were 71 pelvic or calyceal solitary stones, 62 non-complete staghorn kidney stones, 17 ureteral stones, 32 kidney + ureteral stones (concomitant kidney and ureteral stones) and 28 complete staghorn stones. Average stone size was 3.5 ± 2.8 (range 0.7cm to 11.8 cm).

Operating time – The average operative time was 85.0 ± 29.4 minutes (64.7 min, 73.8 min, 78.0 min, 88.2 min, and 108.5 min for pelvic or calyceal solitary stones, non-complete staghorn kidney stones, ureter, kidney + ureter and complete staghorn stones respectively).

All patients had hemoglobin level more than 9 gm % before the operation, only 3 (1.4%) patients required post-operative transfusion which was in staghorn stone and multiple tract. No patient underwent surgical exploration or nephrectomy due to severe post-operative hemorrhage. Two patients need

angiographic embolisation due to delayed hemorrhage. No any Pulmonary complication were reported, it may be due to our method. We used lower and middle calyx tracts until it was impossible to remove stone from upper calyx, even in that case we first try to push stone from upper calyx to pelvis with water pressure through puncture middle or Alken cannula. We observed success in 90% cases and there was no need of upper tract formation. 10% cases we made upper calyx tract. We discharged patients within 24 hours as a study protocol on antibiotic and follow up after 5 days. Average hospital stay was 21.7 hrs. Out of 210 patients 6 patients had longer stay due to high grade fever and 3 patients had due to severe pain and 7 patients refused for discharge due to personal or social reasons. Our ambulatory PCNL (discharge with in 24 hrs) rate was 97% (194 out of 210). 19 (9.02%) patient had fever, 8 patient had in evening of surgery which subside on morning and discharged but 6 patient had longer stay and fever took 2 to 3 days. 5 patients readmitted due to fever and 3 patients readmitted due to delayed hematuria and 4 patients readmitted due to severe pain and dysuria and all the patients discharged after 2 to 4 days with conservative treatment. No sepsis and mortality noted. Mild soakage noted at tract site on day 1 and day 5 wound was healed. No major leak was noted.

Table 1: Distribution of the stone characteristics, operating time and complications

Stone characteristics:-	N = (%)
Complete staghorn stones	28 (13.33)
Kidney + ureteral stones	32 (15.23)
Pelvic or calyceal solitary stones	71 (33.80)
Non-complete staghorn stones	62 (29.52)
Ureteral stones	17 (8.09)
Operating time in minues: (mean+SD)	64.7 \pm 17.3
Pelvic or calyceal solitary stones	73.8 \pm 21.8
Non-complete staghorn kidney stones	78.0 \pm 24.1
Ureter	88.2 \pm 31.4
Kidney + ureter	108.5 \pm 42.7
Complete staghorn stones	85.0 \pm 29.4
Overall average operative time	
Average hospital stay: (mean+SD)	21.7 \pm 3.4 hrs.
Visual analogue scale: (mean+SD)	
Zero post op day	3.86 \pm 0.9
First post op day	1.7 \pm 0.6
24 hr discharge (N=210)	194 (97)
Readmission (N=194)	12 (6.18)
Complications:	N = (%)
Postoperative fever	19 (9.02)
Transfusion rate	3 (1.40)
Angioembolisation rate	2 (0.95)
Pulmonary complications	--
Re exploration or nephrectomy	--
Major leak	--
Sepsis	--
Mortality	--

Discussion: Last steps of PCNL include DJ stenting/leaving of ureteric catheter and placement of PNT. It was believed earlier that PNT has temponade effect on tract and prevent parenchymal bleeding. Many authors tried to observe the relationship with diameter of PNT and its temponading effect as reasoning was that bigger PNT, better temponade. But as advancement of instrumentation occurred and experience of urologist increased, many authors tried to prove its non necessity. As in 1997 Bellman [3] and associates showed that without PNT there was less cost, decreased hospital time, was less pain and therefore

less analgesia required. Candela *et al.* [6] compared cost of tubeless procedure with conventional procedure. It was 1638 \$ with tubeless and 3750 \$ with PNT. Many authors' studies proved safety and low morbidity with tubeless PCNL [7, 10]. Earlier studies were had strict case selection. But as PCNL spread widely, and more and more urologist started doing it thus experience increased and fear faded, and they studied its safety and applicability in more complex cases like in 2005 Shah *et al.* [10] did in solitary kidney and multiple renal tracts and Wang *et al.* [11] in 2011 showed its effectiveness in bilateral stag horn stones. In our study we did all the complex stones with multiple tracts. We did not evaluate patient for cost effectiveness but we studied our patients in relation to pain, post op fever, transfusion rate, angioembolisation, pulmonary complications, mortality, re exploration, nephrectomy, major leak and sepsis, and compared our results with traditional PCNL results. Many author used different haemostatic method in tracts like gelatin thrombin sealant [12, 13], fibrin glue [14, 17] oxidized cellulose (surgicel) [18] with mixed results. Many authors cauterised the tract [19, 20] we did not use any maneuver in the tract and did not sutured skin incision also only 5 min hand compression

In 1000 PCNL, Segura *et al.* [21] reported transfusion rate 3.0%, angioembolisation 0.6% and pneumothorax 0.1%. Jones *et al.* [22] reviewed 1000 cases and reported mortality 0.7%, blood transfusion 8.4%, angioembolisation 0.6% and 7.5% sepsis. Tefekeli *et al.* [23] in 2008 retrospectively reviewed 811 PCNL and find his transfusion rate was 10.9%, post operative fever was 2.8%.

In our study, tubeless PCNL did not show worse complication rate than the traditional PCNL with PNT. Our transfusion rate is only 1.4% which is lower than many studies; angioembolisation is 0.95% which is comparable to other studies and post operative fever 9.02% which is not very high. We do not have mortality, sepsis, pulmonary complications and major leak.

Pain as measured by visual analogue scale (VAS) was 3.86 ± 0.86 on day of surgery and 1.7 ± 0.64 on first day of surgery. Singh *et al.* and Shah *et al.* compared VAS scores with tube and without tube with DJ stent on day one and day two and score were significantly reduced in tubeless group.

Table 2: Descriptive presentation of Visual Analogue Scale finding of various studies

	Day one	Day 2
Singh <i>et al.</i> (tubeless with DJ stent) [24]	7.63 ± 0.49	6.03 ± 0.66
Shah <i>et al.</i> (tubeless with DJ stent) [10]	4.4 ± 2.1	2.8 ± 1.8
Our study	3.86 ± 0.86	1.7 ± 0.64

In Agarwal MS *et al.* [25] study, the average hospital stay in the tubeless group (21.8 ± 3.9 hours) was significantly shorter than standard PCNL group (54.2 ± 5 hours) ($P < 0.01$). Berkman DS *et al.* [26], showed tubeless patients were more likely to be discharged post op day one compared to standard patients (96% versus 72% $P = 0.02$). Sofikerim M *et al.* [27]. Mean hospital stay with tube and tubeless were 74.4 hours (3.1 day) and 38.4 hours (1.6 day) respectively ($P = 0.003$). Bellman GC *et al.* hospitalization was 14.4 hours for the study group and 110.4 hours for the control group ($P = 0.0001$). Our mean hospital stay is 21.7 ± 3.4 hours and discharge rate within 24 hrs is 97%

Conclusion

PNT serves purpose of relook PCNL and drainage of urine if there is pyonephrosis or surgeon has doubt about PUJ competency like edema, perforation etc, but other factors like bleeding, fever, sepsis, AV aneurysm, AV fistula, pulmonary

complications if puncture is in upper calyx, mortality are comparable to standard PCNL and advantage of tubeless PCNL are reduced post operative pain which leads to lesser analgesia requirement, less apprehension as no tube is there, therefore more comfort, early discharge and indirectly less hospital expenses, early return to work. Tubeless PCNL is effective and safe. There is limitation of our study that our sample size is small and it is not a case-control study, therefore significance was not established.

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