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Comparison between Standard Percutaneous Nephrolithotomy versus Tubeless Percutaneous Nephrolithotomy

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ABSTRACT

Introduction: Percutaneous nephrolithotomy (PCNL) is the most commonly done procedure for the treatment of large and complex renal calculi. Tubeless PCNL has been advocated in selected patients as it is thought to reduce the post-operative analgesia requirement and postoperative hospital stay.

Methods: A retrospective comparative study was carried out in 100 patients who underwent PCNL between January 2019 to July 2020. Patients were divided into two groups; Group A (Tubeless PCNL) and Group B (Standard PCNL) and were compared in terms of stone-free rate, operative time, postoperative analgesic requirement, postoperative hospital stay, postoperative blood transfusion, and postoperative complication. Statistical analysis was done using SPSS software (version 24). The Chi-square test and Student's t-test were applied for the calculation of variables and a p-value of <0.05 was considered significant.

Results: Stone clearance in Group A was higher than Group B (92% vs 88%, p= 0.51). The overall complication was significantly less in Group A (p=0.03). The mean drop in post-operative hemoglobin in Group A was 0.75 ± 0.26 mg/dl and in Group B was 0.90 ± 0.47g/dl (p=0.44). Post-operative blood transfusion was required in 6 patients in Group A and 14 patients with Group B (p=0.26). The mean operating time in minutes was less in Group A (47.10±5.67, p = 0.048). The requirement of post-operative analgesic (Tramadol) was higher in Group B (172.50 ± 40.75mg. vs 142.31 ± 34.44, (p=0.02). The mean duration of hospital stay for Group A was 3.54 ± 0.91 and Group B was 4.56 ± 0.91 days ($p<0.001$).

Conclusion: Tubeless PCNL is a safe, effective, and feasible procedure for renal stones. It decreases the length of hospital stay, the requirement of blood transfusion, and the need for postoperative analgesia.

Keywords: *Analgesics; Kidney Calculi; Nephrolithotomy, Percutaneous*

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INTRODUCTION

Urolithiasis is a common disorder with a prevalence of 10.9% in males and 9.5% in a female with a lifetime risk of recurrence of 50% within 10 years.[1,2] With the increasing life standard of people the prevalence is gradually increasing.[3] With the recent advancement of surgical technology minimal invasive techniques like Shockwave lithotripsy, Uretero-renoscopic-lithotripsy (URSL), Percutaneous nephrolithotomy (PCNL) have gradually become the preferred methods for urinary stone management as compared to the conventional open method.[4] Today PCNL is the most commonly done procedure for the treatment of a simple and complex renal stone, with a success rate of >90%.[5]

Percutaneous nephrolithotomy (PCNL) using a nephrostomy tube for drainage has been considered as the standard PCNL technique.[6] Since Bellman first introduced tubeless PCNL in 1997, this is gaining popularity day by day.[7] PCNL without postoperative nephrostomy tube is defined as tubeless PCNL.[8]

Several studies both individual and meta-analysis have shown that tubeless PCNL is a cost-effective and safe procedure in selected patients with significantly shorter duration of hospital stay and postoperative complications as compared to standard PCNL.[5-13] There are very few studies comparing tubeless and standard PCNL in Nepal. This study aims to compare the outcome of these two techniques in our setting.

METHODS

A retrospective comparative study was done in all the patients who underwent PCNL between August 2018 to August 2019 at Manipal Teaching Hospital, Pokhara, Nepal to compare the outcomes in terms of the stone-free rate at first postoperative day, operative time, blood transfusion required, post-operative pain in terms of visual analog scale (VAS), postoperative analgesia requirement, hospital stay and complications (drop in hemoglobin, urine leakage, and wound infection) in between standard PCNL and tubeless PCNL. Post-operative time was defined as the time from skin puncture to suture placement in Group A and tube placement in Group B. Postoperative analgesia was studied in terms of the requirement of routine non-steroidal anti-inflammatory drugs (NSAIDS) along with additional opioid analgesic agents required in the post-operative period. Patients were grouped into two groups: Group A (tubeless PCNL) and Group B (standard PCNL) according to the operation performed as mentioned in the patient's operative chart. All the clinical profile and lab parameters along with operation details and postoperative outcomes were retrieved from the patient's chart and filled in a performed performa.

All the patients who underwent PCNL during the study period were included in the study. Those who had congenital urinary tract anomalies; urinary tract infection; bilateral PCNL simultaneously; multiple calculi; deranged renal function; multiple puncture intra-operatively; incomplete or lost records or who had lost follow-ups as scheduled were excluded from the study.

All the patients who were operated on had undergone standard hospital protocol with detailed preoperative investigations which included urine analysis, urine culture and sensitivity, complete blood count, renal function test, liver function test, coagulation profile, electrocardiogram, chest X-ray, X-ray kidney, ureter, bladder (KUB), and plain and contrast-enhanced computerized tomography. According to our standard protocol, all the patients planned for PCNL had undergone a detailed preoperative anesthetic checkup by an anesthesiologist. All PCNL was done under general anesthesia and were given intravenous 1 gram ceftriaxone at the time of induction. The tract size used for dilatation in both groups was between 20F-30F. Pneumatic lithotripter was used for fragmentation of calculus. The difference between the two groups of patients was that; an antegrade 5 Fr or 6Fr ureteric stent was placed in Group A

(tubeless PCNL) without a nephrostomy tube after all the stone fragments were extracted, whereas a 20 Fr nephrostomy tube along with 5 Fr or 6 Fr ureteric stent was placed in patients in Group B (standard PCNL) after the stone fragments evacuation. A nephrostomy tube was placed for 24 hours as per the operating surgeon's preference in those who had no residual calculus and other gastrointestinal complication. After recovery, patients were shifted to the postoperative ward, where they were given intravenous Ketorolac (30mg) for the first 2 days followed by oral Ketorolac thereafter. If the patient's pain did not subside despite the use of Ketorolac, then an additional opioid analgesic (Tramadol) was given to all patients. No extra dose of Ketorolac was given before switching to Tramadol. A numeric pain rating scale (NRS) along with Wong-Baker faces pain rating scale chart (Figure 1) was used to ask the patients about the level of pain they were experiencing on the day of operation and first postoperative day.

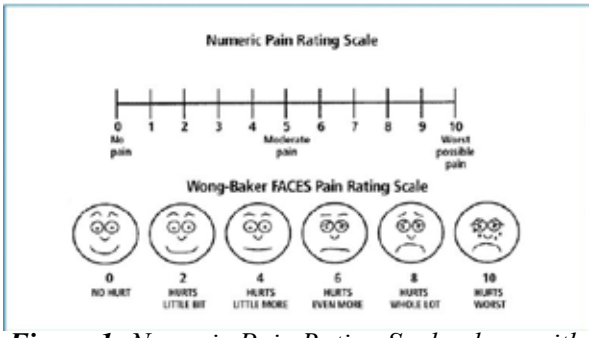

Figure 1: *Numeric Pain Rating Scale along with Wong-Baker faces*

During the post-operative, the vitals and all other parameters were monitored continuously and the record was maintained. An investigation like X-ray KUB, urine routine examination, renal function test, and complete blood count was sent for all patients on the first postoperative day and as required. All the patients of PCNL were followed up according to the standard hospital protocol after 1 week of discharge. On the day of follow-up, the patients were inquired about their complaints, the site of puncture was examined sutured removed and the patients requiring re-intervention was planned for the appropriate procedures.

Descriptive analysis was done to calculate the results initially. All the quantitative data were presented as percentages and qualitative data were presented as mean ±standard deviation. The Chi-square test was used to test the relationship between two categorical values. Comparisons of outcomes between the two qualitative groups were performed by Student's t-test. Statistical Package for the Social Sciences (SPSS) version 23 was used to analyze the results and a p-value of less than 0.05 was taken as statistically significant.

RESULTS

A total of 116 patients underwent PCNL during the study period however 16 patients had either incomplete data, lost records or were lost to follow-ups. Thus 100 patients were included in this study for statistical analysis. Out of 100 patients, 50 patients were without a nephrostomy tube (Group A) while the rest were with a nephrostomy tube (Group B).

In our study, the age of the patients ranged from 18 years to 70 years with a mean age of 40.50 years (SD ± 10.69) in Group A and 41.80 years (SD ± 13.87) in Group B. The incidence of the male patient was 62% and that of females was 38%. The mean stone size in tubeless PCNL was 2.94 cm. while that in standard PCNL was 2.95 cm. The difference between mean age and stone size in both the groups was statistically insignificant suggesting a similar representation of both the groups in terms of age and stone size (Table 1).

Table 1: Comparison between two groups in terms of age and stone size

Variables	Group A (Tubeless)	Group B (Standard)	p-value
Age (mean±SD)	40.50±10.69	41.80±13.87	0.61
Stone size	2.94±0.46	0.45	0.95

The majority of the stone in our study were in the middle calyx while the least number of stones was in the upper calyx (Figure 2). Most of the stone in our study was on the right side (58%). PCNL was performed using subcostal puncture in 86 patients, while the remaining were accessed through the supracostal approach.

The differences between various postoperative parameters in between two study groups are represented in Table 2. The stone clearance rate was found in 46 (92%) patients in Group A and 44 (88%) in Group B. The overall post-operative complications, mean operative time, VAS at 12 and 24 hours respectively, requirement of NSAIDS and Opioids and mean hospital stay were all significantly higher in Group B (Table 2).

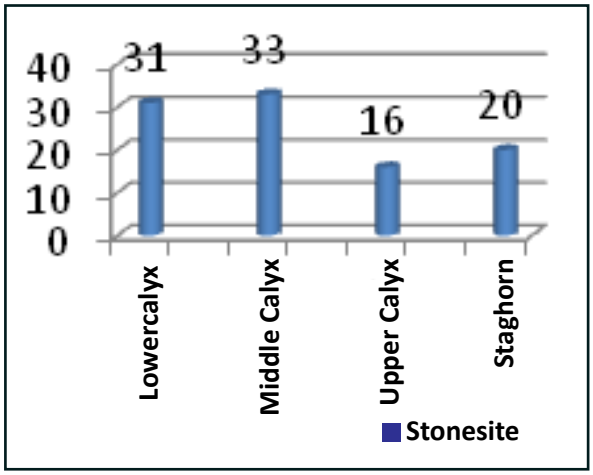

Figure 2: *Location of stone in the kidney in our study population*

DISCUSSION

Renal stone disease is one of the most common urological problems with a burden on the community increasing costs of medical care, lost income, and the social cost of lost opportunity.[14] Surgical management is more effective in the treatment of stone disease. Surgical management as previously explained includes both open and endourological procedures. However, PCNL is now the mainstay of treatment for patients with renal calculi due to its lesser cost, shorter operative time, the minimal requirement for blood transfusion and analgesics, and ability of the patients to regain their routine daily life activities.[15]

In our study, the stone clearance in tubeless PCNL was higher (46, 92 %) than in standard PCNL (44, 88%) although there was no statistically significant difference (p=0.51). Samad et al. also reported no significant difference in stone clearance rate in between tubeless and standard PCNL.[16] However in a study conducted by Gupta et al. the stone clearance rate was seen higher in tubeless PCNL.[17]

In our study we found that bleeding was slightly higher (4 vs. 2 patients) in tubeless PCNL than in standard PCNL. However, significant bleeding requiring blood transfusion was lesser in the tubeless PCNL group (Table 2). Other complications like fever (4 vs. 10 patients), sepsis (0 vs. 1), and urine leakage (0 vs. 5) were observed in tubeless PCNL and standard PCNL respectively. Wound infection was not seen in either of the groups. However, the overall complication was significantly less in tubeless PCNL as compared to standard PCNL (p=0.03). Bhat et al. in a total of 75 patients showed that there was no significant difference between the complications like hemorrhage, postoperative pyrexia however the urinary leakage was significant (24 out of 25) in patients of the standard PCNL group.[18] Similarly in another randomized study by Agrawal et al. the incidence of urinary leakage from the nephrostomy site was significantly less for the tubeless group (0/101), compared with the standard PNL group (7/101).[15]

Studies conducted at different centers throughout the world showed a statistically insignificant difference in hemoglobin drop among the tubeless PCNL and standard PCNL which is similar to our findings. In a study of 101 patients, Yates et al. observed that the mean decrease in post-operative hemoglobin was 2.25 g/dl in PCNL with drain, compared to a 1.89 g/dl in drainless PCNL (P>0.05).[19] Nalbant et al. conducted a study in which they concluded that the

mean hemoglobin drop among drain and drainless PCNL was 3.74±1.9 g/dl and 2.6±1.6g/dl respectively.[20] Similarly, in a study done by Sebaey et al. the mean drop in post-operative hemoglobin was 0.82±0.3g/dl among PCNL with drain and 0.85±0.4 g/dl among drainless PCNL (p>0.05).[21] In our study the mean drop in post-operative hemoglobin in tubeless PCNL was 0.75 ± 0.26g/dl and in standard PCNL was 0.90 ± 0.47g/dl (p=0.44).

In a systematic and meta-analysis conducted by Yuan et al. regarding the efficacy and safety of tubeless percutaneous nephrolithotomy no statistically significant differences were found in postoperative blood transfusion between tubeless and standard PCNL.[4] Ni et al. in their meta-analysis also observed that no significant difference was observed in the postoperative blood transfusion.[22] In our series, 6 patients in tubeless PCNL and 14 patients with standard PCNL required blood transfusion post-operatively (p=0.26).

Table 2: Comparison of the two study groups in terms of various intra and postoperative parameters.

Post-Operative Parameters	Group A (Tubeless)	Group B (Standard)	p-value
Stone Clearance (%)	46 (92%)	44 (88%)	0.51
Post-Operative Complications (%)	8 (16%)	18 (36%)	0.03
Post-Operative Hemoglobin drop (Mean±SD)	0.75±0.26	0.90±0.47	0.44
Post-Operative Blood Transfusion (%)	6 (12%)	14 (28%)	0.26
Operation time (Mean±SD)	47.10±5.67	49.36±5.62	0.04
VAS at 12 hrs Post-operative (Mean±SD)	3.72±1.48	6.38±1.52	0.02
VAS at 24 hrs Post-operative (Mean±SD)	1.90±0.76	3.62±1.24	0.02
Post-operative NSAIDS requirement in mg (Mean±SD)	196.20±27.24	225.80±25.07	0.01
Post-operative Opioids requirement (Mean±SD)	142.31±34.44	172.50±40.75	0.02
Hospital Stay (Mean±SD)	3.54±0.91	4.56±0.91	<0.01

In our study of 100 patients, the mean operating time in minutes in tubeless PCNL was 47.10 ± 5.67mins and in the standard PCNL was 49.36 ± 5.62mins (p = 0.04). In a study by Desai et al. mean operating room time was 44.5±13.2 mins vs 45±13.7 mins in standard and tubeless PCNL groups respectively (p=0.47).[23] Similarly in another comparative study the operating time in the standard PCNL was 96.3 min and in the tubeless patient was 90.7 mins (p = 0.45).[24] Falahatkar et al. also observed that the average operative time was shorter in the tubeless group than in the standard group (93.76 v 109.98 minutes, respectively (p = 0.03).[25]

In our study, 13 patients (25%) in the tubeless PCNL group (Group A) required post-operatively opioids (Tramadol) with a mean of 142.31±34.44 mg, and 39 patients in the standard PCNL group (Group B) required post-operatively Tramadol with a mean of 172.50±40.75mg (p=0.02). The mean post-operative NSAIDS (Ketorolac) requirement in Group A was 196.20 ± 27.24 mg as compared to 225.80 ± 25.07 mg in Group B (P=0.010). Agrawal et al. observed that the mean analgesia requirement for standard PCNL (Meperidine 126.5 ± 33.3 mg) was significantly more compared with tubeless PCNL (Meperidine 81.7 ± 24.5 mg) (P < 0.01).[19] Similarly in another study conducted by Gupta et al. the

analgesic requirement (68 mg vs. 210.5 mg of Pethidine) was also significantly less in the tubeless group.[17] In a prospective randomized comparison conducted by Tefekli et al. the mean postoperative analgesic requirement was significantly ($p< 0.01$) higher in standard PCNL.[26]

The mean duration of hospital stay in our study for tubeless PCNL was 3.54 ± 0.91 and standard PCNL was 4.56 ± 0.91 days ($p<0.001$). Different studies show the duration of the hospital is less in tubeless PCNL as compared to standard PCNL.[27,28]

As the pain is less as observed in our study and various literature in tubeless groups and also because there is no drain the patients are discharged earlier in the tubeless PCNL group. Thus the duration of hospital stay is significantly shorter in the tubeless PCNL group in comparison to the standard ones.

The major limitation of this study is its retrospective nature. Similarly, multiple surgeons were involved with variations in their operative skills and experience which might have affected the surgical outcome. The stone clearance rate was assessed by X-ray KUB rather than CT KUB which might have missed smaller fragments and thus might have been underreported. In our study as the data were retrospective and non-uniformly recorded, we did not include the co-morbid conditions of the patients which might have been a bias in-hospital stay and pain perception. A well-designed prospective and preferably metacentric study of such nature avoiding all the limitations mentioned above is preferred in the future.

CONCLUSION

Tubeless PCNL is an effective and safe procedure as compared to standard ones, in terms of lower postoperative complication, shorter operative time, less analgesic requirement, and shorter hospital stay, with comparable stone clearance.

CONFLICT OF INTEREST

None

SOURCES OF FUNDING

None

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