

Original Research Article

Safety and efficacy of tubeless mini percutaneous nephrolithotomy: A single-centre study

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Abstract

Introduction: Percutaneous nephrolithotomy (PCNL) is considered the 'gold standard' treatment for managing simple and complex renal stones, with a success rate of >90%. Many modifications and refinements of the standard PCNL have been developed to decrease morbidity and hospital stay; such as the use of a smaller working sheath and nephroscope (mini-PCNL), omitting the use of a nephrostomy tube (tubeless PCNL), sealing of the nephrostomy tract with haemostatic materials, and PCNL under regional anesthesia. **Aim :** To assess the and safety and effectiveness of tubeless mini percutaneous nephrolithotomy (PCNL). **Material and method:** In this retrospective observational study, patients with renal or upper ureteric calculi, who underwent tubeless mini PCNL between January 2013 and December 2020, were included. Intraoperative and post-operative events were analyzed. Written consent was obtained from the patients to participate in the study and to publish their data. **Results:** 900 patients were analyzed. The mean age was 37.92 years. 404 patients were females and 496 were males. Stones was in 52% in Left side 48 % in Right side. Renal pelvis was the commonest site of stone location. The mean operative time was 54.5 minutes. The mean hemoglobin concentration drop was 0.8 g/dl. The blood transfusion rate was 1.6%. Stone free rate was 95.33%. The mean length of hospital stay was 48 hours. **Conclusions:** Tubeless mini PCNL is an effective treatment with good clearance rate and acceptable morbidity in experienced hands.

Key Words: Percutaneous, nephrolithotomy, tubeless, renal stone

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Introduction

The prevalence of renal stone disease is up to 15% depends on age, sex, race and geographic location .It has very high recurrence rate of approximately 50%[1].

Renal stone disease has a wide socio-cultural as well as geographical variation. Renal stone disease highly prevalent in "stone belt" region of Saurashtra and Kutch in Gujarat of India .It is common in developed countries[2].

Renal stone disease has many modalities of treatments percutaneous nephrolithotomy (PCNL), retrograde intrarenal surgery (RIRS) and extracorporeal shock wave lithotripsy (ESWL). Miniaturization of instruments leads to decrease blood loss, decrease postoperative pain and less potential renal damage, a modification of the technique of standard PCNL has been developed.

Usually term mini PCNL is used for access sheath 20 Fr or below 20 Fr but it clearly lack standard definition .In some literature says it ranges from 11–20 Fr and another says 14–20 Fr[3,4].

Placement of nephrostomy tube at the end of Standard PCNL helps in urinary drainage adequately, haemostatic tamponade of the access tract and preserve renal access for a possible second-look PCNL[5,6]. Many reports have confirmed the safety and efficacy of tubeless PCNL and demonstrated the benefits of a lower analgesic requirement and earlier hospital discharge with no increase in morbidity.

In our study we have demonstrated safety and outcomes of tubeless mini PCNL in experienced hands.

Material and Methods

This study is a retrospective observational study in single institution by single surgeon between January 2013 to December 2020. The target population were the patients who underwent tubeless mini PCNL . The sample size is 900 in our study.

Inclusion Criteria include that all patients with renal calculi up to 2.0 cm or upper ureteric calculi, negative urine culture ,normal coagulation profile .

Exclusion Criteria were patients who were found to have evidence of active infection in urine, altered renal anatomy such as pelvic kidney, co-morbidities that preclude the surgery (coagulation abnormalities or cardiac, respiratory and other co-morbidities),stag horn calculus , more than 2.0 cm size stones .

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All the patients who underwent tubeless mini-percutaneous nephrolithotomy (mini PCNL) in the specified time period were included as per the inclusion & exclusion criteria, after explaining about the study and getting written, informed consent from the patient for participating in the study and publishing the data. The procedures adhered to the ethical guidelines of Declaration of Helsinki and its amendments.

Pre-operative Evaluation included detailed medical history, physical examination and hematological investigations. Patients with positive urine cultures were given intravenous antibiotics pre-operatively for 5 days. Intravenous Urogram (IVU) or computerized tomography (CT) to assess stone size, site, and anatomy of the pelvicalyceal system was done to plan optimal access to the renal calculi. The size of the stone was measured by analyzing the stones' longest diameter or in cases of multiple calculi by measuring the sum of each stones' diameter. All the patients were operated under spinal anesthesia in prone position. The mini-PCNL procedure was performed under spinal anesthesia. It began with the placement of an open-ended ureteric catheter by cystoscopy with the patient in the lithotomy position. After the catheter was secured to a Foley catheter, the patient was placed in a prone position. Percutaneous access was obtained by the placement of an 18-gauge access needle into the intended fluoroscopic guidance. Mini-PCN sheath and a 12Fr nephroscope were used. Stone fragmentation was done using pneumatic lithoclast or Holmium laser. Irrigation, flushing or grasper was used to extract small stones. Stone clearance was confirmed by endoscopy and fluoroscopy. Double J (DJ stent) or ureteric catheter was placed post surgery. Time from starting of cystoscopy to withdrawal of Amplatz sheath was taken as operative time. Intra-operative complications were recorded.

Post-operatively patients were observed for complications such as hematuria, sepsis, pain based on Visual Analog Score(VAS), signs of other complications and vitals were monitored. Stone free was defined as complete removal of all stones (including clinically insignificant non target stones) as evaluated by a postoperative KUB film performed after the procedure. A body temperature above 38.5°C after the operation was defined as postoperative fever. Sepsis was defined as patients with systemic inflammatory response syndrome with suspected infection. Patient discharged on postoperative day 2 after catheter removal in morning.

Results

In the present study, 900 tubeless Mini PCNL patients were studied and observed. The various preoperative, intra-operative and postoperative parameters were studied.

A. Preoperative parameters

1. Age, Sex distribution and laterality

900 cases with age range from 11 to 68 years. Mean age was 37.92 years. In the study, there were 404 females and 496 males. 52% patients had left side stone and 48% had right side stone

2. Stone Parameters (Hardness and Location):Hardness

In this study we exclude the soft stone with HU<1000 unit. The stone operated in the surgery were between 1000HU and 2500 HU with most of stone in the range of 1000-1500

Table 1: Hounsfield unit wise distribution

Hounsfield Unit	No of Patients
1000-1500	639 (71%)
1500-2000	234 (26%)
2000-2500	27 (3%)
Total	900 (100%)

3. Location

In study group, out of 900 patients ,stone in renal pelvis was in 279 , renal pelvis with lower calyx 209 , in lower calyx 178, 44 patients had stone location in middle calyx, and 14 patients in the superior calyx ,129 Patients having upper ureteric stones ,more than one type of stones are present in remaining cases

B. Operative parameters

i) Operating Time and Number of tracts used

In study the mean operative time was 54.5 minutes (25-120 min). 3 tracts used in 27 (3%) patients, 2 tracts 105 (15%) patients and rest 768 (82%) cases single tract was used. 3 tract used in 9 (3%) patients , 2 tract 45 (15%) patients and rest 246 (82%) cases single tract was used .Harpooning of stone was done in many cases to avoid number of tracts.

ii) Supracostal/subcostal punctures

Subcostal puncture in 624 (69.33%) patients and supracostal in 276 (30.66%) patients were done

iii) Mean Hemoglobin drop

Average postoperatively change in Hb was 0.8 g/dl which was statically significant but not clinically significant

Table 2:Preoperative and postoperative hemoglobin

	Pre operative	Post operative	
Hb (g/dL)	12.27 ± 1.42	11.46 ± 1.52	P < 0.05

iv.) Complications and their management

Table3: Complications

Complications	
Post operative Fever	25 (2.77%)
• Sepsis	3 (0.03)
Haematuria	17 (1.88%)
Pleural injury	3(0.33%)
Colonic injury	3(0.33%)

In the study group, 25 patients had postoperative fever for which they were admitted and antibiotics given according to urine culture/sensitivity and 3 patient underwent sepsis which was managed by higher antibiotics ,17 patients having hematuria , 14 patients managed hematuria subsides gradually ,3 patients required angiembolisation in refractory cases , all patients detected in postoperative period ,all 3 patients in pleural injury cases managed by intercostal drainage (ICD) insertion
3 patients of colonic injury ,in 2 patients injury detected postoperative period , in 1 patient detected in intra operatively all are managed by conservative approach .

4. Stone free rates

In Mini PCNL group had 858 Patients (95.33 %) had complete stone clearance at immediate post operative , 42 cases have small fragment remaining in which due to bleeding and because of fragment migrate to inaccessible location

Out of 42 patients 24 patients with stone size up to 6 mm and managed with lithotripsy.18 patients needed RePCNL

Table 4:Stone free rates

		Patients
Immediate	Stone free	858 (95.33%)
	Residual stone	42 (4.66%)

5. Blood transfusion

In the study 15 (1.6 %) patients out of 900 total patients required blood transfusion.

6. Hospitalization time

Mean hospitalization time in our study was 48 hours

Discussion

PCNL is most common procedure for upper renal tract stone . Standard PCNL is placement of a nephrostomy tube after completion of procedure. Mini PCNL is PCNL performed through a tract of less than 22 F. It was first developed in the early 1990s. Webb et al. Were

the first to report mini PCNL in paediatric patients underwent PCNL using a 16-F sheath and 11-F Storz paediatric 'STING' cystoscope. However term 'mini-perc' is attributed to Jackman et al. who performed miniPCNL in adults through a 13-F URS sheath. Despite miniPCNL being associated with reduced blood loss and excellent stone clearance rates, miniPCNL fell out of favour. This may be because most miniPCNLs were performed with instruments not designed for the procedure[7].

PCNL Complications include bleeding, infectious complications, rupture of the PCS, urinary system leakage, thoracic complications, other organ injury (colon, bowel, spleen, liver), and postoperative pain. Mini PCNL is equally effective and less complications compared to standard PCNL. Stone free rate does not significantly differ between these two procedures. Postoperative hospitalization, Bleeding, blood transfusion are slightly less in Mini PCNL[8,9].

Zeng et al. studied the largest series of mini-PCNL outcomes of 13,984 cases. large renal stone is easily clear through one tract. Most common punctured calyx is middle and single tract is used[10]. Mini PCNL having less bleeding than standard PCNL included blood transfusion in 7% of cases and an average hemoglobin drop of 2.3 g/dL. In our study, these bleeding complications were decreased as blood transfusion was needed in 1.6%, and the average hemoglobin drop was 0.8 g/dL[11]. Above facts were supported by Ruhayel et al. systematic review in 2017 that analyzed mini-PCNL studies and found that smaller tracts associated with lesser blood loss or less blood transfusion[12]. advantage of mini PCNL to avoid nephrostomy tube insertion. A meta-analysis comparing tubeless versus standard PCNL procedures reported that tubeless procedures led to shorter hospital stay, less postoperative pain, and possibly quicker recovery[13].

Bellman et al.[5] in 1997 considered first tubeless PCNL. Desai et al[14] first compared tubeless PCNL, small bore tube and large bore nephrostomy tube it is a prospective randomized study including 30 patients in 2004, and their results supported that tubeless PCNL is associated with less postoperative pain and urinary leakage and shorter hospital stay. A randomized comparison of tubeless and standard PCNL by Agrawal et al[15] demonstrated that tubeless PCNL decrease postoperative urinary leakage and local pain and minimized hospital stay without increasing morbidity. With the growth of experiences, the application of tubeless PCNL in more complicated stone disease has been reported. In 2005, tubeless PCNL was safe and effective even in patients with a solitary kidney, or with multiple renal access tracts. Shah et al[16] advocated that tubeless PCNL was safe and effective even in patients with a solitary kidney, or with multiple renal access tracts. In our study we combine with both mini and tubeless modification of PCNL.

Conclusion

Our study demonstrated that adequate hemostasis, minimal complications rate and good stone clearance rate, tubeless mini PCNL modification is a safe and effective modality for PCNL.

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