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Original Research Article

Comparative Study of Standard PCNL versus Mini PCNL for the Treatment of Renal Stone of Size 10-30 Mm

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Abstract

The aim of the present study was to evaluate and compare the mini PCNL and standard PCNL for the treatment of renal stone of size 10-30 mm.

Material & methods: A randomized prospective study of the patients presented to the department of urology, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India with calyceal or pelvic kidney stone (10–30 mm) in the period of 2 years. All procedures performed in this study involved human participants with written informed consent in accordance with the ethical standards of the institutional research committee.

Results: The mean age of patients was 36.4 ± 9.4 and 34.6 ± 6.5 years in sPCNL and mPCNL respectively. The patient characteristics and stone characteristics in both groups were comparable with mean stone size of 21.9 ± 2.5 mm in sPCNL and 20.4 ± 3.7 mm in mPCNL group. There was no significant difference in total post-operative time, overall stone free rate (96.4 ± 3.7% vs 95.5 ± 4.5%) and postoperative complications and total hospital stay in both groups. Post-operative drain site leak was higher in sPCNL group. The drop in post-operative haemoglobin (3.2 ± 0.4 gm% vs 1.5± 0.8 gm%) was significantly less in mPCNL than sPCNL ($p < 0.05$). In subgroup analysis the total stone free rate was higher in mPCNL for multiple and calyceal stones. Significantly greater number of patient underwent tubeless PCNL in mini PCNL group than standard PCNL.

Conclusion: Mini PCNL is as effective as standard PCNL with fewer bleeding complications in management of medium sized nephrolithiasis.

Keywords: Mini Percutaneous Nephrolithotomy; Nephrolithiasis; Percutaneous Nephrolithotomy

Introduction

Urolithiasis means a calculus anywhere in the urinary tract, whereas nephrolithiasis refers to a calculus in kidney. Globally, the incidence and prevalence of kidney stones are increasing. [1,2] The renal stone has upgrading role in the morbidity and quality of life of patients and its prevalence is about 10%. [3] Also, the recurrence of renal stones may be up to 50%. [4] Though kidney stones initially remain asymptomatic, the treatment is commonly performed to avoid future problems linked

with the disease. The impact of recent technology on the kidney stone management has a great role, especially the advancement of minimally invasive technique such as extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL) and MINI percutaneous nephrolithotomy (mPCNL).

The shortcomings of ESWL are a lower stone free rate (SFR) and the need to repeat sessions, especially for stones located in the lower polar region or harder stones. [5] PCNL is currently considered the first line of treatment for larger renal stones (> 2 cm). [6,7] Nevertheless, considering the complications associated with PCNL, which may include bleeding, pain, and urine leakage [8,9], alternative treatment methods e.g., minimally invasive procedures (MPCNL and SPCNL) have been investigated [10,11]. MPCNL has a lower risk of surgical morbidities and requires a shorter hospital stay; nevertheless, it has a similar stone free rate when compared with conventional PCNL. [9,12] The international guidelines recommend Percutaneous Nephrolithotomy (PCNL) as first line of treatment for renal stones more than 20 mm size. [7] The procedure PCNL has evolved since 1976 and has undergone many modifications. One of them is miniaturising the access sheath. Standard PCNL (sPCNL) is done with sheath size of 24-30 French (Fr) whereas the Mini PCNL/Miniperc is done with sheath size 14 - 20 Fr. Mini PCNL (mPCNL) is safer and had equal efficacy rate for management of renal stones. [13]

Retrograde intrarenal surgery (RIRS) was considered a new era in the minimally invasive treatment of renal stones and upper urinary tract tumors. [14,15] The beginning of use of RIRS was in the treatment of small size renal stones. [16] Also, it gained its attraction in the management of large stone, the surgeons initially used RIRS in medium then larger stones, but the disadvantage is the long operative time. [17,18] The morbidity and complications of RIRS were considered few, and it showed high success rate which allow several centers to apply it in the treatment of large renal stone instead of ESWL. [19]

Thus, the aim of study was to evaluate and compare the mini PCNL and standard PCNL for the treatment of renal stone of size 10-30 mm.

Materials & Methods

A randomized prospective study of the patients presented to the department of urology, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India with calyceal or pelvic kidney stone (10–30 mm) in the period of 2 years. All procedures performed in this study involved human participants with written informed consent in accordance with the ethical standards of the institutional research committee. The hospital records of patients who underwent PCNL was reviewed in the study. The records showed 100 patients underwent standard PCNL (sPCNL) and 75 patients underwent mini PCNL (mPCNL).

Patient assessment required through full medical history, general, local examination, laboratory investigation (urinalysis, complete blood count, kidney function test, liver function test, prothrombin time, concentration and random blood glucose level), and radiological investigation in the form of computed tomography (CT). CT scan was used to calculate the size of the stone in its longest diameter.

All patients were informed about the advantages, disadvantages, and possible complications of both Mini PCNL and standard PCNL. Patients with history of kidney stones surgery or congenital anomalies were excluded from the study. Patients were randomized using computer-based program into 2 groups; group A (Mini PCNL), and group B (SPCNL) with 50 patients in each group. Complete blood count, serum biochemistry, CT for the stone clearance is carried out to all patients at the frst postoperative day. The data were collected on stone details and patient

characteristics. The post procedural data collected were total operative time, drop in haemoglobin, infectious and bleeding complications, post operative analgesic use, hospital stay, urine leak and stone free rate. The success of the technique was considered when status is stone-free or clinically insignificant residual fragments<4 mm on CT.

Statistical Analysis

The data collected were analysed and compared between standard min-PCNL and tubeless PCNL. Data were compiled in MedcalR and statistical analysis done. Student t test and Chi square test were done to compare summary measures of stone details and patient characteristics. P value of <0.05 was considered statistically significant.

Results

Table 1: Patient and stone characteristics

	sPCNL	mPCNL	p value
N	100	75	
Mean Age (years)	36.4 ±9.4	34.6 ±6.5	0.444
Mean Stone Size	21.9 ±2.5	20.4 ±3.7	0.540
(mm)			
M:F	60:40	50:25	
Laterality	Right- 45 left- 55	Right- 35 left- 40	
Stone location (n)			0.976
Renal pelvis	30	25	
Calyceal	70	50	
Stone number (n)			0.876
Single	46	32	
Multiple	50	40	
Recurrent	4	3	
Disease			

The mean age of patients was 36.4 ± 9.4 and 34.6 ± 6.5 years in sPCNL and mPCNL respectively. The patient characteristics and stone characteristics in both groups were comparable with mean stone size of 21.9 ± 2.5 mm in sPCNL and 20.4 ± 3.7 mm in mPCNL group.

Table 2: Comparison of Postoperative outcomes

	sPCNL	mPCNL	p value
No of puncture	100	75	
Teflon serial	62	50	
Coaxial metallic	38	25	
Operative time(minute)	56.4 ± 17.0	61± 20.0	0.589
Post op Hb drop	3.2 ± 0.4	1.5± 0.8	0.01
(Gm%)			
Post op leakage	6	2	0.04
Tubeless PCNL	24	34	0.01
Hospital stay	3.3 ± 1.5	2.4 ± 1.6	0.346
SFR (%) overall			
single	96.4 ± 3.7	95.5 ± 4.5	0.540
multiple	95± 2.8	97.3 ± 4.2	

calyceal	94± 2.4	97.6 ± 3.6	
Auxillary procedure (n)	4	7	0.783
Complications	22	17	0.730
Grade I	16	12	
Grade II	2	3	
Grade III	4	2	

There was no significant difference in total post-operative time, overall stone free rate (96.4 ± 3.7% vs 95.5 ± 4.5%) and postoperative complications and total hospital stay in both groups. Post-operative drain site leak was higher in sPCNL group. The drop in post-operative haemoglobin (3.2 ± 0.4 gm% vs 1.5± 0.8 gm%) was significantly less in mPCNL than sPCNL ($p < 0.05$). In subgroup analysis the total stone free rate was higher in mPCNL for multiple and calyceal stones. Significantly greater number of patient underwent tubeless PCNL in mini PCNL group than standard PCNL.

Discussion

There is paradigm shift in the management of the nephrolithiasis with the invention of the minimally invasive endourological procedure. The international guidelines recommend percutaneous nephrolithotomy (PCNL) as the first line of treatment for renal stones more than 20mm in size. Whereas for stones of size 10 to 20mm the treatment options can be shock wave lithotripsy (SWL), PCNL, or retrograde intrarenal surgery (RIRS). [3,20] The procedure PCNL has evolved since 1976 and has undergone many modifications and refinements in the techniques and the instruments to achieve maximum stone clearance with minimal complications. One of them is miniaturizing the access sheath. Standard PCNL is done with sheath size of 24to 30F,whereas the mini-PCNL/mini perc is done with sheath size 14 to 20 F.5 A meta-analysis6 published in 2015 mentioned that the size of PCNL access sheath matters. Mini-PCNL is safer and had equal efficacy rate for management of renal stones. [21,22] In recent years, many studies have focused on investigating the effectiveness and safety of MPCNL versus RIRS in the management of upper urinary stones and reported different results. The meta-analysis performed by Jiang et al [23] showed that MPCNL led to a higher SFR compared with RIRS.

The mean age of patients was 36.4 ± 9.4 and 34.6 ± 6.5 years in sPCNL and mPCNL respectively. The patient characteristics and stone characteristics in both groups were comparable with mean stone size of 21.9 ± 2.5 mm in sPCNL and 20.4 ± 3.7 mm in mPCNL group. Li et al. published reports with comparable stone free rate between mini and standard PCNL with significantly lesser rate of blood transfusion in mini PCNL group (1.1 % vs. 6.9%). [24] Mini PCNL is associated with higher number of tubeless PCNL, lesser hospital stay (3.2 vs. 4.8 days, $p < 0.05$) and reduced drop in haemoglobin (0.8 ± 0.9 vs. 1.3 ± 0.4 gm%, $P = 0.01$). [25]

There was no significant difference in total post-operative time, overall stone free rate (96.4 ± 3.7% vs 95.5 ± 4.5%) and postoperative complications and total hospital stay in both groups. Post-operative drain site leak was higher in sPCNL group. The drop in post-operative haemoglobin (3.2 ± 0.4 gm% vs 1.5± 0.8 gm%) was significantly less in mPCNL than sPCNL ($p < 0.05$). In subgroup analysis the total stone free rate was higher in mPCNL for multiple and calyceal stones. Significantly greater number of patient underwent tubeless PCNL in mini PCNL group than standard PCNL. Complex stone burden with stone size of 10 to 35 mm can be effectively managed with minimum blood loss in Mini-PCNL technique. Elsheemy et al. [27]

randomised stones (irrespective of size and location into sPCNL or mPCNL (n = 151 vs. 378). He found that mini-PCNL has longer operative times, shorter hospital stay and higher rate of tubeless PCNL with lesser complication rate (7.9% vs 20.5%). Complex stone burden had lesser overall SFR during mPCNL (86.8 % vs. 90.7 % in first session) and required multiple tracts or multiple sessions of PCNL. [26, 27]

Zeng G. et al. [28] claimed that the overall complication rate after mini PCNL (n = 10,000) was 20.1%, out of which 7.4% are Clavien grade I, 8.8% was grade II and 3.5% was grade III complications, but no grade IV or V complications (Zeng). SFR was higher with simple with low burden nephrolithiasis. Multiple calyceal stones were more efficiently managed with mPCNL. [29]

Conclusion

Mini PCNL is as effective as standard PCNL with less blood loss in small and medium size stone (10 to 30 mm). Stone burden is the key factor for optimal stone free rate. Higher number of tubeless procedure can be performed with lesser morbidity. Puncture technique and energy used for lithotripsy can act as significant confounders in outcome.

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