AMBULATORY MINI PERCUTANEOUS NEPHROLITHOTOMY (MINI-PCNL): FEASIBILITY AND OUTCOMES IN 1000 CASES IN PAKISTAN

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ABSTRACT

Objective: To review the outcomes of a consecutive cohort of 1000 patients with renal stones managed with mini-percutaneous nephrolithotomy at our institute.
Study Design: Prospective observational study.
Place and Duration of Study: Armed Forces Institute of Urology Rawalpindi, Pakistan, from Jan 2016 to Dec 2018.
Methodology: Surgery was carried out under general anesthesia in prone position. Access was made by single step dilatation by 14-17 French sheath, pneumatic lithoclast was used for stone disintegration and fragments removed. Foley and ureteric catheters were removed following morning of surgery after confirming stone clearance on plain X-Ray kidney ureter and bladder.
Results: Mean stone size was 3.1 ± 2.1cm (2-6). Upper pole access was utilized in 398 (39.8%) while lower pole in 587 (58.7%) cases. Mean operative time was 67 ± 15.4 minutes (45-120) while the mean hospital stay was 22 ± 13.2 hours (20-120). A complete clearance rate of 93.3% was achieved as assessed by plain X-Ray kidney ureter & bladder. Residual stones were treated with either shock wave lithotripsy or redo mini-Percutaneous Nephrolithotomy. 910 (91%) of patients were discharged within 24 hours of surgery.
Conclusion: Mini Percutaneous nephrolithotomy was found as a safe and feasible alternative contemporary established technique for treatment of nephrolithiasis which can be offered as a day case surgery except for complete staghorn calculi.

Keywords: Ambulatory care facility, Hematuria, Kidney stones, Percutaneous nephrolithotomy, Renal calculi, Therapeutic chemoembolization, Thoracotomy.

INTRODUCTION

Renal calculus disease has afflicted mankind since antiquity[1]. Pakistan falls in the stone belt and thus accounts for a high prevalence of stone disease and accounts for major bulk of work in urology clinics. A recurrence rate of 35-50% has been documented in the literatur[2]. Various treatment options available range from Shock wave lithotripsy (SWL), percutaneous nephrolithotomy (PCNL), retrograde intrarenal surgery (RIRS) to open surgery[3]. Choice of treatment depends on many factors among which are stone burden, location of stone in the renal tract, anatomy of the renal tract and patient factors including patient's preference[3]. According to the European association of Urology (EAU) guidelines, percutaneous nephrolithotomy is indicated for renal stones greater than 20 mm and lower pole stones 10-20 mm when there are unfavorable factors for SWL[4]. It is considered as the treatment of choice for large impacted proximal ureteral stones, staghorn calculi and lower calyceal stones[5]. According to Clinical Research Office of the Endourological Society (CROES) data, PCNL is associated with complications including significant bleeding (7.8%), renal pelvic perforation (3.4%), hydrothorax (1.8%), blood transfusion (5.7%) and fever of >38.5°C (10.5%) of the patients[6]. Stone free rate was documented as 75.7%[7].

In order to minimize the risk of complications of the standard PCNL, advances have

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been made to decrease the size of endoscope and sheath[8]. This led to the development of minimally invasive Percutaneous Nephrolithomy (mini-PCNL)[9]. We manage patients of all age groups including children. Urolithiasis is a disease of young adults and use of minimally invasive techniques to treat patients reduces the short-term morbidity, limits the damage to the renal parenchyma and shortens the period off work.

Standard PCNL has been regularly performed in Pakistan but mini PCNL is relatively newer technique and very less is published regarding total stay in hospital and its complications, In this study we evaluated the efficacy of mini-PCNL in terms of perioperative complications, it's feasibility as an ambulatory procedure in terms of stone free rate, defined as any residual fragments <3mm as determined by X-Ray KUB and in doubtful cases by non-contrast Computed Tomography Kidney Ureter Bladder (CT - KUB).

METHODOLOGY

This prospective observational study included patients who were operated in Armed Forces Institute of Urology, Rawalpindi, Pakistan from 1st January 2016 to 31st December 2018. All patients presenting with renal calculi and suitable for the mini-PCNL (as per EUA guidelines and our institute policy) were included in this prospective study after approval from the Institutional review board & Ethics Committee (IRB-AFIU-105-217-2015). Sample size was calculated by using Open Epi, Version 3, open source calculator – SSCC[10]. All patients were selected from the outpatient department of AFIU. Patients with congenital anomalies, coagulopathy and age <18 months were excluded. Pre-operative investigations included a CT-KUB, full blood count, coagulation screen, renal function tests and urine culture/sensitivity. The procedures were performed by one of the four consultant urologists trained in the technique and who were well over their learning curves in the standard and mini PCNL. All procedures were performed under general anesthesia after obtaining informed written consent. First dose of intravenous antibiotic (Amikacin 15mg/kg body weight) was given at time of induction and two further doses post-operatively. After cystoscopy, 4 or 5 French (Fr) ureteric catheters were inserted under fluoroscopic guidance and secured to allow injection of contrast (Urograffin) to opacify and distend the collecting system. Patient was then placed in the prone position. The procedure was performed using Karl Storz Nagele minimally invasive PCNL (MIP) system (Karl Storz Germany). An 18-gauge Chiba needle was used to gain access to the collecting system via suitable calyx and 0.032 inch guide wire was passed through it and needle removed. Tract was dilated over the guide wire using single step metallic dilator after fascial dilatation. Then a 14 or 17 Fr metallic sheath was used through which 12 Fr rigid nephroscope was introduced. Pneumatic stone fragmentation was done using Swiss Lithoclast Master. Fragments were removed by the "vacuum effect". Adherent fragments were extracted using graspers. Foley and ureteric catheters were removed on the next morning following plain X-Ray KUB. Stable patients were discharged on oral antibiotics as per hospital policy after getting informed written consent.

All complications were recorded and graded using modified Clavien Dindo's Classification. Mean ± SD were calculated for continuous variables. Frequency and percentage were calculated for qualitative variables. The data was analyzed using the Statistical Package for the Social Sciences (SPSS) version-23.

RESULTS

A total of 1000 patients, 634 (63.4%) males and 466 (46.6%) females, with a mean age of 43.4 ± SD 21.2 years (range 3 to 75 years) under went mini-PCNL. Mean stone size was 3.1 ± 2.1 cm (2-6 cms). Upper pole access was utilized in 398 (39.8%) while lower pole in 587 (58.7%) cases, depending upon the location and stone burden. Sequential upper and lower pole access was established in 15 (1.5%) of the cases. Mean operative time was 67 ± SD 15.4 minutes (45-90 min) while the mean hospital stay was 22 ± 13.2

hours (20-120 hours). A clearance rate of 93.3% was achieved based on assessment by KUB x-ray.

Table-I: Distribution and mean hospital stay of the patients according to stone type and location.

Type/location	Number (%)	Mean of hospital stay of the patients with following stones
Partial staghorn stones	301 (30.1)	22 ± 3.2
Complete staghorn stones	47 (4.7)	31 ± 6.2
Renal pelvis stones	511 (51.1)	21 ± 5.3
Lower pole stones	127 (12.7)	21 ± 4.8
Stones in horse-shoe kidney	10 (1.0)	21 ± 5.5

In those with residual stones (n=73), 55 (75.3%) underwent SWL, while 18 (25%) underwent redo mini- PCNL.

The stone distribution according to the stone burden and location with mean hospital stay according to the stone type (table-I).

Overall complication rate was 9.2% and described as per the modified Clavien Dindo system (table-II). Major complications included bleeding requiring blood transfusion 11 (1.1%), angioembolization 5 (0.5%), ureteric (Double J) stenting 18 (1.8%), chest tube insertion 6 (0.6%) and sepsis 4 (0.4%). Abdominal drain was placed

Table-II: Distribution of complications according to modified clavien system.

Grade	Description	Frequency (%)
Grade 1	Transient fever Transient elevation of creatinine	34 (3.4) 7 (0.7)
Grade 2	i. Blood transfusion ii. Pneumonia	11(1.1) 4 (0.4)
Grade 3	Angioembolization Chest tube insertion JJ stenting Abdominal drain placement Thoracotomy	5 (0.5) 6 (0.6) 18 (1.8) 4 (0.4) 2 (0.2)
Grade 4	Grade 4a Sepsis	 4 (0.4)
Grade 5		-

Table-III: Summary of results (n=1000).

Type	Patient %	Mean Hospital stay (hours)	Re-admis-sion %	Blood Trans-fusion %	Clea-rance %	Angioem boliza-tion %	Chest intuba-tion%	Sepsis %	DJ stenting %
Partial staghorn	30.1	22	1.2	0.2	91	0.1	0	0.1	0.6
Complete staghorn	4.7	31	2.0	0.7	87	0.2	0.6	0.3	0.8
Renal pelvic	51.5	21	0.8	0	97	0.1	0	0	0.3
Lower pole	12.7	21	1.0	0.1	98	0.1	0	0	0.1
Horse shoe kidney	1.0	21	0	0.1	100	0	0	0	0

Table-IV: Comparison of complications of mini- percutaneous nephrolithotomy according to various studies.

Studies	Total Cases (n)	Stone Size	Overall complications (%)	Clavien Dindo Classification Grade				
				Grade I (%)	Grade II (%)	Grade III (%)	Grade IV (%)	Grade V (%)
Knoll *et al*[17]	25	1.8 cm	28	24	4	0	0	0
Zeng *et al*[18]	12,482	4.56 cm	25.9	16.8	5	3.9	0.05	0.02
Hafez *et al*[19]	172	2.5 cm	23	12	5.8	5.2	0	0
Long *et al*[20]	163	1.84 cm	23.1	14.6	8.5	0	0	0
Pan *et al*[21]	59	2.2 cm	11.9	3.4	8.5	0	0	0
Present study	1000	3.1 cm	9.2	4.1	1.1	3.5	0.4	0

in 4 (0.4%) and chest tube insertion was done in 6 (0.6%) of the cases. 2 patients (0.2%) underwent thoracotomy because of persistent drainage from chest tube. There were no deaths in this series. The overall summary of the results is shown in table-III.

DISCUSSION

Since the first ever use of nephroscope by Rupel and Brown in 1941 to remove residual stone fragments after open surgery, minimally invasive technique to treat renal stones have become standard of care for stones larger than 2 cm. Overall complication rate for Standard percutaneous nephrolithotomy quoted in literature ranges from 20% in one series to 83% in another[11]. Complications like urinary extravasation, transfusion, fever, sepsis, bowel and pleural injury have been documented.

Helal *et al*[12] were the first to use Hickmann's catheter sheath to gain access and perform first mini PCNL in a 2-year-old female child. Jackmann *et al*[13] presented his experience of this "novel" technique in paediatric population with a stone free rate of 85% at three months. Ferakis *et al*[7] in his review concluded that mini PCNL is related to less blood loss and shorter hospital stay and recommended its use for treatment of larger stones in children as well as adults. Various authors have published their experience of mini-PCNL from the days of its infancy till present day when due to advancements in endourological equipment, it has become more efficacious and safe. Initial stone free rate documented in literature ranges from 78.6% to 96.6%[14,15].

Zeng *et al*[13] in his study of 12,482 patients showed mean operative time of 83 minutes with an initial stone free rate of 78.6% for a mean stone size of 4.56 cm. A stone free rate of 77.5 to 97.8% has been documented in the literature[16]. We observed a stone free rate of 93.3% in our series. Percentage of auxiliary procedures used to clear residual stones ranges from 3.4% to as high as 23.1%[15,16]. A total of 7.3% of patients underwent auxiliary procedure in our study. Mini-PCNL has shown a great improvement in terms of mean operative time and a range from 27.4 to 83 minutes[11,13] has been quoted. This depends upon many factors including stone burden. We observed a mean operative time of 67 minutes.

Comparison of complications post mini-PCNL is given in table-IV. While comparing this data one can find out that major number of complications fall in Clavien Grade I, which included transient rise in temperature and serum creatinine in the early post-operative period[17,18]. Though in our study we found a very low rate of overall complications but Clavien grade III complications were 3.5% which though compared with Hafez *et al*[19] who quoted it at 5.2%, is still high as compared to other studies.

Break down of these complications showed that majority of them 1.8% were those who had a stone fragment greater than 6 mm impacted in the ureter. This can be due to the fact that we were doing a tubeless procedure and we kept a low threshold for placing a DJ stent post operatively. Chest tube was placed for pneumothorax (if >25%) or hydrothorax under local anesthesia in 0.6%. One factor which explains this low complication rate is that we were already doing standard PCNL in our setup[20,21].

There has been a previous study carried out by Asghar *et al*[22] in the same institute over one-year period in 2014, in which prospective case analysis in regard to complications was carried out on the patients subjected to standard PCNL. To compare those complications with the current study, a significant fall in grade-1 complications by 4% and in grade-2 by 6% can be seen in mini-PCNL cohort. While grade-3 complications remained nearly the same. Grade-4 complications were also lower in mini-PCNL group by 2.5%. We however cannot comment about its statistical significance due to the difference in sample size of both cohorts.

Mini PCNL is relatively a new procedure in Pakistan. Despite thorough search through Google Scholar, Pakmedinet, PubMed and Medline, we could not find any published study from Pakistan.

CONCLUSION

Mini Percutaneous nephrolithotomy was found as a safe and feasible alternative contemporary established technique for treatment of nephrolithiasis which can be offered as a day case surgery except for complete staghorn calculi.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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