

Original Research Article

Safety and efficacy of mini-percutaneous nephrolithotomy in the treatment of large impacted proximal ureteral stones

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ABSTRACT

Background: To evaluate the efficacy and safety of Mini-Percutaneous Nephrolithotomy (PCNL) in the treatment of large (≥ 15 mm) impacted proximal ureteral stones.

Methods: This was a prospective observational study and was conducted in the Postgraduate Department of Surgery, Govt. Medical College, Srinagar. A total of 60 patients were included in this study.

Results: The mean age (in years) of patients was 38.5 ± 9.31 and range 22-58, the male female ratio was 40:20, the disease laterality (right: left) was 48:12, the mean stone size (in mms) was 17.6 ± 2.11 . All the patients were having hydronephrotic kidneys, however, all the renal units were functional. The mean operative time (in minutes) was 62 ± 9.62 . The overall success rate was 96.7% after one month of follow-up the stone free rate was 96.7% while as the stone free rate on discharge was 86.7%. The mean hospital stays (in days) was 2.8 ± 1.08 . The overall complication rate in this study was 15 patients (25%) which include post-operative fever in 5 patients (8.33%), prolonged hematuria in 4 patients (6.67%), residual stone/disease after 4weeks of follow-up was seen in 2 patients (3.33%) and in 4 patients (6.67%) thoracic complication was seen. However, no ureteral injury, hollow visceral or pelvic perforation was noted. The post-operative analgesic requirement was 100 ± 40.45 mgs of Inj. Tramadol. The need of auxiliary procedures was required in 3.3% of patients.

Conclusions: Mini-PCNL is both safe as well as an effective therapy for large impacted proximal ureteral stones with a higher success, stone clearance rate and with acceptable complications.

Keywords: Hydronephrotic, Mini-percutaneous nephrolithotomy, Proximal ureteral stone

INTRODUCTION

The management of large, impacted upper ureteric calculi remains challenging for urologists. Various treatment options include Extracorporeal Shock Wave Lithotripsy (ESWL), Ureteroscopic Lithotripsy (URSL), Percutaneous Nephro-lithotripsy (PCNL), laparoscopic and open ureterolithotomy. ESWL has poor overall success rate in the treatment of large stones with a significant possibility of residual fragments. Semi-rigid or flexible Ureteroscopic with Holmium: YAG laser

lithotripsy (URSL) has a stone-free rate of 89-100% in managing proximal ureteral calculi.¹⁻⁷ However, large and impacted proximal ureteral stones are difficult to approach. PCNL was introduced as an alternative treatment for large renal and proximal ureteric stones and achieved success in the 1980s.⁸ The modified version of PCNL using a miniature endoscope by way of a small access tract can be routinely performed to manage stones in the kidney and proximal ureter.⁹ PCNL has been widely accepted as the treatment of choice for renal stones since the 1980s and is shown to have a higher

success rate compared to other minimally invasive procedures thus became the gold standard treatment for complex and large renal stones. However, bleeding and fever are the common complications. Laparoscopic ureterolithotomy is associated with a shorter period of convalescence when compared to an open procedure but is associated with a higher learning curve.^{10,11} Open ureterolithotomy is indicated for failure of all minimally invasive modalities in presence of a concomitant open procedure and the presence of large impacted stone where patients don't consent for multiple procedures.¹²

So, to evaluate the efficacy and safety of mini-PCNL in impacted proximal ureteral calculi, author started this hospital-based study (2014-2018) to use mini-PCNL (14F semi-rigid nephroscopy via a 16-Fr percutaneous tract) for the treatment of large (≥ 15 mm) impacted proximal ureteral calculi (from PUJ to lower border of L4 vertebra).

METHODS

After obtaining the ethical clearance, this study was conducted in the Postgraduate Department of Surgery, Government Medical College, Srinagar (December 2014 to January 2018). The study comprised of 60 patients with large (>15 mm), impacted (diagnosed when there was failure to visualize the ureter distal to a stone with proximal hold up of contrast material as long as 3 hours of excretory urography or stone remaining at the same site in the ureter for more than 2 months or inability to pass guide-wire beyond the stone at initial attempts), upper ureteral (from PUJ to lower border of L4) stones.

Each patient/attendant(s) was fully explained the nature of procedure and the possible inherent complications associated with the procedure. Informed consent was taken from patients/attendants before procedure. The patients/attendants were explained for the possible need of tube thoracostomy and consent was taken pre-operatively for same.

The patients with stones located between the pelviureteric junction and the upper border of the 4th lumbar vertebra, upper ureteral stone ≥ 15 mm in largest diameter by plain film/ultrasound, with split glomerular filtration rate of the affected kidney ≥ 20 ml/min and patients with a stone diameter ≥ 12 mm with previous history of abdominal surgery or repeated sessions of ESWL treatment were included. Exclusion criteria were uncorrected coagulopathy, pyonephrosis, or glomerular filtration rate < 20 ml/min. Preoperatively, patients were evaluated by a urine routine test, urine culture and sensitivity test, plain radiography of kidneys, ureters and bladder (KUB), and intravenous urography. Ultrasonography or unenhanced helical computed tomography for the degree of hydronephrosis, computed tomography urography (CTU) and radionuclide imaging were also performed if necessary. Antibiotics were administered prophylactically to all patients with WBC-positive urine. Calculus

clearance was assessed on postoperative day 2 with a plain film of KUB. 'Stone-free' was defined as no residual stones or fragments ≤ 3 mm detected on KUB, as fragments ≤ 3 mm have a likelihood of passing spontaneously. The operative time was calculated from performing the puncture to placing of the nephrostomy, which was also called skin-to-skin time. The time from insertion of the ureteric catheter to the turn in the prone position was not included.

Operative technique of mini-Percutaneous Nephrolithotripsy (mini-PCNL):

Under general anaesthesia, patient was placed in dorsal lithotomy position. Cystoscopically, the retrograde ureteric catheterization (5F) was done over a guide-wire and position confirmed under fluoroscopy. This ureteric catheter was used to perform real-time fluoroscopic contrast and/or air-pyelography which helps in making the puncture accurately into the intended calyx. After confirming the position of ureteric catheter, the indwelling catheterization was done and both the ureteric catheter and ID catheter are tied and secured over postero-lateral aspect of opposite thigh. The patient was now positioned in "Swimmer's" prone position and the C-arm adjusted and fixed. In prone position, the puncture was made by using a 16cm long (18G) puncture needle by Bull's eye technique. This was also called as 'eye of the needle' or 'end-on technique'. In patients where ureteric catheter could not be negotiated, ultrasonography (USG) -guided puncture was made. The position of the needle was confirmed, in the pelvicalyceal system by observing free flow of normal saline through the puncture needle injected from below. After the successful puncture was made, a 0.035" Turemo guide-wire was introduced into the pelvicalyceal system and if possible, into the corresponding ureter and thus urinary bladder. The puncture needle was removed and the tract was dilated over a 0.035" hydrophilic Turemo guide-wire using a 14F fascial screw dilator mounted over by a 16F Amplatz sheath. The mounted Amplatz sheath was then introduced through the dilated tract into the PCS under C-arm guidance. The 14F semi-rigid nephroscope was introduced and the stone(s) visualized. The stones once identified are fragmented using a Swiss Lithoclast for lithotripsy, most stone fragments (< 4 mm) could be flushed out by infusion of normal saline irrigation, along with the backflow through the Amplatz sheath, while the remaining big fragments are extracted with stone forceps. Once complete intra-operative, i.e., nephroscopic and C-arm clearance was achieved, a 5F DJ stent was then placed in. Nephrostomy tube was placed in, when required. In the immediate post-operative period, the X-ray chest was done to rule out any possibility of pneumothorax /hydrothorax /hemothorax. At the same time X-ray KUB was done to look for DJ stent position and residual stone fragments, if visualized.

Patients with residual fragments in both the groups were followed up for a period of four weeks with X-ray-KUB

for assessment of residual stones. The patient was deemed stone free when there was complete clearance of all stone fragments or the presence of fragments <3mm, seen on non-contrast CT scan). The procedure was defined as unsuccessful when the procedure was converted into some alternative treatment modality or the stone could not be reached or fragmented in a single sitting or fragments >3mm were seen on non-contrast CT scan at 1month follow-up. The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were summarized in the form of means and standard deviations and categorical variables were summarized as percentages.

RESULTS

All patients were treated with one session of percutaneous surgery. Among these 60 patients none required second puncture. Demographically, the mean age of patients was 38.5±9.31 years and range of 22-58, male to female ratio was 40:20, the disease laterality (right:left) was 48:12 and mean stone size was 17.6±2.11 mm (Table 1). None of the patients had previous history of ESWL.

Table 1: Demographic characteristics.

Parameters	Values
Mean age (yrs) (Range)	38.5±9.31 (22-58)
Male to female ratio	40:20
Disease laterality (R/L ratio)	48:12
Mean stone size (mm)	17.6±2.11

Mini-PCNL: mini-percutaneous nephrolithotripsy, R/L ratio: right to left.

Table 2: Treatment results and complications.

Variables	Results
Mean operative time (mins)	62±9.62
Mean hospital stay (days)	2.8±1.08
Success rate	96.7%
Stone free rate on discharge	86.7%
Stone free rate at 1month	96.7%
Overall complication rate	25%
Fever	8.33%
Prolonged hematuria	6.67%
Stone migration	3.33%
Thoracic complications	6.67%
Ureteral injury	-
Analgesia requirement (mg)	100±40.45
Auxiliary procedures	3.33%
Retreatment	-

Mini-PCNL: mini-Percutaneous Nephrolithotripsy.

The mean operative time was 62±2.11minutes. The mean hospital stays 2.8±1.08days. At discharge from the

hospital, stone free rates were 86.7% and at 1-month follow-up, the stone free rates were 96.7% (Table 2).

Thus, the overall success rate was 96.7% (58/60). In present study, the overall complication rate was 25%, with 5 patients (8.33%) developing post-operative fever and 4 patients (13.3%) had prolonged hematuria, 1 patient required (350ml of blood) blood transfusion in the post-operative period. Four patients (i.e., 6.67%), in this study, developed thoracic complications (Table 2). One patient developed pneumothorax and three hydrothoraxes. All required intercostal tube thoracostomy. Two patients (3.33%) had stone/fragment(s) migration (Table 2) and all patients required auxiliary procedures (Table 2). The mean analgesia requirement (in the form of injectable tramadol) was found to be 100±40.45mg (Table 2). At 1-month follow-up, patients with residual fragments were re-assessed. 1 patient had residual stone/fragment(s) more than 3mm. Two patients with persistent distal ureteral fragments (>7mm in size) were cleared with URSL. Therefore, in present study, the rate of auxiliary procedures was 3.3%, i.e., was required in both patient (Table 2). No loss of follow-up was noted.

DISCUSSION

Ureteric calculi are a common entity encountered in urology clinics. With increasing size and degree of impaction, ureteric calculi pose a serious threat to the function of the kidney on the affected side and thus, the health of the patient. Therefore, timely effective treatment is the key to preventing irreversible damage.

Technical achievements have revolutionized the methodology for the removal of ureteral stones. Open ureterolithotomy, once used to be the standard treatment for impacted, upper ureteric stones, however, with the advent of lithotripters, endourology and laparoscopy, less invasive procedures are preferred. Both PCNL and retrograde ureteroscopy are accepted treatment modalities for large, impacted, proximal ureteric calculi. ESWL has proved to be safe and relatively effective for treating upper ureteral stones. Many centers state in their studies ESWL as first-line treatment for ureteral stones.

Although traditional PCNL has many advantages, such as clear vision, high stone clearance rate and short operation time, the indications were strictly limited for a number of serious complications.¹³

Besides, the usual 26- to 34-Fr tract size of standard PCNL may be too large to be used in pediatric kidneys and in some adult undilated kidneys. Some urologists have modified the technique of standard PCNL by performing it with a miniature endoscope via a small percutaneous tract (11- to 20-Fr) and termed it as minimally invasive PCNL or mini-PCNL, making the treatment of upper ureteral stones with mini-PCNL a potential option.

A longer mean operative time, longer mean hospital stay and higher stone clearance rate in antegrade than in retrograde approach for large, impacted, upper ureteric stones has been reported previously.¹⁴⁻¹⁶ In this study, a significantly longer mean operative time was seen (Table 2). In present study, the mean hospital stay was significantly longer (Table 2).

The main aim of stone operation was to get a high stone clearance rate, so it is important to deal with the stone fragments effectively. Clinically Insignificant Residual Fragments (CIRFs) after PCNL remains a major concern, e.g. Skolarikos A et al, believed that if CIRFs were left untreated, approximately half of the patients would experience a stone-related event for which more than a half would also need a secondary surgical intervention.¹⁷ In present study, at discharge from the hospital, stone free rates was 86.7% and at 1 month follow-up, the stone free rates were 96.7%, i.e., 6 patients had a successful spontaneous passage of residual fragments.

A significantly higher success rate (96.7%) was noted in present study. Similar comparisons were observed in various previous studies.^{15,18} Fever and hematuria are known complications of the procedure.^{14,15,19} In this study, a higher number of patients developed post-operative fever and prolonged hematuria (8.33% and 6.67% respectively). One patient required blood transfusion. Supracostal approach is known to lead to thoracic complications ranging from 5 to 25%.²⁰⁻²³ Two patients in this study with supracostal approach, developed thoracic complications. One patient developed pneumothorax and three had hydrothorax. All the patients were diagnosed peri-operatively and all required tube thoracostomy.

In present study, the stone/fragment(s) migration was 3.33% and required auxiliary procedure in the form of ureteroscopic removal of the fragments. The overall complication rate of mini-PCNL was 25%. Authors did not experience any major complications such as hemorrhage necessitating transfusion/embolization/or nephrectomy, urinary leakage, visceral injuries or sepsis.

The mean analgesic requirement (in the form of injectable tramadol) was found to be on higher side (100±40mg), which signifies that the post-operative pain is significantly more. More pain and analgesia requirement in antegrade than in retrograde approach for impacted, upper ureteric calculi have been reported.¹⁸

Author experiences are thorough preoperative examination can effectively reduce the chance of sepsis, percutaneous renal access was carried out by a skillful surgeon, when there is difficulty with the puncture, combined ultrasound guidance and fluoroscopic guidance may be useful, skilled teamwork is greatly helpful in shortening the operative time, which can in turn reduce the complications of a longer operation time associated with both septic shock and severe renal bleeding.²⁴

CONCLUSION

Mini-PCNL is a safe and more effective method for the management of large (>15mm), impacted, upper ureteral stones with a higher success rate and stone free rate. Mini-PCNL greatly reduces the complications of PCNL. Though the primary treatment of impacted proximal ureteral calculi is still controversial, mini-PCNL provides another option for urologists.

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REFERENCES

1. Scarpa RM, DeLisa A, Porru D, Usai E. Holmium: YAG laser ureterolithotripsy. *Euro Urol.* 1999;35(3):233-8.
2. Dretler SP. Prevention of retrograde stone migration during ureteroscopy. *Nature Rev Urol.* 2006;3(2):60.
3. Salem HK. A prospective randomized study comparing shock wave lithotripsy and semirigid ureteroscopy for the management of proximal ureteral calculi. *Urol.* 2009;74(6):1216-21.
4. Preminger GM, Tiselius HG, Assimos DG, Alken P, Buck AC, Gallucci M, et al. 2007 Guideline for the management of ureteral calculi. *Eur Urol.* 2007;52(6):1610-31.
5. Lam JS, Greene TD, Gupta M. Treatment of proximal ureteral calculi: holmium: YAG laser ureterolithotripsy versus extracorporeal shock wave lithotripsy. *J Urol.* 2002;167(5):1972-6.
6. Preminger GM, Tiselius HG, Assimos DG, Alken P, Buck C, Gallucci M, et al. 2007 guideline for the management of ureteral calculi. *J Urol.* 2007;178(6):2418-34.
7. Araki M, Wong C. Direct comparison of fiberoptic and digital ureteroscopy for upper urinary tract lithotripsy. *J Endourol.* 2007;21:A80-A81.
8. El-Nahas AR, Eraky I, El-Assmy AM, Shoma AM, El-Kenawy MR, Abdel-Latif M, et al. Percutaneous treatment of large upper tract stones after urinary diversion. *Urol.* 2006;68(3):500-4.
9. Li X, He Z, Wu K, Li SK, Zeng G, Yuan J, et al. Chinese minimally invasive percutaneous nephrolithotomy: the Guangzhou experience. *J Endourol.* 2009;23(10):1693-7.
10. Wickaham JEA. The surgical treatment of renal lithiasis. In: *Urinary Calculus Disease.* New York: Churchill Livingstone, 1979; 145-198.
11. Raboy A, Ferzli GS, Ioffreda R, Alber PS. Laparoscopic ureterolithotomy. *Urol.* 1992;39(3):223-5.
12. Ather MH, Paryani J, Memon A, Sulaiman MN. A 10-year experience of managing ureteric calculi: changing trends towards endourological

- intervention-is there a role for open surgery?. *BJU Inter.* 2001;88(3):173-7.
13. Amer T, Ahmed K, Bultitude M, Khan S, Kumar P, De Rosa A, et al. Standard versus tubeless percutaneous nephrolithotomy: a systematic review. *Urol Inter.* 2012;88(4):373-82.
 14. Xiao-jian G, Lin LJ, Yan X. Treatment of large impacted proximal ureteral stones: randomized comparison of minimally invasive percutaneous antegrade ureterolithotripsy versus retrograde ureterolithotripsy. *World J Urol.* 2013;31:1605-10.
 15. Bozkurt IH, Yonguc T, Arslan B, Degirmenci T, Gunlusoy B, Aydogdu O, et al. Minimally invasive surgical treatment for large impacted upper ureteral stones: Ureteroscopic lithotripsy or percutaneous nephrolithotomy?. *Can Urol Assoc J.* 2015;9:E122.
 16. Sfoungaristos S, Mykoniatis I, Isid A, Gofrit ON, Rosenberg S, Hidas G, et al. Retrograde versus Antegrade Approach for the Management of Large Proximal Ureteral Stones. *BioMed Res Int.* 2016;2016.
 17. Skolarikos A, Papatsoris AG. Diagnosis and management of postpercutaneous nephrolithotomy residual stone fragments. *J Endourol.* 2009;23(10):1751-5.
 18. Moufid K, Abbaka N, Touiti D, Adermouch L, Amine M, Lezrek M. Large impacted upper ureteral calculi: A comparative study between retrograde ureterolithotripsy and percutaneous antegrade ureterolithotripsy in the modified lateral position. *Urol Ann.* 2013;5(3):140.
 19. Sun X, Xia S, Lu J, Liu H, Han B, Li W. Treatment of large impacted proximal ureteral stones: randomized comparison of percutaneous antegrade ureterolithotripsy versus retrograde ureterolithotripsy. *J Endourol.* 2008;22(5):913-8.
 20. Lojanapiwat B, Prasopsuk S. Upper-pole access for percutaneous nephrolithotomy: comparison of supracostal and infracostal approaches. *J Endourol.* 2006;20(7):491-4.
 21. Yadav R, Aron M, Gupta NP, Hemal AK, Seth A, Kolla SB. Safety of supracostal punctures for percutaneous renal surgery. *Inter J Urol.* 2006;13(10):1267-70.
 22. Mousavi-Bahar SH, Mehrabi S, Moslemi MK. The safety and efficacy of PCNL with supracostal approach in the treatment of renal stones. *Inter Urol Nephrol.* 2011;43(4):983-7.
 23. El-Karamany T. A supracostal approach for percutaneous nephrolithotomy of staghorn calculi: A prospective study and review of previous reports. *Arab J Urol.* 2012;10(4):358-66.
 24. Wang Y, Jiang F, Wang Y, Hou Y, Zhang H, Chen Q, et al. Post-percutaneous nephrolithotomy septic shock and severe hemorrhage: a study of risk factors. *Urol Inter.* 2012;88(3):307-10.

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