Prospective Outcomes of Ultra Mini Percutaneous Nephrolithotomy: A Consecutive Cohort Study

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Purpose: Ultra mini percutaneous nephrolithotomy is a less invasive technique of percutaneous nephrolithotomy to treat small to medium sized calculi.

Materials and Methods: We prospectively evaluated the outcomes of ultra mini percutaneous nephrolithotomy in a single surgeon, consecutive cohort study. Data on 94 patients who underwent ultra mini percutaneous nephrolithotomy were collected.

Results: Mean ± SD calculus size was 15.9 ± 4.5 mm and mean density was 1,106 ± 167 HU. Access was achieved via the upper pole in 8 cases, interpolar in 33 and lower pole in 54. Mean operative time was 54 minutes (range 28 to 120). Mean hemoglobin loss was 0.81 gm/dl and the mean creatinine increase was 0.05 mg/dl. There were no transfusions or kidney injuries. Grade I and IIIb complications were observed in 4 and 1 patients, respectively. The most serious complication was a perinephric collection. Postoperatively oral analgesia was sufficient in 86 patients (91%). Mean length of stay was 38.2 ± 15.9 hours. Nephrostomy drainage was used in 13 patients while 7 (7%) required a stent for 1 week. Intraoperatively 99% of renal units were stone free (absence of detectable calculi) on fluoroscopy, and 74% and 81% were stone free on day 1 postoperative ultrasound and 1-month computerized tomography, respectively. The 10 to 20 mm stones showed less bleeding, shorter operative time and a significantly lower requirement for nephrostomy or a Double-J® stent.

Conclusions: Ultra mini percutaneous nephrolithotomy appears to be effective and safe with a short length of stay. It may be a valuable addition to the armamentarium to treat 10 to 20 mm calculi in patients who wish to avoid routine nephrostomy or stents. Randomized, controlled trials are required.

Key Words: kidney calculi; nephrostomy, percutaneous; laser therapy; minimally invasive surgical procedures; lithotripsy

Abbreviations and Acronyms

CT = computerized tomography

Hb = hemoglobin

KUB = plain x-ray of kidneys, ureters and bladder

PCNL = percutaneous nephrolithotomy

RIRS = retrograde intrarenal surgery

UMP = ultra mini percutaneous nephrolithotomy

Accepted for publication July 11, 2015.

The corresponding author certifies that, when applicable, a statement(s) has been included in the manuscript documenting institutional review board, ethics committee or ethical review board study approval; principles of Helsinki Declaration were followed in lieu of formal ethics committee approval; institutional animal care and use committee approval; all human subjects provided written informed consent with guarantees of confidentiality; IRB approved protocol number; animal approved project number.

* No direct or indirect commercial incentive associated with publishing this article.

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‡ Financial interest and/or other relationship with LUT.

There is an increased incidence of renal calculi globally across gender, race and age[1] with more patients being identified with calculi due to the widespread use of medical imaging technology.[2] The economic burden of nephrolithiasis in 2000 was estimated to be $5.3 billion in the United States.[3]

PCNL is widely used to treat renal calculi greater than 2 cm.[4] A high stone-free rate can be achieved compared to RIRS.[5] However, PCNL has been shown to have a higher complication rate, blood loss and length of stay.[5] Much of the morbidity associated with PCNL has been due to the size of the tract.[6] Reduction in

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tract size to 14Fr to 18Fr has been reported to lessen bleeding, analgesic requirements and length of stay.[7] This is thought to be due to reduced renal parenchymal trauma.

The challenge is to combine excellent stone-free rates with minimal morbidity. The technique of UMP was proposed to treat mid-sized (1 to 2 cm) calculi.[8] UMP uses an 11Fr to 13Fr outer sheath combined with a novel irrigation system and a 3.5Fr telescope.

The aim of this study was to prospectively study UMP efficacy and safety. Secondary study outcomes were operative time, length of stay and analgesic requirements.

PATIENTS AND METHODS

This prospective, consecutive, single surgeon cohort study was performed between February and December 2013. Institutional review and ethical committee approval was obtained. All patients provided signed informed consent before the procedure. The study population and design differed from those of our previously published study.[8]

Study inclusion criteria were an index calculi 9 mm or greater and age 18 years or greater. Calculi size was determined by measuring the longest axis on CT KUB. Exclusion criteria were calculi greater than 30 mm, untreated urinary tract infection, bleeding diathesis or markedly abnormal calyceal anatomy.

A standardized protocol was followed after inducing general anesthesia. After receiving amikacin intravenously patients were placed in the modified lithotomy position. Cystoscopy was performed and a 6Fr ureteral catheter was placed in the renal pelvis. The ureteral catheter was secured to a Foley catheter. The patient was placed prone. After a retrograde study the selected calyx was punctured under fluoroscopic or ultrasound guidance by the urologist. An 18 gauge needle was used to puncture the collecting system of the kidney. This accepted a 150 cm 0.035-inch (0.89 mm) angled nitinol guidewire, which was placed safely in the collecting system or down the ureter. After 0.5% bupivacaine infiltration for postoperative analgesia a 4 mm skin incision was made and the tract was dilated with 7Fr and 12Fr polytetrafluoroethylene dilators over the guidewire.

The 13F UMP outer sheath (LUT, Denzlingen, Germany) was inserted in the pelvicalyceal system using a twisting motion. The inner sheath, including the 3.5F telescope, was connected, allowing for visualization of the pelvicalyceal system and the calculus. The guidewire was removed and a standard 365 μ laser fiber was deployed to fragment the stone. A 3Fr grasper could be used to remove clots or stone fragments if required. Intrarenal pressure remained low as saline was allowed to escape between the inner and outer sheaths.[9]

Calculi were fragmented with the holmium laser at settings of 1.5 J and 8 Hz to produce 1 to 2 mm fragments. After fragmentation was achieved saline was injected from the side port and ureteral catheter with a 20 ml syringe to create a Venturi effect in the collecting system. This pushed fragments from inside the kidney out through the sheath on a swab for subsequent stone analysis. Intrapelvic pressure measurements have not shown significant increases during fragment flushing.[8]

After checking visually and fluoroscopically for any remaining fragments the guidewire was replaced. The UMP sheath was removed while inspecting the tract.

Pressure was applied to the kidney to tamponade tract bleeding and the wire was then removed. An adhesive dressing was applied. Nephrostomy drainage was considered for significant bleeding and a Double-J stent was placed if there was suspicion of residual fragments or urothelial injury. The ureteral and urethral catheters were usually removed the next day. The patient was discharged home after routine blood tests and ultrasound of the kidney.

Data were recorded on patient demographics, stone diameter size, density in HU, access, operative time, intraoperative findings, change in Hb and creatinine (preoperatively vs day 1 postoperatively), length of stay, stent/nephrostomy placement, analgesic requirements, complications, postoperative day 1 ultrasound, 30-day low dose CT KUB status and infrared spectroscopy stone analysis. Stone free was defined as the absence of any fragments.

Data are reported as the mean ± SD. Subgroup analysis was performed for stones 20 mm or less, and between 21 and 30 mm. We used the D'Agostino-Pearson omnibus normality test before selecting the Student t-test or Mann-Whitney test.

RESULTS

A total of 95 procedures were performed in 58 male and 36 female patients with a mean age of 46.5 ± 13.7 years. A total of 102 calculi were treated. There were 52 right, 41 left and 1 bilateral procedures.

Table 1 lists preoperative calculi positions and sizes. Mean stone size was 15.91 ± 4.5 mm (range 6 to 30) and the mean density of treated stones was

Table 1. *Characteristics of 94 patients*

Mean age ± SD (range)	46.5 ± 13.7
No. male (%)/No. female (%)	58 (62)/36 (38)
No. stone location (%):	
Upper pole calyx	7 (7)
Interpolar calyx	5 (5)
Lower pole calyx	31 (30)
Renal pelvis	56 (55)
Calyceal diverticulum	1 (1)
Upper ureter	2 (2)
No. stone diameter (mm):	
5.1—10	10 (10)
10.1—15	42 (41)
15.1—20	36 (35)
20.1—25	12 (12)
25.1—30	2 (2)
Mean ± SD stone diameter (mm)	15.91 ± 4.5
No. laterality:	
Rt	52
Lt	41
Bilat	1
Mean ± SD density (HU)	1,106 ± 167

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