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Original Article
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Initial Experience of Totally Tubeless Ultra-Mini Percutaneous Nephrolithotomy

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Abstract

Objectives : *The Objectives of this study is to determine the outcome and effectiveness of Ultra-mini percutaneous nephrolithotomy (PCNL) for treating low-volume renal stone without placement of any stent and nephrostomy tube as a supplement to the conventional PCNL.*

Material and methods: *The Patients who underwent ultra-mini PCNL bwtween July 2018 to December 2018. were studied.This was a prospective study of 14 patients.This study was carried out in urology centre of CMH Dhaka.Before the study ethical clearance was taken from hospital ethical committee. All these patients had their first-line treatment. The patients had calculus limited to either a single calyx or just extending to the pelvis and the stone size was less than 1.5 cm in its maximal dimension. The mean stone size was 10.8+_4.2(5-15mm). An 6 Fr operating nephroscope was used. The patients were placed in prone position. The stones were fragmented using Holmium-YAG laser. Various surgical outcomes including duration of the surgery, stone-free rate and any subsequent complications-if any-were analyzed.The stone free rate was assessed on the 1st day and at three month after surgery by X-ray KUB and ultrasonography.*

Results: *The study includes a series of 14 patients (one patient treated with bilateral renal stone disease). The mean age of the patients was 39.07 years and body mass index was 25.5 kg/m^2. Intrarenal stone location was as follows: lower calyx, n=7; middle calyx, n=3, upper calyx, n=1, and pelvis, n=3. Median operative time was 52.66 min (range: 40–65) and the stone-free rate was 93.3% at first day and 97% after three month follow up.. Only one patient had residual fragments and needed subsequent extracorporeal shock wave lithotripsy.*

Conclusion: *Ultra-mini PCNL in prone position with a complete tubeless approach for renal stone disease is a safe method for treating low-volume stone disease. A long term large scale multicentre study may be required to validate this technique.*

Keywords: Ultra-mini, percutaneous nephrolithotomy, total tubeless

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Introduction

The treatment of urolithiasis has undergone a paradigm shift in the past decade. Management of urolithiasis necessitates a balance between stone clearance and morbidity related to the procedure. As a low-risk procedure with a high retreatment (18%-67%), ESWL often leads to persistent residual stones [1–3]. The developing retrograde intrarenal surgery (RIRS) can minimize the risk associated with bleeding and visceral injury ,but the absence of ideal pelvicalyceal anatomy and poor durability of the flexible ureterorenoscopy may impact its success rate and applications [4–6]. Of the minimally invasive treatment strategies, the PCNL procedure is simply based on the creation of a proper percutaneous renal access, through the most appropriate part of the kidney, dilation of this tract, and fragmentation and removal of the stone fragments using the nephroscope through the access sheath. It has been reported that PCNL can be performed safely and effectively to achieve a higher stone-free rate and allow a short treatment period in most patients1,[2,7], despite its well-known hazardous and serious complications [8,9]. Most of these complications are related to tract formation and size. Efforts to decrease the complications of PCNL have focused on access size. After enough evidence in the literature suggested that decreasing the tract size for PCNL could decrease bleeding and morbidity, Desai et al. developed an all-seeing needle and used it in a 4.85Fr tract size without a working sheath to perform PCNL, which was called "microperc"[10,11]. Here, we adopted a new 6Fr Mini nephroscope with some special features that allow the performances of PCNL in an 11–13Fr metal sheath. We termed the procedure as ultra-mini-percutaneous nephrolithotomy (UMP) because of its smaller tract compared to mini-PCNL. We reviewed our initial experience with the first 14 consecutive patients with moderate-sized(<15mm) kidney stones to undergo the UMP.The ultra-mini-PCNL (UMP) is the latest inclusion in the MIP incorporating a 6 Fr telescope within a strategically devised 7.5 Fr nephroscope being introduced via the 11–13Fr sheath[12] thus enabling a reduction in the invasiveness and subsequent complications of bleeding and trauma to the kidney[9].

Material and methods

This is a prospective study among patients with nephrolithiasis with low-stone burden and undergoing supine total tubeless UMP as their first modality of treatment within the time frame of July 2018 and December2018. The patients' inclusion criteria included: (1) stone size <15 mm; (2) body mass index (BMI) <30 kg/m^2; (3) stone occupying a single calyx or extending into the pelvis; (4) favorable calyceal anatomy(5).No significant co morbidity.

Initial detailed evaluation of the patients included a careful medical history and physical examination along with routine laboratory investigations (Complete Blood count, renal function tests, serum electrolytes, sterile urine culture) and radiological investigations (digital intravenous Urography and contrast CT Scan of KUB).

Ultra Mini-PCNL technique

The patients under general anesthesia were placed in the prone position .[12,13] A 5 Fr ureteric catheter was passed into the ipsilateral ureteropelvic junction. The pelvicalyceal system (PCS) was opacified and the desired calyx (for best stone clearance) was selected for the initial puncture. An 18 G initial puncture needle was used for the percutaneous puncture of the desired calyx and a 0.035 hydrophilic terumo guide wire was introduced into the PCS and gradually negotiated into the ureter. Tract dilatation was done up to 10 Fr and then an 11 Fr outer sheath of the 8.5 Fr ultra-mini nephroscope was introduced .

Subsequently after withdrawing the guide wire, the nephroscope was introduced into the PCS up to the desired calculus. A 365 micron Holmium laser fiber was used for stone fragmentation and dusting (high frequency and low dose energy (0.6–0.8 Joule). The fragments were extracted by intermittent removals of the nephroscope out of the outer sheath. After complete clearance of the stones, assessed by fluoroscopy, the nephroscope along with the outer sheath was removed and compressive dressing was applied. Neither nephrostomy tube nor any skin suture was required in any of the cases. Only compressive dressing was applied at the surgical site .Postoperatively the patients were allowed normal diet after twelve hours. For the first 48 hours the patient received intravenous antibiotics and analgesic. Subsequently the patients

were switched to oral medications. Postoperative urine cultures of all patients were obtained. Ureteral catheter was removed within 18–24 hours as a protocol for total tubeless procedure. A bedside ultrasonographic evaluation was done for all patients to look for any peri-renal collection.

Postoperative follow up

The patients were followed up with a digital X-ray KUB (kidney, ureter and bladder),Ultrasonography and urine culture at 1 and 3 months. Stone clearance was defined by absence of residual radio-opaque shadow in the renal region or fragments which were asymptomatic and less that 4 mm in diameter (clinically insignificant residual fragments).

Results

There were fourteen patients who underwent ultra-mini-PCNL (one patient had bilateral PCNL) (Table 1). Two patients (13.3%) underwent the procedure under spinal anesthesia and general anesthesia was given to the rest of the patients. Among 14 patient seven were females (46%). The mean age of the patients was 39.07 years (range, 21–55). The mean BMI was 25.7kg/m^2. The right side was involved in eight cases and the rest had their left kidneys with stones. Majority of the patients belonged to ASA Grade 1 except for four who belonged to ASA Grade 2. Eleven patients had symptoms attributable to their renal calculi and the rest had vague abdominal discomfort and their renal stones were detected during radiological examinations. All patients had UMP as their initial modality of therapy for renal calculi without any other previous therapeutic interventions. Among fifteen patients , eight (53.3%) had the stones were located in the lower calyx (n=8: 53.3%), the middle calyx (n=3: 20%), pelvis (n=3: 20%) and the upper calyx (n=1)(6.7%) The mean stone size was 9mm (range, 08–10).

Initial puncture which took 5.4 minutes (range, 3–10) time. Median time periods required for dilatation, and laser fragmentation of the stones were 7.3 minutes (range, 4–13) and 26.6 minutes (range, 25–45), respectively. The total mean time of the procedure was 52.66 minutes (range, 40–70). There was a significant positive correlation between the higher stone burden and the increased duration of the procedure.

Postoperatively there was an average drop in hemoglobin of 0.55 mg/dL (range, 0.1–1.1) and this correlated positively with the increasing size of the stones. The average postoperative hospital stay was 2.8 days (range, 2–4).

Only one patient had urinary leakage after removal of the ureteral catheter that subsided within 48 hours with compressive dressing. None of the patients had any perirenal collections at 24 hours after surgery. One patient had residual fragments detected during postoperative radiological investigation and the rest (93.3%) had complete stone clearance. One patient had urosepsis that was treated with appropriate antibiotics. Subsequently, after controlling the infection, the patient had undergone shockwave lithotripsy for the removal of residual fragments.

Table I : *Details of patients along with peri-operative outcomes*

S no	Age	Sex	BMI (kg/m^2)	Laterality (R/L)	Size of stone (mm)	Stone location	Fragmentation time (mins)	Total procedure (mins)	Hb drop (g/dL)
01.	21-55 Y	M-08 F-07	21-29	R- 08 L- 07	08-15	Lower Calyx-08 Middle Calyx-03 Upper Calyx-01 Pelvis - 03	15-40	40-70	0.65

BMI: Body mass index; Hb: Hemoglobin; R: right; L: left

Discussion

Urolithiasis is a worldwide problem in the general population, due to its high prevalence and frequency of recurrence [12]. At present,various minimally invasive treatment strategies have been recommended to treat the urinary tract stones including ESWL, standard PCNL, mini-PCNL, RIRS, and a new emerging technique termed "micro-PCNL." For the principle of stones treatment, there is a need for a surgical method that will allow both high stone-free rate and short treatment times, without the increased risk of hemorrhage.

The location of the stone and pelvicalyceal system anatomy are the factors affecting the selection of the appropriate treatment regimen. Although the noninvasive nature, minimal anesthesia requirement, and high acceptance rate by the patients and physicians are main advantages of ESWL, low stone-free and higher retreatment rates are considered as the drawbacks. The reported stone-free rates of ESWL at three months for stones are 86%to89%(renal pelvis),71%to83% (upper calyx), and 73%to84%(middle calyx) and for lower pole stones based on stone size are 63% to 74% (1–10mm), 23% to 56% (11–20mm), and 14% to 33% (21–30mm) [2].

RIRS has been popularized with the advances in endoscope and lithotripter technology. However, the collecting system anatomy restricts its success rate, and the high sustainable cost and poor durability restrictits wide application in most basic-level hospitals [4–6]. The lower calyceal fragment reaccumulation may be a cause of stone recurrence[3].

However, conventional percutaneous nephrolithotomy (PCNL) can cause a somewhat higher associated morbidity despite the fact that it achieves a higher stone-free rate and allows a short treatment period [1, 2, 7–9]. Most of these complications are related to tract formation and size. Efforts to decrease the complications of PCNL have focused on access size. Theoretically, a smaller tract gives rise to fewer complications. After enough evidence in the literature suggested that decreasing the tract size could decrease bleeding and morbidity without affecting success rate, Desai et al developed a 4.85 Fr all-seeing needle and used it in a 4.85Fr tract size without a working sheath to perform PCNL, which was called "microperc"[10,11].

During the development of the PCNL technique, the different terminology of it came out mainly according to the tract size such as standard, mini-, and micro-PCNL. The essential element of the novel UMP is using a novel 6Fr Mini nephroscope through an 11– 13 Fr metal sheath to perform holmium: YAG laser lithotripsy. Dilation is achieved in one step with much less fluoroscopy time, and the cross-section of the puncture channel is only approximately 30% of that required with the conventional mini-PCNL (reference to 18Fr size). This miniaturization is the main reason why no blood transfusion and why no nephrostomy tube routinely placed in this group of patients. These results match those of Jackman etal. Who also observed no significant bleeding and suggested that the nephrostomy tube was unnecessary[12,13].

UMP also would be an alternative to SWL or flexible ureteroscopy to suffer the less impact of pelvicaliceal anatomy. UMP provides the ability to gain direct access to the desired calyx and accomplish a higher immediately stone- free rate 93% in our study which is comparable to other study (88.9% Desai etal)[18]. As a results, the UMP would shoulder the responsibility for RIRS and ESWL failure cases. In our study, the fragmentation time was 15-40 min which was shorter than the study done by Desai etal (30-90 min). This may be related to stone size and density of the stone .

Percutaneous nephrolithotomy with its excellent stone clearance rates is a brilliant option for the treatment of renal stones especially staghorn calculi within a short time.[14–16] The main concern, however, with PCNL is bleeding which can be seen in up to 23% of cases.[17] Reducing the caliber of the access sheath decreases the damage to the renal parenchyma and hence reduces risk of bleeding. The question remains as to what is the adequate small size tract that is best suited for the PCNL procedure. On one side of the spectrum is the standard size 24Fr nephroscopes and on the other end microperc-PCNL performed through a 4.85 Fr tract size without using a working sheath as described by Desai et al.[18-20] Mini PCNL lies somewhere in between these where a 12–14 Fr nephroscope is used in a 15–18 Fr amplatz sheath for addressing the renal calculi.

The recent modification by Desai et al.[8] is the UMP. This uses a 3 Fr telescope in a 7.5 nephroscope which is introduced into the PCS via the 11–13 Fr size amplatz sheath. This decrease in the size of the tract has reduced the renal tissue trauma and the hemorrhagic complications associated with PCNL. UMP seems to be a safe and efficient option for small volume renal stones

with good stone-free rates and decreased procedural complications. UMP is best suited for small to medium sized stones (usually <20 mm in diameter) and especially the lower pole stones and the diverticular stones which are difficult to gain access with the RIRS and those stones which are refractory to ESWL.[21, 22,23] Desai et al.[8] had reported a hematocrit drop of 1.4 mg/dL, a hospital stay of 1.2 days and a stone-free rate of 82% with UMP. In our series of UMP the average drop in hemoglobin was 0.55 mg/dL and the average hospital stay was 2.8 days. The average drop of hematocrit was minimal thus making it a safer option. As a complication only a single event of urinary leakage was documented in our series which took about 48 hours to settle.

Conclusion

We have performed 14 ultra-mini-PCNL procedures, and the initial results are promising. UMP is technically feasible, safe, and efficacious and an alternative for small volume renal calculus disease with an advantage of high immediate and final stone-free rate and lower complication rates. The indications for UMP are moderate-sized stones as an alternative to ESWL or RIRS, lower pole stones which were not amenable to RIRS, diverticular renal stones, and stones refractory to ESWL.

Hence, total tubeless ultra-mini-PCNL is a feasible option to treat renal calculi especially those less than 1.5 cm in their longest dimension. We believe that this is a unique and good technique that can be undertaken safely. Studies with a larger cohort may be required to finally validate this technique.

References

1. Feng MI, Tamaddon K, Mikhail A, Kaptein JS, Bellman GC. Prospective randomized study of various techniques of percutaneous nephrolithotomy. Urology. 2001;58:345–50.
2. Kumar R, Anand A, Saxena V, Seth A, Dogra PN, Gupta NP. Safety and efficacy of PCNL for management of staghorn calculi in pediatric patients. J Pediatr Urol. 2011;7:248–51]
3. Helal M, Black T, Lockhart J, Figueroa TE. The Hickman peel-away sheath: alternative for pediatric percutaneous nephrolithotomy. J Endourol. 1997;11:171–2.
4. Kukreja R, Desai M, Patel S, Bapat S, Desai M. Factors affecting blood loss during percutaneous nephrolithotomy: Prospective study. J Endourol. 2004;18:715–22.
5. Ferakis N, Stavropoulos M. Mini percutaneous nephrolithotomy in the treatment of renal and upper ureteral stones: Lessons learned from a review of the literature. Urol Ann. 2015;7:141–8.
6. Cheng F, Yu W, Zhang X, Yang S, Xia Y, Ruan Y. Minimally invasive tract in percutaneous nephrolithotomy for renal stones. J Endourol. 2010;24:1579–8
7. Mishra S, Sharma R, Garg C, Kurien A, Sabnis R, Desai M. Prospective comparative study of miniperc and standard PNL for treatment of 1 to 2 cm size renal stone. BJU Int. 2011;108: 896–9.
8. Desai J, Solanki R. Ultra-mini percutaneous nephrolithotomy (UMP): one more armamentarium. BJU Int. 2013;112:1046–9.
9. de la Rosette JJ, Tsakiris P, Ferrandino MN, Elsakka AM, Rioja J, Preminger GM. Beyond prone position in percutaneous nephrolithotomy: A comprehensive review. Eur Urol. 2008;54:1262–9.
10. Manohar T, Jain P, Desai M. Supine percutaneous nephrolithotomy: Effective approach to high-risk and morbidly obese patients. J Endourol. 2007;21
11. Liu L, Zheng S, Xu Y, Wei Q. Systematic review and meta-analysis of percutaneous nephrolithotomy for patients in the supine versus prone position. J Endourol. 2010;24:1941–6.
12. Valdivia Uría JG, Valle Gerhold J, López López JA, Villarroya Rodriguez S, Ambroj Navarro C, Ramirez Fabián M, et al. Technique and complications of percutaneous nephroscopy: experience with 557 patients in the supine position. J Urol. 1998;160:1975–8.
13. Ibarluzea G, Scoffone CM, Cracco CM, Poggio M, Porpiglia F, Terrone C, et al. Supine Valdivia and modified lithotomy position for simultaneous anterograde and retrograde endourological access. BJU Int. 2007;100:233–6.
14. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg. 2004;240:205–13.
15. Scales CD, Jr, Smith AC, Hanley JM, Saigal CS Urologic Diseases in America Project. Prevalence of kidney stones in the United States. Eur Urol. 2012;62:160–5.

16. Albala DM, Assimos DG, Clayman RV, Denstedt JD, Grasso M, Gutierrez-Aceves J, et al. Lower pole I: A prospective randomized trial of extracorporeal shock wave lithotripsy and percutaneous nephrostolithotomy for lower pole nephrolithiasis-initial results. J Urol. 2001;166:2072–80.

17. Srisubat A, Potisat S, Lojanapiwat B, Setthawong V, Laopaiboon M. Extracorporeal shock wave lithotripsy (ESWL) versus percutaneous nephrolithotomy (PCNL) or retrograde intrarenal surgery (RIRS) for kidney stones. Cochrane Database Syst Rev. 2009;11

18. Akman T, Binbay M, Ugurlu M, Kaba M, Akcay M, Yazici O, et al. Outcomes of retrograde intrarenal surgery compared with percutaneous nephrolithotomy in elderly patients with moderate-size kidney stones: A matched-pair analysis. J Endourol. 2012;26:625–9.

19. Bozkurt OF, Resorlu B, Yildiz Y, Can CE, Unsal A. Retrograde intrarenal surgery versus percutaneous nephrolithotomy in the management of lower-pole renal stones with a diameter of 15 to 20 mm. J Endourol. 2011;25:1131–35.

20. Srisubat A, Potisat S, Lojanapiwat B, Setthawong V, Laopaiboon M. Extracorporeal shock wave lithotripsy (ESWL) versus percutaneous nephrolithotomy (PCNL) or retrograde intrarenal surgery (RIRS) for kidney stones. Cochrane Database of Systematic Reviews. 2009:CD007044.]

21. Sabnis RB, Jagtap J, Mishra S, Desai M. Treating renal calculi 1–2 cm in diameter with minipercutaneous or retrograde intrarenal surgery: A prospective comparative study. BJU Int. 2012;110:346–9.

22. Michel MS, Trojan L, Rassweiler JJ. Complications in percutaneous nephrolithotomy. Eur Urol. 2007;51: 899–906.

23. Desai J, Zeng G, Zhao Z, Zhong W, Chen W, Wu W. A novel technique of ultra-mini-percutaneous nephrolithotomy: Introduction and an initial experience for treatment of upper urinary calculi less than 2 cm. Biomed Res Int. 2013;2013:490793.