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Original Article

Combined micro-and standard percutaneous nephrolithotomy for complex renal calculi

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ABSTRACT

Objective: We aimed to present the technique of combination of standard percutaneous nephrolithotomy (PNL) with microperc for achieving higher success rates without increasing complication rates in the management of complex renal calculi.

Material and methods: The patients who underwent microperc procedure as a complementary procedure to standard PNL for complex kidney stones in two reference hospitals between 2013 and 2015, were evaluated retrospectively.

Results: All patients underwent a total of two accesses one for standard PNL and one for microperc. The mean stone size was measured as 54.3 mm. The procedures were completed after an average operative time of 88.2 minutes and fluoroscopy time of 5.3 minutes. Stone free status was achieved in 18 cases (78.2%) and small residual fragments (≤4 mm) were detected in 3 cases (13.1%). Complications were seen in three patients (13%) as hemorrhage in one and postoperative fever in two patients.

Conclusion: Despite the limitations of this study, the combination of standard PNL and microperc might reduce the complication rates and increase the success rates when treating complex kidney stones. Future prospective and comparative studies are needed.

Keywords: Complex kidney stone; microperc; outcome; standard percutaneous nephrolithotomy.

Introduction

Percutaneous nephrolithotomy (PNL) has been the first-line treatment for large, complex kidney stones for three decades.[1] Since its introduction in 2011, micro-percutaneous nephrolithotomy (microperc) has been used increasingly for moderate-sized kidney stones.[2-6]

The complete clearance of stones from the kidney is important for preventing recurrence and morbidity in both standard PNL, and microperc, procedures. However, achieving a stone-free status in a single session in cases with complex renal calculi is not always possible. Therefore, many studies have focused on increasing the success rate without increasing the complication rate by performing multiple treatments, using additional instruments, and exploiting technological advances.[7-15]

Here, we present a technique that combines standard PNL with microperc to achieve stone free status without increasing complication rates. To the best of our knowledge, this is the first study presenting the efficacy of combined micro-, and standard PNL techniques for complex kidney stones.

Material and methods

The patients who underwent microperc as a complementary procedure to standard PNL for complex kidney stones in two referral centers between 2013 and 2015, were reviewed retrospectively. Patients with complex renal calculi including partial or complete staghorn calculi or multiple renal calculi requiring multiple accesses were enrolled in the study. Patients aged <18 years and those with solitary kidney and renal insufficiency were excluded. Demographic characteristics such as age, gender, American Society of Anesthesiologists (ASA)

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scores, stone size and location, and perioperative parameters (fluoroscopy and operation time, hemoglobin drop, and stone-free and complication rates) were analyzed.

All patients received routine physical examination, biochemical, and microbiological tests preoperatively. Patients with positive urine cultures were treated using appropriate antibiotics. In addition, radiological evaluations were performed using renal ultrasonography (US), KUB, and/or computed tomography (CT). The stone size was reported as the longest diameter of stone or sum of the stones. Numerical variables are presented as means ± standard deviation and categorical parameters as percentages (%).

Operative technique

A 6-Fr open-end ureteral catheter was inserted with cystoscopy up to the upper collecting system under anesthesia with the patient in the lithotomy position. Following dilatation of the kidney using diluted contrast agent through the ureteral catheter, percutaneous renal access into the proper calyx was achieved using an 18-G needle with C-arm fluoroscopy guidance with the patient in the prone position. The access tract was dilated gradually using Amplatz sheaths up to 30 Fr. The stone was fragmented using pneumatic lithotripsy using a 24-Fr rigid nephroscope and the stones were removed using retrieval forceps.

Fluoroscopy was used to assess the intraoperative stone- free status or presence of any residual calculi. A second access point was considered for any residual stones when the rigid/flexible nephroscope failed to reach the stone. Then usage of microperc through an additional tract for the residual stone of <2 cm in diameter was planned. An additional tract was done using the 4.8 Fr "all-seeing needle" (PolyDiagnost, Pfaffenhofen, Germany) under direct vision and with the guidance of fluoroscopy. Then, stone fragmentation was performed using Ho:YAG laser lithotripsy in setting of 0.8 J at 8 Hz. Finally, stone-free status was confirmed by the fluoroscopic and endoscopic imaging. Procedure was completed with insertion of nephrostomy catheter via Amplatz sheath in order to drain the kidney (Figure 1, 2).

All patients were evaluated with KUB and biochemical tests postoperatively. The patients were discharged in the lack of any complication after removal of the nephrostomy tube on postoperative days 1 to 3. The success of the procedure was assessed with CT at postoperative 4 weeks.

Results

A total of 8 female and 15 male patients were included in the study. The mean age of patients was 51.5±18.3 years (range, 32–66) with a mean BMI of 29.7±4.4 kg/m^2 (range, 24-40). A complete staghorn calculus was seen in fifteen patients, whereas the stones were in multiple locations in the remaining patients. We calculated the mean stone size as 54.3±7.9 mm (40–68 mm). A horseshoe kidney and a semi-opaque calculus were seen in two separate patient.

A total of two accesses including one for standard PNL and one for microperc were used in all patients. The puncture sites were lower + upper calyx (n=15; 65.2%), middle + upper calyx (n=4 17.4%), middle + lower calyx (n=2; 8.7%), and 2 different lower calices (n=2; 8.7%). In 3 (13.1%) patients supracostal, and rest of the patients subcostal space were used as access sites The procedures were completed after a mean operative time of 88.2±29.5 minutes (range, 50-150) and fluoroscopy time of 5.3±2.9 minutes (range, 3-8).

While stone- free status was achieved in 18 cases (78.2%), small residual fragments (≤4 mm) were detected in 3 cases (13.1%). On the other hand residual fragments of >4 mm were observed in 2 cases (8.7%). In three patients (13%) complications such as bleeding (n=1), and postoperative fever (n=2) were observed. Blood transfusion was needed in a case with hemorrhage. Two patients with fever were treated with medical management sufficiently. The mean hemoglobin drop was 2.5±1.3 (range, 1.8–4.5) mg/dL. Patients were discharged after a mean hospitalization period of 2.9±0.8 days (range, 1–5). Calcium oxalate, struvite,

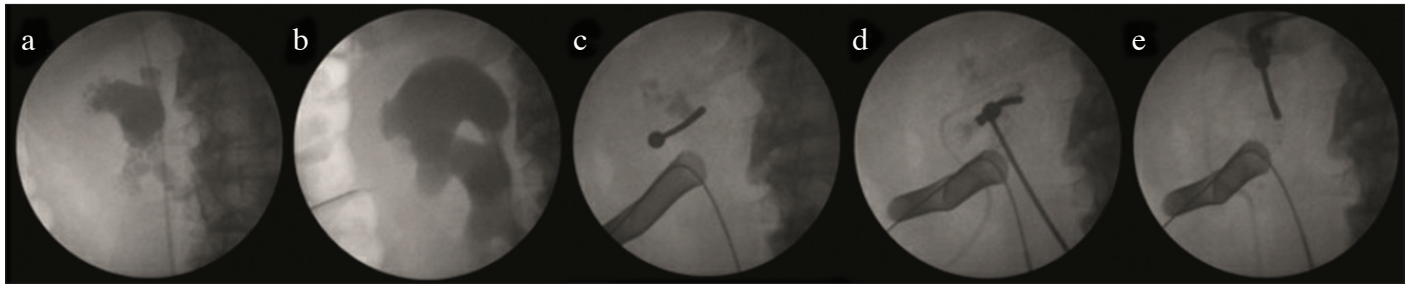

Figure 1. a-e. (a) Fluoroscopic images of combined standard percutaneous nephrolithotomy-microperc procedure; (a, b) Complex staghorn calculi of the patient with horseshoe kidney. (c) Insertion of microperc sheath into the kidney after clearance of stones except for upper caliceal system. (d) Microperc procedure for upper caliceal stones. (e) Appearance of the collecting system after complete clearance of stones

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Figure 2. Standard and microperc access sites in the combined standard percutaneous nephrolithotomy -microperc procedure

uric acid, and mixed stones were found in 8 (34.8%), 3 (13%), 1 (4.4%), and 11 (47.8%) patients, respectively. Demographic and operative data are summarized in Table 1 and Table 2.

Discussion

Staghorn calculi are complex stones extending into multiple calyceal systems. Stones in multiple caliceal systems are also deemed to be complex kidney stones. The treatment of such stones may lead to problems for both urologists and patients because of higher complication and lower success rates. Complementary procedures, such as shock wave lithotripsy and PNL, may be needed postoperatively for failed cases.[12] Complete clearance of kidney stones in a single session is important for minimizing recurrence and morbidity.[1]

Popular endoscopic combined technique called endoscopic combined intrarenal surgery (ECIRS) is considered for a large stone burden or complex renal calculi. It is performed with the patient in a modified supine position, using a retrograde approach with flexible ureteroscopy (f-URS) and an antegrade approach with PNL. This technique is especially advantageous for obese patients. ECIRS has a comparable stone-free rate with no increase in access number or blood loss.[14,15] Although supine PNL is gaining popularity, prone position is used most commonly and it is the traditional position for PNL. We routinely perform prone PNL in our department because of lack of experience with supine PNL.

Using a flexible nephroscope through a sheath might increase the success rate of PNL for the treatment of complex kidney stones. However, this approach is associated with several challenges, such as a steep learning curve, prolonged operating and fluoroscopy times, and decreased image quality due to urine leakage around the sheath.[9] Therefore, it may not be possible to use a flexible nephroscope in all cases and they may not be readily available in all urology clinics. Even with the use of a flexible nephroscope, residual fragments located in peripheral calices may not be accessible. In this situation, an additional access should be created to achieve stone removal. In our series, the decision to make an additional access was taken when we could not reach a residual stone using rigid/flexible nephroscopes.

Akman et al.[7] reported the management of complex kidney stones with multiple accesses. In their method, the operating and fluoroscopy times were prolonged, although the stone-free and hemorrhage rates were higher with multiple accesses compared with single access. In a clinical trial of the multi-mini-perc technique in a pediatric cohort aged <5 years, Maholar et al.[13] reported higher rates of stone-free status and hemorrhage with multiple accesses. In a prospective trial analyzing the factors related to hemorrhage in PNL, Kukreja et al.[16] reported a correlation between the sheath diameter and the bleeding rate. Therefore miniaturized instruments through smaller sized tracts were used to achieve comparable success with lower complication rates.

To reduce morbidity and hemorrhage, Desai et al.[2] minimized the access sheath using a 4.8 Fr diameter instrument called a "microperc". Clinical trials have proven the efficacy and safety of the microperc, especially for isolated lower pole and moderate-sized kidney stones.[3-6] In our study, in addition to an absence of major complications, stone clearance was achieved using two access tracts in all patients: one for standard PNL and one for microperc. We did not need to perform any additional microperc accesses in our series. The technical similarity of microperc to standard PNL seems to be an advantage of the presented method especially for surgeons who are not familiar with the use of flexible nephroscopes. The probability of increased intrarenal pressure, which is reported as a disadvantage of microperc, does not occur with our approach due to the co-existing standard PNL access sheath that allows proper drainage. Fever was observed postoperatively in two patients and treated medically, and one patient had a hemorrhage requiring blood transfusion.

Table 1. Demographic characteristics of the patients

Patients (n)	23
Age (years)*	51.5±18.3
Sex (Female/Male)	8/15
Side (Right/Left)	6/17
BMI (kg/mm²)*	29.7±4.4
ASA (n) (%)	
-ASA 1	12 (52.2%)
-ASA 2	8 (34.8%)
-ASA 3	3 (13%)
Stone size (mm)*	54.3±7.9
Stone locations (n) (%)	
-Staghorn	15 (65.2%)
-Multipl Calices	8 (34.8%)
Grade of Hydronephrosis (n) (%)	
-Nil or Mild	14 (61%)
-Moderate or severe	9 (39%)
Opacity (n) (%)	
-Opaque	22 (95.6%)
-Non opaque	1 (4.4%)

*mean±SD. ASA: American Society of Anesthesiologists; BMI: body mass index

Table 2. Operative outcomes of the patients

Puncture site (n) (%)	
-Lower + upper calyx	15 (65.2%)
-Middle + upper calyx	4 (17.4%)
-Middle + lower calyx	2 (8.7%)
-Lower + lower calyx	2 (8.7%)
Access location (n) (%)	
-Subcostal	20 (86.9%)
-Supracostal	3 (13.1%)
Operative time (minutes)*	88.2±29.5
Flouroscopy time (minutes)*	5.3±2.9
Post-operative catheterization (n) (%)	
-Only Nephrostomy	19 (82.6%)
-Only DJ stent	1 (4.4%)
-Nephrostomy +DJ stent	3 (13%)
Complication (n) (%)	3 (13%)
-Hemorrhage	1 (4.3%)
-Fever	2 (8.7%)
Hemoglobin drop (mg/dL)*	2.5±1.3
Blood transfusion (n) (%)	1 (4.4%)
Hospital stay (days)*	2.9±0.8
Outcome (n) (%)	
-Stone free	18 (78.2%)
-≤4 mm rest	3 (13.1%)
->4 mm rest	2 (8.7%)

*mean±SD. DJ stent: double J stent

The retrospective nature and lack of a comparison group may be regarded as limitations of the current study. In addition, the small sample size makes it difficult to draw definitive conclusions. Despite these drawbacks, we believe that it is possible to achieve treatment goals using the approach outlined here.

In conclusion, the treatment of complex renal calculi is challenging that may require multiple renal accesses or multiple sessions of procedures. In these cases, using a smaller sized microperc technique for the residual fragments <2 cm as an additional access combined to standard PNL is an effective and safe method. Future prospective and comparative studies are needed.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Mevlana University School of Medicine.

Informed Consent: Due to the retrospective nature of the study, written informed consent could not obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

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