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Original Research

Comparative Evaluation of Micropercutaneous Nephrolithotomy and Retrograde Intrarenal Surgery in the Management of Renal Stones 10–20 mm in Size

Osman Barut, Faruk Küçükdurmaz, Mehmet Kutlu Demirkol, Bekir Türkay Demir, Tayfun Şahinkanat, Sefa Resim

Department of Urology, Sütçü İmam University School of Medicine, Kahramanmaraş, Turkey

ABSTRACT

Objective: To assess the effects of micropercutaneous nephrolithotomy (microperc) and retrograde intrarenal surgery (RIRS) on treating 10–20-mm kidney stones.

Methods: Twenty-eight patients who underwent microperc (group 1) and 30 patients who underwent RIRS (group 2) between February 2015 and April 2017 were examined. This study included patients with 10–20-mm kidney stones located at a single location. Stone characteristics, fluoroscopy and operation times, stone-free rates (SFRs), and postoperative complications were compared between the two groups.

Results: Age, gender, size, laterality, and stone location,and operation times were similar between the two groups. Moreover, the two groups had similar SFRs (92.9% vs. 90%, p=1.00, respectively). The mean fluoroscopy time was higher in group 1 than in group 2 (p=0.001). The two groups were similar in terms of SFRs (92.9% vs.90%, p=1.00, respectively). The decrease in hemoglobin levels was signifcantly more in group 1 than in group 2 (p=0.001).In terms of postoperative complications, no statistically significant difference was observed between the groups (p=0.277). The mean hospitalization time was 50.21±9.62 and 27.46±7.23 hours in groups 1 and 2, respectively (p=0.001).

Conclusion: Both techniques are successful in treating renal stones and have low complication rates. Microperc is an effective method for managing medium-sized renal stones. However, longer fluoroscopy time and longer hospital stay are the main disadvantages of this technique.

Keywords: Micropercutaneous nephrolithotomy, retrograde intrarenal surgery, renal stone

INTRODUCTION

Urinary system stone disease is a common disease in urology practice. Shock wave lithotripsy (SWL), percutaneous nephrolithotomy (PCNL), and, less frequently, open or laparoscopic pyelolithotomy are standard approaches for treating renal stones (1). The appropriate method is chosen based on the following factors: the location of the kidney stone and its size and the urinary system anatomy. With technological advances, the efficacy of treating kidney stones has improved significantly (1, 2). Recently, retrograde intrarenal surgery (RIRS) has become a more common, effective, and safe treatment option for stones smaller than 20 mm due to the development of the optical system and the introduction of the Holmium: YAG (Ho: YAG) laser (2, 3). RIRS has potential advantages as follows: lower morbidity than percutaneous procedures and a higher success rate in the first session than SWL (4, 5). In 1976, Fernström and Johansson performed the first successful percutaneous removal of renal stones (6). Since then, PCNL has been increasingly used by urologists. PCNL is a successful method for treating kidney stones; however, it has a high risk of complications (7). Technical improvements such as miniaturization of the instruments and the development of smaller sheaths (mini, ultramini, etc.) reduced the procedure-associated morbidity, thereby decreasing the rate of complications without negatively affecting its therapeutic efficacy (8). On the other hand, micropercutaneous nephrolithotomy (microperc) is a single-step procedure performed using an optical puncture system. According to a microperc series by Desai (9) in 2011, high success rates were reported in both adult and pediatric populations (10), indicating that this technique has a high SFR, provides renal access, and reduces the time to initiate lithotripsy (9, 10).

Therefore, in this study, we determined the success and complication rates of microperc and RIRS techniques in patients with medium-sized (10–20 mm) kidney stones retrospectively.

METHODS

We retrospectively analyzed the data of 58 patients who underwent surgery for 10–20-mm kidney stones at a single location

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Corresponding Author: Osman Barut **E-mail:** osmanbrt@hotmail.com

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from February 2015 to April 2017. Twenty-eight patients were treated with microperc (group 1) and 30 patients with RIRS (group 2). A single surgeon conducted all the procedures. Patients with a single renal stone up to 20 mm in size without contraindication to microperc and RIRS were included in the study. Exclusion criteria were as follows: patients who underwent different surgical treatments such as ureterorenoscopy (URS), those who had multiple stones at different locations, and those with active urinary tract infection or hypersensitivity to anesthetic drugs. All patients were informed in detail about the success rates and complications of both treatment methods. The patients' requests and malfunctioning of the devices were factors taken into account when choosing the suitable surgical technique.

Stone size and location, intraoperative findings, and postoperative complications were recorded for all patients. Noncontrast computed tomography (CT) was used to measure maximum stone length defined as stone size. Residual stones were detected with CT 3 months postoperatively; stones of 4 mm or smaller were considered insignificant residues. We evaluated the urine culture results of all patients preoperatively. The antibiotic treatment protocol was similar in both groups. Stone size and location, operation and fluoroscopy times, postoperative hospital stay, analgesic requirements, complications (using the Clavien grading system), hemoglobin levels, and SFRs were compared between the two groups. All procedures performed in studies involving human participants were in accordance with the 1964 Helsinki Declaration and its later amendments.

Microperc Technique

First, a 6-French (Fr) ureteral catheter was inserted into the ureter using a cystoscope in the lithotomy position and fixed to the Foley catheter. Then, the patients were placed in the prone position. A 16-gauge 4.8 Fr all-seeing needle (PolyDiagnost, Pfaffenhofen, Germany) under fluoroscopy was employed to access the appropriate calyx of the kidney. After the stone was visualized, the inner part of the instrument was removed and a three-way connector was attached to the outer part. A connector side port was used for irrigation and the telescope was inserted through the other side. An optical fiber was inserted into the central connector side port, whereas the other port was used for the laser probe (Ho: YAG laser device, Quanta System, S.p.A., Italy). Generally, 272 µm laser probes were employed and the energy settings of the device were set to dust conditions of 0.8 J energy and 8 Hz frequency instead of fragmentation. The foot pedal was used for irrigation. The ureteral catheter was usually removed on the first postoperative day. A double-J (JJ) stent was inserted if there was a significant stone burden or residual stones. The operative time was calculated from the time from accessing the collecting duct system to the removal of the microperc system from the kidney.

Main Points:

- We observed that the success and complication rates of the microperc and RIRS techniques were similar in patients with medium-sized renal stones.
- However, microperc was associated with longer fluoroscopy time, greater decrease in hemoglobin levels, and longer hospital stay.
- Where there is a narrow infundibulopelvic angle, microperc is more useful and favored than a flexible ureteroscope because it provides direct access to low calyx stones.

RIRS Technique

Under fluoroscopy guidance, a guidewire (Sensor ™, Boston Scientific, USA) was inserted into the ureter in all patients under general anesthesia. The collecting duct system was reached using a flexible ureteroscope (7.5 Fr FlexX™ 2, Karl Storz, Tuttlingen, Germany) with a 12 F ureteral access sheath (Flexor®, Cook Medical, USA). Ho: YAG laser was applied with a 200 µ laser probe and the stones were broken in situ. For lithotripsy, the laser was used at a frequency of 0.8–1.5 joules, 10–25 pulses. If necessary, a grasper and 2.4 F Zero Tip Nitinol Basket were employed to manipulate small stone fragments after fragmentation. Fragments of about 2 mm or smaller were not broken down any further. After the procedure, a fluoroscopy-guided placement of a 4.8 F JJ stent or a 5 F ureter catheter was conducted. The ureter catheters were used in the following cases: patients who were declared stone-free postoperatively or when there were no postoperative complications; they were removed on the first postoperative day. On the other hand, the JJ stents were placed in patients with prolonged operation time or minor ureteral wall damage. The operative time was calculated from the beginning of the cystoscopy procedure to the insertion of the ureter catheter or JJ stent into the ureter.

Patients who had no additional complications or complaints in both groups were discharged on the first postoperative day.

Statistical Analysis

Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) software, version 20 (IBM SPSS Corp.; Armonk, NY, USA). Mann–Whitney U test was utilized for comparing the nonparametric values. Pearson's chi-square test was used to compare proportions in different groups. In the power analysis using the G-power computer program for lower calyx stone subgroups, the large effect size (d:0.8) was detected with a power of 80% and an alpha of 0.05. A p value of <0.05 was considered statistically significant.

RESULTS

The patients' demographic characteristics are listed in Table 1. Age, gender, operation times, laterality, and size and location of stones were similar in both groups. The mean fluoroscopy times were 91.00±15.99 seconds (sec) and 48.33±11.78 sec in groups 1 and 2 (p=0.001), respectively. The SFRs were similar in the two groups (92.9% vs. 90%, p=1.00, respectively). In the microperc group, noncontrast urinary CT detected residual stones in two patients had on the third postoperative month; subsequently, they underwent re-microperc and became stone-free. On the other hand, in the RIRS group, residual fragments were observed in 3 patients who became stone-free after the re-RIRS. In group 2, JJ stents were inserted in two patients with minimal ureteral wall injury (Clavien II) and two patients due to the risk of steinstrasse formation, whereas in group 1, JJ stent was placed in one patient

due to the migration of residual stone to the ureter (p=0.354). Hemoglobin levels decreased in both groups; however, group 2 had significantly low levels compared to group 1 (1.47±0.61 g/dL vs. 0.76±0.31 g/dL, p=0.001, respectively). Postoperative fever was observed in four and three patients in the RIRS group and the microperc group, respectively (p=1.00), who were treated with antipyretics (Clavien I). Two patients in group 1 and one patient in group 2 required narcotic analgesics postoperatively (p=0.60). The mean hospitalization time was significantly longer in the microperc group (50.21±9.62 hours vs. 27.46±7.23 hours, p=0.001, respectively). Table 2 summarises the intraoperative and postoperative parameters of the study groups.

Table 1. Patient demographics and stone characteristics for each group

	Microperc group	RIRS group	p
Patients, n	28	30	
Mean (SD) age, years	48.75±8.26	48.03±12.20	0.796
Gender, male:female	19:9	20:10	0.923
Mean (SD) stone size, mm	15.07±2.37	15.43±2.50	0.589
Laterality, right:left	15:13	16:14	1.000
Stone location, n			0.865
Pelvis	11 (39.3%)	14 (46.7%)	
Upper calyx	3 (10.7%)	2 (6.7%)	
Middle calyx	3 (10.7%)	2 (6.7%)	
Lower calyx	11 (39.3%)	12 (52.2%)	

p<0.05 values are statistically significant. SD: standard deviation; n: number; microperc: micropercutaneous nephrolithotomy; RIRS: retrograde intrarenal surgery.

DISCUSSION

SWL, standard PCNL/miniperc, and RIRS are some treatment options for small kidney stones. RIRS and different PCNL sizes (mini, ultramini, and microperc) have similar success and complication rates. In this study, we compared the outcomes of applying microperc and RIRS techniques for treating patients with medium-sized kidney stones and observed that their success rates were similar. However, microperc was associated with longer fluoroscopy time, greater decrease in hemoglobin levels, and longer hospital stay.

SWL is a popular method due to its noninvasive nature; however, it has several drawbacks such as requiring many sessions and additional procedures to achieve renal stone clearance (11). A Cochrane review has reported that PCNL is more effective than SWL in treating renal stones (12). PCNL and RIRS techniques are favored techniques with high success rates, but PCNL is more invasive and has a higher complication rate (13). Blood loss is one of the PCNL complications and might be associated with tract size (14). The use of miniaturized instruments (mini, ultramini, micro, etc.) is starting to be popularized to reduce complication rates. Accordingly, microperc, which involves a single-step stone fragmentation is applied using an optical puncture system for small stones, is speculated to be associated with SFRs and the lowest incidence of morbidity in selected cases (9).

Table 2. Comparison of intraoperative and postoperative variables in the two study groups

Variables	Microperc group	RIRS group	p
Operation time, minutes (mean±SD)	57.60±6.31	56.43±6.08	0.477
Fluoroscopy time, seconds (mean±SD)	91.00±15.99	48.33±11.78	0.001
Intraoperative double-J stenting, n (%)	1 (3.6%)	4 (13.3%)	0.354
Intraoperative complications, n (%) Minor ureteral wall injury (Clavien II)	0 (0.0%)	2 (6.7%)	0.492
Postoperative complications, n (%)	8 (28.5%)	5 (16.6%)	0.277
Hematuria (Clavien I)	3 (10.7%)	0 (0.0%)	0.242
Fever (Clavien I)	3 (10.7%)	4 (13.3%)	0.617
Colic pain (Clavien I)	2 (7.1%)	1 (3.3%)	0.605
Hemoglobin drop g/dl (mean±SD)	1.47±0.61	0.76±0.31	0.001
Postoperative narcotic analgesic requirements, n (%)	2 (7.1%)	1 (3.%)	0.605
Hospital stay, hours (mean±SD)	50.21±9.62	27.46±7.23	0.001
Stone-free rates, n (%)	26 (92.9%)	27 (90%)	1.000

p<0.05 values are statistically significant. SD: standard deviation; n: number; microperc: micropercutaneous nephrolithotomy; RIRS: retrograde intrarenal surgery.

In 2010, Desai et al. (9) first described the microperc technique. Since then, several case series were conducted on the treatment of 10–20-mm renal stones in both children and adults, with approximately 90% SFR and up to 10% complication rates (15).

RIRS is an effective and safe surgical management option for treating medium-sized kidney stones (<20 mm), which has high SFRs and a low risk of major complications (16). Severe bleeding or infection after RIRS is rare. Sabnis et al. reported that SFRs after RIRS ranged from 84% to 97% and that the risk of complications for small renal stones was low (17). In Tepeler et al.'s study, using microperc in 21 patients with lower pole stones resulted in 85.7% SFR (18). In the current study, SFRs were similar in both the groups (92.9% v.s 90%, respectively). Many studies have demonstrated that there were no significant differences between the two techniques in terms of complications (19-21). Cepeda et al. compared the microperc and RIRS procedures and found no significant differences for mild and severe complications (20). In this study, the intraoperative and postoperative complications were statistically insignificant between the two groups, which is in line with Cepeda et al.'s results. None of the patients complained of organ injury or sepsis. Kandemir et al. stated that there was no significant difference in hemoglobin decrease between the microperc and RIRS groups (22). Alternatively, in this study, we observed a significant decrease in hemoglobin levels in the microperc group, which is in agreement with Sabnis et al.'s results (23).

Moreover, in this study, the fluoroscopy time was longer in the microperc group than in the RIRS group, which was similar to the results of Armağan et al. and Kandemir et al. (19, 22). All-seeing needle access was applied to the renal unit under fluoroscopic guidance, leading to prolonged fluoroscopy time, which is a disadvantage of the microperc procedure.

Furthermore, the mean operative time was similar in both the groups, agreeing with the findings of Kandemir et al. and Sabnis et al. (22, 23).

In the RIRS group, the JJ stent was placed in two patients due to the risk of steinstrasse and in two patients for minimal ureteral wall injury, whereas in the microperc group, it was inserted in one patient due to the migration of residual stone to the ureter. However, no significant differences were observed between the two groups. These findings were in line with the findings of Cepeda et al. and Kandemir et al. (20, 22).

Two patients in the microperc group and one patient in the RIRS group required narcotic analgesics postoperatively. Additionally, Sabnis et al. reported that the mean requirement for postoperative narcotic analgesia was higher in the microperc group (23).

In our study, the mean hospitalization time was longer in the microperc group than that in the RIRS group that is similar to Armağan et al. and Kandemir et al. studies (19, 22). Since the incidence of complications associated with bleeding was higher in the microperc group, the length of hospital stay was longer. However, in terms of hospital stay, these findings were not similar to those in Cepeda et al. and Bağcıoğlu et al. studies (20, 21). The number of patients with lower calyx stones was low in both groups; as a result, subgroup analyses for lower calyx stones were conducted. Where there is a narrow infundibulopelvic angle, microperc is more useful and favored than a flexible ureteroscope because it provides direct access to low calyx stones; besides, it is preferred over RIRS in the case of the ureteral strictures or narrow ureters.

The retrospective nature and small sample size were the main limitations of this study. To obtain more accurate results, multicentre studies with large numbers of patients are warranted.

CONCLUSION

Both techniques had high success rates and low complication rates The microperc technique is an effective and reliable management option for renal stones smaller than 2 cm. However, this method has major disadvantages, such as prolonged hospital stay, longer fluoroscopy times, and more hemoglobin drops. Therefore, prospective controlled studies with large sample sizes are required to confirm these results.

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