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The Comparison of Flexible Ureterorenoscopy and mini-Percutaneous Nephrolithotomy in the Treatment of 10-25 mm Kidney Stones in Elderly Patients

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What's known on the subject? and What does the study add?

The surgery of elderly patients are mostly high risk due to the their comorbidities. Although the success rates are similar compared to flexible ureterorenoscopy (F-URS) and mini-percutaneous nephrolithotomy in the treatment of 10-25 mm kidney stones, F-URS is more safety treatment option due to the lower operation time and hemoglobin decrease.

Abstract

Objective: The elderly population has been increasing due to extension in lifespan. Chronic comorbid disorders and medications render a recheck of the treatment modalities of urinary stones for this population. This study aimed to analyse the results of mini-percutaneous nephrolithotomy (PNL) and flexible ureterorenoscopy (F-URS), which are minimally invasive techniques for the treatment of kidney stones in elderly patients.
Materials and Methods: Data of patients who are older than 65 years with 10-25-mm kidney stones and who underwent F-URS (n=51) and mini-PNL (n=33) between 2015 and 2019 were retrospectively studied. Demographic data, operative data and postoperative data were evaluated.
Results: The mean age of group 1 (F-URS) was 71.5±6.4 and of group 2 (mini-PNL) 70.2±5.6 and the mean stone size was 16.1±3.8 mm for group 1 and 19.7±3.5 mm for group 2. The complete stone-free rate was similar in groups 1 and 2 at 1 month postoperatively (78.4% and 72.7%, respectively; p=0.549). Haemoglobin decrease and operation and hospitalisation time were found to be higher in group 2 (p=0.000, 0.0001, 0.002). Complication rates (transfusion-required haemorrhage, fever and colon perforation) were not statistically different between the two groups (p=0.8).
Conclusion: In this study, although the stone-free rate in the F-URS and mini-PNL groups was similar, we believe that F-URS is a safer treatment method in elderly patients with 10-25-mm kidney stones than mini-PNL because of its shorter operation time and lower haemoglobin decrease.
Keywords: Flexible ureterorenoscopy, mini-PNL, urolithiasis

Introduction

Currently, the increase in the average life expectancy has led to an increase in the elderly population in Turkey and worldwide. According to the Turkish Statistical Institute data, the average life expectancy in our country was 78 years (1). This extension in lifespan is followed by an increase in comorbid diseases and the use of multiple drugs, particularly anticoagulants. Although stone diseases do not have an increased prevalence in this patient group, their treatment presents another problem. Therefore, the age and comorbidities of these patients require a review of our priorities in the treatment of kidney stones.

Treatments of kidney stones in elderly patients include shock-wave lithotripsy (SWL), flexible ureterorenoscopy (F-URS), percutaneous nephrolithotomy (standard, mini-, micro-PNL) and laparoscopic or open surgery, as in the normal population. With the recent advances in technology, the use of thinner ureterorenoscopes and nephroscopes has emerged and surgical interventions such as F-URS and mini-PNL have become alternatives to SWL for kidney stones. Studies that have compared mini-PNL and micro-PNL to standard PNL reported similar stone-free rates and similar or even lower complication rates than standard PNL (2,3). Concurrently, the diameters of flexible renoscopes gradually decreased and laser technology

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became stronger, and F-URS has become the forefront alternative surgical technique for kidney stones <2 cm. Several studies in the literature have reported F-URS to have lower complication rates than PNL and above 80% stone-free rates (3). Even though the European Urology Guidelines recommend PNL for stones over 2 cm and F-URS and SWL for stones under 2 cm, F-URS can be used frequently and safely for stones over 2 cm (4). Considering the current comorbidities in the elderly patient group, the use of F-URS is preferred primarily in stones over 2 cm, particularly by experienced clinicians.

This study retrospectively evaluated the minimally invasive techniques, mini-PNL and F-URS, in the treatment of elderly patients with kidney stones 10-25 mm in size and aimed to investigate the effectiveness and safety of two methods used in minimally invasive stone therapy in the elderly patients.

Materials and Methods

Patients and Grouping

Following the approval of the Koru Ankara Hospital local ethics committee (approval no: 07.05.2018/002-1), 174 patients over 65 years who underwent kidney stone treatment between February 2015 and January 2019 were retrospectively analysed. F-URS and mini-PNL surgeries for 10-25-mm kidney stones were included the study. The inclusion and exclusion criteria are presented in the patient flowchart (Figure 1). A total of 84 patients were included in the study, 51 for F-URS and 33 for mini-PNL. The patients who underwent F-URS were classified as group 1 and those who underwent mini-PNL as group 2. The patients' demographical data, comorbid diseases and chronic drug use were evaluated. Anaesthesia risk classification was evaluated using the American Society of Anesthesiologists (ASA) scores. The haemoglobin (Hb), creatinine, urinalysis, urine culture and bleeding parameters including prothrombin time/international normalised ratio were recorded for each patient in the preoperative period and analysed. Ultrasonography and computed tomography (CT) were the imaging methods used. For stone size imaging, the measurement of the longest diameter was used.

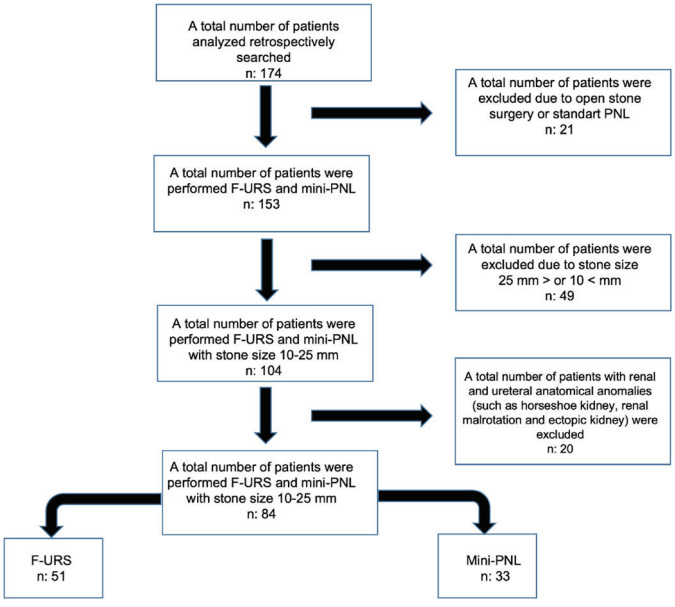

Figure 1. Patient flowchart

PNL: Percutaneous nephrolithotomy, F-URS: Flexible ureterorenoscopy

Hb measurements were performed in each patient in the postoperative period, and plain films of the kidney, ureter and bladder (KUB) were obtained to evaluate stone-free status in day 1. CT was performed to determine the final stone-free status at the first postoperative month. Stone-free status was defined as being completely stone-free in the follow-ups. The operative and postoperative data of the patients were recorded, and complication classification was evaluated using the modified Clavien-Dindo Classification (5).

Each patient was given a single dose of prophylactic antibiotic (third-generation cephalosporin or quinolone) intravenously in the operating room prior to the surgery. All surgeries were performed under general anaesthesia.

Surgical Technique

F-URS: Semi-rigid ureterorenoscopy (7.5 Fr, Richard Wolf GmbH, Knittlingen, Germany) was routinely performed in the lithotomy position for optic dilation and the simultaneous detection of ureteral stone. The ureteropelvic junction was accessed with a 0.035-inch-thick hydrophilic guidewire, which was left in the kidney, and the ureterorenoscope was removed. Then, as described previously (6), the ureter length was measured with a ureteroscope, and a 9.5/11.5-Fr (Cook Medical, USA) ureteral access sheath was placed in the ureter. In cases wherein the ureteral access sheath could not be inserted or no access could be created, the procedure was terminated by inserting a DJ stent in the ureter and postponed to a later time. These patients were excluded from the study. After creating ureteral access, the kidney was accessed using a 7.5-Fr F-URS (Flex X2, Karl Storz, Tuttlingen, Germany). The stone(s) was detected under endoscopic vision and was fragmented with holmium: YAG laser (270 mm fibre, 0.6 J and 6-8 Hz) until it decreased to a size that it could pass by itself. For stone samples, a fragment was taken where possible using a nitinol basket. At the end of surgery, DJ stents were routinely placed in each patient. The DJ stents were removed under sedation at postoperative days 15-21. Operation time was defined as the period starting from the beginning of general anaesthesia until the placement of the DJ stent.

mini-PNL: With the patient in lithotomy position, the open-ended ureteral catheter (5 Fr) was placed retrogradely with the use of a 22-Fr cystoscope in the ureter where the stone was

located. Then, a 16-Fr Foley ureteral catheter was placed in the bladder and determined with a ureteral probe. Afterwards, the patients were placed in the prone position by rotating them over silicone support pads corresponding the pressure points. An 18-gauge access needle was used to determine the appropriate calyx using a C-arm fluoroscopy device (SIEMENS Arcadis Varic C-arm), and entry was achieved. A 0.0035-inch-thick guidewire was sent through the needle and into the kidney (preferably to the upper calyx or the ureter). The nephrostomy tract was provided (14-16 Fr) with Teflon Amplatz dilators (Cook Medical®) through the guidewire. The fluids used had to be close to body temperature to avoid the risk of hypothermia. The stones were reached under endoscopic and fluoroscopic vision using a 10-Fr rigid nephroscope (Karl Storz, Berlin GmbH, Germany). After reaching the stone, ultrasonic, pneumatic (EMS Swiss Lithoclast®Master, Switzerland), or laser (Dornier© MedTech Laser GmbH, Medilas H, h20-1518, Germany) lithotripsy was applied. The fragmented pieces were removed with forceps or a nitinol basket. The operation was completed when no residual stone was seen endoscopically and fluoroscopically. An antegrade D-J ureteral stent and a 10-Fr percutaneous nephrostomy catheter were routinely placed in each patient at the end of the operation and removed at 18-48 hours postoperatively. The DJ stents were removed under sedation on postoperative days 14-21.

Postoperative Follow-up

On postoperative day 1, hemogram, routine biochemistry, and KUB tests were performed on each patient. Fever, urine output, haematuria status and nephrostomy colour were assessed during general examinations. In addition to general and routine examinations, CT was performed on each patient in the first postoperative month to evaluate stone-free status. Ultrasonography was not routinely performed. Ultrasonography was performed when needed. The patients were given a single dose of third-generation cephalosporin postoperatively for preventive purposes for 3-5 days. Paracetamol was preferred for analgesia. Meperidine hydrochloride was given in appropriate doses when needed and only within the hospital stay period. Those who discontinued anticoagulants were recommended to re-start taking their medications on postoperative day 7 if bleeding was not noted. During anticoagulant administration, low-dose enoxaparin sodium was applied subcutaneously. Enoxaparin sodium was started as of postoperative day 1.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for Social Sciences 20.0 software (SPSS 20.0 for MAC). Descriptive statistics are presented as mean ± standard deviation, frequency and percentages. The Shapiro-Wilk test was used to determine whether the data showed normal distribution. It was observed that all the parameters we examined conformed to normal distribution. Student's t-test (t-test in independent groups) was used to compare normally distributed continuous variables, and the chi-squared test was used to compare stone-free rates. $p<0.05$ was considered statistically significant.

Results

The patients' demographic data and preoperative parameters are presented in Table 1. There was no statistically significant difference between the demographic data of the two groups. The mean stone size was calculated as 16.1±3.8 mm for group 1 and 19.7±3.5 mm for group 2 (p=0.687). The mean ages of the patients included in the study were 71.5±6.4 for group 1 and 70.2±5.6 for group 2.

When the groups were compared, the complete stone-free rates in the first postoperative month were similar (p=0.549). Hb decrease, operation time and duration of hospital stay were found to be higher in the mini-PNL group (p=0.0001, p=0.0001, p=0.002, respectively). Perioperative and postoperative parameters are presented in Table 2.

When preoperative anaesthesia risk classification was developed, group 1 had 1 ASA I patient, 26 ASA II patients, 22 ASA III patients and 3 ASA IV patients, whereas group 2 had 1 ASA I patient, 15 ASA II patients, 16 ASA III patients and 1 ASA IV patient (p=0.981).

When the patients were compared in terms of complications, no statistically significant difference was found between the two groups (p=0.08). No major complications were seen in group 1.

Table 1. Demographic data and preoperative parameters of patients

	F-URS (n=51)	mini-PNL (n=33)	p
Mean age ± SD	71.5±6.4	70.2±5.6	0.292
Mean stone size (mm)	16.1±3.8	19.7±3.5	0.687
Gender (male/female)	35/16	23/10	0.918
Surgical side (%)			
Right	21 (41.2%)	16 (48.5%)	0.122
Left	24 (47%)	17 (51.5%)	
Bilateral	6 (11.8%)	0	
Stone placement (%)			
Upper pole	4	2	0.346
Medium pole	5	4	
Lower pole	13	15	
Renal pelvis	19	7	
Multiple	10	5	

F-URS: Flexible ureterorenoscopy, mini-PNL: Mini-percutaneous nephrolithotomy, SD: Standard deviation

Non-persistent fever was recorded in two patients, and urinary tract infection was noted in one patient; both conditions were treated appropriately. In group 2, bleeding requiring transfusion was detected in one patient and colon perforation in another. The patient with colon perforation was explored intraoperatively and treated appropriately. The ASA scores and complications of the patients are presented in Table 3.

Table 2. Preoperative and postoperative parameters

	F-URS (group 1)	mini-PNL (group 2)	p
Fluoroscopy time (seconds)	0	183.1±33.1	0.0001
Operation time (minutes)	56.4±14.2	77.2±28.4	0.0001
Haemoglobin decrease (mg/dL)	0.21±0.2	1.96±0.9	0.0001
Complication rate (%)	3 (5.8)	2 (6.1)	0.08
DJ stent insertion (%)	46 (90.1)	29 (87.9)	0.856
Nephrostomy tube placement rate (%)	0	5 (15.15)	0.0001
Hospitalisation time (hours)	19.48±3.6	36.4±8.5	0.002
Stone-free rate (1st month) (%)	78.4	72.7	0.549

F-URS: Flexible ureterorenoscopy, Mini-PNL: mini-percutaneous nephrolithotomy

Table 3. ASA scores of patients and complications

Complication	F-URS (n)	mini-PNL (n)
Transfusion requiring haemorrhage (Clavien 2)	0	1 (ASA 2)
Fever (Clavien 1)	1 (ASA 2) 2 (ASA 3)	0
Colon perforation (Clavien 3)	0	1 (ASA 3)
TOTAL	3	2

F-URS: Flexible ureterorenoscopy, mini-PNL: Mini-percutaneous nephrolithotomy, ASA: American Society of Anesthesiologists

Discussion

Alternatives for surgical techniques for the treatment of kidney stone diseases have been gradually increasing with the advancement of technology. The surgical technique recommended for the normal patient population is generally clear, whereas it is not clearly defined for specific patients such as the elderly. Although the European and American guidelines have listed treatment options (4,7) according to parameters such as size, location, and type of the stone, the order of these options can vary in paediatric and elderly groups, patients with comorbidities, pregnant patients and groups with anatomical anomalies. Hence, we retrospectively screened patients who underwent F-URS and mini-PNL to determine the safest and most effective surgical treatment method for 10-25-mm kidney stones in elderly patients, which has increased in number with the extension of the average life span in our society.

Accompanying comorbid diseases, increased anaesthesia risks and multiple-drug use, particularly anticoagulant drugs, should be considered in urinary tract stone surgery in elderly patients. It is seen that the preoperative ASA scores of our patient group were concentrated at the second and third degrees. This comes with higher complication rates due to surgery compared to younger patients. In our study, the comorbid disease rate was found to be at 78%.

Currently, renal access diameters are known to be between 14 and 22 Fr for mini-PNL, 11 and 13 Fr for ultra-mini-PNL and 4.8 and 10 Fr for micro-PNL (8-10). Previous studies have stated that the reduction of renal access diameters have resulted in lesser haemorrhage incidence, analgesia and complication rate and shorter hospitalisation time. Moreover, stone-free rates have been reported to be the same as standard PNL (11-13). Stone-free rates appear to be at 87-90% for mini-PNL (14-18) in literature. In our study, the stone-free rate was found to be 72.7% in mini-PNL, which is not consistent with that of existing literature. We defined stone-free as no stone. However, the studies in the literature described stone-free as residual stones <3 mm. Thus, we believe that our stone-free rate seems to be low compared to that of the literature.

The most concerning complications that may occur during PNL operations in the elderly patient group are cardiac and pulmonary complications. No cardiac or pulmonary complications occurred in any of our patients. In a study by Okeke et al. (19), the results of PNL operations were compared between elderly and young patient groups, and it was found that stone-free rates did not change in PNL, while complication rates increased with age (20). In our study, the complication rate for mini-PNL was found to be at 6.1% in advanced age patients, similar to our complication rates after mini-PNL in the younger age group. The colon perforation that occurred in one patient was noticed during the operation, and a temporary ileostomy was opened in the patient with the help of the general surgery team. The patient was then discharged on postoperative day 4. One of our patients had an Hb decrease requiring transfusion in the postoperative period. Although our complication rates seem to be low in the mini-PNL group, we believe that more serious complications may be seen in elderly patients undergoing PNL. Causes such as bleeding diathesis due to intense use of anticoagulants and replacement of the colon and/or other organs to the back of the kidney in the retroperitoneum due to previous operations are some of the factors that increase the risk of complications.

In contrast, stone-free rates in endoscopic stone disease treatment with flexible renoscope have been reported to be between 75 and 85% in the literature, similar to mini-PNL (15,21,22). In our results, the stone-free rate after F-URS was found to be at 78.4%, consistent with that of the literature. In 2014, the Clinical Research Office of the Endourological Society

URS study group published the results of 1210 patients who underwent F-URS. The patients were divided into three groups according to stone size: under 10 mm, 10-20 mm and over 20 mm. In the study, stones larger than 1 mm were defined as residual kidney stones. According to this study, the stone-free rates were reported to be at 90.5% in the first group, 76.9% in the second group, and 31.4% in the third group. However, in this study, stones larger than 1 mm were considered as stone-free. Therefore, we hypothesised that the stone-free rates of F-URS are determined to be low for stones 10-20 mm and over 20 mm in size (23). In another study on 279 patients, stones larger than 3 mm were determined as residue stones, and the patients were similarly divided into three groups. In the study, the stone-free rates were reported as 84.4%, 76.5%, and 60%, respectively (24).

In studies comparing F-URS and mini-PNL, operation time and duration of hospital stay were reported to be higher in the mini-PNL groups. A study by Gao et al. (17) comparing the F-URS and mini-PNL groups reported that Hb decrease and hospitalisation time were significantly increased in the mini-PNL group; however, operation time and complication rate between the two groups showed no difference (19). Conversely, Pan et al. (25) compared operation times between two groups and reported them to be 73 minutes in the F-URS group and 62 minutes in the mini-PNL group. These studies were conducted on the young age group. In our patient group, the operation times were 56.4±14.2 and 77.2±28.4 minutes in groups 1 and 2, respectively, whereas hospitalisation times were 19.48±3.6 and 36.4±8.5 hours in groups 1 and 2, respectively. The mean Hb decrease was 0.21±0.1 mg/dL in group 1 and 1.96±0.9 mg/dL in group 2, including one patient in group 2 who had a Hb decrease requiring transfusion.

Study Limitations

Our study had two main limitations. The first was the low number of study patients. The other was that our study was conducted retrospectively. However, there are clear difficulties in carrying out a prospective study with a large population in this patient group, considering the conditions of our country.

Conclusion

Our results showed similar stone-free rates in the F-URS and mini-PNL groups. Additionally, both groups had extremely low complication rates. These results are consistent with those in existing literature. However, this study had a few negative outcomes such as longer operation times and higher Hg decrease in the mini-PNL group compared to the F-URS group. Thus, we suggest that F-URS is a more appropriate treatment option for renal stones 10-25 mm in size in elderly patients.

Ethics

Ethics Committee Approval: This study was approved by the Koru Ankara Hospital Local Ethics Committee (protocol no: 07.05.2018/002-1).

Informed Consent: All patients underwent the procedure after obtaining written informed consent.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: G.E., B.K., M.K., Concept: G.E., M.K., Design: G.E., M.K., Data Collection or Processing: B.K., Analysis or Interpretation: G.E., B.K., Literature Search: G.E., B.K., M.K., Writing: G.E., B.K., M.K.

Conflict of Interest: No conflict of interest was declared by the authors.

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