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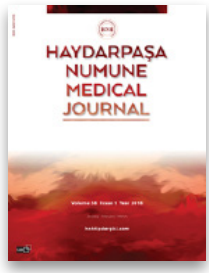

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ORIGINAL ARTICLE

Retrograde Intrarenal Surgery for Management of Kidney Stones Smaller Than 20 mm: A Singe Center Experience of 452 Cases

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Abstract

Introduction: This study presents our outcomes of 452 patients who underwent retrograde intrarenal surgery (RIRS) for treatment of renal stones smaller than 20 mm in last five years.

Methods: We retrospectively reviewed file of 452 patients who were performed RIRS for renal stones in our clinic between January 2013 and February 2018. Fluoroscopy was always used in all cases. Patients were investigated regarding to demographic and operation data, stone location and size, and stone free rates. Patients were controlled by direct urinary system graphy at postoperative first day and by non-contrasted computed tomography (CT) at 1 month after the intervention. Stone-free status was documented on CT if there were no residual stones or presence of residual fragments smaller than 3 mm after 1 month.

Results: There were 285 (63%) male and 167 (36.9%) female patients with a mean age of 47.9 (range 12-85) years. Mean stone size was 13.5 mm (range 7-20 mm). Ureteral access sheath was used in 388 (85.8%) patients. Mean operative and fluoroscopy screening times were 70.6 (range 45-150) minutes and 17.6 (range 3-55) second, respectively. The average hospital stay was 1.3 (range 1-5) days. Twenty (4.4%) patients had minor complications, including renal colic, hematuria, infection and/or fever. No major complications and blood transfusions were noted. Stone-free status was achieved in 403 (89.1%) patients at first month postoperatively.

Discussion and Conclusion: We believe that RIRS is an effective, reliable and safe treatment modality for kidney stones smaller than 20 mm. The procedure has low morbidity and high success rate.

Keywords: Flexible ureterorenoscopy; renal stone; retrograde intrarenal surgery.

Kidney stones are one of the most common diseases causing patient suffering, loss of work, and morbidity with socioeconomic consequences [1]. The prevalence of urolithiasis has been noticed as 2.8% in the USA, 1.5% in the Europe, and 14.8% in Turkey [2,3]. In addition, urinary system stone disease has a tendency for recurrence with a rate of 50% over 10 years.

The treatment of renal calculi has evolved considerably during last four decades. In parallel with progress of technology in management of renal stones, lower morbidity and higher stone-free rates have been obtained. Previously, renal stones have been managed with open surgery, while currently many minimally invasive treatment techniques as electroshock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL), retrograde intrarenal surgery (RIRS), and laparoscopic surgery can be applied in place of open surgery. The ideal treatment would be complete stone clearance in a single session with minimum trauma

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to the patients and prevention of new stone formation. The preference among the treatments depends on size, hardness and position of stone and experience of surgeon [4, 5].

With advances and highly qualified imaging modalities in technology, minimally invasive methods are all used more effectively for management of renal stones. Technical improvements including endoscope miniaturization, improved deflection mechanism, enhanced optical quality and tools, and introduction of disposables have led to an increased use of RIRS for renal stones. The purpose of all these technological developments is to provide the least morbidity and achieve no stone state. According to European Association of Urology guidelines, use of flexible ureterorenoscopy (f–URS) as an reliable and efficient alternative usually for patients with obesity, complex anatomical kidney, musculoskeletal deformities, bleeding diathesis, unsuccessful ESWL procedure, and stones with size less than 2 cm [6]. Although PCNL with an enhanced morbidity for compact, and rigid stones larger than 2 cm in diameter has been suggested as a first-line treatment, f-URS can be performed as an alternative surgical treatment for this type of stones [6, 7].

In the present study, we retrospectively analyzed and presented outcomes of 452 patients who underwent RIRS due to different size kidney stones in the last five years.

Materials and Methods

We retrospectively reviewed medical records of 452 patients who underwent RIRS for renal stones at Istanbul Haydarpasa Numune Training and Research Hospital from January 2013 to February 2018. Presented study was conducted in compliance with ethical principles defined in Helsinki Declaration. Approval was obtained from the scientific committee of our hospital and written informed consent was obtained from all participants and/or relatives before the operations. The study included patients with kidney stones with smaller than 20 mm, ESWL-refractory or previously failed ESWL, those associated with musculoskeletal deformities and bleeding disorders. Demographic data of patients, size and site of stones, duration of operation, stone free rates, and duration of hospital stay were investigated. All patients were preoperatively evaluated with physical examination, routine blood tests, coagulation tests, urinalysis, urine culture, direct urinary system graphy (KUB), urinary system ultrasound (US), non-contrasted computed tomography (CT) and/or intravenous pyelography (IVP). Patients with positive urine cultures were adequately treated with appropriate antibiotics and all patients had a negative urine culture prior to surgery. Stone size was determined by measuring the longest axis on preoperative radiologic investigation. In patients with multiple renal stones, the stone size was calculated as the sum of the greatest dimensions of each stone.

Surgical Technique

Before the procedure, intravenous antibiotics (first–generation intravenous cephalosporin) were administrated. Under general anesthesia, firstly patients were placed in the lithotomy position on an endoscopy table with fluoroscopic imaging capability. Then under scopy, a hydraulic 0.035-inch safety guidewire was advanced upward inside ureter. Semi-rigid ureterorenoscopy (9.5 Fr Karl Storz Ureterorensocope, Germany) was performed to exclude presence of any ureteral surprise pathology such as transitional cell carcinoma in the ureter and dilate the ureter. After two guidewires were advanced to renal pelvis, a 9.5/11.5 F ureteral access sheath (UAS) was placed over guidewire to sustain low intrarenal pressure and to simplify extraction of stone fragments. Then a 7.5 to 8.5 Fr flexible ureterorenoscope (FLEX-X2Karl Storz Endoscopy, Germany) was passed through UAS. F-URS was passed into the renal pelvis over the guidewire in the case of unsuccessful placement of UAS. When access could not be provided due to obstruction in ureteral orifice or other areas of ureter, a Double-J stent was inserted, and operation was done after 2–4 weeks of passive dilatation. Stones were fragmented with a 272 µm holmium laser probe at an energy level of 0.6–1.0 J and frequency of 10–20 Hz until they were deemed small enough to pass spontaneously. Irrigation was delivered using pressure pump with regulated rate and pressure. At the end of the procedure, a fluoroscope was used to check for large residual fragments. Stone fragments larger than 3 mm were taked out using basket catheter. A Double-J (4.8F) stent and 16 F Foley urethral catheters were inserted in all cases at the end of the procedure.

Patients were controlled at the first postoperative day by KUB after removal of the urethral catheters. If necessary, patients treated with appropriate medical therapy and dietary suggestions were made postoperatively in the outpatient setting. Double-J stents were removed under local anesthesia 2-4 weeks after the operation. If available, stone analyses were done. Stone-free status was determined by low dose protocol spiral CT scan first month after the operation and success was defined as stone-free status or presence of insignificant residual fragments smaller than 3 mm. In patients with residual calculi, second stage RIRS or PCNL was performed. After the first month follow-up, patients were seen

every 6 months during the first year and yearly thereafter.

The data were entered into statistics program. All statistical analysis tests were performed with Statistical Package for the Social (SPSS Version 17.0 for Windows, SPSS Inc., Chicago, IL, USA). As descriptive statistics, frequencies, percentages, and mean values were calculated. Data are presented as mean (min-max) or number and percentage of patients.

Results

Total of 452 patients (male, n=285; female, n=167) underwent RIRS operation. Mean age of female and male patients were 46.3 years (12-83) and 48.9 years (13-85), respectively. Patients' demographic data is summarized in Table 1. The mean stone size was 13.5 mm (range 7-20 mm). The mean stone sizes were 13.6 (9-20) mm in lower, 15.8 (9-20) mm in middle, 14.8 (7-20) mm in upper poles, 17.4 (10-20) mm in renal pelvis, and 12.9 (8-20) mm in multiple calyceal stones. Stones located in lower (n=116; 25.6%), middle (n=49; 10.8%), and upper (n=46; 10.1%) poles, renal pelvis (n=153; 33.8%), and multiple calyces (n=88; 19.4%). Patients' stone characteristics are summarized in Table 2.

Bilateral RIRS was applied in 13 patients (2.8%) with bilateral calculi during the same session. The patients had solitary kidney (n=18), kyphoscoliosis (n=7), horseshoe kidney (n=6), rotation anomaly (n=5), duplicated collecting system (n=4) and pelvic kidney (n=2). During the surgery, access sheath could not pass, and operation was performed without access sheath in 64 (14.1%) patients. There were 26 (5.7%) patients who semirigid ureterorenoscope could not be advanced bladder and ureter due to stricture, abnormality of prostatic urethra and/or bladder neck even in young patients. For these cases, ureteral Double J catheter was put in then RIRS was carried out 2-4 weeks later. No balloon dilation was applied to any patient.

Mean operation time was 70.6 (range 45-150) minutes. Mean operation times according to location of stones were as follows: lower pole 78.1 (55-150) minutes, upper pole 57.3 (45-90) minutes, middle pole 67.4 (60-90) minutes, pelvis 69.9 (40-150) minutes and multiple calyces 71.9 (45-150) minutes. The mean duration of fluoroscopy and hospital stay were 17.6 (3-55) second and 1.3 (1-5) days, respectively. There were total twenty (4.4%) minor complications which included thirteen patients with infection and/or fever (>38°C) were hospitalized for about 5 days and treated with antipyretics and appropriate antibiotics according to their urinary culture results. Other remaining seven patients suffered from renal colic and hematuria treated with oral analgesics. No major complication occurred. No blood transfusion was required. There were no admissions to intensive care or deaths. At postoperative first month follow up, complete stone-free rates and insignificant residual fragments (<3 mm) were achieved in 355 (78.5%) patients and 48 patients (10.6%), respectively, while 49 (10.8%) patients with residual stones >3mm in size. These patients with greater than 3 mm residual stones were managed

Table 1. Demographic datas of the patients

Parameters	Values n (%)
Gender	
Male	285 (63)
Female	167 (36.9)
Age, years	
<18	10 (2.2)
18-65	390 (86.2)
>65	52 (11.5)
Antithrombotic and/or antiaggregant use	
Yes	25 (5.5)
No	427 (94.4)
History of ESWL	34 (7.5)
Prior history of open surgery	
Yes	13 (2.8)
No	439 (97.1)
Preoperative Double-J stent	42 (9.2)
Degree of hydronephrosis before operation	
None or mild	386 (85.3)
Moderate or severe	66 (14.6)

Table 2. Demographic characteristics of the stones

Parameters	Values n (%)
Stone Diameter	
10-20 mm	405 (89.6)
<10 mm	47 (10.3)
Stone location	
Pelvis	153 (33.8)
Lower pole	116 (25.6)
Upper and middle pole	95 (21)
Multiple calyces	88 (19.4)
Number of stones	
Single	313 (69.2)
Multiple	139 (30.7)
Stone side	
Left	206 (45.5)
Right	233 (51.5)
Bilateral	13 (2.8)
Stone opacity	
Radiopaque or poor radiopacity	432 (95.5)
Non-opaque	20 (4.4)
Hounsfield units, average (range)	898.3 (580-1270)

with second session RIRS (n=32), PCNL (n=9) and conservative medical management (n=8). Operation was ended prematurely due to very hard stone in 7 patients, blurred vision secondary to bleeding in 12 patients, inability to approach to stone using flexible ureterorenoscope in 12 patients and technical fault in 2 patients. At first month control, we achieved a total success rate of 89.1% (n=403). Distribution of success rates according to location of renal stones was detected as follows: lower pole 76.3%, middle pole 85.6%, pelvis 93.9%, upper pole 94.3%, and multiple calyces 81.5% percent.

Discussion

Urinary system stones are third most common pathological condition following urinary tract infections and prostate diseases. Aim of urinary stone management is achieving the highest stone-free rate with the lowest morbidity. In recent years treatment of renal stones changed considerably, and thanks to advancement of minimally invasive methods, highest stone-free rates have been achieved with minimal morbidity. Treatment options have varied from open surgery to less invasive standard, mini-ultra mini or micro PCNL, ESWL and RIRS. Among these procedures, role of RIRS has broadened in last decade and f-URS has become a very important alternative in diagnosis of upper system pathologies and treatment of renal stones. In recent years, with its low morbidity and its use of natural orifice, this technique is accepted as the first-line treatment for renal stones by both patients and surgeons.

The first RIRS series was carried out in the year 1990 using f-URS in 208 patients with renal stones, following mechanical ureteral dilation performed for one or two weeks with resultant 87% stone-free rates [8]. Today, ureterorenoscopic management of renal calculi provides an alternative to SWL or PCNL, potentially achieving higher stone-free rates than SWL with lower morbidity than PCNL. Although RIRS is usually recommended as a first-line management for renal calculus up to 20 mm, it allows for the treatment of increasingly larger stones in kidney thus decreasing role of PCNL and open surgery. Recent studies reported that stone free rates above 90% for RIRS in management of renal stones and as high as 85% for management of lower pole stones [9]. Even in complicated cases, such as stones in chronic kidney disease patients or stones larger than 20 mm, high stone free rate and safety have been reported [10].Although RIRS can also be safely used in stones larger than 20 mm, we did not evaluated patients with larger than 20 mm renal stones.

Double-J stenting, as an end part of the procedure, is still controversial and frequently is recommended to place at the end of the operation. Wu et al. [11] has suggested that a Double-J catheter should be placed in all patients if an access sheath has already been placed. When absence of trauma and no residual stone was present, some authors reported that stent was not needed to place and that no complication was occurred [12]. They recommended that it is not necessary to place a ureteral stent routinely after uncomplicated ureterorenoscopic lithotripsy [12]. In order to reduce mucosal edema and facilitate small stone fragment passage, we have preferred to place a Double-J catheter in our all cases at the end of operation.

Watterson et al. performed F-URS in 25 patients with bleeding diathesis who were receiving antiaggregant and anticoagulant therapy with 96% success and noticed development of retroperitoneal hematoma during postoperative session which needed blood transfusion [13]. In these patients, authors underlined that antiaggregant and/or anticoagulant therapy should be stopped in patients planned for PNL or ESWL and for these patients RIRS was a safety and effective treatment option. Unlike this study, RIRS was successfully carried out on 25 patients with renal stones without discontinuance of anticoagulant or antiaggregant therapy. No complication was seen in our presented study. We think that anticoagulant and/or antiaggregant treatment has no effect on treatment of renal stone success rates.

Nowadays in complicated and challenging patients with bleeding diathesis, urinary diversion, morbid obesity, horseshoe and pelvic kidney, calyceal diverticula, polycystic kidney, lower pole stones, non-opaque and ESWL refractory stones, RIRS has been choosing as a the first-line treatment [14]. When reviewing the literature Eryildirim et al. [15] retrospectively evaluated results of RIRS they carried out on 50 cases with horseshoe kidneys. Astolfi et al. performed RIRS on 13 patients with fusion and ectopic renal anomalies [16]. In both studies, RIRS has been indicated as safe and feasible choice for the treatment of kidney stones in patients with renal ectopic and fusion anomalies. In our study, RIRS was performed in complicated cases with solitary kidney (n=18), kyphoscoliosis (n=7), horseshoe kidneys (n=6), renal malrotations (n=5), duplicated collecting systems (n=4), and pelvic kidneys (n=2). We did not encounter any complication in these patients, so we believe that presence of renal anomalies do not affect success rates.

Percutaneous nephrolithotomy has its own limitations and possible complications including fever, sepsis, pneumothorax, colonic injury and hemorrhage requiring blood transfu-

sion [17]. On the contrary, in many studies, it was reported that major complications were seen rare, while RIRS complications were seen as lower in Clavien degrees [17]. Considering complication rates, RIRS may have a lower risk of severe complications compared to PCNL because the instruments used are of lower caliber and flexible, and operation is performed through direct vision. Bryniarski and colleagues have assessed outcomes after RIRS and PCNL [18]. They have found that transfusion required in 13 of PCNL patient group and no transfusion in the RIRS patients group [18]. Serious complications are not frequently occurred following RIRS compared to other techniques. The most common complication following RIRS is fever and infection as is seen in other endourological interventions, while the most serious one is ureteral stricture. Most of these patients with infection and fever were treated with antipyretics without change or addition of appropriate antibiotics. Postoperative fever can occur even with a sterile preoperative urine and appropriate antibiotic prophylaxis. We think, positive preoperative urine culture, irrigation rate and speed, and operative time are factors may affect occurrence of complications. In our study, we believe that since all patients applied appropriate antibiotic prophylaxis, a serious infection was not encountered. Only 13 patients had high fever (>38°C) at postoperative first day which was relieved with appropriate antibiotherapy according to urine culture results. No patients experienced severe complications, and there were no admissions to intensive care or deaths in presented series. Results of our study showed a total complication rate (4.4%) lower than previous reports (16.6–27.4%) in the literature [19, 20].

Routine use of ureteral access sheath during RIRS is still under discussion. It is known that access sheath facilitates repeated passage of the ureteroscope, minimizes damage to ureter, improves flow of irrigation fluid and visualization within the urethra, and reduces operative times. In addition, it is known that UAS using, prevent breaking and damaging of ureterorenoscope and prolonged its life. This can improve both the effectiveness of the surgery and reduces the costs. In this context, in a study where effectiveness of access sheaths were evaluated, its routine intraoperative use during RIRS was recommended in that it decreases costs and duration of operations, and causes minimal morbidity [14]. In another study by Kourambas et al. effectiveness of access sheaths was assessed, authors suggested routine use of access sheaths with its advantages of decreased morbidity and expenditures [21]. However, placement of access sheath can carry an increased risk of ureteral wall ischemia and injury to mucosal or muscular layers of ureter, and a theoretically enhanced risk of ureteral narrowing related to the dimensions. Another disadvantage of access sheath is development of postoperative ureteral edema. In a study intrapelvic pressure during f-URS with and without UAS and found higher pressures in without using of the UAS group [22]. According to this study, they concluded that UAS is potentially protective against pyelovenous and pyelolymphatic backflow with clinical implications for the ureteroscopic management of struvite stones or calculi associated with urinary tract infection [22]. Owing to its above-mentioned advantages, we preferred to use access sheaths for most of our patients and did not encountered any sepsis related events. We propose strict aseptic precautions, plasma sterilization, negative urine culture and low intrapelvic pressures due to mostly using UAS as the factors responsible for our low infection rates.

Many authors reported that RIRS as reliable and effective treatment technique in management of renal stones. In the literature, success rates have been reported to range between 65 and 100 percent [14]. Takazawa reported treatment of 2–4 cm renal stone handling RIRS and reached a stone free rate of 100% [23]. Similarly, Prabhakar showed that RIRS could achieve a ultimate 100% stone free rate in treating renal calculi with an average diameter of 25mm after a single or staged procedure [24]. Success rates calculated in our study (78.4%) and complied with these success rates.

Our study has some limitations including its retrospective design in a single center, definition of stone free is a fragment no more than 3 mm, not no stones and lack of any comparison with any other renal stone management modality. In addition, despite same surgical techniques were used in all cases, different surgeons were involved in the procedures and history of previous stone surgery were not evaluated in analysis of results; these factors can be presumed as a limitation.

Conclusion

We think that as an outcome of our study, in line with advanced technology and increased experience together with its minimal morbidity and high success rates of RIRS and laser lithotripsy will play a gradually evolving role in treatment of kidney stones smaller than 2 cm. We also believe that our results should be confirmed by further prospective randomized controlled trials conducted in multicenter.

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