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Original article

Outcome of Retrograde Flexible URS in the Treatment of Renal Stones at Ibn Sina Teaching Hospital, Sirte, Libya

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A B S T R A C T

Renal stones, with a global prevalence of 10%, pose significant challenges, particularly when 2–3 centimeters in size, because of limitations of treatments like percutaneous nephrolithotomy (PCNL) and extracorporeal shock wave lithotripsy (ESWL). Retrograde intrarenal surgery (RIRS) using flexible ureterorenoscopy (F-URS) provides a minimally invasive alternative. To investigate the result of retrograde flexible URS in the management of renal stones (2–3 centimeters) at Ibn Sina Teaching Hospital, Sirte, Libya. This was prospective observational research carried out at Ibn Sina Teaching Hospital in Sirte, Libya. A total of ninety-seven consecutive cases with renal stones of 2-3 centimeters were enrolled in the research. All cases provided informed consent before the procedure, and the research was permitted by the institutional ethics committee. The mean age of cases was 48.7 ± 11.3 years (63.9% male). The mean size of the stone was 2.3 ± 0.3 centimeters, predominantly in the renal pelvis (42.3%). SFR was 68.04% after one session, 88.6% after two, and 94.8% after three. Mean operative time was 102.01 ± 34.69 minutes, and hospitalization was 2.5 ± 1.3 days. Complications included mild hematuria (12.4%), fever (8.2%) (Clavien Grade I), urinary tract infections (6.2%, Grade II), and sepsis (4.1%, Grade IV). RIRS is an effective, safe choice for 2–3 cm kidney stones, offering higher SFR and reduced complication rates than PCNL.

Introduction

Kidney stones are prevalent, with a lifetime occurrence of ten percent in adults. The worldwide frequency is rising because of diabetes and obesity [1]. The predominant cause for emergency admissions to urology departments is flank pain resulting from stones (renal colic). Stones develop in the lower pole of the kidney in roughly thirty-five percent of cases, where they are least likely to be expelled naturally [2].

Developments in technology and case demands for quicker stone removal have prompted alterations in clinical stone treatment. The European Association of Urology (EAU) guidelines suggest ESWL as the primary treatment for kidney stones measuring under twenty millimeters, whereas percutaneous nephrolithotomy is suggested for stones larger than twenty millimeters [3]. Nevertheless, there hasn't been any consensus about the treatment of numerous intrarenal stones in both the American Urological Association (AUA) and the European Urological Association guidelines [4].

The success rate of ESWL in handling numerous intrarenal stones declines to fifty percent, particularly for stones in the lower calyx [5]. Furthermore, due to hard stones, obesity, and unfavorable calyceal anatomy, kidney stones frequently need recurrent interventions or additional procedures [6]. Despite the stone-free rate (SFR) after PCNL being between seventy-eight percent and ninety-six percent, the significant probable related complications and invasive nature of the procedure remain a matter of concern. Furthermore, in cases with significant comorbidities like hemorrhagic diathesis and morbid obesity, PCNL may not be the optimal option [7, 8].

Due to the restrictions of PCNL and ESWL, along with current advancements in laser and F-URS technology, urologists have been investigating non-invasive procedures like RIRS for the treatment of kidney stones in the pelvicalyceal system, which has reported a success rate ranging from 50% to 94.2% [9]. Our research aimed to examine the results of retrograde flexible URS in the treatment of renal stones (two to three centimeters) at Ibn Sina Teaching Hospital, Sirte, Libya.

Methods

Study design and Patients

This was prospective observational research performed at Ibn Sina Teaching Hospital in Sirte, Libya. A total of ninety-seven consecutive cases with renal stones of two to three centimeters have been enrolled in the research. All cases provided informed consent before the procedure, and the research was permitted by the institutional ethics committee.

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Eligibility criteria
Adult cases (eighteen years and older) with renal stones measuring 2-3 centimeters in diameter and patients without significant ureteral strictures that would prevent ureteroscope passage were included. We had excluded cases with stones greater than 3 centimeters in diameter, cases with stones smaller than 2 centimeters, pregnant women, patients with solitary kidneys, and patients with severe cardiac, pulmonary, or other comorbidities that would increase surgical risk.

Data collection
All patients underwent a comprehensive evaluation that included personal history and complete history taking, covering the presenting complaint and its duration, current history, past medical history, and past surgical history. A physical examination was performed, consisting of both general and local assessments. Investigational studies were carried out, including routine laboratory tests such as complete blood count, renal function tests, and coagulation profiles. In addition, non-contrast computed tomography (NCCT) was performed to determine stone size, location, and density.

Surgical technique
All procedures have been conducted via a single surgeon utilizing the Flex-X F-URS. A 10F=12F ureteral access sheath & regulated irrigation utilizing the single-action pumping system have been utilized for each case. Holmium laser lithotripsy has been performed utilizing a combination of 400-, 270-fiber.m. Upon reaching the safe deflection limitations for each fiber size, the subsequent smaller size has been utilized. A mixture of basket extraction and irrigation via the access sheath utilizing a 5F open-ended catheter positioned in the upper pole, along with a single-action pumping device, has been utilized to facilitate the removal of fragments. All cases had a Double-J ureteral stent retained. Procedures have been concluded when fragmentation was considered complete or when visibility was technically restricted due to fragment load or hemorrhage. Patients received perioperative antibiotics, predominantly a 3rd-generation cephalosporin combined with ampicillin in the presence of a stent. Three days of fluoroquinolone were administered post-procedure. Patients having a pre-existing ureteral stent or a history of frequent infections of the urinary tract received a fluoroquinolone for 5 days before the procedure and three days post-treatment, unless the preoperative urine culture indicated an alternative antibiotic regimen. If the stone was deemed sufficiently addressed following the initial surgery, a follow-up abdominal X-ray was arranged for two weeks later. Patients with identified remaining stones were scheduled for the 2nd stage of ureteroscopy one to two weeks later.

Outcome Measures
The 1ry finding was the SFR. 2ry finding involved operative time, the interval of hospital stays, and complications.

Statistical Analysis
Information has been analyzed using the Statistical Package for the Social Sciences (SPSS) software program. Information has been presented as numbers and percentages for qualitative factors and as mean plus SD for the quantitative information. A P value under 0.05 signifies statistically significant outcomes.

Results
(Table 1) illustrates that the mean age of the study group was 48.7 ± 11.3 years. Men represented 63.9% and females 36.1%. The mean BMI was 24.8 ± 3.2 kilograms per square meter. Comorbidities included hypertension in 9.3%, diabetes mellitus in 6.2%, and cardiac conditions in 16.5% of the participants. Preoperative laboratory values showed a mean hemoglobin concentration of 13.6 ± 2.1 grams per deciliter and a mean creatinine level of 0.96 ± 0.3 mg/dl.

Table 1: Baseline characteristics of the study group.

Baseline characteristics	Study group (number=97)
Age years Mean ± SD	48.7 ± 11.3
Gender	
Male	62 (63.9%)
Female	35 (36.1%)
BMI (kg/m²)	24.8 ± 3.2

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Mean ± SD	
Comorbidities	
Hypertension	9 (9.3%)
Diabetes Mellitus	6 (6.2%)
Cardiac	16 (16.5%)
Preoperative laboratory	
Hemoglobin (g/dl) Mean ± SD	13.6 ± 2.1
Creatinine Mean ± SD	0.96 ± 0.3

SD: Standard Deviation

Table 2 shows that the mean size of the stone was 2.3 ± 0.3 centimeters. Stone laterality was nearly evenly distributed, with a slight predominance on the left side (54.6%) compared to the right (45.4%). The most common stone site was the renal pelvis (42.3%), followed by the lower calyx (32%), while the upper calyx was the least affected site (6.2%). The mean density of stone was 836 ± 262 Hounsfield units (HU).

Table 2. Stone characteristics in the study group.

Stone characteristics	**Study group (number =97)**
Stone Size (centimeters) Mean ± SD	2.3 ± 0.3
Stone side	
Right	44 (45.4%)
Left	53 (54.6%)
Stone Location	
Pelvis	41 (42.3%)
Lower calyx	31 (32%)
Middle calyx	19 (19.6%)
Upper calyx	6 (6.2%)
Stone Density HU Mean ± SD	836 ±262

Table 3 shows that the mean operative interval was 102.01 ± 34.69 minutes. The mean fluoroscopy time was 32.10 ± 6.53 seconds. The mean duration of hospitalization was 2.5 ± 1.3 days. Postoperative laboratory results revealed a mean hemoglobin concentration of 12.8 ± 1.6 grams per deciliter and a mean creatinine concentration of 1.02 ± 0.2 mg/dL.

Table 3. Operative and postoperative data in the study group.

Variables (Mean ± SD)	**Study group (n=97)**
Operative time	102.01 ± 34.69
Fluoroscopy time (s)	32.10 ± 6.53
Hospitalizations in days	2.5 ± 1.3
Postoperative laboratory	
Hemoglobin	12.8 ± 1.6
Creatinine	1.02 ± 0.2

Table 4 shows that the SFR following the 1st session was 66 patients (68.04%). Following the 2nd session, the rate rose to 86 patients (88.6%), and after the third session, it reached 92 patients (94.8%).

Table 4. SFR in the study group.

Stone-Free Rate	First session	second session	Third session
	66 (68.04%)	86 (88.6%)	92 (94.8%)

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Table 5 shows that the most common complications were mild hematuria (12.4%) and fever (8.2%), both classified as Clavien Grade I. Clavien Grade II complications occurred in 6.2% of patients due to urinary tract infections. Severe complications classified as Clavien Grade IV (sepsis requiring ICU care) were seen in 4.1% of patients.

Table 5: Complications by Clavien-Dindo Grade in the Study group.

Variables	Study group (number =97)
Clavien I	
Fever	8 (8.2%)
Mild Hematuria	12 (12.4%)
Clavien II	
Urinary tract infections	6 (6.2%)
Clavien IV	
Sepsis requiring ICU management	4 (4.1%)

Discussion

Our results showed that the mean age of the study group was 48.7 ± 11.3 years. Men represented 63.9% and females 36.1%. The mean BMI was 24.8 ± 3.2 kilograms per square meter. Comorbidities included hypertension in 9.3%, diabetes mellitus in 6.2%, and cardiac conditions in 16.5% of the participants. Preoperative laboratory values showed a mean hemoglobin concentration of 13.6 ± 2.1 grams per deciliter and a mean creatinine level of 0.96 ± 0.3 mg/dl. In agreement with our results, Mahmood et al. [10] assessed the effectiveness and safety of retrograde intrarenal operation using laser lithotripsy and flexible URS in the management of multiple KSs. They reported that the mean age of their studied population was 45 ± 13.82 years and a mean BMI of 25 ± 3.39 kilograms per square meter. The majority of the cases (66.4%) were males. A positive history of KS intervention was found in 26.4% of cases. Hypertension was the most frequent comorbidity (74.5%). Ten cases (9.1%) had a history of ischemic heart disease, and nine of them were receiving anticoagulant medications. Also, this study was consistent with Ibrahim et al., [11], who evaluated the clinical result of FURS in the management of kidney stones. They stated that the mean age of cases was 43.7 ± 12.5 years; 58 (38.2%) were women, while 94 (61.8%) were men. The associated co-morbidities included hypertension, hepatic dysfunction, diabetes mellitus, and cardiac problems in 20 (13.1%), 15 (9.9%), 14 (9.2%), and 3 (2%), respectively.

This study reported that the mean size of the stone was 2.3 ± 0.3 centimeters. Stone laterality was nearly evenly distributed, with a slight predominance on the left side (54.6%) compared to the right (45.4%). The most common stone site was the renal pelvis (42.3%), followed by the lower calyx (32%), while the upper calyx was the least affected site (6.2%). The mean density of stone was 836 ± 262 Hounsfield units (HU). Our findings revealed that the mean operative interval was 102.01 ± 34.69 minutes. The mean fluoroscopy time was 32.10 ± 6.53 seconds. The mean length of hospitalization was 2.5 ± 1.3 days. Our results demonstrated that the SFR following the 1st session was 66 patients (68.04%). Following the 2nd session, the rate increased to 86 patients (88.6%), and after the third session, it reached 92 patients (94.8%). The present study showed that the most common complications were mild hematuria (12.4%) and fever (8.2%), both classified as Clavien Grade I. Clavien Grade II complications occurred in 6.2% of patients due to urinary tract infections. Severe complications classified as Clavien Grade IV (sepsis requiring ICU care) were seen in 4.1% of patients.

In harmony with our findings, Mahmood et al. [10] demonstrated that seven cases (6.3%) experienced intraoperative complications, including bleeding in four cases (3.6%) and ureteral injury in three cases (2.7%). Complications following the operation were urinary tract infection (5.5%) and hematuria (1.8%), of which seven cases (6.4%) were readmitted to the hospital and managed conservatively. Five cases (4.5%) needed the second stage of RIRS due to residual stones. Following four weeks, SFR has been achieved in 80.9% of the cases, and this elevated to 93.6% following three months. They concluded that SIRS with flexible URS might be an efficient and possibly safe process for managing numerous KSs. It may produce an excellent SFR with an acceptable complication rate. Also, Ibrahim et al. [11] reported that the mean operative interval was 78.2 ± 17.03 min. Complications following the operation occurred in 65 (42.8%) patients, including UTI in 26 (17%) patients, renal colic in 20 (13.1%) patients, fever in 8 (5.2%) patients, and hematuria in 8 (5.2%) patients. With regard to the modified Clavien classification system (CCS), grade 1 was detected in 36 (23.7%) cases, grade 2 in 26 (17.1%) cases, grade 3 in 2 (1.32%) cases, and a grade 4 complication was seen in one (0.7%) case. After 3 months, the SFR was 68% (104/152 patients) after a single session of FURS. This figure rose to 81% and 82.4% after the 2nd and 3rd sessions, respectively. They concluded that FURS showed elevated effectiveness and reduced major complications in the

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management of kidney stones. Similarly, Alazaby et al. [12] assessed retrograde intrarenal surgery for the treatment of multiple kidney stones and reached a positive conclusion regarding its efficacy. The total success rate is 92.8%; nevertheless, the SFR following a single retrograde intrarenal surgery is at 42.8%, which improves to 87.5% following a second RIRS procedure. Retrograde intrarenal surgery with F-URS and laser lithotripsy is an effective therapeutic modality for cases with numerous unilateral intrarenal calculi measuring eleven to thirty millimeters, accompanied by minimal complications. The success rate is inversely correlated with the burden and number of stones. They recommended the utilization of RIRS for patients with multiple KSs, especially in cases where prior treatments such as ESWL and PCNL have been unsuccessful.

Palmero et al. [13] showed that the mean size of the stone was 2.46 centimeters, with a single stone present in 87.7 percent of cases. The predominant site was the renal pelvis stones (forty-four percent), followed by the lower calyx (thirty-nine percent). The rate of complications following surgery was 6.7 percent, all of which were of minimal significance. The success rate for a single procedure ranged from 79.4 percent to 94.1 percent when considering retreatment. They determined that RIRS is a legitimate substitute for treating kidney stones above two centimeters due to its elevated success rate and minimal complications when conducted in specialized centers.

Cosmin et al. [14] evaluated the effectiveness and safety of FURS compared to PCNL for the management of kidney stones measuring between twenty and forty millimeters in diameter. The SFR following the initial ureteroscopy was superior in the PNL group (90.4 percent) compared to the flexible ureterorenoscopy group (68 percent). Following 2 sessions of ureteroscopy, the stone-free rate was 88.8 percent in the 1st group, and following three procedures, the stone-free rate increased to 95.2 percent. The total complication rate in group 1 was greater in comparison with group 2 (18.4 percent vs. 16.8 percent), though this difference lacks statistical significance ($p > 0.5$). Moreover, the PNL group experienced a higher incidence of grade III and IV problems (8.8 percent versus 4.8 percent, p-value under 0.05). They determined that flexible ureteroscopy is effective in managing renal stones larger than two centimeters. Patients must be informed that numerous procedures may be required to address the complete stone burden.

Conclusion

This study demonstrated that Retrograde intrarenal surgery utilizing flexible ureteroscopy represents a safe and effective minimally invasive approach for the management of kidney calculi measuring between 2 and 3 centimeters. These results support the application of RIRS as a viable alternative to more invasive procedures such as percutaneous nephrolithotomy, particularly for cases with moderate-sized renal calculi, where lower complication risks and faster recovery are desired.

Conflict of interest. Nil

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