Original Article

Efficacy and Safety of Ureteroscopy Without Fluoroscopy **During Retrograde Intrarenal Surgery in Elderly Patients**

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ABSTRACT

Objectives: To determine the efficacy and safety of retrograde intrarenal surgery (RIRS) without fluoroscopy for treating renal or proximal ureteral calculi in an elderly patient population.

Methods: We conducted a retrospective analysis of patients who had RIRS for proximal ureteral or renal stones. Patients were not allowed to participate in the trial if they did not fit the inclusion criteria. Data on preoperative double J (DJ) stent, the side and location of the stone, the size of the stone, the length of surgery, stone-free rates, and complications were documented.

Results: Two hundred eighty-one patients who underwent fluoroless-RIRS (fRIRS) were included in the study. A total of 75 (26.6%) patients underwent general anesthesia and 206 (73.3%) patients underwent spinal anesthesia. The mean operation time was 36.8 ± 18.09 minutes. The mean duration of hospitalization was 1.5 ± 1.8 days. The stone-free rate at the end of the third month was 88.6% (249 patients). No major complications were observed in any patient. The overall complication rate was 7.8%. The most common complications were postoperative colic pain 9 (3.2%), followed by fever 7 (2.4%) and hematuria 6 (2.1%).

Conclusion: Retrograde intrarenal surgery can be performed safely and effectively without fluoroscopy to protect the entire surgical team and elderly patients from the harmful effects of fluoroscopy.

Keywords: Retrograde intrarenal surgery, fluoroscopy, elderly patient, lithotripsy

INTRODUCTION

Renal calculi are a health problem that constitutes a significant share of health expenditures due to their high morbidity rate and frequency of hospital admissions.¹ The recurrence rate after primary renal calculi is approximately 31%, with a high rate of recurrence throughout life. Even though it can be detected at any age, 10%-20% of patients are over 65 years of age.²

Around the world, the number of people aged 65 years and older is expected to represent 16% of the world population by 2050.³ Many studies to date have shown that retrograde intrarenal surgery (RIRS) can be performed safely in elderly patients and has the same success rates as in younger patients.^{4,5} Retrograde intrarenal surgery is currently a practical treatment option for all patients. However, elderly patients usually have more comorbidities and anesthesia-related risk factors than younger patients. Because of the increased complication and mortality rates in geriatric patients due to comorbidity, a multifaceted approach that takes into account risk factors is needed.

In general, fluoroscopic imaging is used for stone delineation, renal anatomy, and to ensure patient safety during RIRS.^{6,7} Fluoroscopy used during urologic surgical procedures exposes the surgeon, patient, and operating room staff to radiation. This carries some potential risks, such as the development of malignancy.8

Some studies investigating the use of the fluoroless-RIRS (fRIRS) technique for the management of stone diseases are available.9

This study aimed to assess elderly patients undergoing surgery for renal or ureteral calculi and to evaluate the

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efficacy and safety of RIRS without fluoroscopy in this demographic.

MATERIAL AND METHODS

The study was designed in accordance with the Declaration of Helsinki and approved by the Karabük University Non-Interventional Clinic Research Ethics Committee (Date: 26.06.2024; Approval No.: 2024/1852). After obtaining the approval of the Local Ethics Committee, the data of the patients were retrospectively analyzed by archive search. Permission was obtained from the hospital management to scan patient files.

We conducted a retrospective analysis of the data from patients who had RIRS for renal or proximal ureteral stones in our clinic between January 2018 and December 2023. Patients with renal anomalies, age <65 years, concurrent bilateral ureteral or renal stones, a history of open renal or ureteral surgery, ureteropelvic obstruction, or urinary diversion were excluded from the study. Patients over 65 years of age, with stones smaller than 20 mm, not using anticoagulants, and having a sterile urine culture were included in the study.

The demographic data, side and locations of the stone, stone size, preoperative imaging method, duration of surgery, preoperative placement of a double J (DJ) stent, stone-free rates (SFR), and complications data were recorded.

The preoperative imaging procedure used in all patients was computed tomography (CT). Stone sizes were identified according to the maximum longitudinal axis of the stones on CT.

Patients were evaluated 6 weeks after surgery with a noncontrast abdomen CT for residual stones and stone-free status. Stone-free data were then classified into 3 grades.

The same surgeons conducted all procedures under spinal or general anesthesia in the lithotomy position. Thirdgeneration cephalosporin was administered intravenously to all patients as prophylaxis.

MAIN POINTS

- Retrograde intrarenal surgery (RIRS) is generally performed under fluoroscopic guidance, which has many adverse effects in elderly patients. Fluoroscopy-free technique eliminates these harmful effects of radiation
- RIRS without fluoroscopy has similar success rates to conventional RIRS.
- The duration and complication rates are very low in fluoroscopy-free RIRS procedure.

Fluoroscopy was not used in our standard fRIRS technique. In this step-by-step technique, all steps were performed visually under direct vision as previously described in pediatric patients by Kirac et al.¹⁰

All patients without any postoperative medical complications were successfully discharged within the first 24 hours postoperatively. Non-contrast CT with 2 mm sections was performed to evaluate stone-free and residual stone status. With the data obtained, the stone-free status was categorized into 3 different groups: grade A (no stones on CT scan), absolute stone-free, grade B (fragments \leq 2 mm) relatively stone-free, and grade C (2.1-4 mm fragments) relatively stone-free. During the postoperative period, all patients underwent a complete metabolic evaluation for stones.

Ethics Committee Approval

The study did not contravene ethical guidelines for research involving human subjects because it was designed in accordance with the principles outlined in the World Medical Association's (WMA) Declaration of Helsinki, Ethical Principles for Medical Research Involving Human Subjects (Declaration of Helsinki), and Good Clinical Practices. Every patient who was part of the study and whose information was used was made aware of it, and their consent was acquired. Before the study began, the Karabük University Non-Interventional Clinic Research Ethics Committee granted the necessary approval (Date: 26.06.2024; Approval No.: 2024/1852).

STATISTICAL ANALYSIS

The data from the patients were assessed using the Statistical Package for Social Sciences (SPSS®), version 21.0 (IBM SPSS Corp.; Armonk, NY, USA). The mean \pm standard deviation (SD) represents the results. The mean and SD values, or maximum median and minimum values, were used to represent numerical data with and without a normal distribution.

RESULTS

Two hundred eighty-one patients who underwent fRIRS were included in the study. Of the 281 patients, 161 (57.2%) were male, and 120 (42.7%) were female. The mean age of the patients was 67.4 ± 6.6 years, and the mean stone size was 13.5 ± 6.26 mm. The total complication rate in our study was 7.2% (22 patients). Clinical data and information about the patients are given in Table 1.

A total of 75 (26.6%) patients underwent general anesthesia, and 206 (73.3%) patients underwent spinal anesthesia for the fRIRS procedure. The operation time was

Variable	Value (n, %)
Gender	
Male	161 (57.2)
Female	120 (42.7)
Age (years)	67.4 ± 6.6
ASA	
I	4 (1.4)
II	70 (24.9)
111	185 (65.8)
IV	22 (7.8)
BMI (kg/m²)	27.7 ± 4.5
Stone laterality	
Right	118 (41.9)
Left	163 (58.0)
Stone size (mm³)	13.5 ± 6.3
Stone localization	
Ureter	79 (28.1)
Renal pelvis	105 (37.3)
Calyces	107 (38.07)
HU	824.81 ± 269.8
Number of stones	1.3 ± 0.76
Preoperative double J stent	
Yes	88 (31.3)
No	193 (68.6)

Table 1.Demographic Data of Patients and Data RegardingKidney or Ureteral Stones

ASA, American Society of Anesthesiologists; BMI, body mass index; HU, Hounsfield unit.

 36.8 ± 18.09 minutes. A total of 88 (31.3%) patients had preoperative DJ stents. The mean duration of hospitalization was 1.5 ± 1.8 days.

Table 2. Surgical Data and Complication Rates of Patients		
Variable	Value (n, %)	
Anesthesia Spinal General	206 (73.3) 75 (26.6)	
Operation time (minute)	36.8 ± 18.09	
Duration of hospitalization (day)	1.5 ± 1.8	
Stone free rate (n, %) Grade A Grade B Grade C	249 (88.6) 201 (71.5) 30 (10.6) 18 (6.4)	
Residual stone >4 mm (n, %)	54 (12.8)	
Postoperative double J stent Yes	421 (100)	
Complication (n, %) Clavien 1-2 Clavien 3-4	22 (7.8) 22(7.8) –	

Among the 281 patients who underwent successful fRIRS, 88.6% (249) were stone-free at the end of the third month: 201 (71.5%) for grade A, 30 (10.6%) for grade B, and 18 (6.4%) for grade C, respectively. The reduction in the average stone volume in patients for whom a stone-free status was not feasible was 53% (32 patients). Perioperative characteristics of the patients and postoperative results are summarized in Table 2.

No major complications (Clavien–Dindo grade 3 and 4) were observed during the study period. The overall complication rate was 7.8% in all patients. The most common complication was postoperative colic pain 9 (3.2%), followed by fever in 7 (2.4%) patients and hematuria in 6 (2.1%) patients. Massive hemorrhage requiring transfusion was not observed. Postoperative septic shock and patient death never occurred.

The number of patients with Clavien–Dindo grade 1 and 2 ureteral injuries was 3 and 1, respectively. After the operation, a DJ stent was implanted in each patient. Double J stent time was maintained longer in patients with ureteral injuries.

DISCUSSION

Demographic studies show that the world's population is getting older. Until 2050, human average life expectancy is projected to increase to 83 years in developed countries and 75 years in underdeveloped countries.¹¹

Studies assessing the efficacy and safety of fRIRS in elderly patients receiving treatment for renal or ureteral calculi are nonexistent, as far as we are aware. Our goal in this study was to assess fRIRS's effectiveness and dependability in elderly individuals.

In studies evaluating the quality of life of geriatric patients in the literature, the age of 60 or 65 years was accepted as the age limit, and these patients were compared with younger patients.¹² In our study, we evaluated patients aged 65 years and older. We found that RIRS without fluoroscopy can be performed safely in this patient group.

Retrograde intrarenal surgery is now the standard endoscopic treatment for stones in the kidney or proximal ureter. In general, the use of fluoroscopy during the procedure is necessary for ensuring the safety of the operation. However, the use of routine fluoroscopy is discussed.

Medical radiation is known to pose a potential cancer risk to doctors, patients, and other healthcare personnel.

Skin, extremity, thyroid, and hematologic malignancies may occur following exposure to chronic radiation.^{13,14} Fluoroscopy is likely to be the primary source of radiation exposure for urologists in general. Patients, operating room personnel, and surgeons are all exposed to radiation at the same time during a fluoroscopy. The length of exposure is the primary indicator of radiation exposure.

Fluoroscopy time is variable in standard RIRS. Hsi and Harper¹⁵ reported that the mean fluoroscopy time in the ureteroscopy (URS) was 144 seconds in their study, including the results of 9 URS series. In this study, they reported that the need for fluoroscopy was reduced by 85% using tactile sensation and endoscopy and that this method can be used effectively and reliably. In our current study, the fRIRS procedure was performed with a success rate of 97.4%.

Hellawell et al.¹⁶ reported that the mean radiation value for urologists was 11.6 gray (Gy). Considering that a surgeon performing routine surgical operations can perform an average of 500 operations each year, this rate is much higher. This radiation dose is reported to be more than half that of non-contrast CT. Therefore, in order to protect both the patient and the surgical team from these harmful effects of radiation, the issue of less use of fluoroscopy has come to the fore. Our study (fRIRS) is important for protecting elderly people with high comorbidities from these risks.

In a study by Lipkin et al.,¹⁷ the mean radiation dose for the URS was calculated to be 0.31-7.17 mS/s (mSv). The radiation dose of a chest X-ray is approximately 0.02 mSv. Fluoroscopy was not used during the RIRS procedure to protect elderly patients from this radiation dose.

Senel et al.⁹ retrospectively reviewed 350 patients undergoing RIRS for renal or upper ureteral stones and compared 2 groups with and without fluoroscopy for RIRS. There was no significant difference between the 2 groups in terms of SFR and complication rates. The authors reported that fRIRS is a practical and safe technique. Our fRIRS procedure was performed safely, with a SFR (grade A+B) of 88.6% and a complication rate of 7.8% in accordance with the literature.

Classical URS is a widely used and effective treatment method with successful SFRs and low complication rates. The majority of complications are minor. Overall SFRs have been reported to be 84%-91% in many studies.¹⁸⁻²⁰ From another perspective, the complications that develop as a result of fURS are usually minor, and the overall complication rate is around 9%-25%.^{21,22} In our study, the SFR (grade A+B) was 88.6\%. The rate of overall complications was 7.8%, and all complications were insignificant. According to the present results, SFR and complication rates were generally similar to the currently published results.

Xu et al.²³ published a retrospective study of 375 patients evaluating complications using the Clavien grading system in terms of the effects of various factors. Positive preoperative urine culture and prolonged operation time are considered to be the main causes of complications. The mean patient duration was 40 minutes; 13% of patients had fever, 7.7% had intraoperative hematuria, and 6 patients had significantly elevated creatinine. In our study, the mean operation time was 37 minutes. Fever and hematuria were observed in 2.4% and 2.1% of the patients, respectively, and this was consistent with the current literature.

We believe that fRIRS is an effective surgical treatment for elderly patients with kidney and ureteral stones and has a low surgical complication rate. There have been several studies to reduce fluoroscopy exposure during fRIRS. In this study, we evaluated fRIRS in elderly patients, and this is the first such study in this field.

The strength of our study is that the fRIRS technique is effective and feasible in the treatment of renal and ureteral calculi and has low SFR and complication rates, similar to conventional retrograde ureteral surgery. In this way, it has been shown that it is possible to protect elderly patients from the harmful effects of fluoroscopy and that surgery can be performed effectively and safely without fluoroscopy. We have also shown that it is possible to protect surgeons and patients from the harmful effects of radiation.

Although our study included a large population of elderly individuals over 65 years of age, it has some limitations. These include single-center, retrospective, and nonrandomized studies.

Retrograde intrarenal surgery can be performed safely and effectively without fluoroscopy to protect the surgical team and patients in the elderly population from the side effects of fluoroscopy. This is a method that can be used in clinics with large case series.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Ethics Committee Approval: The study was approved by the Karabük University Non-Interventional Clinic Research Ethics Committee (Date: 26.06.2024; Approval No.: 2024/1852).

Informed Consent: N/A. Permission was obtained from the hospital management to scan patient files.

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