MAEDICA – a Journal of Clinical Medicine
2023; 18(2): 203-208
https://doi.org/10.26574/maedica.2023.18.2.203

MAEDICA - a Journal of Clinical Medicine

ORIGINAL PAPER

Flexible Ureteroscopy Without Radiation Exposure

Marius BRAGARU[a, b], Razvan-Ionut POPESCU[a, b], Andreea-Madalina MUNTEANU[b], Cosmin COZMA[a, b], Petrisor GEAVLETE[a, b, c], Bogdan GEAVLETE[a, b]

[a]Saint John Clinical Emergency Hospital, Bucharest, Romania

[b]"Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

[c]Sanador Hospital, Bucharest, Romania

ABSTRACT

Introduction: *Renal stones are a common pathology in daily practice with a continuously increasing incidence. Using flexible ureteroscopy (fURS), urologists can treat difficult renal stones through the natural orifice and maintain a satisfactory stone-free rate. Even though advancing technologies offer the opportunity for minimally invasive surgery, the surgeon is still exposed to a considerable amount of ionizing radiation during several procedures. In this study, the aim is to determine the efficacy of flexible ureteroscopy without fluoroscopy in terms of stone-free rates and complications.*

Materials and methods: *In the Urology Department of Saint John Clinical Emergency Hospital in Bucharest, Romania, a retrospective study was conducted on 98 patients diagnosed with renal calculi between September 2020 and December 2021. Using two different groups, the demographic characteristics of patients, characteristics of stones (size, number, location), the use of fluoroscopy, the operative time (in minutes) and postoperative complications, and the stone-free rate were compared. In one of the groups, fluoroscopy was used during fURS (Group I), while in the second group (Group II), no ionizing radiation was used during fURS.*

Results: *Twenty-four males and 23 females were enrolled in Group I, whereas 31 males and 20 females were enrolled in Group II. The mean age of subjects was 63.2 years old in the fluoroscopy group and 61.6 years old in the group without fluoroscopy. While the stone characteristics revealed some variations in stone location between the compared groups, there were no statistical differences in mean stone diameter (1.489 mm – Group I* vs. *1.588 mm – Group II). Stone-free rates and complications classified using Clavien-Dindo modified system for urological surgeries were used to analyze the main results. Group II had a slightly higher stone-free rate, but statistical studies found no significant differences; therefore, both methods are deemed equal in this field. Identified complications were classified as Clavien I and II and were successfully treated for both groups.*

Conclusion: *This study reveals that by adhering to additional intraoperative measurements for guiding the access sheath, fURS without fluoroscopy can be performed safely and with a high success rate.*

Keywords: fURS, no fluoroscopy, access sheath, renal stones, stone-free rate.

Address for correspondence:
Razvan-Ionut Popescu
Email: dr.razvanp@gmail.com

Article received on the 6th of April 2023 and accepted for publication on the 29th of June 2023

INTRODUCTION

Global data show that the prevalence of kidney stone disease has been increasing. The management of kidney stone disease relies on ionizing radiation from diagnostic procedures, treatment, and follow-up of patients. Therapeutic options for lithiasis include ESWL (extracorporeal shockwave lithotripsy), PCNL (percutaneous nephrolithotomy), flexible ureteroscopy (fURS) and laparoscopic surgery, each with specific advantages and disadvantages. Flexible ureteroscopy plays an essential role in treating kidney stones by removal of the stones. Innovative technical progression in fURS has made this technique the main treatment modality to target upper urinary tract lithiasis < 15 mm, having the advantage of being low invasive. Moreover, the increased use of fURS for the treatment of kidney stones has been enabled by the development of flexible ureteroscopes that provide better access to the urinary tract and the collecting system, allowing for a better visual aspect of the procedure (1, 2).

An ureteroscope is optically guided and by radiation in this procedure. As urologic surgical interventions have become increasingly complex, the use of fluoroscopy has also grown steadily over the past 20 years. The use of fluoroscopy in endourological procedures has been considerably reduced in recent years due to the harmful effects of radiation on the human body. Radiation exposure can have significant stochastic effects, particularly on the operating urologist. According to the occupational guidelines of the International Commission on Radiologic Protection (ICRP), the maximum one-year radiation dose is 50 or 20 mSv *per* year (3).

It has become increasingly popular in urology to use fluoroscopy-free techniques and minimize radiation exposure. Flexible URS was described in a few studies, but it was used without radiation and with a new guidance method (5-8).

This study was conducted to evaluate the efficacy and safety of our X-ray-free fURS technique. ❑

MATERIAL AND METHODS

Between September 2020 and December 2021, 98 patients with renal calculi were retrospectively evaluated in the Urology Department at Saint John Clinical Emergency Hospital in Bucharest, Romania. Patient's demographic characteristics, stone features (size, number, and location), fluoroscopy use, operative time (in minutes) and postoperative complications, as well as the stone-free rate, were compared between the two study groups (Group I with fluoroscopy and Group II with no fluoroscopy). During the preoperative period, all patients were given complete blood counts, serum creatinine, platelet counts, bleeding and coagulation profiles as well as urine cultures.

Computed tomography (CT), ultrasonography and kidney, ureter and bladder (KUB) imaging were used to diagnose urolithiasis preoperatively. The location, laterality and size of the stones were estimated using a preoperative CT scan. Data regarding patients' demographics, the size and imagistic characteristics of the stones were collected. Informed consent was obtained from all patients. In spite of the fact that patients had previously undergone sterile urinary cultures, a single dose of 1 g of third-generation cephalosporin was routinely administered to each of them before surgery. One month after a single procedure, the main outcomes comprised the number of stones free of stones and the number of complications. On the first postoperative day, all patients underwent KUB radiography. A low-dose CT scan or ultrasonography was performed one month after surgery. Stone-free and residual stones were classified based on the results. An asymptomatic, non-obstructing, non-infectious, and non-obstructing stone-free state is defined as the absence of any fragments or fragments of less than 3 millimeters (11). Stones were considered residual if they were either smaller than 3 mm or symptomatic.

A spinal anesthetic was administered to the patient while he/she was lying in the standard lithotomy position. Using ureteroscopy, two 0.035" stiff hydrophilic guidewires were inserted into the renal cavities after performing a routine cystoscopy and identifying the ureteral orifices. The length of the guide wire inserted through the URS was measured from the ureteropelvic junction to the external meatus. Subsequently, without fluoroscopy, the ureteroscope was withdrawn and reinserted into the bladder's nearby guidewire for visual guidance during the course of ureteral access sheath (UAS) insertion. During the procedure of UAS insertion on the guidewire, ultrasound was used to verify the correct placement of the guide in the pyelocaliceal system. Ureteral access sheath (10.7/12 F, Cook Flexor) was used in all cases until an angulation/resistance was encountered. The UAS was accessed with an 8,4 Fr flexible ureteroscope (Olympus URF-V2). A thorough examination of the upper, middle and inferior calyx was conducted at the outset. After identifying the stone, Holmium laser lithotripsy using a 270 μm fiber was performed in fragmentation mode, dusting, or both. The retrieval of stones was carried out using baskets when necessary. At the end of the procedure, another inspection of all the caliceal groups was performed. UAS was removed. A JJ stent was inserted at the end of all procedures. When the placement of an access sheath was not possible, a double J stent was inserted into the renal pelvis and left in place for three weeks before a second surgical procedure was performed. The Clavien Classification System was used to classify postoperative complications (9). Python 3.11.2 version was used for statistical analysis. ❑

RESULTS

After analyzing 98 cases, the registered demographic data revealed a mean age of 63.2 years old in the group with fluoroscopy (Group I) and 61.6 years old in that without fluoroscopy (Group II), with no statistical differences being found (p=0.44). There were 24 males and 23 females enrolled in Group I, compared to 31 males and 20 females in Group II. All demographic data are summarized in Figures 1 and 2.

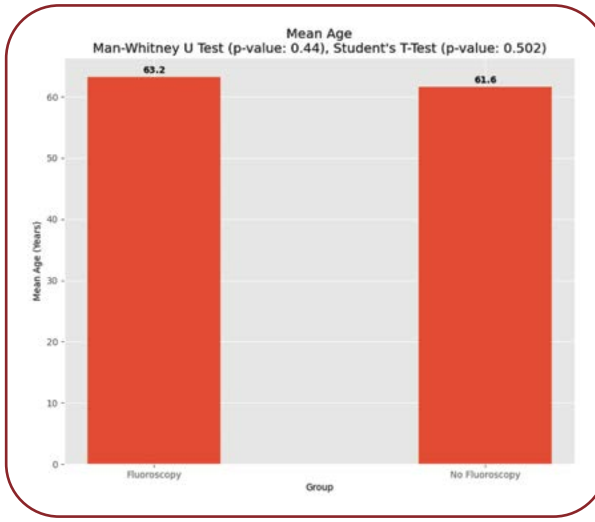

FIGURE 1. Mean age of study participants

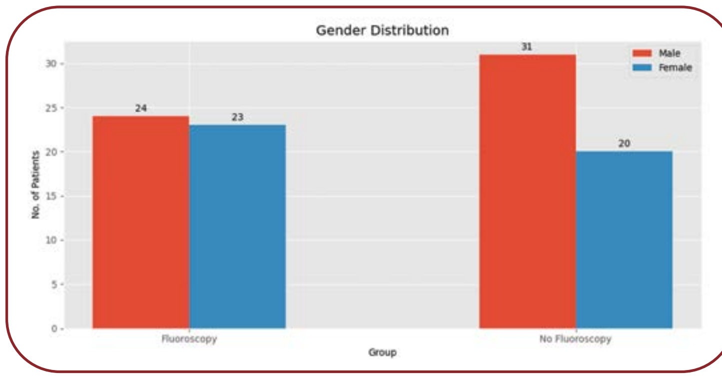

FIGURE 2. Gender distribution between groups

Stone characteristics were comparatively assessed in both groups, including the location in

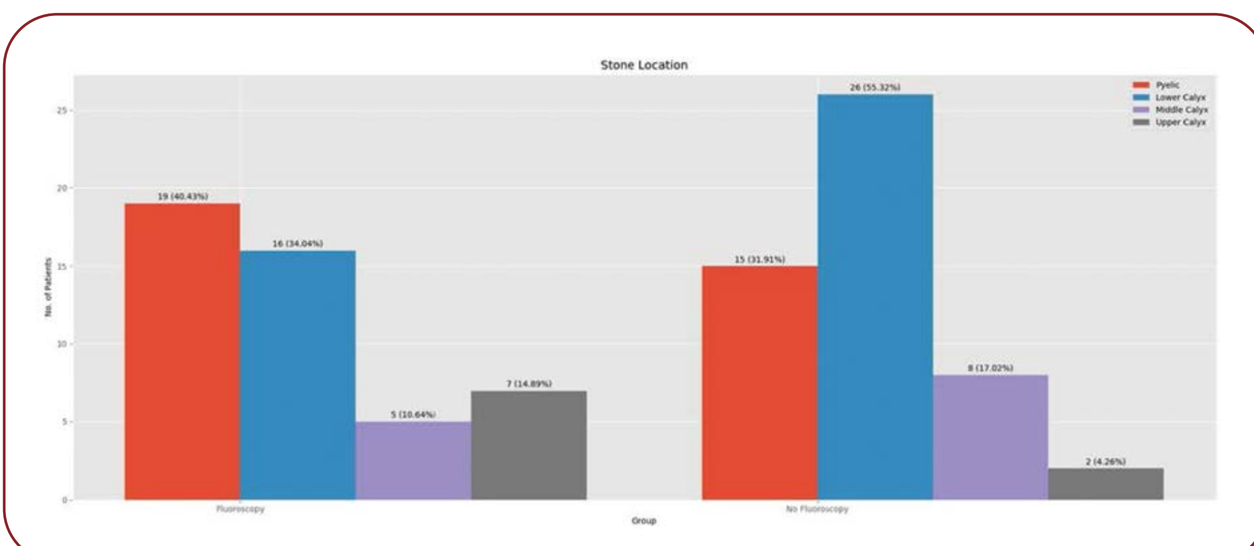

FIGURE 3. Stone location

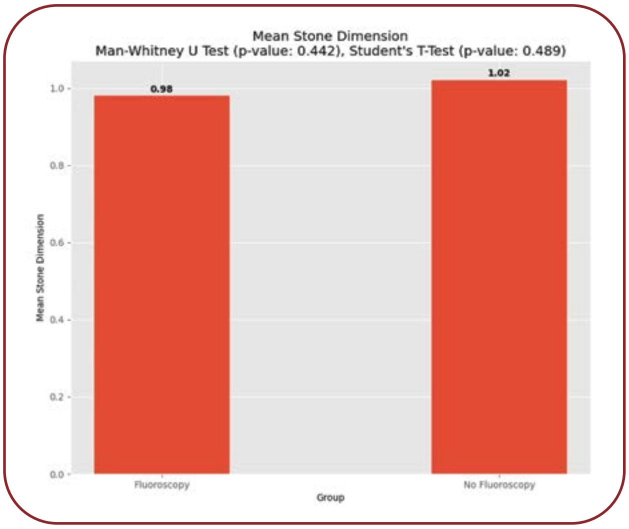

FIGURE 4. Stone dimension

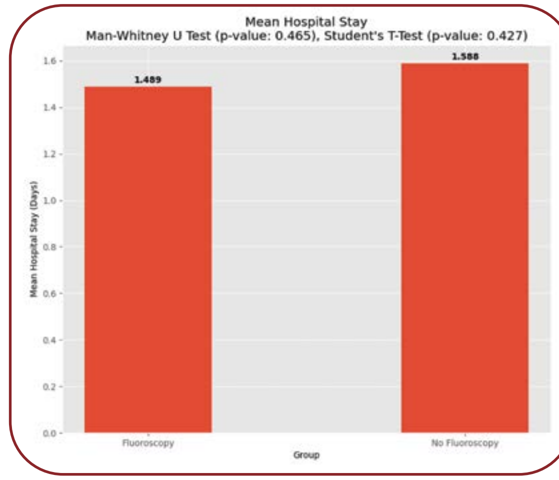

FIGURE 7. Mean hospital stay

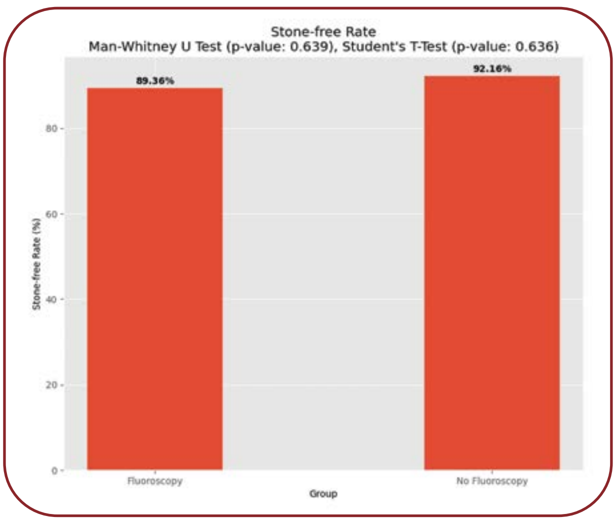

FIGURE 5. Stone-free rate

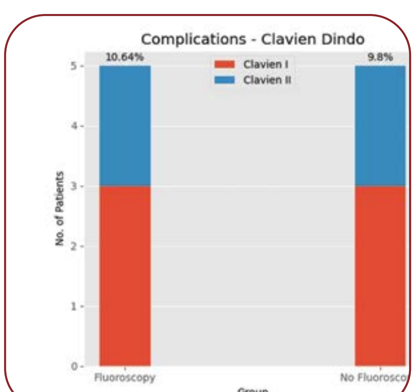

FIGURE 6. Complication rate

the pyelocaliceal system and dimension evaluated by the longest diameter. Stone location is illustrated in the bar chart in Figure 3. Thus, stones were mainly located in the renal pelvis among subjects in Group I and in the lower calyx among those in Group II.

There were no statistical differences in mean stone diameter between the two study groups: 1.489 mm in Group I *vs.* 1.588 mm in Group II (p-value 0.465).

The main results were evaluated by the obtained stone-free rates and complications classified using Clavien-Dindo modified system for urological procedures. A slightly increased stone-free rate was obtained in Group II, but the statistical analyses revealed no significant differences, so both procedures are considered equal in this field.

All complications were represented by mild complications classified Clavien I and II and were successfully treated. Even after including these data, there were no statistical differences in terms of analyzed procedures. There were no complications while inserting the UAS. In two cases, the ultrasound check could not find the guidewire in the pyelocaliceal system after performing the semirigid ureteroscopy, so the access sheath placement was stopped until guidewire repositioning.

The mean hospital stay ranged between 1.489 and 1.588 days, mentioning that all patients were admitted in a programmed system and were previously investigated with complete blood and urine tests and imagistic data. All preoperative medical complimentary evaluations were performed in the hospital ambulatory in agreement with the pre-anaesthetic evaluation. ❑

DISCUSSION

Currently, "personalized minimally invasive surgery" is tailored to the particularities of each patient and the associated pathology. Flexible retrograde ureteroscopy with laser lithotripsy (Holmium or Thulium) is increasingly used in most urological referral centers worldwide. Consequently, technological advancements have allowed fURS to gain a broader spectrum of indications. Developing smaller caliber ureteroscopes with their increased deflection capacity and single-use ureteroscopes together with Holmium or Thulium lasers (TFL) make fURS an attractive treatment modality. In conventional surgery, fluoroscopy is used during this procedure not only to place the access sheath, but also to assess the anatomical structure and location of the stone (10). There are some risks associated with using fluoroscopy in urological procedures, such as the risk of radiation-induced malignancy in patients and surgeons (11, 12). To reduce the risk of radiation, fluoroscopy-free fURS techniques have been reported.

Steps have been taken to eliminate fluoroscopy altogether from ureteroscopy. Güner B *et al* utilized a semi-rigid ureteroscope instead fluoroscopy to demonstrate access to the renal pelvis during retrograde ureteroscopy. There were no differences in operative time, complications, or stone-free rate without fluoroscopy. In the opinion of these authors, it is possible to eliminate fluoroscopy, especially when accessing the renal pelvis, by using direct visualization first (13).

The use of ultrasound to guide ureteroscopy has also been demonstrated to be effective. A randomized controlled trial was conducted by Deters *et al* to compare fURS with ultrasound-guided ureteroscopy. Neither group reported any differences in complication rates or rate of stone-free surgery (14). Ultrasound guidance during access sheath insertion was successfully performed in the present study without complications. The stone-free rate seemed to be unaffected by less fluoroscopy usage.

A study by Hamdy *et al* reported the placement of an access sheath without the use of fluoroscopy (15). In the present study, the access sheath was manually controlled. The procedure was stopped if the surgeon felt any obstacle in placing the sheath.

The length of the guided wire taken by Taken *et al* from the URS to the external meatus was measured and the distance to which the access sheath should be improved was determined. The ureteroscope was actively deflected to allow surgeon's access to all calyces (16). As a comparison, the same measurement system was used during the present procedures to determine approximately how far the access sheath should be inserted through the ureter. According to their study, Kirac M.*et al* also marked the external portion of the ureteroscope after insertion in the pieloureteral junction endoscopically. The ureteric access sheath was gently inserted into the renal pelvis after measuring the distance between the tip of the ureteroscope and the line that had been marked (17)

A small randomized controlled trial conducted by Olgin *et al* compared the outcomes of fluoroscopy-free ureteroscopy to fluoroscopy alone in non-complex cases and found that it was safe and effective to do without fluoroscopy (18). In the present study, patient numbers were greater than those reported by Olgin *et al* and revealed no static differences between the compared groups.

Recently, a novel method was described by Hein *et al* for ultra-low fluoroscopy utilization in fURS. The study evaluated 174 procedures and demonstrated significant reductions in radiation exposure using their protocol (19). The present study reflects the same good outcome after performing fURS with no fluoroscopy.

Similarly, a retrospective study performed by Senel *et al* on 350 patients who underwent retrograde intrarenal surgery for renal and upper ureteric stones compared two groups for retrograde intrarenal surgery with and without fluoroscopy, with 255 patients in the group without fluoroscopy. According to their findings, there was no significant difference in terms of stone-free rates and complications between the two groups. According to the authors, fURS is a safe and feasible method (20).

A limitation of the present study is its retrospective nature and the possibility of selection bias based on the decision to abandon the flourless approach when/if it was made. In addition, there was no standardization of postoperative imaging between the flourless and conventional cohorts. However, in this regard, the practice patterns of the physicians involved in the study did not change. As the fluoroscopy exposure was not blinded, measurement bias is another potential bias. ❑

CONCLUSIONS

This study demonstrates that flexible ureteroscopy without fluoroscopy can be performed safely and successfully by respecting intraoperative measurements for introducing the access sheath. Gentle usage and immediate stopping of the UAS insertion when felling obstacles represent a very important aspect while performing this technique. Further studies on larger groups are necessary to confirm this approach. ❑

Conflicts of interest: none declared.
Financial support: none declared.

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