

EVALUATION OF THE OUTCOMES OF RENAL STONE MANAGEMENT BY FLEXIBLE RETROGRADE INTRARENAL SURGERY WITHOUT PREOPERATIVE URETERAL STENTING

Truong Thanh Tung^{1*}
Le Quang Anh¹, Le Quang Hai¹

ABSTRACT

Objective: To evaluate of the results of renal stone treatment by retrograde intrarenal surgery using flexible endoscopy without preoperative ureteral stenting.

Subject and methods: An interventional study with retrospective and prospective descriptive design, including 232 patients, who had indications for and underwent retrograde intrarenal surgery using flexible endoscopy without preoperative ureteral stenting at Thanh Hoa Provincial General Hospital from January 2025 to January 2026.

Results: The mean age of patients was 49.8 ± 12.6 years. The mean renal stone size was 12.39 ± 4.97 mm. The rates of isolated lower calyceal stones and isolated renal pelvic stones were 24.1% and 34.5%, respectively. The mean operative time was 45.00 ± 11.63 minutes. The mean lithotripsy time was 33.75 ± 10.06 minutes. The mean postoperative hospital stay was 3.43 ± 1.70 days. The stone-free rate was 77.2% immediately after surgery, 85.3% at 1 month postoperatively, 86.6% at 3 months postoperatively.

Conclusions: Retrograde intrarenal surgery using flexible endoscopy without preoperative ureteral stenting is an effective, safe treatment method for renal stones, with a low complication rate and reduced hospital stay.

Keywords: Renal stones; retrograde intrarenal surgery; flexible endoscopy; no preoperative ureteral stenting.

Corresponding author: Truong Thanh Tung, Email: tungtnqy@gmail.com

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¹Thanh Hoa General Hospital.

1. INTRODUCTION

Scientific and technological advancements have brought about significant positive changes across various aspects of social life. Along with these developments, surgical treatment techniques have gradually been refined and applied toward minimally invasive approaches, aiming to reduce invasiveness, shorten recovery time, effectively treat disease, and improve patients' quality of life.

Conventional open surgery for renal stones has gradually been replaced by minimally invasive procedures such as extracorporeal shock wave lithotripsy (ESWL) and percutaneous nephrolithotomy (PCNL). According to the guidelines of the European Association of Urology (EAU), ESWL is indicated for renal stones smaller than 2 cm, while PCNL is recommended for stones larger than 2 cm [1],[2]. However, in clinical practice, ESWL has a success rate of only about 50% in cases

with multiple renal stones, particularly in lower pole stones, hard stones, or in patients with anatomical abnormalities of the pelvicalyceal system. Although PCNL achieves a higher stone-free rate (approximately 78–96% [1]), it is not performed through the natural urinary tract and carries a higher risk of complications such as bleeding and injury to adjacent organs. Furthermore, PCNL may not be the optimal choice in obese patients or those with coagulation disorders.

Flexible retrograde intrarenal surgery (RIRS) has been widely implemented in many medical centers and has demonstrated high effectiveness and favorable outcomes in the treatment of renal stones. However, preoperative ureteral stenting, typically placed 1–2 weeks before surgery to assess and dilate the ureter and facilitate flexible ureteroscopy access, causes discomfort to patients and increases treatment costs and duration.

To overcome these limitations, Thanh Hoa Provincial General Hospital has implemented flexible retrograde intrarenal surgery without preoperative ureteral stenting, and initial results have been encouraging.

Based on these considerations, we conducted this study to evaluate the outcomes of renal stone treatment using flexible retrograde intrarenal surgery without preoperative ureteral stenting at Thanh Hoa Provincial General Hospital.

2. SUBJECTS AND METHODS

2.1. Subjects

A total of 232 patients with renal stones who had indications for and underwent flexible retrograde intrarenal surgery without preoperative ureteral stenting at Thanh Hoa Provincial General Hospital from January 2025 to January 2026 were included in the study.

- Inclusion criteria: Patients with solitary or multiple pelvicalyceal stones, stone size < 25 mm, kidneys with preserved function, no contraindications to anesthesia or the surgical procedure, and patients who agreed to the treatment method and consented to participate in the study.

- Exclusion criteria: Patients with ipsilateral ureteral stricture, calyceal diverticulum, renal stones \geq 25 mm, grade IV or higher hydronephrosis, or incomplete medical records according to the study design.

2.2. Methods

- Study design: A retrospective and prospective interventional descriptive case series study.

- Equipment and instruments: A Full HD endoscopic surgical system; Sphinx 100W Holmium:YAG laser lithotripter (Germany); 7.5/9.5 Fr semi-rigid ureteroscope; 8.5 Fr flexible ureteroscope; 12 Fr ureteral access sheath; 2.4 Fr Nitinol stone retrieval basket; 3.5 Fr PTFE guidewire; and 6 Fr or 7 Fr double-J ureteral stents.

- Study variables:

+ General characteristics: age, sex, body mass index (BMI).

+ Clinical and paraclinical features: degree of hydronephrosis, stone location and size.

+ Intraoperative parameters: time to successful ureteral access sheath placement, lithotripsy time, total operative time, and intraoperative complications.

+ Treatment outcomes: early postoperative outcomes (hospital stay, stone-free rate) and intermediate outcomes at 1 and 3 months postoperatively, including stone-free rate.

- Definitions and criteria used in the study:

+ Degree of hydronephrosis was assessed according to Onen's classification [3].

+ Complications were classified according to the Clavien–Dindo classification system [4].

+ Postoperative stone-free status was evaluated based on X-ray and ultrasound imaging findings [5].

+ Surgical procedure of flexible retrograde intrarenal surgery without preoperative ureteral stenting [6]:

- Patient preparation: Patients underwent clinical and paraclinical evaluation for diagnosis and indication. General anesthesia with endotracheal intubation was used. Patients were placed in the lithotomy position.

+ Step 1: A semi-rigid ureteroscopy was performed to evaluate the ureter, and a guidewire was advanced through the ureter into the renal pelvis.

+ Step 2: A ureteral access sheath was placed up to the ureteropelvic junction. A flexible ureteroscope was then advanced to assess the renal collecting system, stone number, and size. If ureteral access sheath placement failed, the flexible ureteroscope was advanced directly into the renal pelvis. If the flexible ureteroscope could not be advanced into the renal pelvis, the procedure was terminated and a double-J stent was placed.

+ Step 3: After stone localization, laser lithotripsy was performed using laser energy via the guidewire.

+ Step 4: After fragmentation, stone clearance was confirmed. The flexible ureteroscope was removed, and double-J ureteral stent and Foley catheter were placed.

- Postoperative follow-up: Patients were monitored for general condition, abdominal status, urine output, and possible complications. X-ray and urinary tract ultrasound were performed on postoperative day 2 to assess stone-free status. Follow-up was conducted at 1 and 3 months postoperatively. The double-J stent was removed 1 month after surgery.

- Ethical considerations: The study protocol was approved by the Ethics Committee of Thanh Hoa Provincial General Hospital (Decision No. 4389/

QD-BVDKT dated December 1, 2023). Patient identities were anonymized and kept confidential. The study did not interfere with patient treatment. The authors declared no conflict of interest.

- Statistical analysis: Data were analyzed using SPSS version 22.0. Categorical variables were expressed as percentages, and continuous variables were expressed as mean \pm standard deviation.

3. RESULTS

Table 1. Preoperative characteristics of patients

| Patient characteristics (n = 232) | | Results |
|-----------------------------------|------------------|------------------|
| Age (years) | Min-max | 20-79 |
| | $\bar{X} \pm SD$ | 49.8 \pm 12.6 |
| Sex, n (%) | Male | 124 (53.5) |
| | Female | 108 (46.5) |
| BMI (kg/m ²) | Min-max | 17.2-25.1 |
| | $\bar{X} \pm SD$ | 21.33 \pm 2.17 |
| Degree of hydronephrosis (n, %) | None | 28 (12.1) |
| | Grade I | 152 (65.5) |
| | Grade II | 52 (22.4) |

Male patients were more numerous than female patients. The mean age was 49.8 \pm 12.6 years, and the mean BMI was 21.33 \pm 2.17 kg/m². Most patients had no hydronephrosis or only mild hydronephrosis (grade I). No patients had grade III or grade IV hydronephrosis.

Table 2. Characteristics of renal stones indicating surgery

| Renal stone characteristics (n = 232) | | Results |
|---------------------------------------|------------------------------|------------------|
| Stone location (n, %) | Lower calyx | 56 (24.1) |
| | Renal pelvis | 80 (34.5) |
| | Lower calyx and renal pelvis | 88 (37.9) |
| | Lower and middle calyces | 8 (3.4) |
| Stone size (n, %) | < 10 mm | 44 (19.0) |
| | 10-20 mm | 164 (70.7) |
| | 21-25 mm | 24 (10.3%) |
| | Min-max (mm) | 7-24 |
| | Mean \pm SD (mm) | 12.39 \pm 4.97 |

The most common stone distribution was combined lower calyceal and renal pelvic stones. Lower calyceal stones were present in almost all cases. The mean stone size was 12.39 \pm 4.97 mm, with most stones ranging from 10 to 20 mm.

- Operative characteristics

Table 3. Operative characteristics

| Operative characteristics (n = 232) | | Results |
|--|-------------------------------|-------------------|
| Ureteral access sheath placement (n, %) | Successful | 219 (94.4) |
| | Failed* | 13 (5.6) |
| Stone access (n, %) | Successful | 228 (98.3) |
| | Failed | 4 (1.7) |
| Lithotripsy time (minutes) | Min-max | 15-65 |
| | $\bar{X} \pm SD$ | 33.75 \pm 10.06 |
| Operative time (minutes) | Min-max | 25-90 |
| | $\bar{X} \pm SD$ | 45.00 \pm 11.63 |
| Complications (Clavien-Dindo classification) | Grade I (Hematuria) | 16 (6.9) |
| | Grade I (Renal pelvis injury) | 1 (0.4) |

Thirteen patients could not undergo successful ureteral access sheath placement; in these cases, the flexible ureteroscope was advanced directly into the pelvicalyceal system. Among them, in four patients, although the flexible ureteroscope reached the renal pelvis, the stone could not be accessed, and the procedure was converted to percutaneous nephrolithotomy (PCNL). The main postoperative complication was hematuria.

A total of 17 patients (7.3%) experienced complications, all classified as Clavien–Dindo grade I. These cases were managed with standard postoperative medical treatment without the need for blood transfusion or secondary intervention.

Table 4. Surgical outcomes

| Surgical outcomes (n = 232) | | Results |
|------------------------------------|------------------------|----------------|
| Postoperative hospital stay (days) | Min-max | 2-6 |
| | $\bar{X} \pm SD$ | 3,43 \pm 1,7 |
| Postoperative day 2 (n, %) | Stone-free | 179 (77.2) |
| | Residual stones | 53 (22.8) |
| 1 month postoperatively (n, %) | Stone-free | 198 (85.3) |
| | Residual stones | 34 (14.7) |
| | Double-J stent removal | 232 (100) |
| 3 months postoperatively (n, %) | Stone-free | 201 (86.6) |
| | Residual stones | 31 (13.4) |
| Postoperative ureteral stricture | | 0 |

The postoperative hospital stay ranged from 2 to 6 days, with a mean of 3.43 \pm 1.7 days. On

postoperative day 2, 179 of 232 patients (77.2%) were stone-free based on imaging evaluation. At 1-month follow-up, all patients had their double-J stents removed, and imaging revealed a stone-free rate of 85.3% (198/232). At 3 months postoperatively, the stone-free rate was 86.6% (201/232). No cases of postoperative ureteral stricture were recorded.

4. DISCUSSION

Patients with renal stones in this study ranged from 20 to 79 years of age, with a mean age of 49.8 ± 12.6 years. The male-to-female ratio was approximately 1.2:1. These findings are consistent with those reported by Hoang Long [5] (mean age 47.14 ± 16.53 years, male-to-female ratio $\sim 1.26:1$) and Bui Dang Ngoc [6] (52 patients undergoing flexible ureteroscopy, mean age 50.4 ± 10.2 years, male-to-female ratio 2.1:1). Differences in sex distribution among studies may be attributed to variations in sample size and study populations. However, a common finding across studies is that renal stones are more frequently observed in males and in middle-aged patients.

Flexible retrograde intrarenal surgery using flexible endoscopy without preoperative ureteral stenting is performed entirely through the natural urinary tract. Therefore, patient body habitus has minimal impact on indications, surgical procedure, and outcomes. This is also considered an advantage of flexible ureteroscopy compared with extraluminal approaches such as percutaneous nephrolithotomy (PCNL) or retroperitoneal stone surgery. In this study, the mean BMI was 21.33 ± 2.17 kg/m², with a maximum of 25.1 kg/m². Yuri (2018) [1] similarly reported that BMI does not affect the indication or outcomes of flexible ureteroscopic renal stone treatment.

In our study, the majority of stones were located in the lower calyx and renal pelvis (96.6%), while only 3.4% were located in the middle calyx. Regarding hydronephrosis, grade I dilation accounted for 65.5% of cases, and 12.1% of patients had no hydronephrosis. These results are comparable to those reported by Bui Dang Ngoc [6] (67.3% of patients had grade I or no hydronephrosis) and Minh An [7] (67.7% of patients had grade I hydronephrosis). The authors generally agree that increasing degrees of hydronephrosis are associated with more difficult stone access, longer operative time, and reduced clearance of stone fragments after lithotripsy [5],[8].

Indications for RIRS are based on stone size, according to the European Association of Urology (EAU) guidelines, with the optimal indication being stones ≤ 20 mm, and it may also be performed for stones < 30 mm [2]. In this study, the mean stone size measured on computed tomography was 12.39 ± 4.97 mm (range 7-24 mm), with most stones ranging from 10 to 20 mm (70.7%). These findings are consistent with those reported by several domestic authors, such as Hoang Long (2023) [5], who reported a mean stone size of 12.6 ± 3.3 mm, and Bui Dang Ngoc [6], who reported a mean stone size of 14.9 ± 4.6 mm.

In our study, all patients underwent flexible ureteroscopy without preoperative ureteral stenting. This approach has some limitations, including the inability to preoperatively assess ureteral anatomy in detail, inability to detect ureteral strictures before surgery, and the lack of time and opportunity for pre-dilation of the ureter. To overcome these limitations, we initially advanced a rigid ureteroscope up to the renal pelvis to evaluate the entire ureter and simultaneously dilate the ureterovesical junction and selected physiologic narrowings of the ureter.

We used a 12 Fr ureteral access sheath. In our study, ureteral access sheath placement was successfully achieved in 219 of 232 patients (94.4%). The sheath plays three main roles: protecting the ureteral mucosa during scope manipulation, maintaining irrigation pressure during lithotripsy, and facilitating outflow of irrigation fluid and stone fragments. Therefore, successful placement of the access sheath ensures better surgical outcomes, including reduced ureteral injury, shorter lithotripsy time, and improved clearance of stone fragments.

In this study, ureteral access sheath placement failed in 13 patients (5.6%). These cases involved patients with a narrow ureter, in whom advancement of the sheath was difficult. We did not apply excessive force when advancing the sheath through the ureteral orifice or physiologically narrowed segments of the ureter, as this may increase the risk of ureteral injury (perforation, laceration, or ureteral avulsion), or even injury to the renal pelvis or kidney.

In these 13 cases, several intraoperative difficulties were encountered, including prolonged lithotripsy time and impaired outflow of irrigation fluid during the procedure. Among them, 4 patients (1.7%) developed postoperative complications, including hematuria and fever.

Hoang Long [5] reported a 4.3% rate of unsuccessful ureteral access sheath placement, in which flexible ureteroscopy was performed directly without sheath insertion to access the stone. According to Lumma (2013) [9] and Netsch (2012) [10], studies comparing flexible ureteroscopy with and without preoperative ureteral stenting demonstrated that pre-stenting was associated with a higher success rate of ureteral access sheath placement; however, this difference was not statistically significant.

The mean operative time was 45.00 ± 11.63 minutes (range 25-90 minutes), and the mean lithotripsy time was 33.75 ± 10.06 minutes (range 15-65 minutes). Patients with larger stone burden or stones located in multiple calyces required the longest lithotripsy time. Some authors have suggested that prolonged lithotripsy (over 90 minutes) increases the risk of bleeding complications, retroperitoneal fluid extravasation, and, in particular, urosepsis due to bacterial dissemination from infected stones into the bloodstream.

Lithotripsy time is also influenced by several factors, including surgeon experience, stone size, stone hardness, stone location within the calyces, and the degree of hydronephrosis [5]. Therefore, to optimize operative time, we selected patients with appropriate stone sizes; when stone fragments were sufficiently small, they were retrieved using a Nitinol basket rather than being further fragmented. The absence of preoperative ureteral stenting may increase difficulty and prolong the step of ureteral access sheath placement into the renal pelvis. However, other procedural steps, such as stone localization and fragmentation, were not significantly affected. As a result, with comparable stone sizes, our operative times were similar to those reported in other studies, such as Minh An (2023) [7], who reported a mean operative time of 50.9 ± 11.2 minutes, and Jae Yong (2023) [11], who reported a mean lithotripsy time of 36.1 ± 17.6 minutes in patients with a mean stone size of 11.2 ± 5.4 mm.

During the early phase of implementation, due to limited technical experience and tactile feedback, we encountered one case (0.4%) of renal pelvic injury during ureteral access sheath insertion. This was the only case of renal pelvic rupture recorded in our study. Other studies have also shown that most ureteral injuries during flexible ureteroscopy are minor, including ureteral or renal pelvic perforation, with reported rates of 1.8% in the pre-stented group and 4% in the non-pre-stented group. In cases of

minor injury, the procedure may still be completed; however, the duration of postoperative double-J stenting should be extended. Ureteral avulsion is extremely rare.

According to the experience of many authors, when excessive resistance is encountered during advancement of the ureteral access sheath, forceful insertion should be avoided, and the procedure should be discontinued to prevent severe injury [12],[13].

The failure and conversion rate in our study was 4/232 patients (1.7%). The cause was stones located in the lower posterior calyx, where the flexible ureteroscope could not access the calyceal infundibulum, leading to conversion to percutaneous nephrolithotomy (PCNL). Hoang Long reported that in a series of 69 patients undergoing flexible ureteroscopy with preoperative stenting, 3/69 patients (4.3%) were converted to PCNL due to inability to advance the flexible ureteroscope into the renal pelvis [5].

Complications were classified according to the Clavien-Dindo system. We recorded 17 patients (7.3%) with grade I complications, among whom postoperative hematuria or dark-colored urine was the most common, occurring in 16 patients (6.9%). One patient (0.4%) experienced renal pelvic injury.

According to the same classification, Hoang Long (2023) [5] reported a 9.5% rate of grade I complications, mainly hematuria; Nguyen Minh An (2023) [7] reported postoperative fever in 3/31 patients (9.7%); and Jae Yong Jeong (2023) [11] reported a 11.7% rate of grade I complications. Thus, compared with some studies in which preoperative ureteral stenting was performed, the postoperative fever rate in our study was lower.

Currently, there remains ongoing debate regarding whether preoperative ureteral stenting before flexible ureteroscopy increases the risk of postoperative fever. Studies by JiaQiao Zhang (2016) [13] and Shigemura (2012) [14] reported higher postoperative fever rates in patients with preoperative stenting, suggesting that prolonged stent placement may contribute to subclinical urinary tract infection. In contrast, Skolarikos (2015) [12] reported opposite findings, showing a lower postoperative fever rate in the pre-stented group.

The mean postoperative hospital stay in our study was 3.43 ± 1.7 days (range 2-6 days), which was comparable to the study by Minh An [7] (3.6 ± 1.1 days) and longer than that reported by Hoang Long (2023) [5] (1.4 ± 1.1 days).

The stone-free rate after flexible retrograde intrarenal surgery has been reported to range from 50% to 94.2%, with large variations among studies due to differences in patient selection criteria and equipment [8]. In our study, the immediate stone-free rate was 77.2% (179/232 patients), which was lower than that reported by Bui Dang Ngoc [6] (81.3%) and Nguyen Minh An [7] (83.2%). The rate of residual fragments > 3 mm was 22.8%; these patients were followed up at 1 month, and additional imaging showed that 19 more patients achieved stone-free status. The stone-free rate at 1 month was 85.3% (198/232 patients), which was comparable to that reported by Bui Dang Ngoc [6] (84.5%) and Nguyen Minh An (2023) (87.5%). At 3 months, the stone-free rate in our study was 86.6%, similar to that reported by Bui Dang Ngoc (87.3%).

Assimos (2016) [15] studied 1,622 patients undergoing flexible ureteroscopy and found that preoperative ureteral stenting increased the immediate stone-free rate (79.6% vs. 72.9% in the non-stented group) and reduced intraoperative and early postoperative complications; however, the stone-free rates at 1 and 3 months were comparable between the two groups.

The reported rate of ureteral stricture and postoperative hydronephrosis following flexible retrograde intrarenal surgery, with a follow-up period of up to 1 year, ranges from 0.5% to 2.5% and is influenced by multiple factors, including the degree of preoperative hydronephrosis, duration of ureteral stone impaction, ureteral injury during stone access, prolonged operative time, and the use of a large ureteral access sheath, among others [4].

In this study, no cases of postoperative ureteral stricture were observed. This may be explained by patient selection criteria, as most patients had low-grade hydronephrosis, relatively short operative times, and small to medium stone sizes. In addition, the follow-up duration in our study was limited to 3 months.

This study demonstrates that flexible retrograde intrarenal surgery without preoperative ureteral stenting achieves a high stone-free rate (86.6%) and a low complication rate (7.3%), which are comparable to those reported in studies involving pre-stented patients undergoing flexible ureteroscopy [5,6,7]. However, this technique offers additional advantages, including avoidance of preoperative stent-related discomfort, reduced treatment duration, and lower overall cost.

These findings provide a scientific basis for further studies and wider implementation of this technique in appropriately equipped medical centers, thereby improving the quality of care for patients with renal stones in the future

5. CONCLUSIONS

In a study of 232 patients with renal stones who had indications for and underwent flexible retrograde intrarenal surgery without preoperative ureteral stenting at Thanh Hoa Provincial General Hospital, the stone-free rate at 3 months was 86.6%. The overall postoperative complication rate was 7.3%, and the mean hospital stay was 3.43 ± 1.7 days. No major postoperative complications were recorded.

Based on these results, we suggest that further studies are warranted to support the broader indication and application of this technique in patients with renal stones who are candidates for flexible retrograde intrarenal surgery.

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