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# Laparoscopic Ureterolithotomy and Single-Use Digital Flexible Ureteroscope For Unilateral Large Ureteral Stone and Small Renal Stone

## Authors' Contribution:

Study Design A  
Data Collection B  
Statistical Analysis C  
Data Interpretation D  
Manuscript Preparation E  
Literature Search F  
Funds Collection G

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**Patient:** Male, 60-year-old  
**Final Diagnosis:** Renal calculi  
**Symptoms:** Urinary frequency  
**Clinical Procedure:** —  
**Specialty:** Urology

**Objective:** Unusual or unexpected effect of treatment

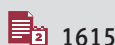
**Background:** The removal of concurrent ureteral and renal stones within a single procedure has always been a challenge for urological surgeons. The incorporation of single-use digital flexible ureteroscopes into laparoscopic ureterolithotomy procedures has demonstrated effective removal of concurrent stones with a good clearance rate and decreased risk of bleeding and trauma. We report the successful removal of a unilateral upper ureteral stone and a smaller renal stone with this procedure.

**Case Report:** A 60-year-old man visited the outpatient clinic with an ultrasonography report that revealed a large proximal ureteral stone with moderate hydronephrosis, accompanied by bilateral renal stones and prostatic hyperplasia. He had been experiencing urinary urgency for a year and was determined to undergo lithotomy. Due to his longstanding history of coronary artery disease and myocardial ischemia, the urologists decided that concurrent stone removal within an operation would be the best treatment. A preoperative computed tomography urogram measured the left ureteral and renal stones to be 2.0×0.8 cm and 0.6 cm, respectively. Both stones were successfully removed by laparoscopic ureterolithotomy using a single-use digital flexible ureteroscope. The patient had an uneventful recovery and remained well 1 month post-operation.

**Conclusions:** The application of single-use digital flexible ureteroscopes for laparoscopic ureterolithotomy has demonstrated safety, efficiency, and cost-effectiveness. The authors believe that it is a safe alternative for the removal of concurrent ureteral and renal stones, especially in patients with multiple comorbidities.

**Keywords:** Case Reports • Laparoscopy • Ureteroscopes

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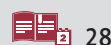
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## Background

Ureteral calculi  $>2$  cm are considered large and can result in ureteral obstruction if the calculus remains in the same location for  $\geq 2$  months [1]. In complicated cases, such as unilateral large ureteral stones with a concurrent small renal stone, urological surgeons find it difficult to extract the stones in a single session. Laparoscopic ureterolithotomy (LU) has demonstrated a high stone-free rate (93.3-100%) after removing large upper ureteral stones within a procedure, yet can fail mainly due to ureteral stone migration [2]. Retrograde flexible ureteroscopy performed through a laparoscopic port and ureterostomy incision has been practiced in selected patients and can successfully remove the concurrent renal stone [3]. In this case, we detail a similar surgical experience, but with a disposable flexible ureteroscope, and further discuss its advantages.

## Case Report

A 60-year-old man consulted our institute's urologist with an ultrasonography report that revealed a large left proximal ureteral stone with moderate hydronephrosis, accompanied by bilateral renal stones and prostatic hyperplasia. The ultrasound was performed 10 days earlier at a local hospital, but the patient complained of having experienced urinary urgency for a year. The patient was afebrile and vital signs were stable. Physical examination was unremarkable for tenderness around the flank region and no biochemical abnormalities were detected. The patient was admitted due to his determination to undergo lithotomy. A pre-operative computerized tomography urogram revealed a large proximal ureteral stone (size  $2.0 \times 0.8$  cm; maximum 1726 Hounsfield units [HU], mean 1045 HU) with a small renal stone (size 0.6 cm) in the left urinary tract (Figure 1). Given the patient's 8-year history of coronary

artery disease and myocardial ischemia with poor medical adherence, the urologists decided to perform elective laparoscopic ureterolithotomy, and achieve the removal of both stones within a single session with the aid of a single-use digital flexible ureteroscope.

Under general anesthesia, the patient was placed in a right decubitus position with the left flank facing upwards. The procedure was performed through 3 ports. The camera port (10 mm trocar) was inserted 1 cm below the 12<sup>th</sup> intercostal space at the posterior axillary line. The first working port (10 mm trocar) was inserted 2 cm above the superior iliac crest at the mid-axillary line. The second working port was inserted at the junction between the anterior axillary line and 2 cm below the 12<sup>th</sup> intercostal space. The ureter was identified and isolated with a Harmonic ultrasonic scalpel (Johnson & Johnson, New Brunswick, NJ, USA). The large ureteral stone was extracted through the ureterostomy incision. A ureteral polyp was incidentally identified, dissected, and sent for biopsy. Afterwards, the first working port was replaced with the camera to guide the insertion of the single-use digital flexible ureteroscope (REDPINE, Guangzhou, China) through the second working port. The ureteroscope was delivered into the ureterostomy incision under the assistance of laparoscopic Kelly forceps and entered the renal pelvis via retrograde access (Figure 2). The renal stone was located and retrieved with a stone extraction basket (COOK Medical, Bloomington, IN, USA). The ureteroscope was withdrawn and an F5 double-J stent was inserted through the ureterostomy incision before closing with 4.0 Vicryl sutures. A retroperitoneal drain was placed before completing the operation. The procedure duration from skin to skin was 2 hours and 39 minutes. The estimated blood loss was 10 mL. The 2 stones (Figure 3) were sent for analysis and both were found to be composed of calcium oxalate monohydrate. Biopsy results of the ureteral polyp revealed that it was benign.

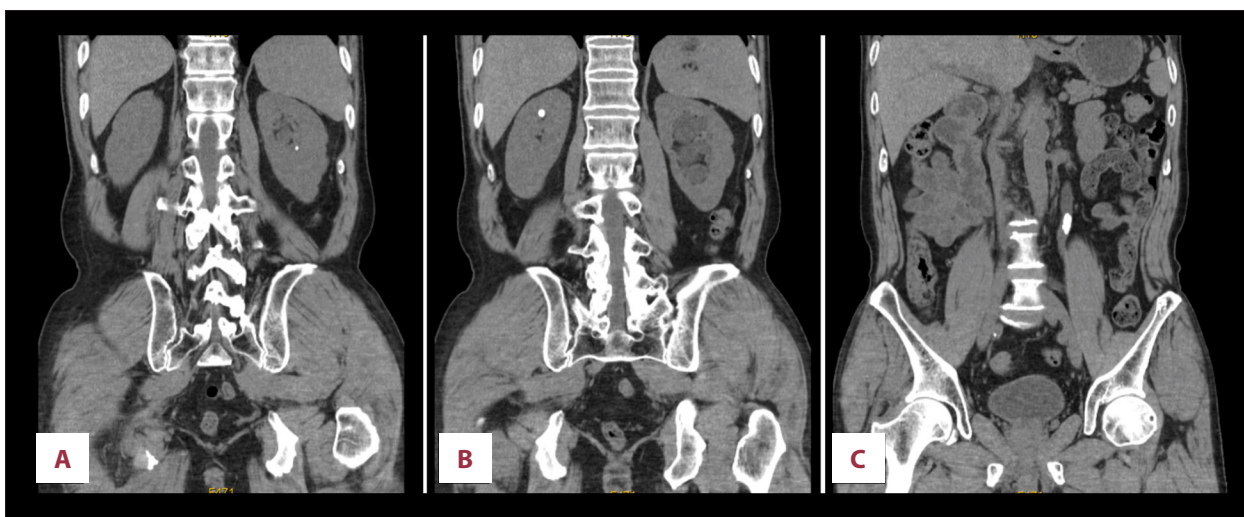
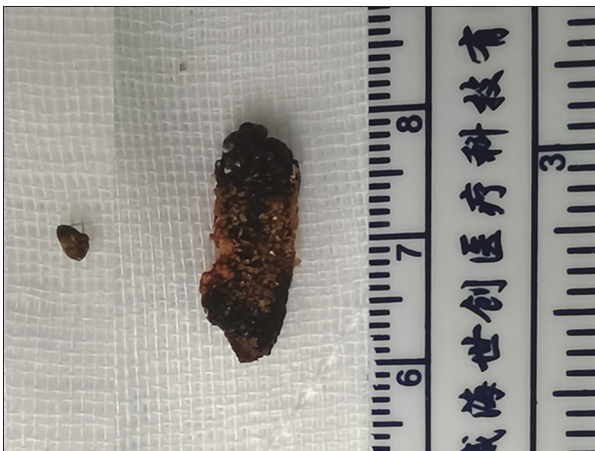


Figure 1. Preoperative computed tomography, revealing (A) a left renal calculus, (B) a right renal calculus, and (C) a left ureteral stone.



**Figure 2.** External view of the operation shows the left laparoscopic monitor and right digital flexible ureteroscope monitor.



**Figure 3.** Specimen of the large ureteral calculus and smaller renal calculus.

No postoperative complications were observed and the drain was removed 3 days later. The patient was discharged on the 6<sup>th</sup> postoperative day after removal of the Foley catheter. He was scheduled for follow-up a month later, and the 1-month postoperative kidney, ureter, and bladder X-ray (**Figure 4**) revealed no migration of the left stent. The stent was removed and the patient did not show discomfort or difficulty while passing urine.

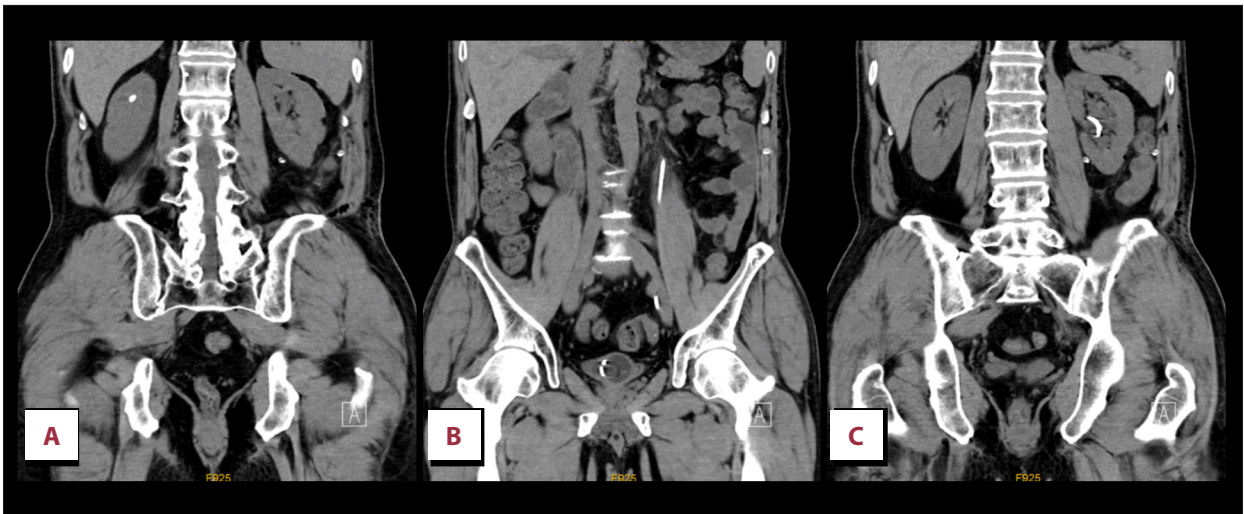
## Discussion

Percutaneous nephrolithotripsy (PCNL) and retrograde intrarenal surgery (RIRS) are alternative procedures for the removal of large upper ureteral stones and concurrent renal stones within the same session [4]. The American Urological Association and European Association of Urology strongly recommends PCNL as the first option for stones >20 mm for every location [5]. PCNL has the advantage of an early stone-free rate, but carrying out stone pulverization from within the ureter would

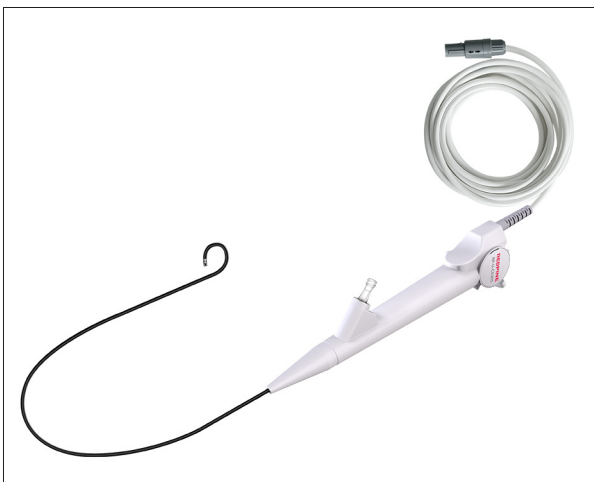
increase the risk of bleeding. We reviewed several retrospective comparative studies. Güler et al compared LU, PCNL, and RIRS, and concluded with a preference towards PCNL [6]. However, PCNL resulted in a higher rate of need for blood transfusion compared with LU and RIRS. Topaloglu et al have also reported that PCNL resulted in a higher volume of bleeding than LU [7]. Kumar et al reported that retrieval of large stones by LU was much more effective than fragmentation by ureteroscopic lithotripsy and results in fewer complications [8]. Similarly, Tugcu et al found that post-LU complication rates were much lower than RIRS for the management of ureteral stones >15 mm [9]. Choi et al concluded that LU and RIRS both demonstrate similar effectiveness in the management of stones >15 mm [10].

In 2004, Ball et al documented the first combination of flexible scope with laparoscopy, also known as laparoscopic pyeloplasty with flexible nephroscopy, in patients with ureteropelvic junction obstruction and nephrolithiasis [11]. The flexible nephroscope was introduced to the renal pelvis or calyces via the trocar for stone retrieval. Stravodimos et al reported a case series on robot-assisted laparoscopic pyeloplasty with flexible nephroscopy to treat the same pathology and was able to achieve a 100% postoperative stone clearance rate [12]. Su et al reported favorable clinical outcomes for LU with flexible cystoscope in the management of unilateral ureteral stones and nephrolithiasis [13].

In 2009, Mongiat-Artus et al reported the first case of LU with flexible ureteroscopy for removal of renal and ureteral calculi, and similar cases followed suit [14-16]. All procedures were successful and yielded good clinical outcomes. This procedure allows complete stone extraction without pulverization from within the ureter. The flexible ureteroscope was later introduced through the ureteral incision to retrieve the renal stone. As the diameter of the ureteral segment above the obstruction had been chronically dilated, the application of a flexible ureteroscope sheath was unnecessary, even for the retrieval of larger nephroliths.



**Figure 4.** Postoperative computed tomography, revealing (A) a right renal calculus and (B, C) left double-J stent before removal.



**Figure 5.** The REDPINE single-use digital flexible ureteroscope (use of this image has been permitted by the manufacturer).

In the aforementioned cases, the flexible ureteroscopes were constantly reused. The equipment is costly, and repetitive use can easily damage the device. In 2013, Khan et al reported that a pressure leak test was effective in evaluating and extending the lifespan of repetitively used flexible ureteroscopes, and they have been promoting this technique since [17]. According to Legemate et al, epidural rupture-induced leakage was the main cause of damage in these flexible ureteroscopes [18]. During practice, the lens of the flexible ureteroscope is often clamped with a laparoscopic foreign body forceps to assist its delivery through the ureterostomy incision at a near-vertical angle. This can cumulatively damage the outer layer of the flexible ureteroscope and eventually lead to leakage. The refurbishment cost was approximately \$590 per case [19]. However, this problem can be avoided by replacing traditional flexible ureteroscopes with disposable ones.

The LithoVue system single-use digital flexible ureteroscope (Boston Scientific, Marlborough, MA, USA) was launched in 2011 and has already demonstrated similar potential when compared with traditional ureteroscopes in several studies [20,21]. Mazzucchi et al stated that single-use flexible ureteroscopes were lighter and had superior quality of image when compared with fiberoptic ones [22]. Leveillee et al combined the single-use digital flexible ureteroscope and holmium laser fiber in the treatment of lower pole calculi [23]. A systematic review calculated that single-use scopes cost \$1300-\$3180 per procedure [24]. Although there was a partial overlap in ranges of costs with reusable scopes, other costs such as case-load, repair bills, added expenses when negotiating purchase prices, repair prices, and warranty conditions were not taken into consideration in the study.

China has also developed different single-use digital flexible ureteroscopes that have demonstrated favorable clinical outcomes [25-27]. The REDPINE Medical Instrument became commercially available in 2020. We used the same device (Figure 5) during the laparoscopic lithotomy procedure and were able to achieve a 273° rotation even with a lithotripsy basket attached, which has made nephrolithiasis extraction even more convenient. This case report documents our first experience in using the REDPINE single-use digital flexible ureteroscope to remove a unilateral large ureteral stone with nephrolithiasis in the same session with no obvious major or minor complications. However, the procedure lasted 159 minutes, which is longer than other experiences, which have a mean operating time of 70 minutes (range 35 to 129 minutes) [28].

It is undeniable that the development of single-use digital flexible ureteroscopes has eliminated the need for costly repairs and the occurrence of unpredictable performance that may delay the operation. To determine the efficacy and safety of

the newer devices, more clinical trials are warranted. We believe that with more practice, the overall operation time can be reduced, which is beneficial for the surgeon and patient.

## Conclusions

Single-use digital flexible ureteroscopes provides an economical advantage over reusable digital ureteroscopes. By combining this type of ureteroscope with LU, we were able to achieve unilateral large ureteral stone and concurrent renal stone extraction within an operation. We believe that it is a clinically feasible and safe method that can be improved with practice.

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