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# Comparison of combined laparoscopic ureterolithotomy and flexible ureteroscopy with percutaneous nephrolithotomy for removing large impacted upper ureteral stones with concurrent renal stones

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ABSTRACT

*Objectives:* The present study compared the safety and efficacy of combined laparoscopic ureterolithotomy (LU) and flexible ureteroscopy with percutaneous nephrolithotomy (PCNL) for removing large impacted upper ureteral stones with concurrent renal stones.

*Methods:* This study included 52 patients who underwent combined LU and retrograde flexible ureteroscopy for removing renal stones (group A) or PCNL ( group B ) for removing large upper impacted ureteral stones and concurrent renal stones at our department from January 2014 to December 2016. Patient demographics, stone characteristics, and procedure-related parameters including: stone-free rate, operation time, hospital stay after surgery, mean decrease in hemoglobin levels, visual analog scale (VAS) score, auxiliary procedure rate, and complication rate were compared between groups A and B.

*Results:* Results of this study showed that both procedures were effective for removing large impacted upper ureteral stones with concurrent renal stones. The stone-free rate after a single procedure was 95.7% in group A and 89.7% in group B ($p = 0.62$). The operation time was longer in group A than in group B (112.2 ± 23.3 min versus 96.2 ± 16.4 min, $p = 0.006$). However, no significant difference was observed between the two groups with respect to the length of hospital stay after the surgery (5 days versus 6 days, $p = 0.06$). The decrease in hemoglobin levels was significantly higher in group B than in group A (−0.64 ± 0.36 g/dL versus −1.44 ± 0.65 g/dL, $p < 0.0001$). The mean VAS scores obtained at 24 hours (2.91 ± 1.08 versus 5.10 ± 1.01, $p < 0.0001$) and 48 hours after the surgery (1.09 ± 0.73 versus 2.28 ± 0.96, $p < 0.0001$) were significantly higher for group B than for group A. Moreover, the auxiliary procedure rate was higher in group B than in group A (6% versus 0%).

*Conclusion:* These results indicate that both combined LU and flexible ureteroscopy and PCNL are suitable for removing large impacted upper ureteral stones with concurrent renal stones and are associated with a high rate of patients being stone free afterwards. Despite the longer operation time, the combined laparoscopic and endourological procedure may be associated with less postoperative pain and fewer major complications. However, the choice of treatment depends on the preferences of surgeons and patients.



## 1. Introduction

Large impacted upper ureteral stones are defined as stones located above the lower border of the fourth lumbar vertebra that stay in the same location for at least 2 months, resulting in ureteral obstruction. These stones cannot be bypassed by a wire or a catheter.[1–3] Extracorporeal shockwave lithotripsy (SWL) and ureteroscopic lithotripsy (URS) are the first choices for the active treatment of ureteral calculi.[4] However, impacted ureteral stones do not respond well to SWL and URS. Moreover, SWL and URS are associated with low stone-free rates of 35.7% and 62.5%, respectively, when removing large proximal ureteral stones.[5] Furthermore, SWL shows a low stone-free rate and a higher number of procedures

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needed when removing large proximal and mid-ureteral stones. The success rate of URS for removing large mid- or upper-ureteral stones is low.[4] The use of flexible URS (FURS) has increased in recent years because of its high success rate and minimal invasive procedure. However, retreatment rates with FURS for removing large proximal ureteral stones are 20%–42%.[6] Despite the availability of different treatment options, the optimal management of patients with large impacted ureteral stones is controversial and needs to be defined further.

Laparoscopic ureterolithotomy (LU) is used for removing large impacted upper ureteral stones and is associated with a high stone-free rate (93.3%–100%) in a single procedure.[4,5,7] LU is a highly successful technique for managing urolithiasis because it is associated with a high stone-free rate in one session.[8] Migration of ureteral stones to the kidney is an important reason for the failure of LU. However, development of flexible equipment may help in overcoming the disadvantages of LU. Selected patients with large impacted upper ureteral stones and concurrent renal stones may be treated by performing LU and retrograde flexible ureteroscopy for removing renal stones through a laparoscopic port and ureterotomy site.

Percutaneous nephrolithotomy (PCNL) is another option for removing large upper ureteral stones, with a reported median stone-free rate of 86%.[2,9] PCNL can remove both large ureteral and renal stones at the same time. Despite its high efficacy, PCNL may cause various complications such as bleeding, injury to surrounding structures, and infection.[10] PCNL is a procedure with an inherent high risk of surgical complications, whereas LU has gained some popularity because of its relative safety.[8]

The present study examined the outcomes and compared the safety and effectiveness of combined LU and flexible ureteroscopy with PCNL for removing a large impacted upper ureter stone with concurrent renal stones.

## 2. Materials and methods

This study included patients who underwent combined LU and retrograde flexible ureteroscopy for removing renal stones or PCNL for removing large upper impacted ureteral stones and concurrent renal stones at our department from January 2014 to December 2016. The study was approved by the local ethics committee of Sir Run Shaw Hospital, and informed consent was obtained from each patient included in the study. Patients with a radiopaque upper ureteral stone (located at the level of the third or fourth lumbar vertebra) and several concurrent renal stones, with a ureteral stone having the longest diameter of >15 mm that stayed in the same location for at least 2 months, and with less than 10 renal stones having a diameter of <10 mm were included in the study. Patients with a solitary kidney, bilateral upper urinary tract obstruction, nonfunctional renal unit, distal ureteral stone, ipsilateral ureter operation history, active urinary infection, or urinary tract abnormalities were excluded from the study. The patients were selected in a non-randomized manner, and their data was collected and analyzed retrospectively.Treatment method was chosen based on the preferences of surgeons and patients after discussing the advantages and disadvantages of each procedure. The eligible patients were divided into two groups, namely, group A ($n$ = 23) that included patients undergoing combined LU and retrograde flexible ureteroscopyfor removing renal stones and group B ($n$ = 29) that included patients undergoing PCNL for removing large upper impacted ureteral stones and concurrent renal stones.

Before the treatment, a detailed medical history of each patient was determined; moreover, each patient underwent physical examination, urinalysis, urine culture, complete blood count analysis, serum biochemical analysis, coagulation tests, ultrasonography, kidney-ureter-bladder (KUB) abdominal plain film examination, and CTscan. Stone size was measured by viewing the longest axis of a stone by performing preoperative KUB imaging. Urinary infection was controlled by administering sensitive antibiotics before surgical intervention.

Patient demographics; stone characteristics; and procedure-related parameters, including stone-free rate, operation time, hospital stay after the surgery, mean decrease in hemoglobin levels, visual analog scale (VAS) score,[11] auxiliary procedure rate, and complication rate were determined and compared between the two patient groups. Complications were classified by the Modified Clavien Grading System.[12] Stone-free status was defined as the absence of residual stones (fragments of greater than 3 mm in diameter) on a KUB abdominal plain film examination that was performed 1 month after surgery. The VAS scores were evaluated at 24 and 48 hours after the surgery. All the patients underwent ultrasonography and/or CTscans 3 months after the surgery to check for ureteral stricture. Moreover, all the patients had follow-ups 6 and 12 months after surgery. Both LU and PCNL were performed under general anesthesia by Dr. Xu and Dr. Yu, respectively.

### 2.1. Surgical techniques

#### 2.1.1. Laparoscopic ureterolithotomy

LU was performed by using a typical three-port transperitoneal approach.[13] The patients were positioned in a 70° lateral decubitus position. After establishing the pneumoperitoneum, a 10-mm camera port was introduced at the umbilicus level in the ipsilateral abdominal wall. Next, two work ports were created.The colon was mobilized to explore the ureter, and the ureteral stone was identified rapidly near the dilated proximal ureter. Once the stone was located, a longitudinal incision was made over the conspicuous bulge on the ureter by using a cold knife and the ureteral stone was extracted carefully by using a grasper.

Once the ureteral stone was removed, a flexible ureteroscope (Olympus Corporation, Tokyo, Japan) was inserted into the ureter through the lower work port and ureterotomy site. Because the upper portion of the ureter was dilated, the flexible ureteroscope could be easily inserted into the ureter under the direct guidance of a laparoscope and with the help of the grasper, which was inserted through the other work port. Stones in the renal pelvis or calyces were removed using a nitinol stone basket (Cook Medical, Bloomington, USA). A 6F double-J stent was inserted laparoscopically in an antegrade manner (Fig. 1), and the ureterotomy site was closed using a 4-0 Vicryl suture and interrupted sutures. At the end of the procedure, the peritoneum and Gerota's fascia were closed in a continuous manner by using 2-0 Vicryl sutures. A drainage tube was routinely inserted near the ureter and was removed after confirming the absence of urinary leakage (<50 mL). The ureteral stents were removed 4 weeks after surgery.

### 2.2. Percutaneous nephrolithotomy

When performing PCNL, an open-ended 5Fr ureteral catheter was first placed in a lithotomic position by using a transurethral approach. Next, the patients were repositioned into a standard prone position, and apercutaneous access point was created under the guidance of ultrasonography. An 18-gauge puncture needle was pushed into the designated calyx (upper or middle calyx)and a guide wire was placed in the collecting system through the puncture needle. The percutaneous access was dilated to 24 Fr by using a high-pressure balloon dilator (C.R.Bard, New Jersey, USA), and a matched sheath was placed in. The stones were fragmented using Lithoclast Master™ (EMS -Electro medical Systems S.A., Nyon, Switzerland). Next, a 6Frdouble-J stent was indwelled through the



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