



Left endoscopic combined intrarenal surgery with electrocoagulation hemostasis and right flexible ureteroscopic lithotripsy for bilateral upper urinary tract stones: a case report

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Background: Percutaneous nephrolithotomy (PCNL) is the first-line treatment for large renal stones. However, multi-tract or staged procedures may be necessitated in bilateral or anatomically-complex stones to achieve stone clearance. Endoscopic combined intrarenal surgery (ECIRS) integrates the advantages of PCNL and retrograde intrarenal surgery. In this article, we detail a hybrid surgical technique adopted for the management of complex simultaneous bilateral upper urinary tract stones. In addition, we discuss the advantages and disadvantages of combining a variety of new techniques that may improve post-operative outcomes and patient satisfaction.

Case Description: We report the case of a 36-year-old male with a large left renal pelvis stone, right proximal ureteric stone, and bilateral renal stones. Biochemical results showed raised inflammatory markers but he denied pre-stenting and staged surgery. After receiving 3-day antibiotic prophylaxis, he underwent an elective hybrid procedure. Under split-leg prone position, we performed a hybrid procedure that included left ECIRS with tubeless single-tract mini PCNL and left flexible ureteroscopy, and right flexible ureteroscopic lithotripsy. Hemostasis was achieved by electrocauterization with a novel device. The patient made an uneventful recovery. Follow-up computed tomography (CT) at 1-month revealed complete stone clearance.

Conclusions: Unilateral ECIRS with tubeless single-tract mini PCNL with electrocoagulation hemostasis and adjacent retrograde intrarenal surgery in split-leg prone position is a safe, feasible, and efficient technique to manage large renal stones.

Keywords: Flexible ureteroscopy; percutaneous nephrolithotomy (PCNL); electrocoagulation; endoscopic combined intrarenal surgery (ECIRS); case report

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Introduction

Recent epidemiological studies have reflected an increase in the prevalence of nephrolithiasis due to modern lifestyle and dietary habits (1). Despite being a common urological problem, challenges may arise for the treatment of complex stones. Current advancements in urological procedures have improved the management of complex stones over time, including innovative endoscopic procedures and adjusted percutaneous nephrolithotomy (PCNL) techniques. Endoscopic combined intrarenal surgery (ECIRS) combines PCNL with retrograde intrarenal surgery (RIRS) in a minimally invasive method. This combination has been increasingly adopted to treat complex upper urinary tract calculi as it has been found to offer advantages such as reduction of repeat operations, decreased in number of PCNL tracts, and improved stone clearance rate in a single operation (2-4).

In this study, we report our initial experience with a single-session bilateral endoscopic surgery—left ECIRS with tubeless PCNL where hemostasis was achieved by transcatheter electrocoagulation, left flexible ureteroscopy, and right flexible ureteroscopic lithotripsy. The hybrid operation in split-leg prone position was successfully performed on a 36-year-old hypertensive male with left renal pelvis stone, right upper ureteric stone, and bilateral renal stones. His postoperative course was uneventful.

Highlight box

Key findings

- Combined left endoscopic combined intrarenal surgery (ECIRS) with tubeless mini percutaneous nephrolithotomy (PCNL) and right retrograde intrarenal surgery (RIRS) is a safe and effective method to achieve complete stone clearance in cases with complex stones.

What is known and what is new?

- Complex stones often require staged procedures to achieve complete stone clearance. PCNL is the primary treatment for large or complex stones but may lead to complications such as bleeding.
- Combined left ECIRS with tubeless mini PCNL by electrocoagulation hemostasis and right RIRS is a safe and feasible approach to achieve complete stone clearance in simultaneous bilateral complex stones.

What is the implication, and what should change now?

- Urologists should smartly apply different operative techniques that can improve the efficiency and efficacy of stone removal operations safely.

One-month follow-up computed tomography (CT) scan revealed complete stone clearance. We present this article in accordance with the CARE reporting checklist (available at <https://tau.amegroups.com/article/view/10.21037/tau-23-424/rc>).

Case presentation

A 36-year-old male presented with hematuria for 2 months and intermittent bilateral flank pain that persisted for 7 years. He was afebrile and vital signs were stable. His body mass index was 25.6 kg/m². Physical examination found bilateral costovertebral tenderness. Biochemical results revealed elevated white blood cell count ($13.97 \times 10^9/L$), C-reactive protein (11.21 mg/L), HbA1C (6.2%), and normal creatine (93 $\mu\text{mol/L}$). Urinalysis detected the presence of erythrocytes (3+) and protein (2+). Medical history was significant for primary hypertension, hyperlipidemia, and patent foramen ovale that were all well-controlled pharmacologically.

Preoperative CT revealed a left renal pelvis stone [max diameter 25.9×16.0 mm; max density 1,898 Hounsfield units (HU); Guy's stone score (GSS) Grade II], right proximal ureteric stones (max diameter 10×5 mm; max density 1,918 HU), bilateral renal stones, and mild hydronephrosis, and left adrenal gland hyperplasia (*Figure 1*). Antihypertensives and a 3-day prophylactic antibiotic therapy with Augmentin (Hubei, China) was initiated upon admission. Our team of specialists discussed the management plan with the patient, to which he consented to undergo an elective hybrid procedure to decrease the risk of postoperative complications and duration of hospital stay. He refused pre-stenting and elective surgery despite raised inflammatory markers.

Under general anesthesia, the patient was placed in a split-leg prone position. A rigid 8/9.8 Fr ureteroscope (Richard Wolf GmbH, Knittlingen, Germany) was directly inserted and revealed a normal bladder. The flexible guidewire was carefully passed through the urethra, bladder, and into the right ureter under ureteroscopic guidance. The proximal ureteric stone was identified and pulverized by holmium laser lithotripsy (VersaPulse® PowerSuite 100W, LUMENIS, Boston Scientific, CA, USA) at 1.0 W, 15 Hz setting. The flexible guidewire was further advanced towards the renal pelvis to introduce the flexible ureteroscope (FURS). Larger renal stones were pulverized by holmium laser lithotripsy and the larger fragments were retrieved with a stone basket (Cook Medical, Bloomington,

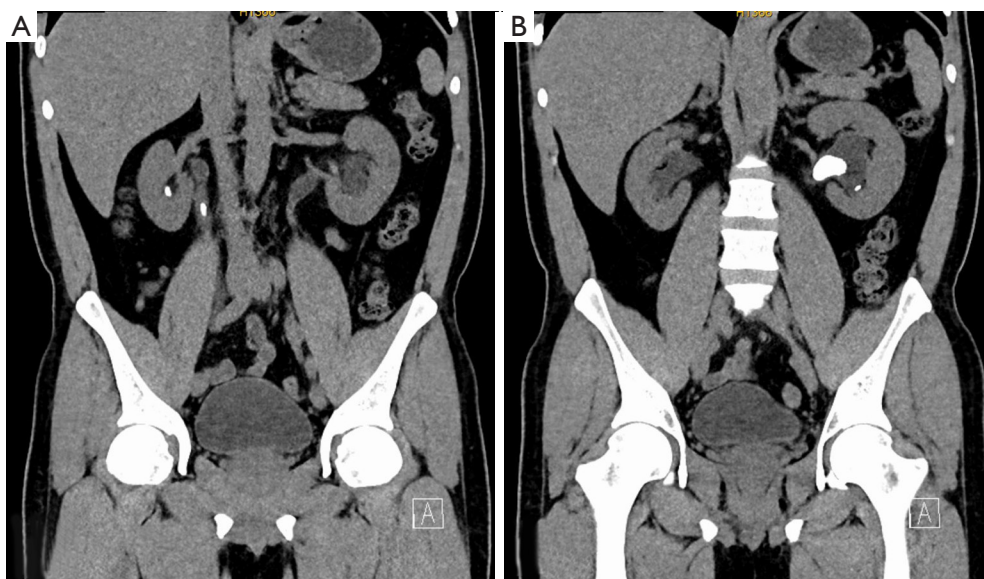


Figure 1 Preoperative computed tomography scan revealing (A) right renal calculi and right proximal ureteric stone and (B) a large left renal stone.

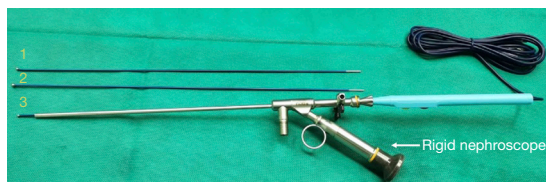


Figure 2 The electrocoagulation device used intraoperatively with its three different detachable electrodes (1 to 3) that can be attached to the rigid nephroscope. The probe tips have different diameters and angles to facilitate hemostatic electrocoagulation.

IN, USA). Residual stones <2 mm diameter remained and a 5 Fr double (D)-J stent (Boston Scientific, Marlborough, MA, USA) was inserted. A 25 cm 6 Fr ureteral catheter was introduced into the left ureter. This was done to induce artificial hydronephrosis to facilitate mini PCNL in the left.

Simultaneously, a single PCNL tract was established under extraplanar ultrasonography (USG) guidance: The C251 Curved Array transducer and ALOKA ARIETTA60 (Hitachi Medical Corp., Tokyo, Japan) were used. An 18 G PCNL needle was inserted against the lateral aspect of the probe after estimating a suitable angle. The needle tip was seen on the surface of the renal capsule and the entire puncture course was visualized through minimum adjustment of the probe. Finally, the access needle was

inserted into the middle renal calyx and a safety guidewire was retained. Tract dilatation was achieved by gradually using sequential dilators up to 8–18 Fr from a nephrostomy kit (CLINY, Create Medic, Kanagawa, Japan). An 18 Fr peel-away sheath was retained. A rigid 8/12 Fr ureteroscope (Richard Wolf, Knittlingen, Germany) was inserted via the guidewire to access the pelvis and the left renal stone was identified. Pneumatic lithotripsy (Swiss LithoClast® Select, Boston Scientific, NJ, USA) was performed with a 2.0 mm × 425 mm probe. To check for residual stones, a disposable digital FURS (RedPine, Guangzhou, China) was inserted via the PCNL tract and another FURS was accessed via the lower urinary tract. Larger fragments were retrieved with a stone basket. After confirming no residual stone, a 5 Fr ultra D-J stent was retained as a precaution for tubeless PCNL. The ureteroscope was withdrawn and a 16 Fr Foley catheter was retained.

Bleeding points were inspected through the rigid 8/12 Fr ureteroscope. Our institute patented a microchannel hemostatic device that has different detachable electrodes (*Figure 2*). As the electrode probe tip's diameter was larger than the rigid ureteroscope channel (6 Fr), it had to be inserted via the proximal opening of the rigid ureteroscope before connecting to the power source. Hemostasis was achieved by introducing the combined device through the PCNL channel and performing electrocauterization. No nephrostomy tube was placed at the end of the procedure

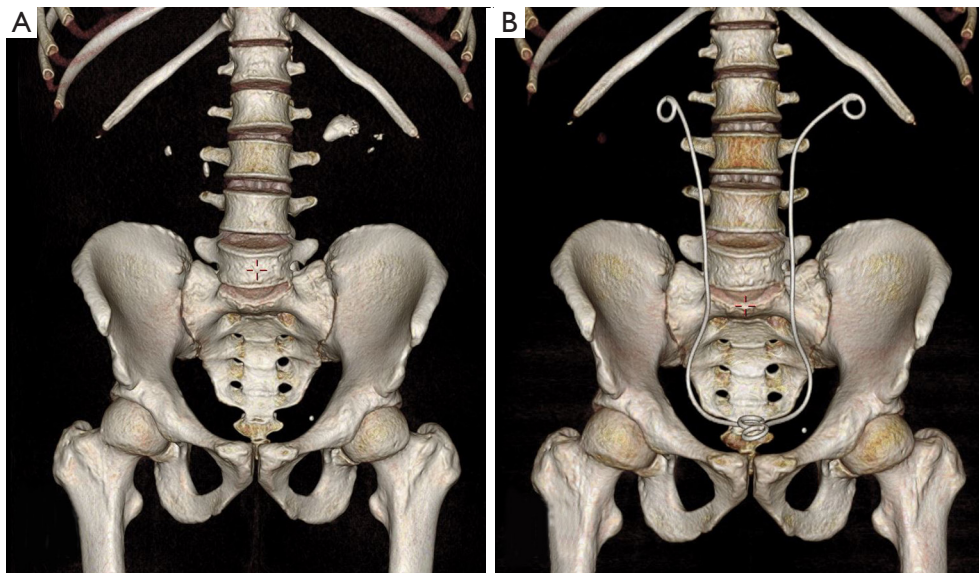


Figure 3 Three-dimensional segmented computed tomography (A) preoperative scan revealing bilateral renal stones and (B) one-month postoperative scan revealing complete stone clearance and intact double-J stents.

when no bleeding was observed. The total operative time was 113 minutes and total blood loss was insignificant.

The patient made an uneventful recovery. The Foley catheter was removed on day 1 post-operation and he was discharged on the fourth once we confirmed that there was no bleeding complication. One-month follow-up CT scan revealed no residual stones and intact bilateral D-J stents (Figure 3) that were removed without any complications.

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Publication of this case report and accompanying images was waived from patient consent according to the University of Hong Kong – Shenzhen Hospital institutional review board. We made sure that this case report was sufficiently anonymized and patient identifiers were all removed.

Discussion

Advancements in urological techniques not only aim to improve the safety and efficacy of the surgical procedure, but also guarantee patient satisfaction, such as lowering costs, reducing duration of hospital stay, and reducing the number of reinterventions. PCNL remains the primary treatment for large stones but experts have considered RIRS a feasible alternative in selected cases (5,6). ECIRS

integrates the advantages of both procedures. In our patient, we have successfully combined several developing techniques within a single session, this hybrid procedure consisted of split-leg prone position, extraplanar USG for PCNL needle access, simultaneous anterograde-retrograde FURS approach with lithotripsy, and tubeless single-tract mini PCNL with transcatheter electrocoagulation hemostasis.

PCNL in prone position provides a larger area for percutaneous renal access. It is associated with significantly shorter nephrostomy tract length and more potential access sites, which improves the safety and convenience of PCNL (7). A retrospective study on mini PCNL combined with retrograde FURS found that simultaneous anterograde-retrograde approach offered better visibility through fluid irrigation stone removal and a subsequently higher stone-free rate for large renal calculi (8). From our experience, split-leg prone position alone enabled RIRS and PCNL for bilateral stone-clearance with no difficulty in catheter placement, unlike lateral PCNL.

USG-guided percutaneous puncture is crucial for an accurate PCNL. Standard access is made by puncturing through the aspect of the indicator of the USG probe, which allows observation of almost the entire needle length. From our experience, access by puncturing through the lateral aspect of the USG probe requires a narrower insertion angle to maintain the needle within the visual field

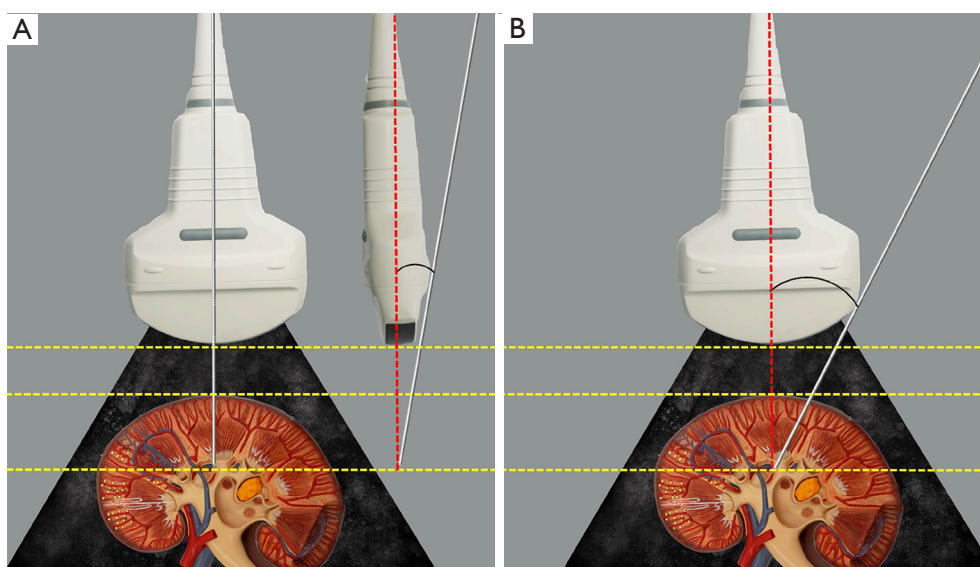


Figure 4 Illustration depicting difference in ultrasound-guided percutaneous needle access via (A) extraplanar puncture and (B) in-planar puncture, where the angle of insertion and distance of needle travelled to reach the renal calyx are comparatively shorter through extraplanar puncture. Red line demonstrates the midline of the probe that is perpendicular to the yellow lines, which is a reference to the level of the probe on the body surface, renal capsule, and target middle renal pelvis (from top to bottom).

and a shorter travelling distance that can minimize renal structure damage (*Figure 4*). However, this technique is preferred to locate stones in the middle renal pelvis, which is closer to the skin surface, but may be interfered by the adjacent costal bones. The learning curve to perfect this technique may be much longer than the standard technique. Nonetheless, this technique is feasible to safely establish an accurate PCNL tract.

Tubeless PCNL has been found to be associated with shorter hospital stay, faster recovery, and lower total procedure cost, which may be preferred for patients who prioritize cost-effectiveness and faster recovery (9). However, post-PCNL transfusion rates ranged from 3–23% (10), and factors such as hypertension, puncture site, and operative duration are significantly associated with post-PCNL estimated hemoglobin difference (11). Therefore, it is often reserved for patients with non-complex stones, stones <3 cm, single-tract PCNL, and no residual stones (12,13).

Techniques such as gelfoam hemostatic plug, injection of gelatin matrix hemostatic sealant, and trans-tract electrocoagulation have been attempted to expand the indication of tubeless PCNL by achieving immediate hemostasis (14–16). In our patient with a hypertensive history, electrocauterization with our electrode-rigid ureteroscope device was effective to achieve hemostasis.

Its design three settings and a detachable electrocautery with a larger electrode head. The detachable part can first be introduced via the nephroscope for direct vision electrocautery hemostasis before connecting to power. The procedure was safe and tubeless PCNL was achieved. Post-operative CT scan did not show any complications such as hemorrhage or perirenal hematoma, which effectively reduced post-operative pain and duration of hospital stay.

The combination of double scope contributed greatly to procedural success. FURS demonstrates excellent deflection, allowing access to all renal calices that facilitated the removal of multiple renal stones (17). Because FURS is performed through the natural orifice in antero-gradetrograde approach and can be inserted via the PCNL channel, the risk of severe bleeding due to injury of renal parenchyma has also been significantly diminished by reducing the number of tracts (18). This endovision-guided puncture was found feasible in prone position (19). In addition, stones can be displaced in a more convenient location for the nephroscope, also known as “pass-the-ball” technique (20). The aforementioned techniques greatly benefit final clearance status.

Despite the favorable short-term of this hybrid combination, this solitary case report may overestimate the benefits of this surgery. Long-term follow-up, larger

cohorts, and prospective randomized studies could further elucidate the safety and efficacy of this procedure. Another limitation is that the procedure relied heavily on the urologist's experience and their learning curve may strongly influence the results.

Conclusions

Unilateral ECIRS with tubeless single-tract mini PCNL with electrocoagulation hemostasis and adjacent retrograde intrarenal surgery in split-leg prone position is a safe, feasible, and efficient technique to manage large renal stones. The procedure can be accomplished within a single-session with reasonable operative time and no post-operative complication. However, further larger cohorts and long-term follow-up are necessary to elucidate the safety and efficacy of this technique.

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Footnote

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Ethical Statement: The authors are accountable for all

aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Publication of this case report and accompanying images was waived from patient consent according to the University of Hong Kong – Shenzhen Hospital institutional review board. We made sure that this case report was sufficiently anonymized and patient identifiers were all removed.

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