

Modified Lithotomy Position RIRS For Infectious Staghorn Renal Calculi in a Patient at Extremely High Risk of Thrombosis: A Case Report

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ABSTRACT

Background: Infectious staghorn renal calculi was once referred to as “malignant stone”. During the perioperative period, severe sepsis and even septic shock can occur, posing a risk to the patient’s life. Percutaneous nephrolithotomy (PCNL) is currently the recommended first-line treatment according to international guidelines. However, PCNL may not be suitable for certain special cases.

Case Report: A 78-year-old female was transferred to our hospital due to “right-sided back pain and high fever for 4 days, 1 day after right ureteral stent insertion” On March 5, 2022. After thorough examination the diagnosis revealed: 1. Right renal staghorn calculi, 2. Right ureteral stone, 3. Right pyonephrosis, 4. Urinary sepsis (*Candida albicans*). The Caprini score was 7, indicating a high risk of venous thromboembolism (VTE). Urine culture revealed *Candida albicans*, prompting aggressive antifungal therapy based on sensitivity results. The patient was treated with modified lithotomy position retrograde intrarenal surgery (RIRS). There were no postoperative complications such as bleeding and infection, and a CT scan performed six months postoperatively showed complete clearance of the calculi with no recurrence. This is the first reported case of performing Modified lithotomy position RIRS for Infectious staghorn calculi combined with urinary fungal infection in extremely high-risk patients with VTE risk.

Conclusion: Modified lithotomy position RIRS can be applied to some highly risky patients with infectious staghorn calculi, with good safety and efficacy through adequate preparation.

Keywords: Staghorn Calculi; Invasive Fungal Infection; Ureteroscopy; Venous Thromboembolism (VTE)

Abbreviations: VTE: Venous Thromboembolism; PCNL: Percutaneous Nephrolithotomy; RIRS: Retrograde Intrarenal Surgery; PCT: Procalcitonin; CRP: C-Reactive Protein; KUB: Kidney-Ureter-Bladder Radiography; UAS: Ureteral Access Sheath

Background

Staghorn renal calculi is a special and complex type of kidney stone, and infectious staghorn calculi is even referred to as “malignant stone disease.” Infectious staghorn calculi combined with urinary fungal infection is particularly dangerous. During the perioperative period, severe urosepsis can occur, and even life-threatening septic shock. Percutaneous nephrolithotomy (PCNL) is still the recommended first-line treatment according to current international guidelines.

However, in rare cases, such as high-risk patients for venous thromboembolism (VTE), anticoagulation or antiplatelet therapy should not be discontinued during the perioperative period, and the bleeding risk associated with PCNL is very high. Currently, there is no literature reported internationally on the use of retrograde intrarenal surgery (RIRS) for infectious staghorn calculi combined with urinary fungal infection in extremely high-risk patients with VTE risk. We have made some improvements to RIRS and have successfully treated several cases of infectious renal calculi in extremely high-risk VTE patients,

achieving good therapeutic outcomes. This article intends to report a case of modified RIRS for the treatment of a critically high-risk patient with infectious staghorn renal calculi.

Case Report

The patient is a 78-year-old elderly female who has had repeated lower urinary tract infections and self-administered antibiotics for the past year. On March 3, 2022, she was admitted to a hospital in Dongguan due to "right-sided flank pain with recurrent fever for 4 days". CT scan showed an 8mm*6mm stone in the lower segment of the right ureter, with right ureter dilation and hydronephrosis; a staghorn calculi in the right kidney, with significant swelling and perirenal effusion. On March 4, 2022, due to "septic shock, right staghorn renal calculi, and right ureteral stone", the patient underwent emergency

right ureteral stent insertion procedure. During the operation, purulent fluid was observed flowing out. On March 5, 2022, the patient was transferred to our hospital for further treatment due to severe infection symptoms. The patient had a history of diabetes, coronary heart disease, hypertension, hyperlipidemia, gallstones, and had been taking clopidogrel, atorvastatin calcium, metformin, and glimepiride for a long time. Blood gas analysis showed FIO₂: 29%, PO₂: 70mmHg, GLU: 16.95mmol/l, BE: -10.83mmol/l, AB: 14.2mmol/l, Creatinine: 208 μmol/L. Blood routine showed WBC: 26.54X10⁹/l, PLT: 75X10⁹/l. Procalcitonin (PCT) level was 72.43ng/ml and C-reactive protein (CRP) level was 155.52mg/l. Urine culture showed candida albicans. kidney-ureter-bladder radiography (KUB) showed a twisted DJ stent in the right ureter (Figure 1A), The possibility of unsuccessful intraoperative placement of the DJ stent is considered.

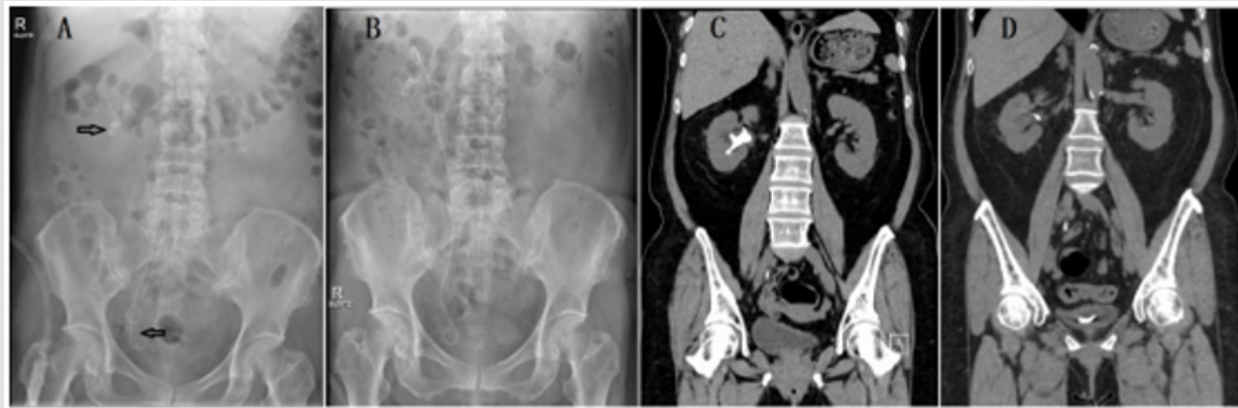


Figure 1: Preoperative and postoperative image.

- (A) KUB after insertion of right DJ stent showing that right staghorn calculi (right arrow), right ureteral calculi (left arrow), and abnormal DJ stent.
 (B) KUB after replacement of right DJ stent showing normal DJ stent.
 (C) CT before RIRS showing right staghorn calculi and right DJ stent.
 (D) One month after RIRS, CT showing right staghorn calculi disappeared completely.

CT scan showed a 7mm*6mm ureteral stone in the lower segment of the right ureter, a 46*36mm staghorn calculi in the right kidney (Figure 1C). No deep vein thrombosis was detected in the lower extremities by color Doppler ultrasound. Preoperative diagnosis:

1. Right staghorn renal calculi
2. Right ureteral stone
3. Right pyonephrosis
4. Urinary sepsis (Candida albicans)
5. Right ureteral stent
6. Metabolic acidosis
7. Hypoproteinemia
8. Renal insufficiency
9. Type 2 diabetes mellitus
10. Coronary atherosclerotic heart disease

11. Hyperlipidemia
12. Hypertension
13. Bilateral pleural effusion
14. Pelvic effusion
15. Gallbladder stones
16. Abnormal liver function
17. Cerebral atrophy

The patient belongs to the extremely high risk group for VTE, and continued to take clopidogrel orally and was instructed to perform ankle pump exercises after admission. The patient was also treated with antihypertensive and lipid-lowering medications, insulin for controlling blood glucose, and fluconazole for antifungal therapy. The patient's body temperature gradually returned to normal. On March 16, the patient developed chills and fever again, with a maxi-

imum temperature of 38.5°C, accompanied by right-sided flank pain. Ultrasound showed right hydronephrosis, so blockage of the right ureteral stent with pus and plaque was suspected. Considering the patient's impaired renal function and the need for ongoing antiplatelet therapy due to an extremely high risk of VTE, we did not opt for PCN. On March 17, emergency replacement of the right ureteral stent was performed, and a large amount of flocculent material was found floating in the bladder and right ureter. Postoperatively KUB showed that the position of the DJ stent was normal (Figure 1B). The patient's vital signs were stable, and the condition improved. Antifungal therapy was continued for 2 weeks, and there was no recurrence of fever. Then we held multidisciplinary discussions including anesthesiology, microbiology department, and hematology departments:

1. The patient's surgical indication is clear, with no absolute surgical contraindications.
2. The patient is elderly with multiple diseases and a extremely high risk of VTE, so it is not advisable to stop using clopidogrel. PCNL is not a suitable surgical method, and RIRS with lower bleeding and trauma risks is preferred.
3. The patient has been using antibiotics repeatedly for the past year, with urine culture showing *Candida albicans* and The CT value of the right renal staghorn calculi is about 500.

Right renal staghorn calculi may be infectious stone, and the risk of perioperative infection is very high. So we should take some measures to reduce the risk of infection: improved lithotomy position, adjusting the ureteral access sheath(UAS) to the appropriate position, injecting water slowly, controlling the operation time (less than 90 minutes) . After adequate preoperative preparation, RIRS were performed on April 15. During the surgery, the improved lithotomy position was used to increase the drop between the right kidney and the distal end of the UAS, facilitating the outflow of fluid from the renal pelvis and reducing intrapelvic pressure: Raise the patient's right side by 45 degrees, the right side of the operating table by 10 degrees and the head side by 15 degrees (Figure 2A). We Used a laryngeal mask for general anesthesia with a very low tidal volume mechanical ventilation mode, VT: 4ml/Kg, RR: 20 times/min. [1,2]. During the surgery, under the guidance of a guide wire, an 6-7.5Fr rigid ureteroscope was passed up to the upper segment of the ureter but no ureteral stones were found. A guide wire was left in the renal pelvis and a 12/14Fr UAS with aspiration was inserted into the renal pelvis-ureter junction. The 8.7Fr flexible ureteroscope was then inserted into the sheath to locate the stone. During the procedure, a 60ml syringe was used for slow irrigation until the wrinkles on the renal pelvis mucosa disappeared.

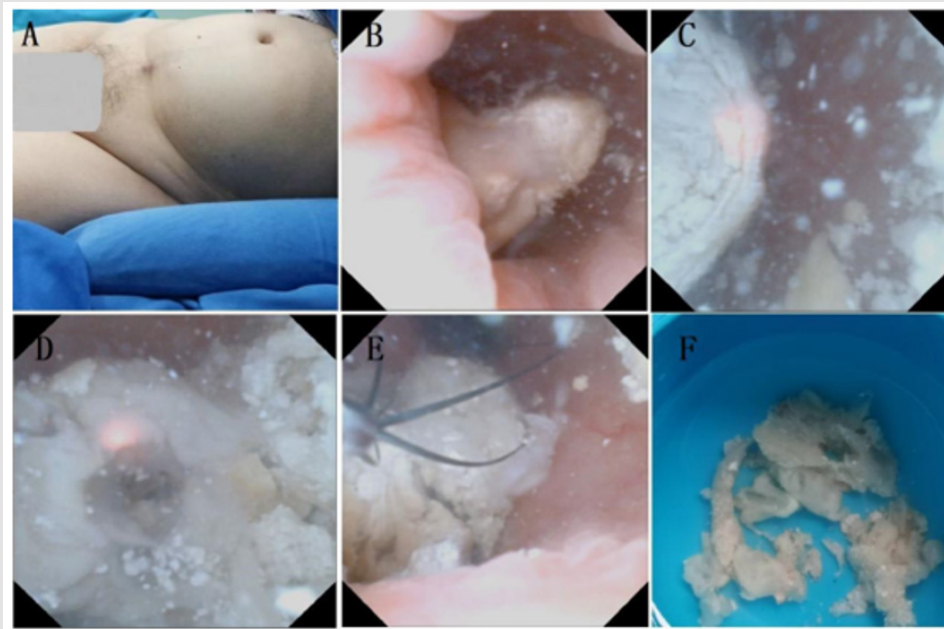


Figure 2: Intraoperative image of RIRS.

- (A) Modified lithotomy position with the right side high, head high and feet low.
- (B) Staghorn calculi under flexible ureteroscopy.
- (C) Holmium laser lithotripsy.
- (D) Pus moss on the stone surface.
- (E) Using basket to remove the stone.
- (F) Stone specimen.

The right renal staghorn calculi was observed in the renal pelvis, which was gray-white and covered with pus. A 200um holmium laser fiber was inserted and the laser energy was set to 0.4J with a frequency of 40Hz for powder fragmentation. The stone surface was poorly fragmented when covered with pus, so a stone retrieval basket was used to remove the pus and small stone (Figure 2). After confirming that all stones in the renal pelvis and calyces were pulverized, an F5 DJ stent and an F14 catheter were inserted. There was no obvious bleeding during the surgery. The operation proceeded smoothly and the operation time was 78 minutes. After the surgery, one gram of meropenem was added for infection prophylaxis, and fluconazole was continued. The patient's vital signs were stable, and there were no complications such as bleeding or fever. The patient was discharged three days postoperatively. Analysis of the stone composition showed struvite, carbonate apatite. A follow-up CT scan on 1 month post operation showed that the original right renal calculi had disappeared (Figure 1D). Urine cultures were negative on follow-up visits in the second and third months after surgery. A follow-up CT scan on October 13th showed no recurrence of the stone. Written informed consent was obtained from the patient for treatment and for publication of the case report. This case report was approved by the Ethics Committee of the University of Hong Kong-Shenzhen Hospital, and conforms to the CARE guidelines.

Discussion

Koga et al. reported that the greatest risk for patients with renal staghorn calculi which are left untreated is chronic renal failure and life-threatening urosepsis, with a mortality rate of up to 28% after 10 years [3]. Therefore, active treatment of renal staghorn calculi is necessary in clinical practice. PCNL is the preferred method for treating renal staghorn calculi due to its high success rate. However, PCNL carries potential complications, including bleeding, sepsis, and renal function impairment. In a prospective study by Zhong Wen on the treatment of renal staghorn calculi, the total incidence of complications in the multi-tract PCNL and standard-tract PCNL groups was 37.9% (11/29) and 52% (13/25), respectively [4]. RIRS is precise, effective, minimally invasive, and has a rapid recovery time, and has become a first-line treatment for kidney stones smaller than 2cm [5]. With the improvement of endoscopic equipment and techniques, more and more literature reports have demonstrated the safety and effectiveness of RIRS in treating kidney stones larger than 2cm. Tolga Akman treated 68 patients with 2-4cm kidney stones, 34 underwent RIRS and 34 underwent PCNL, and the stone-free rates in the first stage were 73.5% and 91.2%, respectively. The second-stage stone-free rate in the RIRS group was 88.2%. Postoperative complications and hospital stay were significantly higher in the PCNL group than in the RIRS group [6].

Guidelines state that RIRS for treating renal staghorn calculi is only suitable for specific patients, such as those with a solitary kidney who strongly request RIRS and those who cannot discontinue antico-

agulant drugs. In clinical practice, some units have started to attempt endoscopic treatment of renal staghorn calculi. Yi-Yong Zhu reported on 54 cases of RIRS for treating renal staghorn calculi, with a first-stage stone clearance rate of 33.3% (18/54) and a complete stone clearance rate of 83.3% (45/54). Compared to PCNL, RIRS reduces the risk of puncture-related bleeding and adjacent organ damage, and has better safety, but requires multiple procedures for treating renal staghorn calculi [7]. The patient in this case report had a infectious staghorn calculi in the right kidney approximately 46mm*36mm. According to the guidelines, PCNL should be selected. However, the PCNL plan has potential risks:1. The patient was an elderly female with urinary sepsis, renal insufficiency, type 2 diabetes, coronary atherosclerotic heart disease, hyperlipidemia, and hypertension, and had been taking clopidogrel for a long time. According to the Caprini risk assessment scale for venous thromboembolism (VTE), the patient was 78 years old (3 points), had sepsis (1 point), obesity (BMI> 25Kg/m²) (1 point), and underwent major surgery (more than 45 minutes) (2 points). The total score for venous thrombosis risk was 7 points, which was in the extremely high-risk group. The incidence of DVT during the perioperative period was 40-80%, and the mortality rate was 1-5%.

The recommended prevention plan was drug and physical prevention, so clopidogrel should not be discontinued [8]. International Alliance of Urolithiasis guideline state that RIRS is categorized as a procedure with low bleeding risk, it is a safe and efficient modality for patients on anticoagulation or antiplatelet therapy. the study by Mary E. Westerman have suggested that antiplatelet therapy does not increase the risk of procedure-related bleeding [9,10]. 2. the patient and family members were not willing to undergo PCNL and hoped for a less traumatic and risky treatment option. After multidisciplinary discussion and adequate communication with the patient, we chose RIRS as the treatment plan. The most common complications of RIRS for treating staghorn calculi are infection and stone street. The mortality rate of sepsis caused by candidemia in the United States is 40%, the highest mortality rate among all types of bloodstream infections [11]. In this case, the patient's urine culture showed white *Candida albicans*, and severe sepsis had developed when transferred to our hospital, with extremely high PCT and CRP levels. The risk of severe sepsis recurrence during the perioperative period was very high. Through multidisciplinary discussions, adequate preoperative preparation, precision operation during surgery, and standardized postoperative treatment, the patient underwent successful surgery and recovered rapidly, without developing sepsis after the operation [12,13].

The following are the key points of the treatment:

1. Fever recurred on March 16th, and inflammatory indicators such as CRP increased significantly compared to before. We suspected that pus and flocculent caused by fungal infection material had blocked the ureter and DJ tube. Therefore, we immediately replaced the ureteral DJ tube to relieve obstruction.

2. Antifungal treatment with ketoconazole was administered according to the guidelines for two weeks before surgery, and the patient was instructed to drink plenty of water (more than 3L per day).
3. During the surgery, we used an improved lithotomy position (as shown in Figure 3), if we did not inject water, the renal pelvis would not become distended. because the renal pelvis was significantly higher than the tail end of the UAS, which promoted the flow of renal pelvis fluid through the UAS and reduced intrarenal pressure. This modified lithotomy position was easy to set up and did not increase complications; however, it was important to ensure proper fixation of the laryngeal mask.
4. During the surgery, the instrument nurse slowly injected water, and the speed was appropriate when the renal pelvis was moderately filled, and the mucosal folds just disappeared.
5. During the surgery, we closely monitored the outflow of fluid from the UAS and intermittently withdrew the flexible ureteroscope to facilitate fluid outflow and reduce intrarenal pressure.
6. We strictly followed the guidelines to control the operation time, the operation lasted 78 minutes, and Intrarenal stone fragmentation and retrieval took 51 minutes. The above is a summary of the treatment experience of this case. The treatment of stones complicated by sepsis still needs to be based on guidelines, and personalized treatment plans should be adopted according to the characteristics of the patient's disease.

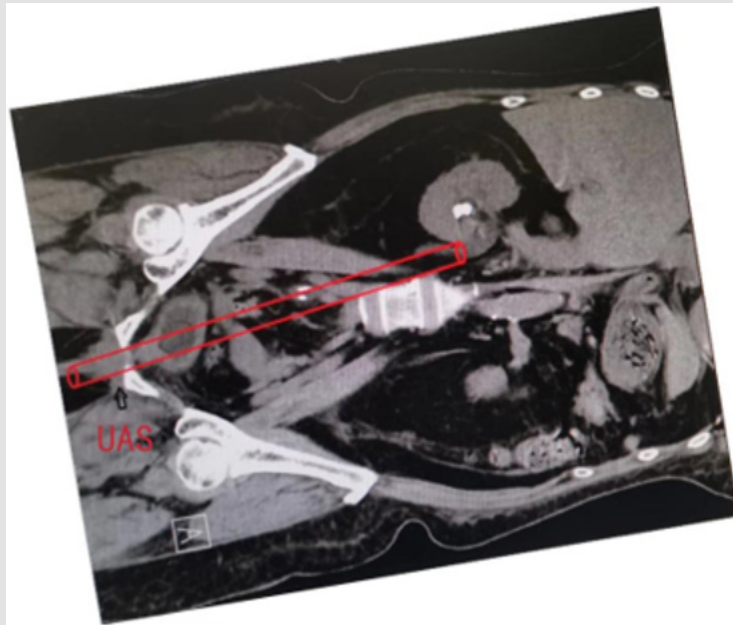


Figure 3: Modified lithotomy position with the right side high, head high and feet low.

Conclusion

This case report suggests that the modified lithotomy position promotes the drainage of fluid from the renal pelvis, decreasing intra-renal pressure. The modified lithotomy RIRS can be applied to some highly risky patients with infectious staghorn calculi, with good safety and efficacy through adequate preparation.

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