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CASE REPORTS

Urosepsis Complicated by Septic Shock After Endoscopic Combined Intrarenal Surgery for a Staghorn Calculus: A Case Report

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ABSTRACT

Endoscopic combined intrarenal surgery (ECIRS) is used for complex renal stones because it combines retrograde and percutaneous access and may allow complete stone clearance in a single session. Infectious complications are recognised after stone surgery. Rapid progression to septic shock, however, is not expected after an apparently uncomplicated procedure, and patients are usually managed postoperatively on the ward.

We present a 51-year-old woman with a right-sided staghorn calculus and multiple documented antibiotic allergies who developed urosepsis complicated by septic shock after ECIRS. The procedure was technically successful, but septic shock developed approximately 10 hours postoperatively, requiring intensive care unit admission. Treatment included fluid resuscitation, noradrenaline, oxygen therapy, and antimicrobial therapy based on the patient's microbiological history and allergy profile.

This case supports better preoperative identification of patients at risk and early recognition of postoperative deterioration after ECIRS.

Keywords: ECIRS; urosepsis; septic shock; staghorn calculus

Introduction

Urolithiasis is a common condition, and its incidence continues to increase worldwide. This has led to ongoing efforts to improve surgical strategies for renal stone management. (1) Percutaneous nephrolithotomy (PCNL) has changed considerably over recent decades. Improvements in renal access, endoscopic equipment, lithotripsy devices, and drainage strategies have all contributed to this development. Supine and modified supine positions have further expanded the procedure, mainly by improving anaesthesiological safety and allowing retrograde intrarenal surgery to be performed at the same time. Endoscopic combined intrarenal surgery (ECIRS) can therefore be adapted to the patient's anatomy, the collecting system, and the size and complexity of the stone burden.

By using both antegrade percutaneous and retrograde ureteroscopic access, ECIRS has become an accepted treatment option for large renal stones. Compared with PCNL alone, it may be associated with lower radiation exposure and less bleeding. (1,2) Infectious complications remain an important concern after ECIRS. This is expected, as the procedure combines elements of both PCNL and ureteroscopy, and both approaches carry a risk of urinary tract infection (UTI). (3–5) Perioperative complications occur in approximately one-third of patients undergoing PCNL/ECIRS. Urinary tract infections are among the most common infectious

complications and have been reported in 10.4-39.8% of cases. (3,6,7) Because available data are limited, there are still no ECIRS specific recommendations for preoperative antibiotic regimens. There is also no clear consensus on how to define patients at high risk for infectious complications. (5,8–10) ECIRS allows antegrade and retrograde endoscopic treatment to be performed during the same procedure. In our institution, patients are usually transferred to the ward after surgery for continued antibiotic prophylaxis, with discharge planned after a short hospital stay, unless their clinical condition requires intensive care unit admission. However, severe infectious complications can still occur after ECIRS, including septic shock.

Case Presentation

We present the case of a 51-year-old female patient (body mass index 27.5 kg/m²) who was scheduled for elective ECIRS due to a staghorn calculus in the right kidney. Her comorbidities included cholelithiasis, autoimmune thyroiditis, and documented multiple antibiotic allergies, and she was classified as American Society of Anesthesiologists (ASA) physical status II. Preoperatively, a urine culture (UC) was obtained and confirmed sterile, and antimicrobial prophylaxis with ciprofloxacin was administered prior to the procedure. A fluoroquinolone was selected because the patient's documented multiple antibiotic allergies precluded beta-lactam–based prophylaxis, and ciprofloxacin is an established, guideline-supported option for antimicrobial prophylaxis in endourological stone surgery. (1,9)

The procedure was performed under general anaesthesia (GA) with a total operative time of 4 hours and 30 minutes. Standard monitoring included non-invasive blood pressure (NIBP), electrocardiography (ECG), pulse oximetry (SpO_2), and end-tidal CO_2 ($EtCO_2$). The patient was positioned in the standard Valdivia position. A flexible ureteroscope was introduced into the right renal collecting system, revealing a staghorn calculus with a characteristic golden-yellow appearance. Under combined ultrasound and fluoroscopic guidance, puncture of the medial calyx was performed, with high-pressure urine backflow noted upon access. The calculus was subsequently disintegrated and extracted nephroscopically.

Final ureteroscopic inspection confirmed complete stone clearance with no residual fragments. A JJ ureteral stent was then positioned, and a percutaneous nephrostomy tube was placed and secured. The immediate postoperative outcome was uneventful. The patient was transferred to the ward in a haemodynamically stable condition with adequate spontaneous breathing, with instructions for continued antibiotic prophylaxis administration at regular intervals. Approximately 10 hours postoperatively, the patient's clinical condition rapidly deteriorated, with abrupt onset of shivering, somnolence, nausea, and vomiting. NIBP was 73/45 mmHg, corresponding to a mean arterial pressure (MAP) of approximately 54 mmHg, and remained refractory to an initial crystalloid bolus of 1000 mL administered on the ward, prompting immediate escalation of care. The patient was tachypnoeic, with SpO_2 maintained at approximately 96% on supplemental oxygen via nasal cannula (NC). In view of suspected septic shock, the patient was emergently transferred to the intensive care unit (ICU). Upon ICU admission, the patient remained spontaneously breathing and maintained adequate oxygenation on supplemental oxygen via NC at 4 L/min, without the need for endotracheal intubation or mechanical ventilation. Invasive blood pressure (IBP) monitoring was established immediately, and a central venous catheter (CVC) was inserted. Vasopressor support with noradrenaline (NA) was then initiated promptly through the CVC at 0.2 mcg/kg/min, targeting a MAP ≥ 65 mmHg. Blood cultures (BCs) and a UC were obtained at ICU admission. The most recent preoperative UC had been sterile, but the patient's earlier UCs had repeatedly grown *Escherichia coli*. Empirical therapy was therefore directed against a likely gram-negative organism while awaiting the culture result.

The patient had a clear history of severe hypersensitivity to penicillin antibiotics, including anaphylactic shock with angioedema upon re-exposure, as well as documented allergies to trimethoprim–sulfamethoxazole, tetracyclines, and chloramphenicol. She had previously been evaluated by a clinical pharmacologist,

with a clear recommendation to avoid these antibiotic classes. Antibiotic selection was significantly limited by the patient's documented multiple antibiotic allergies, necessitating a multidisciplinary approach to antimicrobial management.

Amikacin and fosfomycin were selected because the patient had no documented allergy to either and because they provided appropriate coverage for the suspected gram-negative infection. Treatment was started in consultation with a clinical microbiologist (amikacin 600 mg IV every 12 hours; fosfomycin 4 g IV every 8 hours). Initial laboratory evaluation in the ICU demonstrated severe metabolic acidosis. Arterial blood gas (ABG) analysis showed a pH of 7.10 , pCO_2 of 3.97 kPa, HCO_3^- of 11 mmol/L, and a base excess (BE) of -12.4 mmol/L. Serum lactate was 3.4 mmol/L. Inflammatory markers were markedly elevated, with a white blood cell (WBC) count of 24.3 × 10^9/L, C-reactive protein (CRP) of 228 mg/L, and procalcitonin (PCT) of 56 ng/mL. Urea was 6.7 mmol/L and serum creatinine was 92 µmol/L. ECG showed sinus tachycardia, with heart rate up to 120 beats per minute.

Over the following 24 hours, aggressive fluid resuscitation was continued, with a total crystalloid volume of 3500 mL administered, and NA was gradually tapered. Haemodynamic stability was achieved within 24 hours, with MAP maintained at 83 mmHg. Urine output was monitored hourly and remained adequate at 2 mL/kg/h. Serum sodium levels and renal function were closely monitored during the following days. Despite haemodynamic improvement, inflammatory markers remained markedly elevated, with CRP increasing to 445 mg/L and PCT remaining >50 ng/mL. WBC was 22.3×10^9/L. Serum lactate decreased to 1.1 mmol/L. BCs remained sterile. The UC grew *Escherichia coli* >10^5 CFU/mL, with the result available after two days. The isolate was susceptible to fosfomycin, gentamicin, nitrofurantoin and cephalosporins, and resistant to ciprofloxacin and other fluoroquinolones, ampicillin, amoxicillin–clavulanic acid and trimethoprim–sulfamethoxazole.

The regimen was then changed to meropenem 1 g IV every 8 hours, following consultation with a clinical pharmacologist. NA was discontinued by ICU day 3.

Inflammatory markers declined progressively over the following days, with CRP decreasing to 34 mg/L and PCT to 1.3 ng/mL by ICU day 4. A follow-up UC was sterile on ICU day 5. The patient recovered well and was discharged after 14 days of hospitalisation.

Discussion

Sepsis is defined as life-threatening acute organ dysfunction caused by a dysregulated host response to infection, with septic shock representing a subset characterised by circulatory dysfunction conferring higher mortality risk, as established by Sepsis-3 and reaffirmed by the Surviving Sepsis Campaign 2026 guidelines. (5,11–13) Urosepsis, the most serious infectious complication of endourological procedures, refers to sepsis originating from the urogenital tract. (5,11,14,15) Historically, sepsis was described as a systemic inflammatory response syndrome (SIRS) to infection, and several studies investigating infectious complications following endourological procedures, including ECIRS, have used SIRS-based criteria to define urosepsis. (11) Mariappan et al. (9) and Bag et al. (16) defined urosepsis as fever >38°C and/or leukocyte counts >12,000, after exclusion of alternative sources. The EDGE Consortium applied broader criteria, including temperature abnormalities, tachycardia, tachypnoea, altered mental status, hypotension, and abnormal white blood cell counts assessed at least 12 hours postoperatively. (12) In our patient, the clinical course was consistent with sepsis progressing to septic shock according to the Sepsis-3 definition. Treatment was therefore initiated without delay. This included IV crystalloid resuscitation, early NA support to maintain a MAP of at least 65 mmHg, and antimicrobial therapy within one hour of recognition. Following these measures, haemodynamic stability was restored. (12–15)

Multiple risk factors for infectious complications following endourological procedures have been identified. According to systematic reviews by Corrales et al. and Bhojani et al., independent risk factors for urosepsis include positive preoperative urine culture, female sex, diabetes mellitus, older age, preoperative stent placement, stone size, high irrigation pressure, longer operative time, and ischemic heart disease. (13–15) Bhojani et al. reported a pooled postoperative urosepsis incidence of 5.0% following ureteroscopy, with preoperative stent placement (odds ratio [OR] 3.94) and positive preoperative UC (OR 3.56) being the strongest predictors (14,15). Similarly, infectious complications following PCNL have been reported in 10.4–39.8% of cases, with risk factors including positive preoperative UC, staghorn calculus, prolonged operative time, and preoperative nephrostomy tube use. (3,4,6–8)

A meta-analysis of randomized controlled trials demonstrated that the overall risk of infectious complications following endourological stone treatment ranges from 0-13%. (5) Notably, patient positioning, tract size, obesity, and solitary kidney do not appear to significantly influence infectious complication rates. (3,14) However, several investigators consider patients to be at high risk when stone size exceeds 20 mm and/or collecting system dilatation is present, even with sterile urine, as well as when a positive preoperative UC has been documented within three months of the procedure, or when an indwelling stent or nephrostomy tube is present at surgery. (4,8,14,15) The role of preoperative antibiotic prophylaxis in ECIRS patients remains debated, with no specific recommendations due to insufficient data. (8–10,13) Despite appropriate prophylaxis, infected stones may harbour bacterial biofilms. Bacteria within the stone matrix may be released during endoscopic manipulation and lithotripsy, regardless of preoperative urine sterility. (14,17)

In our case, several established risk factors for urosepsis were identified. The patient was female, which has been consistently reported as an independent risk factor. (14,15) She presented with a staghorn calculus, associated with a higher risk of harbouring bacteria within the stone matrix and recognised as a significant risk factor for postoperative infection. (3,7,14) The procedure lasted 4 hours and 30 minutes, which was well beyond the 60-minute threshold after which the risk of infectious complications has been reported to double. (14,15) The stone itself was also clinically relevant. Its golden-yellow colour was suggestive of an infection-related calculus; therefore, even in the presence of a sterile preoperative urine culture, bacteria embedded in biofilm within the stone matrix may have been released during lithotripsy and caused postoperative urosepsis. (14,15,17)

The combined endoscopic approach may have played a role in this case. Prolonged operative time, continuous irrigation, and the high-pressure urinary backflow noted at puncture could have transiently raised intrarenal pressure and possibly favoured systemic release of bacteria from the infected stone matrix, despite a sterile preoperative urine culture. Several of the usual risk factors were not present in this patient. There was no diabetes mellitus, no preoperative stent, no positive immediate preoperative UC, and no ischemic heart disease. Antibiotic management was particularly challenging because of the patient's severe, multiple documented allergies. Amikacin and fosfomycin were chosen as empirical therapy, as the patient had no documented allergy to either and both offered appropriate coverage for a suspected gram-negative infection, in consultation with a clinical microbiologist. Meropenem was considered, but the patient gave an unclear, undocumented account of a possible previous reaction to it; although the likelihood of a true reaction was low, this uncertainty had to be respected, and all beta-lactams, including carbapenems, were therefore avoided initially, accepting the trade-off of relying on a more nephrotoxic aminoglycoside.

The staghorn morphology and infection-related appearance of the stone supported this choice, as such calculi often harbour biofilm-embedded bacteria that may be released during fragmentation despite a sterile preoperative urine culture. (14,17) Fosfomycin was particularly relevant for its reported anti-biofilm activity.

The culture confirmed an *Escherichia coli* susceptible to fosfomycin and gentamicin, supporting the empirical regimen. The isolate was resistant to ciprofloxacin, the agent used for prophylaxis, which may have cont-

ributed to the breakthrough infection.

After two days, the regimen was switched to meropenem, with faster recovery thereafter. In retrospect, given the very low penicillin–carbapenem cross-reactivity (<1%), meropenem could have been introduced earlier. (18) Routine avoidance of carbapenems in penicillin-allergic patients is no longer justified and may push clinicians toward more toxic alternatives such as aminoglycosides. By clearing the entire stone in a single session, ECIRS removed the infective source, which likely supported the favourable outcome.

Conclusion

ECIRS is an effective and well-established procedure for complex renal stone disease, usually followed by an uneventful recovery and a short hospital stay. Postoperative urinary infections are generally mild and manageable on the ward. This case, however, is a reminder that an apparently routine, technically successful procedure can be followed within hours by rapidly progressive urosepsis and septic shock. The key message is the need for a high index of suspicion, early Sepsis-3–based recognition, and a low threshold for intensive care, especially in patients at higher risk of severe postoperative infection. Antimicrobial prophylaxis in this setting remains uncertain, particularly when multiple allergies limit standard options, and prospective studies are needed to define evidence-based prophylaxis and postoperative risk stratification. (8–10)

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