Received: 27 August 2021 | Revised: 14 January 2022 | Accepted: 18 March 2022

DOI: 10.1111/ijun.12319

CASE REPORT

BAUN BRITISH ASSOCIATION OF UROLOGICAL NURSES WILEY

Case report of rescue of a patient with COVID-19 and shock after holmium laser lithotripsy

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Abstract

Lithotripsy is the primary form of treatment for ureteral calculus. According to clinical data, ureteroscopic lithotripsy (URSL) is characterized by better efficacy, a lower risk of complications, and a quicker postoperative recovery, when compared with open surgery. However, elderly patients often have a variety of chronic diseases that can directly or indirectly influence intraoperative care and postoperative recovery. It is important that medical staff closely observe changes in the postoperative condition of patients and provide them with the best quality care. In order to control the progression of disease and reduce mortality rates, it is very important to promptly eliminate the cause of shock, supplement blood volume, and correct cardiovascular disorders. During the pandemic caused by coronavirus disease 2019 (COVID-19), there has been a significant focus on management, predominantly operating rooms but also intensive care units (ICUs), to ensure that hospitals can provide prompt and effective diagnosis and treatment for every patient with COVID-19 and also prevent the spread of the virus and guarantee the safety of medical staff. During surgery on patients suspected of having COVID-19, it is important that specific personnel take control of the designated work and implement three strict levels of protection to prevent the transmission of the virus by air, droplets, and personal contact. Attention should be paid to the transfer of patients, the protection of medical staff, the management and control of negative pressure operation rooms, and postoperative treatment, thereby ensuring the safety of patients and medical staff. In this case report, we describe the nursing experience of rescuing a patient with COVID-19 who developed septic shock following flexible ureteroscopic holmium laser lithotripsy. The causes of septic shock were subsequently examined to inform a new protective strategy for rescuing patients with COVID-19 in the operating room and ICU, and to prevent and control cross-infection with the virus during surgery.

KEYWORDS
calculi, COVID-19, critical care, lithotripsy, operating room nursing, sepsis

1 | CASE STUDY

A 75-year-old female patient from Suzhou, Jiangsu Province, developed fever without a clear cause on the 1st of February 2020; her highest body temperature reached 39°C. The body temperature returned to normal after the oral administration of ibuprofen sustained-release capsules, but rose again after withdrawal of this drug. The patient was admitted to the Hospital on the 10th of March 2020. On admission, she was clearly conscious, had chest distress and obvious dyspnea; her body temperature, heart rate, respiratory rate,

and blood pressure, were 37.7°C, 71 beats/min, 20 breaths/min, and 131/72 mmHg, respectively. She had positive SARS CoV-2 results in two consecutive throat swab nucleic acid tests. A lung Computed Tomography examination that identified multiple infections in both lungs, and clinical signs led to a diagnosis of COVID-19. Following hospitalization, the patient was isolated in a single ward. The doctors and nurses dressed in two-levels of protective clothing and anti-infective therapy was commenced. The patient had received open lithotripsy in the left middle ureter 10 years ago, without any subsequent overt symptoms. Waist soreness and dysuria had occurred occasionally from June 2019 and on the 12th of March 2020, she was diagnosed with multiple calculi in the right lower ureter following a plain film of the kidney–ureter–bladder (KUB) axis. The KUB showed obvious nonradiolucent calculus shadows in the right renal region and the right lower ureter, with a maximum diameter of approximately 21 mm × 11 mm (Figure 1). On the same day she was given oral medications (Lianhua Qingwen capsules, ibuprofen suspension, and Moxifloxacin tablets); these medications gradually reduced her body temperature back to normal. On the 15th of March, she was diagnosed with mild hydronephrosis by CT urography and an intravenous pyelogram (IVP) was carried out prior to surgery. CT urography identified a calculus in the right lower ureter and right kidney (Figure 2) and IVP showing mild hydronephrosis in the right kidney (Figure 3). The results of a midstream urine drug sensitivity test and bacterial culture

FIGURE 1 On March 12, 2020, a KUB showed obvious nonradiolucent calculus shadows in the right renal region and the right lower ureter, with maximum diameter of approximately 21 mm × 11 mm. A right ureteral calculus was therefore suspected. KUB, kidney–ureter–bladder

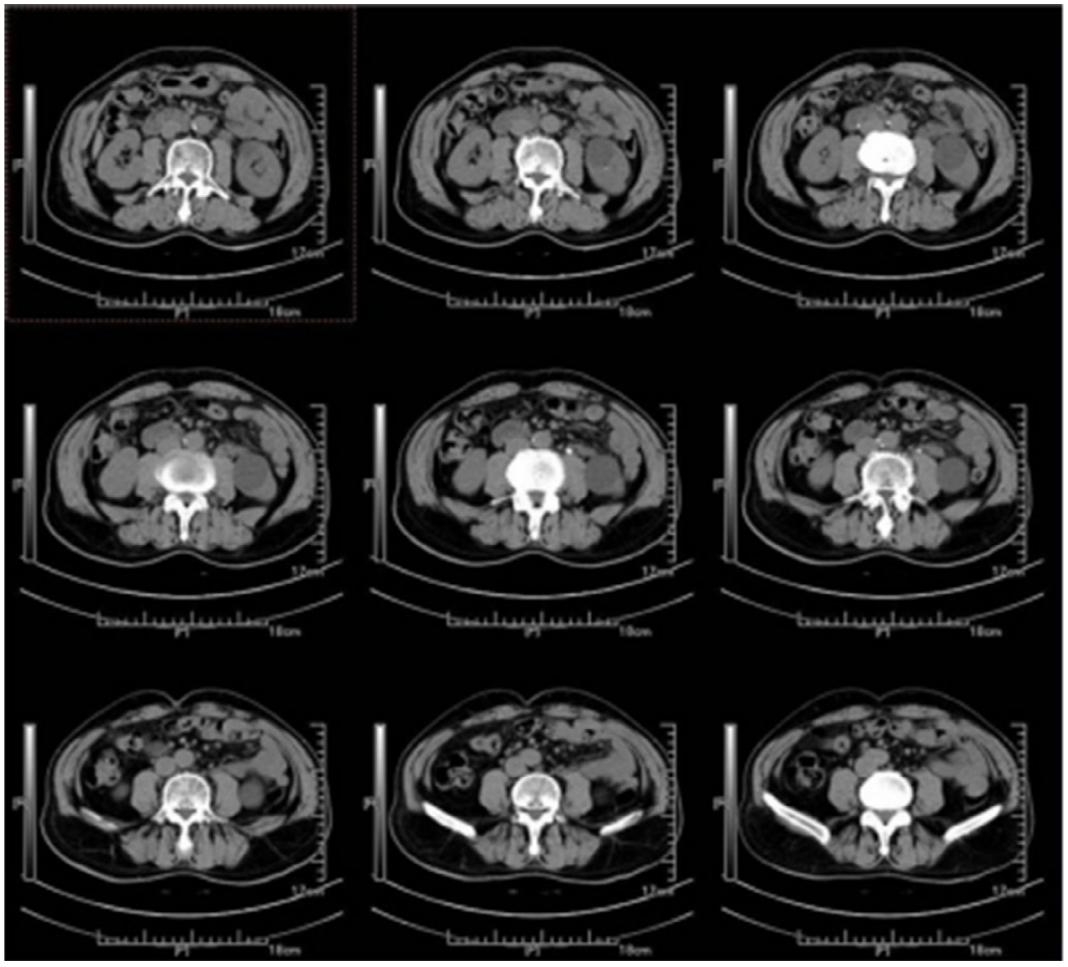

FIGURE 2 On March 15, CT urography identified a calculus in the right lower ureter and right kidney

FIGURE 3 An IVP showing mild hydronephrosis in the right kidney, dilatation of the right upper ureter, and no image development in the left kidney. IVP, intravenous pyelogram

revealed that there was no bacterial growth, while the results arising from chest X-ray and electrocardiography were all normal. Physical examination revealed no abnormalities in the heart and lungs, a flat and soft abdomen with no rebound pain or tenderness, symmetrical costal spinal angles, percussion tenderness in the right renal region but not in the left region, no edema in either of the lower extremities, and that the two renal regions or the upper pubic region were not full. Following discussion, the urologists decided to perform flexible ureteroscopic holmium laser lithotripsy on the 22nd March with 1 g of imipenem and cilastatin sodium infused as a preventive anti-infective therapy 30 min prior to surgery. To avoid cross-infection, the patient wore a disposable surgical mask and entered the isolated operating room through a separate channel. Negative pressure (<−5 Pa) was turned on in the operation room 30 min prior to surgery. The patient entered the operating room at 10:05 AM and tracheal intubation was performed by an anesthesiologist according to three-levels of protection. The patient received laryngeal mask airway ventilation under general anaesthesia. The circulating nurse removed items from the operating room not related to the surgery and hung an isolation card 'COVID-19' on the door of the operating room. Once the operation began, the surgeon conducted retrograde catheterization of the affected ureter and observed that urine in the affected ureter was abnormally turbid and that there was a calculus wrapped within layers of polyps. The polyps were removed using biopsy forceps, followed by lithotripsy with a 1 mm ballistic lithotripsy probe under a pressure of 0.2 mPa.

The door of the operating room was kept closed during the operation, and negative pressure in the room was maintained. The patient suffered from minor blood loss during the operation, which lasted for 48 min. A double-J tube was then inserted for drainage and the operation was successfully completed at 10:55 AM. Following completion, the patient was transferred to a recovery room for observation. A urologist wearing a double layer of sterile gloves sealed the ureteral calculus specimen in a double-layer specimen bag marked with 'COVID-19'. The specimen was then placed in a closed container and sent to the Pathology Department for testing. A circulating nurse disinfected the unmanned operating room with an ultra-low-volume spray of peracetic acid. At 11:15 AM, after waking and extubation, the patient was transferred to the ICU and given care and close observation by a specialist nurse. Following surgery, penicillin was infused intravenously as anti-infective therapy. At 14:30 on the same day, the patient had a pale complexion, dysphoria, and skin clamminess. At 14:40, the patient complained of discomfort again; at this time, her body temperature, blood pressure, mean arterial pressure, central venous pressure, and heart rate were 39°C, <80/50 mmHg, 45 mmHg, only 3 cm H_2O, and >110 beats/min, respectively. Routine haematology showed a total neutrophil count of 8.2 (normal value, 2.0–6.9) and the percentage of neutrophils was 82.1 (normal value, 50–70). Biochemical analysis showed that the levels of creatine kinase were 653 U/L (normal value: 18–198 U/L) and lactate dehydrogenase 650 U/L (normal value: 109–245 U/L). Based on these clinical manifestations, the patient was diagnosed with septic shock. At 14:50, the ICU nurse assisted a doctor to insert a deep venous catheter in the right internal jugular vein to monitor central venous pressure, while also providing a rapid infusion channel. The patient was infused rapidly with 1500 ml of Ringer's solution within 3 h and 250 ml of low-molecular dextran was administered for dilatation and to increase the colloid osmotic pressure and promptly replenish the effective circulating blood volume. During infusion, the patient's consciousness, peripheral circulation, and urinary output were observed closely. The infusion rate was adjusted according to her blood pressure and heart rate. At 15:05, a nurse performed a blood and urine bacterial culture, and a drug sensitivity test and the patient was given mask oxygen inhalation and physical cooling. At 15:30, on the doctor's advice, an ICU nurse intravenously infused 2 g of imipenem and cilastatin sodium every 12 h for anti-infective therapy. At the same time, the nurses monitored the patient's vital signs and observed changes in urinary output. At 15:40, on the doctor's advice, a nurse intravenously infused 250 ml of 5% sodium bicarbonate to correct metabolic acidosis, while 10 mg of norepinephrine injection was added to a 5% glucose injection and then continuously pumped into the patient using a micro-pump to enhance vascular activity and maintain hemodynamic stability. Following these treatments, the patient's vital signs gradually became stable. At 16:10, her blood pressure rose to 100/60 mmHg and the mean arterial pressure, central venous pressure, body temperature, heart rate, and 24-h urinary output were >70 mmHg, 11 cm H_2O, <38°C, <100 beats/min, and >3000 ml, respectively. The urine also became clear. By 20:30, the vasopressor drugs were gradually withdrawn, and antibiotic administration stopped after the patient's body temperature and routine haematology tests became completely normal. At this time, the patient had received negative blood and urinary culture results.

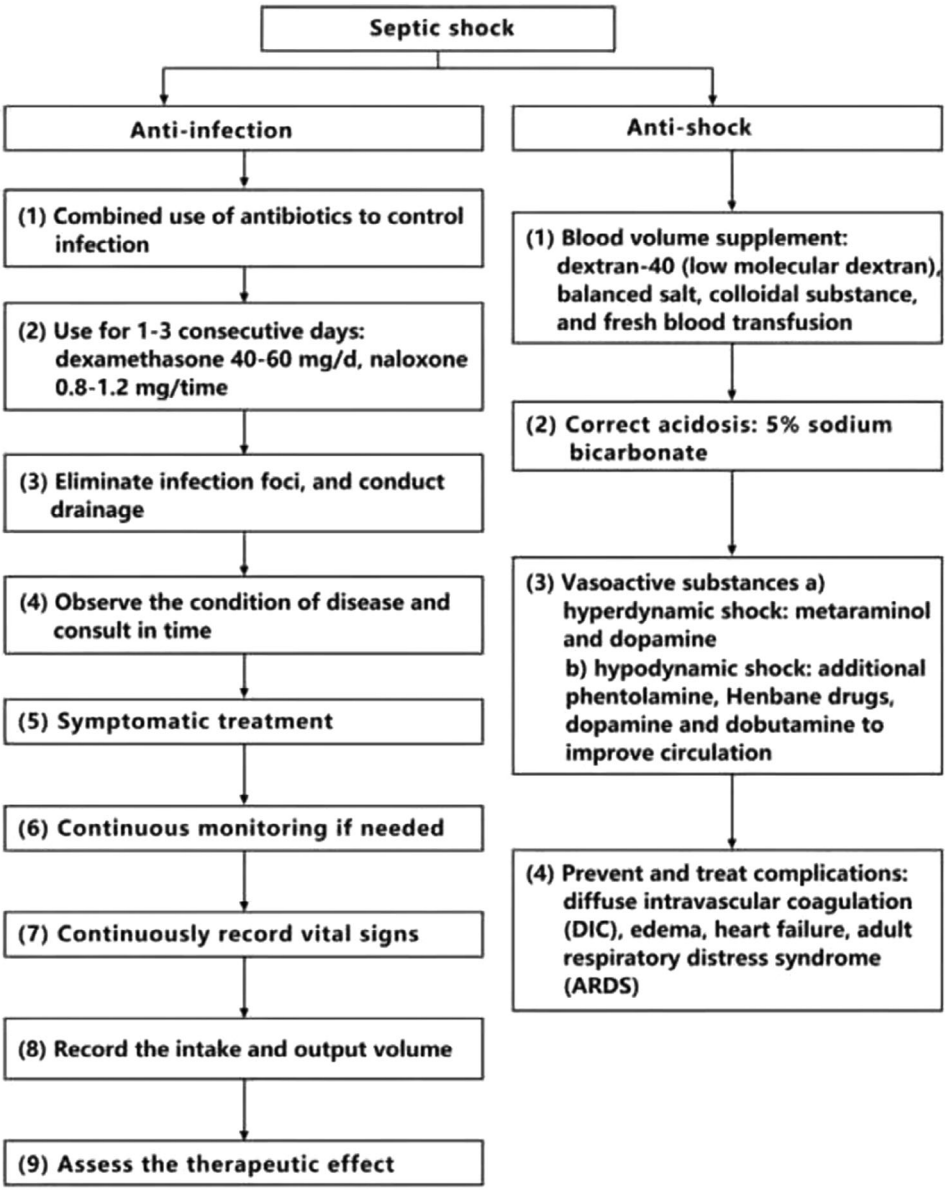

FIGURE 4 The flow sheet of rescue of septic shock

When the patient sweated heavily, the sweat was wiped off promptly and the bedding and clothing replaced in order to keep the skin dry (the flow sheet of rescue of septic shock is shown in Figure 4). From the 24th of March to discharge, 10 mg of dexamethasone was administered, and 20 mg of furosemide was injected intravenously every day to promote urination and improve the symptoms of systemic poisoning. On the 25th of March, routine blood and urinary results had returned to normal and on the 27th of March, the patient was considered to be cured and was discharged, although the ureteral stent was retained. The patient was asked to return for re-examination after 1 month of home quarantine. Thirty-five days after the operation, the patient's body temperature was normal, breathing sounds in both lungs were clear, and there was no sign of respiratory discomfort. The results of a swab nucleic acid test were negative and CT of the urinary tract was normal. Therefore, we removed the ureteral stent.

After the patient was discharged, a surface disinfection cleaner (dressed in disposable protective clothing, a medical protective mask, and rubber gloves) wiped and disinfected the instruments and equipment in the operating room and ICU twice with gauze impregnated with 75% alcohol, including the operating tables, shadowless lamps, anaesthesia machines, and ECG monitors. Each bed unit, and item of floor and office furniture, were wiped twice with 1000 mg/L chlorine-containing disinfectant and then wiped and rinsed with clear water. A scrub nurse soaked the instruments used in the operation for 30 min in 2000 mg/L chlorine-containing disinfectant, and then handed them to the Sterile Supply Department marked as 'COVID-19'. All secretions from the patient's mouth and nose were wrapped completely in tissue paper which was then placed in a yellow garbage bag, sealed, and packed by full-time staff. Then, the bag was placed in a designated medical waste area for handover and registration.

2 | DISCUSSION

As a new form of respiratory infectious disease, COVID-19 is characterized by strong infectivity, a varying severity of disease. To date, no specific drugs have been used clinically to treat this disease.[1] The operating room is an important place for patients diagnosed with COVID-19 who need surgery. Developing emergency plans and work procedures for COVID-19 in the operating room is an important aspect of infection prevention and control in medical institutions. Isolation and protection are the main strategies used for the prevention and control of COVID-19 and should be adopted throughout surgery. Surgery for COVID-19 patients is very different from conventional surgery and needs to be performed in a negative pressure operating room. In our case, standard precautions were strictly adhered to in the operating room and ICU during hospitalization and were based on strengthening prevention and the control of droplets, contact, and airborne transmission. This involved paying strict attention to the transfer of patients, the protection of medical staff, the management and control of negative pressure operation rooms, and postoperative treatment to ensure the safety of patients and medical staff.

Septic shock refers to a sepsis-induced clinical syndrome that can be reversed by fluid resuscitation and is characterized primarily by persistent hypotension. According to epidemiological surveys, septic shock has become a major disease that threatens human health across the world. A small number of cases of septic shock are caused by treatment in the clinic; the condition of such cases is usually very severe. Therefore, early diagnosis and treatment are extremely important. Furthermore, comprehensive and careful observation and analysis of the condition are considered to be critical for successful treatment outcomes. Patients with septic shock may suffer from skin clamminess and mucosal dryness during the early stage (the circulatory function compensatory stage) and the core body temperature may rise significantly (above 38°C) or decline (below 36°C). Patients may also experience a reduction in blood pressure, an increase in heart rate, and enhanced myocardial contractility. Specialist nurses in the ICU should therefore develop individualized nursing protocols based on the actual situation of patients and monitor changes in their condition and vital signs every 30 min in addition to carefully observing the temperature of the patient's extremities and skin colour. COVID-19 may often deteriorate with the occurrence of microcirculatory disturbances that result in skin clamminess. Furthermore, the mood of patients may change from quiet to irritable and from irritable to lethargic. When these abnormalities are observed, it is important that the patient should be treated and rescued as soon as possible.

Septic shock after ureteroscopic lithotripsy (URSL) is a severe complication associated with dangerous clinical conditions. There are several main causes of shock in these patients: (1) urinary tract obstruction that was not effectively controlled prior to surgery, thus resulting in ureteral infection; (2) aseptic techniques were not strictly implemented during the operation and relevant equipment was not adequately sterilized; (3) the patient's ureter was damaged during the operation, thus resulting in the leakage of urine and infection; (4) the perfusion pressure used for high-pressure liquid perfusion during surgery was abnormally elevated, thus leading to fluid reflux and pathogenic microorganisms entering the blood circulation, thereby resulting in infection; (5) a postoperative infection was caused during placement of the drainage tube.[2] Therefore, nurses need to pay attention to the certain situations to prevent septic shock during the perioperative period. Poor preoperative control of urinary tract infections is a major cause of septic shock after ureteroscopic holmium laser lithotripsy. Prophylactic antibiotics should be administered routinely for 3 days and midstream urine bacterial culture and drug sensitivity tests should be performed prior to surgery so that sensitive antibiotics can be used to control infection. Perioperative life monitoring and anti-infective therapy should also be strengthened. During surgery, low-pressure perfusion should be conducted manually in a gentle manner with strict adherence to operating procedures. The perfusion pressure should be adjusted according to intraoperative conditions to reduce reflux infection. In addition, aseptic operations need to be strictly implemented to prevent iatrogenic infections.

With the continuous development of urology technology, ureteral stent implantation has been extensively utilized; this new technique is capable of relieving inflammation and maintaining unobstructed ureters. However, urinary tract infection following ureteral stent implantation is a major cause of unplanned hospital visits, reduces a patient's quality of life and increases treatment costs; however, this also affects a patient's subsequent recovery. Furthermore, the drug resistance of bacteria has increased over recent years, largely because of the irrational use of antibiotics, especially the abuse of broad-spectrum antibiotics, which greatly enhances the difficulty in treating urinary tract infection.[3] To make efforts to prevent infections after ureteroscopic diagnosis and treatment, we analysed the specific reasons and results of a rescue procedure involving a patient with septic shock. We compared this with the clinical data of 325 patients who received ureteral stent implantation in our hospital between January 2019 and December 2021 for retrospective analysis. First, we collated a series of data, including patient age, gender, laboratory indicators, and the use of antibiotics. Then, we investigated the incidence rate and risk factors of urinary tract infection after ureteral stent implantation in urological patients. Analysis showed that postoperative infection occurred in 39 of 325 patients who received the placement of ureteral implants, with an incidence rate of 12%, including 14 patients (4.31%) undergoing URSL and 25 patients (7.69%) undergoing ureteroscopic inspection. In the present study, we discovered that the incidence rate of infection was higher in patients undergoing ureteroscopic inspection than that in patients undergoing ureteroscopic surgery; this finding was associated with local vascular injury and bleeding arising from the tissue biopsies that are often required during ureteroscopic inspection, thus increasing the incidence of urinary tract infection. Furthermore, according to univariate analysis, seven factors were identified to be independent risk factors for urinary tract infection after ureteral stent implantation in urological patients, including hormone use, elevated peripheral blood leukocytes, a history of calculi, diabetes mellitus, malignancy, and other immunodeficiency diseases, long-term indwelling of ureteral stents and ureteral stent size.[4] There were no correlations between hypertension and operation time with

the occurrence of postoperative urinary tract infection. Our analysis indicated that the reduction of calculus formation and postoperative calculus residuals helps to reduce the risk of urinary tract infection following ureteral stent implantation. Furthermore, Escherichia coli are the main form of pathogenic bacteria that cause urinary tract infections after ureteral stent implantation in urological patients, and therefore require particular attention.[5] Therefore, we should take active preventive measures to control underlying diseases and infections prior to surgery in patients with high-risk factors, improve related preoperative examinations and review routine urinary data after surgery, identify pathogenic bacteria in patients, and select appropriate antibiotics for long-term treatment.

Single or multiple organ dysfunction can develop quickly when septic shock occurs simultaneously, thus resulting in a high mortality rate. The patient described herein had COVID-19 with only mild respiratory symptoms, Once septic shock is diagnosed, the perfusion of important organs should be improved as soon as possible, fluid resuscitation should be performed within 6 h, and the following four anti-infective and anti-shock therapies should be performed as soon as possible. First, a reduction in effective blood volume is the most important pathophysiological change in septic shock; therefore, early fluid resuscitation is the key to treating the condition. After shock occurs, the patient should be infused quickly with sufficient colloidal or crystalloid fluids; those with anaemia should also be infused with red blood cells and plasma, so that the central venous pressure and mean arterial pressure reaches 8–12 and >65 mmHg, respectively. During these infusions, the condition of the patient should be monitored comprehensively, including vital signs, central venous pressure, urinary output (an objective quantitative index for shock), laboratory test results, and clinical efficacy. Septic shock is often accompanied by acidosis; therefore, the patient needs to be supplemented with a sodium bicarbonate solution. Second, under the premise of providing an effective circulating blood volume and correcting for acidosis, the patient should be treated with dopamine or norepinephrine. Third, anti-infection therapy is the key to treatment after septic shock. Once septic shock occurs, sensitive and effective antibiotics should be administered as soon as possible, and blood and urinary bacterial cultures and drug sensitivity tests should be performed. High-efficiency and broad-spectrum antibacterial drugs are recommended for this anti-infective therapy prior to obtaining final test results. Fourth, the functionality of the target organs should be protected to prevent cerebral edema or heart failure. In the present case, the reaction to shock was very severe, making it difficult to rescue the patient. Therefore, nurses should make correct and decisive judgements, take quick actions, perform skilled operations, and pay close attention to changes in cardiopulmonary function and vital signs. The patient should also actively receive anti-infective therapy in addition to ensuring shock is prevented by the infusion of fluids.

3 | CONCLUSION

Septic shock is a severe complication of flexible ureteroscopic holmium laser lithotripsy and represents a major threat to the health and safety of patients. The treatment of septic shock is dominated by effective anti-infection therapy, fluid resuscitation, the administration of vasoactive drugs and glucocorticoids, and the provision of supportive treatment. Early and effective anti-infective therapy is the key to correcting shock and avoiding death. Nurses should have a detailed and thorough knowledge of the disease and be able to detect, prevent and promptly manage changes in the patient's condition as early as possible, thereby reducing the risk of death.

In this case report, our patient was diagnosed with COVID-19 complicated by septic shock that was characterized by its extremely rapid development and extreme difficulty with regards to treatment and care. The medical staff were at high risk of exposure to the COVID-19 virus. There are key lessons that arose from this case report. First, standardized emergency nursing procedures and rapid and accurate emergency nursing techniques are the basis for guaranteeing the success of rescue. Nurses in the operating room and ICU should receive regular training so that their busy rescue work can be carried out in an orderly manner and to ensure that targeted rescue nursing can be provided based on variations in the specific clinical condition of the patient. Septic shock is a severe condition and is characterized by its rapid progression and changes over time. Therefore, nurses must be able to respond rapidly, have a diverse knowledge of first aid, possess skilled rescue techniques and the ability to observe disease, be familiar with the rescue process and the use of ECG monitoring and ventilators, and actively take first aid measures, thereby gaining time for the rescue of patients.

Following a series of symptomatic treatment strategies and meticulous care, the vital signs of the patient described in this case report tended to be stable and her urinary output gradually returned to normal. It was therefore considered that the patient was cured and accordingly she was discharged. Close observation, early detection, and the introduction of appropriate anti-shock therapy are all key factors for the diagnosis and treatment of septic shock in this patient. Nurses in the operating room and ICU performed routine midstream urine bacterial culture and drug sensitivity tests prior to surgery. During surgery, the monitoring of vital signs was strengthened, the perfusion pressure was timely and reasonably adjusted based on the patient's condition, and aseptic techniques were implemented rigorously. Following surgery, appropriate antibiotics were administered for anti-infection therapy so that lithotripsy could be performed successfully, thus resulting in the patient being cured and discharged from hospital.

ACKNOWLEDGEMENTS

We are particularly grateful to Mr. Kui Xu for his valuable suggestions and discussions. I would also like to express my gratitude to EditSprings for the expert linguistic services provided, the company that reviewed this English thesis, as well. With all your help and support, I was able to overcome difficulties and doubts until the successful completion of this thesis.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The paper was established, according to the ethical guidelines of the Helsinki Declaration and was approved by the Human Ethics

Committee of the First Affiliated Hospital of Soochow University and ethical approval number is 2021SE-256-73. In addition to the approval of the ethics committee, this retrospective study also obtained the written informed consent, including consent to publish from the patient and family members. Written informed consent was voluntarily obtained from individual or guardian participants who have been informed of the study including any of the benefits and risks involved.

CONSENT FOR PUBLICATION

Written informed consent for publication was obtained from all participants and patients.

DATA AVAILABILITY STATEMENT

The datasets used in the current study are available from the corresponding author on reasonable request.

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How to cite this article: Qu J, Xu K. Case report of rescue of a patient with COVID-19 and shock after holmium laser lithotripsy. *Int J Urol Nurs*. 2022;1-7. doi:10.1111/ijun.12319