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CASE REPORT

Preoperative management of septic shock due to cellulitis cruris

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ABSTRACT

Background: Septic shock is an emergency condition due to a systemic inflammatory response to infection, which can lead to multiple organ failure. Soft tissue infections such as cellulitis are one of the causes of sepsis, especially if not treated properly. Management of septic shock includes hemodynamic stabilization, antibiotic therapy, and control of the source of infection through debridement. The main challenge in this procedure is the risk of hemodynamic instability during anesthesia. **Case Illustration**: A 51-year-old man came with complaints of weakness and decreased consciousness, preceded by swelling and pain in the left leg. Examination showed septic shock with hypotension (69/45 mmHg), leukocytosis (34,000/µL), and AKI (creatinine 2.58 mg/dL). Fluid resuscitation and initial stabilization were performed before debridement. Anesthesia used total intravenous anesthesia (TIVA) with ketamine and sufentanil, and close monitoring with vasopressors. **Conclusion**: Management of septic shock due to cellulitis requires a multidisciplinary approach. Early stabilization, debridement, and appropriate anesthetic techniques play an important role in improving the patient's prognosis.

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Highlights

1. A detailed case report of septic shock in a 51year old male patient
2. The importance of early detection and surgical intervention in the management of sepsis shock in cellulitis cruris

BACKGROUND

Sepsis and septic shock are the main cause of death globally. Septic shock is a medical emergency characterized by organ dysfunction due to the body's uncontrolled response to infection, and it is part of sepsis with the alteration on circulatory, cellular and metabolism with a greater risk of mortality than sepsis (Guarino et al., 2023). Septic shock is defined as sepsis accompanied by persistent hypotension

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despite adequate fluid resuscitation, and requires vasopressor therapy to maintain tissue perfusion (Jarczak et al., 2021; Seymour et al., 2016). Sepsis is a syndrome, not illness (Singer et al., 2016), occurs when the body gives an excessive inflammatory response to infection, causing impaired tissue perfusion, organ failure, and potentially leading to death if not treated quickly and appropriately, so that the Surviving Sepsis Campaign Guidelines 2021 categorized it as a life-threatening organ dysfunction (Coopersmith et al., 2018; Font et al., 2020). The diagnosis is made by an increase in the Sequential Organ Failure Assessment (SOFA) score ≥ 2 from the initial value (Evans et al., 2021). Meanwhile, septic shock is a form of severe sepsis with persistent hypotension that requires vasopressors to maintain MAP ≥ 65 mmHg and serum lactate > 2 mmol/L despite adequate fluid resuscitation (Singer et al., 2016).

Etiologically, sepsis can be caused by various types of infections, including bacterial, viral, fungal, and parasitic infections (Guarino et al., 2023), but mostly, sepsis causes by bacterial infections from various sources such as pneumonia (lung infection), urinary tract infections, intra-abdominal infections, skin and soft tissue infections (cellulitis), that trigger for sepsis. The causes of cellulitis are *Streptococcus pyogenes* and *Staphylococcus aureus* (Bhagat et al., 2023), which can invade subcutaneous tissue and cause extensive inflammation (Dolin et al., 2019; Grondman et al., 2020; Legese et al., 2022).

Cellulitis is a bacterial infection of the skin and subcutaneous tissue (Sullivan and De Barra, 2018), characterized by swelling, pain, erythema, and local temperature elevation in the infected area (Gunderson, 2011). If not treated properly, the bacteria can spread deeper through the blood vessels and lymphatic system, which then triggers a systemic inflammatory response. The spread of these bacteria can over-activate the immune system, releasing various inflammatory mediators such as pro-inflammatory cytokines: TNFα (tumor necrosis factor-alpha), IL-1 (interleukin-1), and IL-6; which ultimately cause endothelial dysfunction, capillary leakage, hypotension, and organ hypoperfusion. If tissue perfusion is not immediately restored, this condition can lead to multiple organ failure, including acute kidney injury (AKI) due to prolonged decreased kidney perfusion (Grondman et al., 2020; Sullivan and De Barra, 2018).

Initial management of septic shock focuses on hemodynamic stabilization through adequate fluid resuscitation, appropriate empiric antibiotic therapy, and identification and control of the source of infection (Park et al., 2024). In cases of severe soft tissue infections such as this, surgical debridement is often required to remove infected necrotic tissue and prevent further spread of infection (Hakkarainen et al., 2014). Debridement is performed by removing necrotic tissue using a scalpel or electrocautery, leaving healthy, well-vascularized tissue. This procedure aims to reduce the bacterial load, accelerate healing, and prevent more severe complications such as necrotizing fasciitis or gangrene (Borguezam et al., 2021; Jia et al., 2020; Martínez et al., 2020).

Debridement procedures in patients with sepsis present their own challenges, especially in terms of anesthesia (Kaur, 2022). Patients with sepsis often experience hemodynamic instability due to systemic vasodilation and capillary leak leading to relative hypovolemia. The use of general anesthesia in such patients requires extra caution because of the risk of severe hypotension that can worsen organ perfusion. Therefore, the anesthetic technique of choice is often total intravenous anesthesia (TIVA) with agents such as ketamine and sufentanil, which have minimal effects on blood pressure and can still provide adequate analgesia (Bajracharya et al., 2023). In addition, the use of vasopressors such as norepinephrine is often required to maintain blood pressure during the procedure. Close monitoring of vital signs, tissue perfusion, and urine output is essential to prevent deterioration of the patient's condition postoperatively (Freise et al., 2009; Myburgh et al., 2005).

OBJECTIVE

In this case report, a patient with septic shock due to cellulitis was reported who underwent debridement. The management of septic shock requires a multidisciplinary approach so that it is more complex and unique compared to other patients.

CASE

A 51-year-old man came to the Emergency Unit (ER) with complaints of weakness and difficulty waking up since the last 1 day. This complaint was preceded by weakness for the last 3 days and pain and swelling in the left leg since 3 days ago, which was getting worse. The patient's family stated that before experiencing decreased consciousness, the patient was still able to communicate even though he appeared weak. The patient did not complain of fever, cough, shortness of breath, chest pain, or pain when urinating, and there was no history of previous trauma. The patient and family denied any history of diabetes mellitus (DM), hypertension (HT), chronic kidney disease (CKD), or heart disease. There was no history of previous hospitalization or known chronic disease. In addition, the patient had no history of routine drug use or allergies to certain drugs.

Upon arrival at the ER, the patient appeared seriously ill. The patient weighed 70 kg and was 165 cm tall, with vital signs showing blood pressure of 69/45 mmHg, pulse rate of 120 beats/minute, respiratory rate of 22 breaths/minute, oxygen saturation of 97% on room air, body temperature of 36.2°C, and level of consciousness Glasgow Coma Scale (GCS) 3-5-6. Further physical examination showed that the conjunctiva of the eyes were not anemic, the sclera was not icteric, and there was no enlarged lymph nodes or masses in the neck. Cardiac and pulmonary examinations were within normal limits, with regular heart sounds without murmurs or gallops and vesicular breath sounds without rhonchi or wheezing. Abdominal examination showed no distension, normal intestinal peristalsis, and no tenderness or masses. Examination of the extremities showed a capillary refill time (CRT) >2 seconds, cold acrals in the upper extremities, while the left lower extremity (genu-cruris) appeared swollen, erythematous, and felt warm, indicating a soft tissue infection.

Physical examination of the left leg found swelling (edema) in the left lower extremity, especially in the ankle and foot area. The skin color appeared erythematous (reddish) with slight hyperpigmentation. There were no large open wounds, but there was a medical plaster that likely covered the area of a small wound or lesion that was in the healing process. There were no signs of necrosis or blackish discoloration.

Figure 1. Clinical Photo of Patient

Laboratory examination results showed leukocytosis (34,000/µL), increased BUN (32.3 mg/dL), increased creatinine (2.58 mg/dL), increased ALT (124 U/L), and hyponatremia (133 mmol/L). Random blood potassium and glucose levels were within normal limits. Radiological examination of the lower extremities showed no fractures or other bone abnormalities, and no gas was found in the soft tissue that could indicate necrotizing fasciitis.

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Based on clinical findings and supporting examination results, the patient was diagnosed with septic shock due to left cruris cellulitis, acute kidney injury (AKI), with the possibility of acute on chronic kidney disease (ACKD). Initial management in the ER included administration of nasal oxygen 3 L/minute and the first resuscitation fluid of crystalloid fluid (0.9% NaCl) as much as 300 ml every 15 minutes with gradual evaluation. After the first resuscitation, the patient's blood pressure increased gradually to 78/51 mmHg, with improvement in pulse rate to 118 times/minute, respiratory rate 20 times/minute, oxygen saturation 99% with the help of nasal oxygen 3 L/minute, body temperature 36.5, Glasgow Coma Scale (GCS) level of consciousness to 4-5-6 but urine production was still negative.

Further treatment was in the form of a second resuscitation of crystalloid fluid (0.9% NaCl) of 300 ml every 15 minutes with gradual evaluation. After the second resuscitation, the patient's blood pressure increased gradually to 88/57 mmHg, with an improvement in the pulse rate to 108 times/minute, respiratory rate 20 times/minute, oxygen saturation 99% with the help of nasal oxygen 3 L/minute, body temperature 36.5, and positive urine production in the catheter tube.

The fourth resuscitation were performed by injecting crystalloid fluid (0.9% NaCl) of 300 ml every 15 minutes with gradual evaluation. After the fourth resuscitation, the patient's blood pressure increased gradually to 105/72 mmHg, with improvement in pulse rate to 90 times/minute, respiratory rate 20 times/minute, oxygen saturation 99% with nasal oxygen assistance 3 L/minute, body temperature 36.5, and positive urine production 50 ml. After fluid resuscitation, the patient received maintenance fluid in the form of crystalloid fluid (0.9% NaCl) with a dose of 2100cc/24 hours with evaluation of vital signs and urine production. The patient was then consulted to the General Surgery Department for debridement as definitive therapy.

Figure 2. Clinical Photo After Procedure

Perioperative management was performed using general anesthesia techniques using total intravenous anesthesia (TIVA). Induction of anesthesia was given using 40 mg ketamine and 5 mcg sufentanil. Monitoring of vital signs during surgery showed relatively stable blood pressure with fluctuations in systolic blood pressure of 120-140 mmHg and diastolic blood pressure of 60-80 mmHg, supported by the use of norepinephrine (average initial blood pressure is around 95/57 mmHg). Pulse rate ranged from 80-100 times/minute, respiratory rate 16 times/minute, and oxygen saturation 100%. During the operation, the patient received 50 ml of 0.9% NaCl fluid and 100 ml of paracetamol infusion as analgesic. Urine production during the operation which lasted for 45 minutes was recorded as 50 ml, with a total amount of bleeding and pus of 20 ml.

Post-operatively, the patient was in stable condition and was given further treatment in the High Care Unit (HCU). The day after the operation, the patient's condition improved significantly, so the patient was allowed to move to the regular treatment room for further monitoring.

DISCUSSION

Sepsis is a condition that occurs as a result of a systemic response to infection, which can lead to organ dysfunction and shock if not treated promptly. In this case, the patient experienced septic shock due to left cruris cellulitis that progressed to systemic infection. In theory, cellulitis is a soft tissue infection that is usually caused by *Streptococcus pyogenes* or *Staphylococcus aureus* and can progress to sepsis if the bacteria spread into the bloodstream. Risk factors that can worsen the course of this disease include diabetes mellitus, chronic kidney disease, immunological disorders, or delays in treating the infection. However, interestingly, the patient in this case did not have any clear comorbid risk factors, indicating that sepsis can occur even in individuals without significant comorbidities (Gyawali et al., 2019; Kamath et al., 2023; Singer et al., 2016). In this case, the patient came with signs of shock in the form of low blood pressure (69/45 mmHg), tachycardia (120 beats/minute), and capillary refill time (CRT) >2 seconds, which is in accordance with the definition of septic shock based on the Sepsis-3 criteria. The theory states that septic shock occurs due to the release of inflammatory mediators that cause systemic vasodilation, increased capillary permeability, and organ dysfunction (Grondman et al., 2020). This was seen in a patient with cold extremities, early oliguria, and elevated creatinine (2.58 mg/dL), indicating acute kidney injury (AKI). Rapid and aggressive fluid resuscitation with crystalloids has been shown to be the mainstay of management of septic shock (Jia et al., 2020). In this case, administration of 0.9% NaCl at a dose of 4 ml/kg BW in 15 minutes succeeded in increasing blood pressure gradually, which indicated a positive response to initial therapy (Spiegel and Hockstein, 2022).

Based on the 2021 Surviving Sepsis Campaign guidelines, indicators of stabilization include mean blood pressure (MAP) ≥ 65 mmHg, decreased lactate, improved peripheral perfusion (CRT <2 seconds), and urine output ≥ 0.5 mL/kg BW/hour. Sepsis patients are considered fit for surgery if these hemodynamic parameters are achieved, and there are no severe contraindications to anesthesia. This evaluation is also important in determining whether the patient requires further vasopressor support during the procedure (Spiegel and Hockstein, 2022).

The definitive management of this patient is debridement, which is the primary procedure to remove infected tissue and stop the spread of infection. In theory, debridement should be performed immediately in cases of soft tissue infection that progress to sepsis, especially if there are signs of necrosis or no response to antibiotics alone. In this case, although there was no gas in the soft tissue that suggests necrotizing fasciitis, the swelling, erythema, and pain in the left lower extremity indicated the need for surgical intervention. In some cases, delay in debridement can increase the risk of multiple organ dysfunction syndrome (MODS) and mortality. Therefore, the decision to perform early debridement in this patient is in accordance with the principle of sepsis management based on the source of infection (source control) (Howell and Davis, 2017).

The administration of maintenance fluids of 2100 ml per 24 hours is calculated based on the patient's weight (70 kg) using the general formula of 30 mL/kgBW/day, which is the standard approach in administering maintenance fluids in adult patients with relatively stable kidney function. This approach aims to meet the basal daily fluid requirements, maintain organ perfusion, and avoid the risk of overhydration which can worsen hemodynamic conditions in patients after sepsis resuscitation. The selection of crystalloid solutions (0.9% NaCl) is also adjusted to the patient's electrolyte status which indicates mild hyponatremia, with regular monitoring of fluid balance and urine output. This principle of fluid administration is also in accordance with the recommendations of the Surviving Sepsis Campaign 2021 and general clinical practice in the continued management of hemodynamically stable sepsis patients (Spiegel and Hockstein, 2022).

In terms of anesthesia, this patient received total intravenous anesthesia (TIVA) using ketamine and sufentanil. Ketamine was chosen because of its effects on maintaining blood pressure and increasing tissue perfusion, which is very important in septic patients who are susceptible to hypotension due to general anesthesia. In theory, patients with septic shock are at risk of severe intraoperative hypotension, which can worsen organ perfusion and increase the risk of renal failure or tissue ischemia (Ali et al.,

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2019; Soumya and Singam, 2023). In this case, the patient's blood pressure remained stable during surgery with the help of norepinephrine, indicating that the anesthetic strategy used was quite effective. In addition, monitoring of urine output during surgery showed improvement in renal perfusion, which is important to prevent the progression of AKI.

Compared with cases of sepsis due to cellulitis in patients with diabetes or chronic kidney disease, these patients showed faster improvement after debridement and fluid resuscitation. Diabetic patients usually have a more severe clinical course due to impaired immune system and poor vascularization, often requiring more aggressive antibiotic therapy and more extensive surgical procedures. In addition, patients with chronic kidney disease (CKD) who experience sepsis are more susceptible to acute on chronic kidney disease (ACKD), which has the potential to cause permanent kidney failure. In this case, the increase in urine output after resuscitation indicates that the AKI experienced is still reversible, which is a better prognosis compared with patients with more severe comorbidities.

Overall, this case illustrates the importance of early diagnosis and aggressive management of a patient with septic shock due to cellulitis. Prompt fluid resuscitation, control of the source of infection through debridement, and appropriate anesthetic strategy contributed to the patient's recovery. A multidisciplinary approach between emergency physicians, surgeons, and the anesthesia team is essential to ensure optimal management and improve the patient's prognosis.

Limitations

This case report provides a comprehensive overview of the patient's clinical course, including medical history, symptoms, examination results, surgical procedures and preoperative care. However, some limitations must be recognized, such as the absence of long-term follow-up and insufficient examination to truly demonstrate sepsis criteria such as lactate examination and blood and pus culture. The author hopes to receive feedback and criticism on this case report.

CONCLUSION

This case highlights the importance of early identification and aggressive management of patients with septic shock due to cruris cellulitis, especially those complicated by acute kidney injury (AKI). Prompt and adequate fluid resuscitation plays a critical role in hemodynamic stabilization, while surgical debridement is essential to control the source of infection. The use of total intravenous anesthesia (TIVA) with ketamine and sufentanil has been shown to be effective in maintaining hemodynamic stability during surgical procedures, with close monitoring of blood pressure, tissue perfusion, and urine output to prevent postoperative deterioration. A multidisciplinary approach involving emergency physicians, surgeons, and the anesthesia team is essential to ensure optimal management, thereby improving the prognosis of patients with similar conditions.

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Conflict of Interest

The authors declare no conflict of interest.

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Patient concern for Publication

Informed consent is obtained from patients for data collection, case information without invading their privacy.

Author Contribution

CEM : patient's care, collecting and interpreting the data, drafting the manuscript, and conducting the literature review; Y : drafting, conducting the literature review, and revising.

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