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Management of Anesthesia in Patients with DIC, AKI, and Post-Laparotomy Hypoglycemia due to Diffuse Peritonitis and Sepsis

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Abstract
This case report describes the management of anesthesia in patients with disseminated intravascular coagulation (DIC), acute kidney injury (AKI), and hypoglycemia after undergoing laparotomy due to diffuse peritonitis and sepsis. The 61-year-old male patient initially came in with acute abdominal pain and underwent an appendectomy, but his clinical condition soon worsened. The study highlights perioperative and clinical decision-making challenges related to airway management, fluid resuscitation, and intensive care. Emphasis is placed on the importance for anesthesia practitioners to recognize sepsis-related complications early.

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Introduction

Diffuse peritonitis is one of the emergency conditions of the abdomen that requires immediate surgical treatment and intensive management (Jamal & Rizky, 2021). The disease occurs when the infection spreads widely throughout the peritoneal cavity, which is generally caused by perforation of the gastrointestinal tract such as in appendicitis perforata, perforation of ulcers, or diverticulitis that have complications (Okaniawan & Dewi, 2022). If the infection is not treated optimally in a short period of time, the patient is at risk of developing sepsis and progressing to sepsis shock and multi-organ dysfunction (Lebedev, Agrba, Popov, Klimov, & Svanadze, 2021)

In these circumstances, the release of systemic inflammatory mediators such as interleukin and TNF-α results in vasodilation, increased capillary permeability, and microcirculation disorders (Jarczak, Kluge, & Nierhaus, 2021). This will decrease tissue perfusion and cause dysfunction of vital organs. Common complications include disseminated intravascular coagulation (DIC), acute kidney injury (AKI), and metabolic disorders such as hypoglycemia, all of which can worsen the prognosis and increase the risk of death (Levi, 2018)

DIC is a condition of uncontrolled activation of the blood clotting system, resulting in the formation of small thrombus extensively in the blood vessels and consuming clotting components to cause bleeding (Umar & Sujud, 2020). Meanwhile, AKI in sepsis patients is associated with decreased renal perfusion, oxidative stress, and the effects of proinflammatory cytokines (Elhapidi, Kalew, Darmadji, Pake, & Regina, 2023); (Fatoni & Kestriani, 2018). Hypoglycemia itself can appear as a result of increased glucose consumption, liver dysfunction, and systemic metabolic disorders, which can interfere with consciousness and worsen the patient's general condition

For an anesthesiologist, dealing with a patient with this condition requires a high degree of precision in assessing organ function and physiological status as a whole. Anesthesia measures must take into account unstable hemodynamic conditions, oxygenation disorders, as well as high risks from the use of certain anesthetic drugs. The selection of anesthesia techniques, the administration of fluids and vasopressors, and monitoring during and after surgery must be carried out with an individual and dynamic approach. Mechanical ventilation support as well as handling in the intensive care room is often required to maintain patient stability.

This case report has important value as a learning material and reference for anesthesia practitioners in treating patients at high risk of mortality due to complications of severe intraabdominal infection. In addition to describing the clinical journey, this report also illustrates the complexity of the decisions that must be made quickly and appropriately by medical teams in a multidisciplinary context. An in-depth understanding of the physiology of sepsis and its impact on anesthesia is the primary basis for providing safe and effective treatment.

Thus, this case study aims to describe an approach to anesthesia management in patients with post-laparotomy multiorgan complications due to diffuse peritonitis, supported by a review of the current literature, in order to be a reference material in clinical practice and anesthesia medical education.

Theoretical studies

Peritonitis is an inflammation of the peritoneal lining that can be triggered by infectious agents or exposure to certain chemicals. Based on the cause, the condition is divided into three main types: primary peritonitis (without a clear source of

intraabdominal infection), secondary peritonitis (due to perforation of visceral organs such as the intestines), and tertiary peritonitis (recurrent or persistent infection despite being treated). Secondary peritonitis is the most common form of peritonitis, and has a great potential to cause sepsis if not treated appropriately.

Sepsis itself is a systemic immune response to infection characterized by the release of various inflammatory mediators, such as TNF-α and IL-6 (Ouch, 2023); (Harahap, Nasution, Munandar, Siregar, & Nainggolan, 2021). This process triggers dilatation of blood vessels, increased capillary permeability, and decreased organ perfusion, which can further lead to failure of vital organs such as DIC, AKI, and severe metabolic disorders.

DIC is a condition in which the coagulation system is activated extensively and uncontrollably, resulting in the formation of small blood clots in the microvessels and at the same time a massive consumption of clotting factors and platelets. This condition causes a risk of bleeding and the formation of thrombus simultaneously (Levi & Ten Cate, 1999). Treatment of DIC involves therapy of its underlying disease such as sepsis, as well as the provision of transfusion support such as platelets, FFP, or cryoprepitute when needed (Taylor et al., 2001; Wada et al., 2013).

AKI in patients with sepsis generally occurs due to sustained renal perfusion disorders, endothelial damage, as well as the toxic effects of systemic inflammation on kidney tissue. The main management includes hemodynamic stabilization to maintain renal blood flow, avoiding nephrotoxic drugs, and strict monitoring of renal function parameters. If the condition worsens, dialysis may be an additional therapy option (Bellomo et al., 2012; Prowle et al., 2015).

Hypoglycemia, or blood glucose levels below 70 mg/dL, is a condition that can cause serious neurological disorders, especially in patients who experience severe metabolic stress such as sepsis. The mechanism involves an increase in cellular energy needs, impaired liver metabolism, and a decrease in gluconeogenesis. Treatment focuses on regular glucose monitoring as well as the administration of glucose infusions to maintain safe levels (Cryer et al., 2003; Marik & Preiser, 2010).

In the management of anesthesia of patients with severe sepsis and complications such as DIC, AKI, and hypoglycemia, a comprehensive approach is needed that considers the overall clinical status. Cardiovascular stability, fluid balance, as well as the choice of anesthetic agent should be adapted to the patient's physiological condition. Given the complexity of cases, intensive monitoring and team-based cooperation—including anesthesia, surgery, and ICU—have become crucial to achieving optimal clinical outcomes.

Methods

This study was prepared in the form of a retrospective descriptive case study that aims to explain anesthesia management in patients with complications of disseminated intravascular coagulation (DIC), acute kidney injury (AKI), and hypoglycemia after undergoing laparotomy due to diffuse peritonitis.

The case discussed is a 61-year-old man who received treatment at dr. Suhatman MARS Hospital. Clinical information was collected retrospectively through a review of medical record documents, which included anesthesia records during surgery, observation sheets in the ICU room, and laboratory test results during hospitalization.

The data collection process is carried out by identifying various relevant clinical aspects of the patient before, during, and after surgery. The aspects studied included the patient's physiological status, the main diagnosis, the type and dose of anesthesia agent

used, fluid resuscitation strategies, the use of vasopressor agents, airway management, and supportive therapy provided in the intensive care unit.

The analysis was carried out descriptively and narratively, by comparing the patient's condition and management against the latest literature and clinical guidelines in anesthesia practice, especially related to the treatment of patients with severe sepsis and its complications. This approach aims to assess the appropriateness of clinical interventions with evidence-based practice, as well as identify important challenges and considerations faced by anesthesia teams in the decision-making process.

Results and Discussion

The 61-year-old male patient came with the main complaint of lower right abdominal pain for 3 days and had an appendectomy. During the postoperative period, patients develop hypoglycemia, progressive respiratory distress, and are eventually referred to the ICU due to ventilator dependence.

In ICU treatment, endotracheal tube (ETT) is installed with a SIMV mode ventilator, adjusted FiO2 and PEEP according to the patient's oxygenation needs. The patient's blood pressure dropped critically so vasopressor therapy was initiated, including the controlled use of norepinephrine and other vasopressors. Blood sugar is closely monitored and maintained through continuous administration of dextrose infusions to overcome hypoglycemia. However, the patient's clinical condition worsened, with the occurrence of disseminated intravascular coagulation (DIC), acute renal failure (AKI), and organ perfusion disorders.

During the intraoperative phase, fluid resuscitation is performed intensively and the patient's hemodynamics are successfully stabilized before anesthesia induction. General anesthesia using ketamine as an induction agent was chosen to keep blood pressure stable and provide adequate analgesia, given ketamine's relatively cardiostimulant profile (White et al., 2016). Transfusion of blood components in the form of fresh frozen plasma (FFP) and platelets is given based on the results of coagulation examinations, to treat active bleeding due to DIC.

Invasive hemodynamic monitoring is applied throughout surgery to monitor arterial blood pressure, central venous pressure, and perfusion of vital organs, especially kidneys with AKI. Postoperatively, patients undergo advanced mechanical ventilation with intensive monitoring, including blood glucose measurements every 30 minutes to prevent recurrence of hypoglycemia. Renal replacement therapy (RRT) is given when indications of progressive kidney failure appear.

With this integrated supportive therapy, patients show gradual improvement in coagulation and kidney function, and hypoglycemia is effectively controlled through glucose infusion. However, severe multiorgan complications and the patient's overall critical condition present a high risk of mortality.

This case demonstrates the complexity of managing patients with severe sepsis accompanied by complications of DIC, AKI, and hypoglycemia, which significantly increases mortality in critical patients (Dellinger et al., 2013; Vincent et al., 2016).

Hemodynamic management is a top priority both in the preoperative and intraoperative phases to ensure the perfusion of vital organs, especially the kidneys that are susceptible to ischemic injury due to septic shock (Prowle et al., 2015). Ketamine was chosen as an anesthetic induction agent because of its pharmacological profile that does not drastically lower blood pressure, even providing sympathomimetic effects to maintain blood pressure and heart rate (White et al., 2016). This is important considering the

coagulation and vasodilation disorders of sepsis that lower perfusion pressure (Apfelbaum et al., 2012).

DIC is a complex coagulopathy with a concomitant risk of bleeding and thrombosis (Levi & Ten Cate, 1999). The main treatment is to stop the causes, such as infection and sepsis (Taylor et al., 2001). Transfusions of blood components such as FFP and platelets are required to improve hemostasis and control active bleeding (Wada et al., 2013).

AKI that occurs due to microvasculature dysfunction and renal inflammation in sepsis requires hemodynamic optimization with careful fluid resuscitation and isotonic fluid administration (Bellomo et al., 2012; Zampieri et al., 2019). The use of vasopressors such as norepinephrine follows guidelines to maintain renal perfusion (Rhodes et al., 2017). Renal replacement therapy is carried out when kidney failure persists or there is fluid overload (Vincent et al., 2016).

Recurrent hypoglycemia in sepsis patients should be closely monitored as it can worsen the neurological and metabolic prognosis (Marik & Preiser, 2010). Glucose monitoring every 30 minutes and continuous administration of dextrose infusions are necessary to maintain glucose stability (Cryer et al., 2003).

The role of anesthesiologists is essential in intra and postoperative management, especially in the selection of hemodynamically stable anesthesia agents, invasive monitoring, as well as collaboration with ICU teams for multidisciplinary intensive therapy (Dellinger et al., 2013). Early detection of complications and timely response to therapy are key to reducing mortality in patients with severe sepsis with multiorgan complications (Vincent et al., 2016).

Overall, the management of severe sepsis patients with DIC, AKI, and hypoglycemia must be integrated, with intensive monitoring and multidisciplinary approaches. Hemodynamic optimization and intensive supportive therapy increase the patient's chances of survival from severe life-threatening complications.

Conclusion

Anesthesia management in patients with diffuse peritonitis and sepsis requires an integrated, individually-tailored multidisciplinary approach. Strict hemodynamic monitoring, stabilization of respiratory function, and early detection and management of complications such as disseminated intravascular coagulation (DIC) and acute kidney injury (AKI) are key to the success of therapy. The use of anesthesia with agents that can maintain hemodynamic stability, as well as intensive coordination between anesthesia, surgical, and intensive care teams, are instrumental in improving the outcomes of these critical patients.

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