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Continuous spinal anesthesia versus general anesthesia in sepsis diagnosed patients

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Abstract
Sepsis is characterized as a severe condition when the body's response to infection becomes uncontrolled, leading to life-threatening organ malfunction. Septic shock, on the other hand, is a specific type of sepsis that involves ongoing low blood pressure. Patients suffering from sepsis may experience unstable blood flow dynamics, and the administration of anesthetic may cause significant low blood pressure as a result of blood vessel dilatation and reduced heart function. Continuous spinal anesthesia (CSA) may lead to reduced hypotension and decreased need for vasopressors in comparison to volatile general anesthesia. CSA and combined spinal epidural anesthesia are secure and dependable types of anesthesia.

Keywords: General anesthesia, Sepsis, Sepsis management, Anesthetic techniques, Anesthesia in sepsis, Septic patients, Anesthesia outcomes

Introduction

Sepsis is a condition characterized by severe dysfunction of organs due to an uncontrolled response of the body to an infection. Septic shock, on the other hand, is a specific type of sepsis where there is ongoing low blood pressure that necessitates the use of vasopressor medications to maintain a minimum average blood pressure of 65 mmHg, and the presence of a serum lactate level higher than 2 mmol/L, even after receiving sufficient fluid replacement. Sepsis and septic shock are urgent medical conditions characterized by a high risk of death. Early detection, prompt administration of antibiotics, and timely management of the infection source are crucial for improving patient outcomes. The patient may necessitate surgical intervention or an invasive operation with the objective of managing the source of infection, and the anesthesiologist plays a crucial role in all aspects of patient care [1].

Patients suffering from sepsis may experience unstable blood flow, and the administration of anesthetic can lead to significant low blood pressure caused by the widening of blood vessels and reduced heart function. Prior to induction, it is essential to make every conceivable effort to optimize hemodynamics. Patients with sepsis/septic shock require both invasive arterial monitoring and a central venous catheter, in addition to the routine monitoring. Preload optimization is necessary to reduce the unavoidable deleterious effects of induction drugs, such as vasodilation. Additionally, it is important to have an immediately available or ongoing vasopressor [2]. Patients suffering from hypovolemia may have significant hypotension when administered any anesthetic medications. This is because the compensatory sympathetic activation is inhibited. Continuous spinal anesthesia (CSA) refers to the sustained use of local anesthetics delivered through a spinal catheter to maintain subarachnoid blocking [3].

General anesthesia (GA) is typically recommended for surgical operations involving sepsis. General anesthetics consist of both intravenous and inhalational anesthetics. The intravenous anesthetics comprise propofol, etomidate, and ketamine. The inhalational anesthetics isoflurane, sevoflurane, and desflurane are included in this category [4, 5].

General anesthesia (GA)

GA induction is commonly achieved through the administration of intravenous anesthetics. GA is considered good for induction and has no effect on cardiovascular characteristics.

Nevertheless, GA has the ability to hinder the action of adrenal mitochondrial 11-β-hydroxylase and may cause adrenal suppression. Two recent studies have shown that the utilization of general anesthesia (GA) is linked to higher fatality rates and adrenal insufficiency in cases of sepsis. GA might not be the best choice as a result. No literature has examined the comparative outcome benefits of maintaining anesthesia for sepsis patients using inhalational or intravenous methods [6]. Sepsis can modify the way medications are absorbed, distributed, metabolized, and eliminated in the body (pharmacokinetics), as well as how pharmaceuticals interact with their target receptors or enzymes (pharmacodynamics). For instance, the necessity for inhalational anesthesia was diminished in cases of severe sepsis. Utilizing bispectral index monitoring can enhance the precision of anesthesia depth assessment and mitigate the negative effects of excessive anesthesia on hemodynamic stability [7].

Anesthetic medications typically reduce the contractility of the myocardium and directly affect the heart and blood vessels, causing vasodilation. Consequently, the administration of anesthesia might potentially exacerbate the state of these patients, imposing a significant load and risk on the anesthesiologist during the induction process. Every induction drug causes a reduction in cardiac work that is directly proportional to the dosage. Therefore, it is crucial to ensure hemodynamic stability during the process of administering anesthesia, as well as carefully selecting the most suitable anesthetic agent [8].

Complications OF GA

Anesthesia-related problems such as postoperative nausea and vomiting (PONV), sore throat, and tooth damage can cause anguish to patients, but they do not result in long-term illness. On the other hand, perioperative complications affecting the heart, lungs, and kidneys are connected with long-term illness and even death. Any problem makes expenses for both patients and the healthcare system [9].

Continuous spinal anesthesia (CSA)

Advantages of CSA

Hemodynamic stability

Studies have confirmed that administering lower dosages of local anesthetic in single dose spinal anesthesia (SDSA) can decrease the occurrence of hypotension. In a similar manner the reduced doses of local anesthetic utilized in CSA lead to greater hemodynamic stability compared to SDSA. A retrospective study of limited scope found that administering a loading dose of CSA between 0.5 and 0.8 ml of bupivacaine 0.5% did not lead to any instances of hypotension [10, 11].

CSA exhibits superior cardiovascular stability when compared to other neuraxial anesthetic procedures, including CSE. Furthermore, there is evidence suggesting that CSA may lead to a reduction in hypotension and the need for vasopressor medication, as compared to volatile general anesthesia. Studies have demonstrated that the cardiovascular effects of a well adjusted continuous spinal anesthesia (CSA) are similar to those of employing peripheral nerve blocks as the only form of anesthesia for hip fracture surgery [12].

Efficacy

When utilizing microcatheters for CSA, a comprehensive analysis found that failure rates can reach up to 7.4%, while patient satisfaction stands at 98.4% when the catheter is successfully inserted. The main reasons for the failure of CSA with microcatheters are typically attributed to challenging insertion or blockage. This could explain the comparatively lower failure rate of 1.7% observed in a previous study that employed Tuohy needles, which employ larger catheters and a more familiar technique [13].

When comparing CSE to CSA, CSA provides a quicker onset of the intended block and is more stable in terms of hemodynamics. In one study, it was observed that Continuous Epidural Anesthesia (CEA) has a greater failure rate compared to CSA, with 9% of cases necessitating conversion to general anesthesia [13].

Safety

Postdural puncture headache

Most studies investigating CSA have focused on older patients, either by intention or due to the specific treatments being performed. Therefore, there is little information to ascertain the prevalence of postdural puncture headache (PDPH) following CSA in younger individuals.

The incidence of postdural puncture headache might be as low as 1.5% when microcatheters are employed. The PDPH rate for CSE and CSA seems to be comparable when microcatheters and older patients are chosen. Conversely, there is a lack of information regarding the occurrence of PDPH in cases where CSA is performed using a Tuohy needle. An incidence of PDPH between 0% and 9.2% is suggested by a few little, outdated research [14].

Neurological deficits

The popularity of CSA experienced a revival with the advent of microcatheters, however this enthusiasm diminished rapidly following the emergence of cauda equina syndrome patients. The recurring motif in these case reports was the utilization of concentrated hyperbaric local anesthetic, the failure to attain a sufficient block, and the subsequent administration of substantial quantities of local anesthetic [15].

Modelling and research indicated that a high concentration of hyperbaric local anesthetic could accumulate near the cauda equina, leading to neurotoxicity. This issue could be worsened by the reduced rate of local anesthetic passing via a microcatheter, placing the microcatheter at a lower position, or putting the patient in a way that the head is higher than the feet during the injection [14]. No cases of cauda equina syndrome or any other lasting neurological impairments were observed in recent investigations that utilized microcatheters containing isobaric bupivacaine 0.5%. Paraesthesia has been recorded in up to 17% of cases when inserting the intrathecal catheter (ITC).

Infection, breakage and hematoma

No cases of hematoma or infections related to the ITC have been documented when the same precautions were employed as those used for other central neuraxial methods. There are no confirmed cases of an ITC breaking during surgery. Nevertheless, there have been reports of microcatheters fracturing or becoming detached when utilized after surgery for pain relief [13].

Complications of Spinal Anesthesia

Spinal block problems are commonly categorized to be major or minor. thankfully most serious consequences are extremely uncommon. Although minor problems are frequent, they should not be disregarded. Minor problems encompass symptoms such as nausea, vomiting, moderate hypotension, shivering, itchiness, hearing impairment, and urine retention. Important side effects of spinal anesthesia include PDPH and unsuccessful spinal blocks. Consequently, we classify them as moderate complications. [16].

Major complication

- Direct needle trauma
- Infection (abscess, meningitis)
- Vertebral canal hematoma
- Spinal cord ischemia
- Cauda equina syndrome
- Arachnoiditis
- Peripheral nerve injury
- Total spinal anesthesia
- Cardiovascular collapse

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