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Fast-Track Anesthesia for Cito Craniotomy Evacuation Hematoma Due to Temporoparietal Subdural Hemorrhagic Hematoma in a Pediatric Patient: A Case Report

Anggia Rarasati Wardhana[1*], Ardana Tri Arianto[1]

[1]Department of Anesthesiology and Intensive Therapy, Dr. Moewardi General Hospital, Surakarta, Indonesia

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***Corresponding author:**
Anggia Rarasati Wardhana

E-mail address:
anggiararasatiw@gmail.com

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A B S T R A C T

Introduction: Subdural hematoma (SDH) in early childhood is a serious condition that requires immediate surgical intervention. Fast-track anesthesia is an approach that aims to speed up the patient's recovery after surgery. This case report presents the experience of fast-track anesthesia in a 4-month-old pediatric patient with SDH who underwent a cito craniotomy. **Case presentation**: A 4-month-old child with a history of head trauma due to shaking experienced recurrent seizures. CT scan examination showed left temporoparietal SDH with intraparenchymal hemorrhage. The patient was classified as ASA IIIE and underwent a cito craniotomy. A fast-track anesthesia strategy was implemented using rapid induction, multimodal analgesia, and strict fluid management. **Conclusion:** Fast-track anesthesia was successfully applied to pediatric patients with SDH undergoing cito craniotomy. This approach allows for a quicker recovery, reduces postoperative complications, and shortens the length of hospital stay.

1. Introduction

Subdural hematoma (SDH) in the pediatric population, especially in infants, is a serious neurological condition often caused by head trauma. This trauma can come from a variety of sources, including accidents, child abuse, or even birth complications. SDH in infants has unique characteristics compared with the adult population, including different pathophysiology, clinical presentation, and management. The incidence of SDH in infants varies depending on the population and the diagnostic method used. However, some studies estimate that SDH occurs in approximately 1-3 per 100,000 babies per year. The main risk factor for SDH in infants is head trauma, both intentional (eg, shaken baby syndrome) and unintentional (eg, falls). Other risk factors that may play a role are blood clotting disorders, infections, and vascular malformations.[1,2]

SDH occurs when blood collects between the dura mater (outer layer of the meninges) and the arachnoid mater (middle layer of the meninges). In infants, SDH is often caused by tears in the bridging veins that connect the cerebral cortex to the dural sinuses. This tear can occur due to rapid acceleration-deceleration of the head, as occurs in shaken baby syndrome.

Blood that collects in the subdural space can cause an increase in intracranial pressure (ICP). Increased ICP can disrupt cerebral blood flow, cause ischemia, and ultimately cause permanent brain damage. In addition, the accumulated blood can also trigger an inflammatory reaction, which can worsen brain damage. Symptoms of SDH in babies can vary depending on age, severity of bleeding, and the presence of other accompanying conditions. The most common symptoms are: The baby may appear fussy, lethargic, or even unresponsive. Seizures are a frequent symptom of SDH babies and can vary in severity. Projectile vomiting often occurs due to increased ICP. Increased head circumference can occur due to accumulation of blood in the subdural space, Protruding anterior fontanel can be a sign of increased ICP. Respiratory disorders can occur due to increased ICP pressing on the brainstem.[3,4]

The diagnosis of SDH in babies is made based on the history, physical examination, and supporting examinations. The most important supporting examination is a CT scan of the head, which can show blood in the subdural space. MRI of the head can also provide additional information about the severity of the bleeding and the presence of brain damage. Management of SDH in infants depends on the severity of bleeding and the presence of neurological symptoms. In mild cases, conservative management with close monitoring may be sufficient. However, in more severe cases or in babies with significant neurological symptoms, surgical intervention may be necessary. Craniotomy is the most common surgical procedure performed to evacuate SDH in infants. This procedure involves creating a hole in the skull to access the subdural space and drain the collected blood. After the blood is removed, the dura mater can be closed or left open, depending on the surgeon's preference. Fast-track anesthesia is an anesthetic approach that aims to speed up the patient's recovery after surgery. This approach involves the use of anesthetic drugs that have short half-lives, multimodal analgesia, and strict fluid management. Fast-track anesthesia has been shown to be effective in reducing postoperative complications, shortening length of stay, and increasing patient satisfaction. In infant patients with SDH undergoing cito craniotomy, fast-track anesthesia poses some special challenges. Babies have unique physiology, including a more sensitive response to anesthetic drugs, a higher risk of hypothermia, and different fluid requirements. Therefore, the choice of anesthetic drug, anesthetic technique, and postoperative management must be adjusted to the baby's needs. This case report presents the experience of fast-track anesthesia in a 4-month-old infant patient with acute SDH who underwent cito craniotomy.[5,6] The aim of this case report is to describe the application of fast-track anesthesia in this case and evaluate the clinical results.

2. Methods

A 4-month-old baby boy was referred to Dr. Soetomo Hospital (RSDM) after experiencing two episodes of seizures in the last week. Medical history revealed that the baby had been shaken by the mother two weeks before the onset of symptoms. On initial examination, the baby appeared fussy and crying, with a Glasgow coma scale (GCS) E3V5M6. Vital signs showed blood pressure 106/85 mmHg, pulse 120-130 beats per minute, respiratory rate 32 times per minute, and oxygen saturation 98-99% with oxygen assistance of 2 liters per minute via nasal cannula. Further physical examination revealed isochore pupils with normal light reflexes, as well as good sensory and motor function without lateralization. A posterior-anterior (PA) chest radiograph showed no fracture or dislocation, and the lung features appeared normal (Figure 1A). However, a computed tomography (CT) scan of the head revealed hypodensity in the left temporoparietal region, indicating acute subdural intracranial hemorrhage (SDH). The estimated bleeding volume was 10 cc, accompanied by bulging and intact dura. Apart from that, there was also intraparenchymal bleeding (Figure 1B).

Based on the American Society of Anesthesiologists (ASA) Physical Status Classification System, the patient was classified as ASA IIIE. This classification indicates that the patient has a severe systemic disease that constitutes a constant threat to life, in this case acute SDH with intraparenchymal hemorrhage. ASA IIIE status indicates a significant

risk of perioperative complications, requiring careful anesthetic planning and strict management. Considering the critical condition of the patient and the need for immediate surgical intervention, the anesthesia team decided to implement a fast-track anesthesia approach. The main goal of this approach is to speed up the patient's recovery after surgery, minimize the side effects of anesthetic drugs, optimize pain management, and speed up mobilization.

Due to the patient's condition requiring immediate action, premedication was not given. Preoperative preparation focuses on optimizing the patient's hemodynamic and respiratory status, as well as establishing an adequate intravenous line for administering fluids and medications. Induction of anesthesia is performed quickly and safely using a combination of intravenous drugs. Atropine sulfate 0.1 mg was given to reduce saliva secretion and prevent bradycardia. Fentanyl 18 mcg is administered as an opioid analgesic to reduce pain and anxiety. Rocuronium 5 mg was administered as a muscle relaxant to facilitate endotracheal intubation. After successful intubation, anesthesia was maintained using sevoflurane in oxygen. Sevoflurane was chosen because it has a rapid onset and offset, allowing more precise control of the depth of anesthesia. During surgery, fentanyl 1 mcg/kg/hour was administered continuously to maintain adequate analgesia. Rocuronium 1 mg was given intermittently as needed to maintain muscle relaxation.

Strict fluid management is essential in pediatric patients, especially in neurosurgical cases. Estimated blood loss (EBL) was calculated at 13.92 cc, and fluid requirements were calculated based on body weight, age and type of surgery. Crystalloid fluids (D5% ½ NS) and colloids are given in balance to maintain normovolemia and prevent hypovolemia or hypervolemia. Effective pain management is an important component of fast-track anesthesia. During surgery, fentanyl was administered continuously to maintain adequate analgesia. After surgery, the patient was transferred to the pediatric intensive care unit (PICU) and administered multimodal analgesia consisting of continuous intravenous fentanyl, intermittent intravenous metamizole, and oral paracetamol. Once the operation is complete and the patient shows signs of adequate recovery, extubation is performed. The patient was then transferred to the PICU for close monitoring. In the early postoperative period, patients were given supplemental oxygen via nasal cannula. In the PICU, the patient continues to receive fluid therapy, antibiotics (ampicillin), and analgesics (metamizole, tranexamic acid). The head position is elevated 30-45 degrees to reduce brain edema. The surgical wound is cleaned and checked regularly. The patient showed good recovery and was discharged after 5 days.

3. Discussion

Subdural hematoma (SDH) in children is a serious condition that requires immediate surgical intervention, usually via craniotomy. Anesthesia in these cases has its own challenges, especially because the patient's condition is often unstable and the risk of perioperative complications is high. Fast-track anesthesia, which aims to speed up postoperative recovery, has gained attention in various types of surgery, but its application in cito craniotomy for SDH in children is still limited. SDH in children can be caused by head trauma, bleeding disorders, or vascular malformations. This condition can cause increased intracranial pressure (ICP), neurological disorders, and even death if not treated quickly. Children who experience Subdural Hematoma (SDH) often present in a critical condition, both in terms of hemodynamics (blood circulation) and neurological (brain function). SDH can cause significant bleeding, which can result in decreased blood volume and low blood pressure. Hypotension can reduce blood flow to the brain, which can cause further brain damage. In response to a decrease in blood pressure, the heart will beat faster to try to maintain blood flow to vital organs, including the brain. In severe cases, excessive bleeding can cause shock, a life-threatening condition in which the body's organs do not get enough oxygen and nutrients. Increased intracranial pressure (pressure inside the skull) due to bleeding can put pressure on the brain and disrupt its function. This can cause decreased consciousness, ranging from confusion to coma. Depending on the location and size of the

hematoma, the child may experience focal neurological deficits, such as weakness on one side of the body, difficulty speaking, or impaired vision. Increased intracranial pressure and brain irritation due to bleeding can trigger seizures.[7-10]

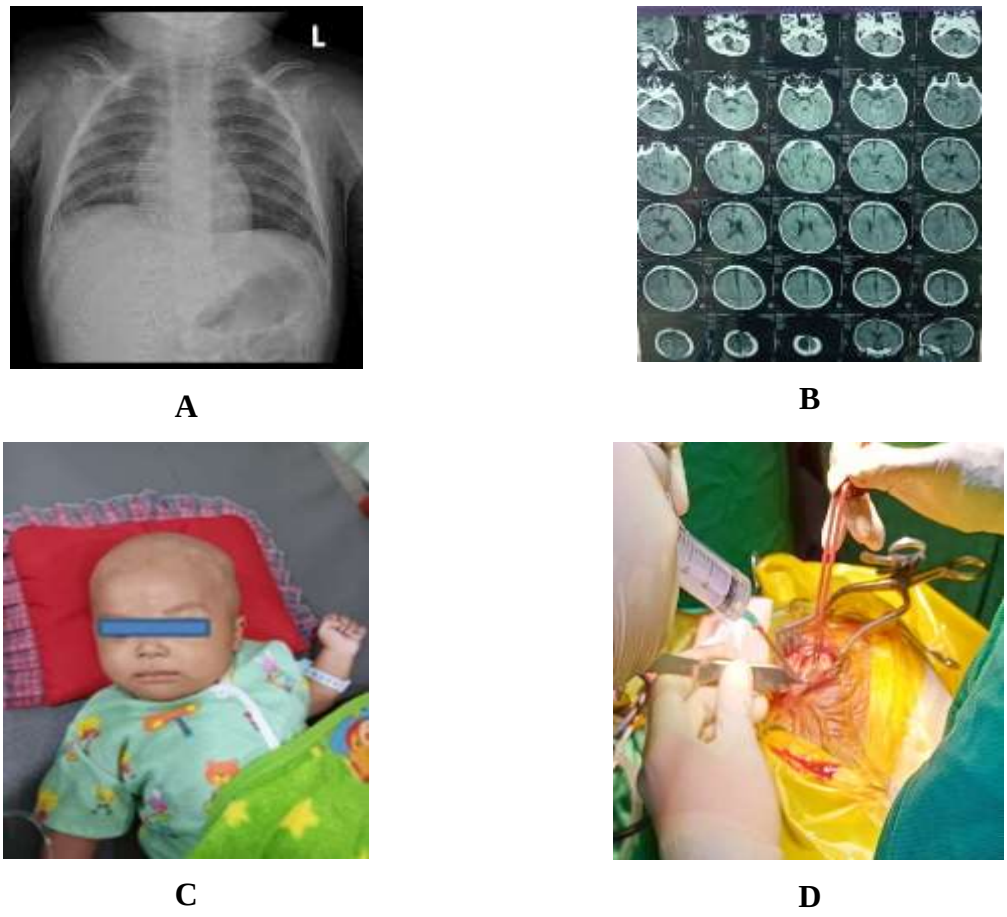

Figure 1. Radiological image (A); CT Scan (B); Clinical (C); Surgery (D).

Figure 2. Durante chart surgery.

Table 1. Fluid balance.

Time (Hour)	Input (cc)	Blood output (cc)	Urine output (cc)	Perspiration output (cc)	Fluid balance (cc)
1	16	5	4	2.9	7.1
2	32	10	5	2.9	14.1
3	30	10	5	2.9	11.1

Anesthesia, which is required for surgical procedures such as craniotomy for evacuation of SDH, can significantly affect ICP. Some anesthetic drugs can cause cerebral vasodilation (widening of blood vessels in the brain), which can increase cerebral blood volume and further increase ICP. Additionally, anesthesia can suppress breathing, causing an increase in carbon dioxide (CO_2) levels in the blood. CO_2 is a potent vasodilator, so increasing CO_2 levels can worsen cerebral vasodilation and increase ICP. Mechanical ventilation techniques used during anesthesia can also affect ICP. Hyperventilation, namely ventilation at a higher rate than normal, can reduce CO_2 levels in the blood and cause cerebral vasoconstriction (narrowing of the blood vessels in the brain). This may help lower ICP, but excessive hyperventilation can excessively reduce cerebral blood flow and cause ischemia.[11,12]

Children undergoing craniotomy for subdural hematoma (SDH) face a significant risk of perioperative complications. These complications can range from hemorrhage and brain edema to seizures, all of which have the potential to impact neurological outcomes and overall recovery. The anesthesiologist's role in anticipating and managing these complications is critical to ensuring the safety and well-being of these young patients. Bleeding is one of the most feared perioperative complications in children with SDH. Several factors contribute to the increased risk of bleeding in this population. First, SDH itself is often the result of head trauma or a bleeding disorder, indicating a predisposition to bleeding. Second, children have immature hemostatic mechanisms compared to adults, making them more susceptible to excessive bleeding. Third, the craniotomy procedure itself involves the manipulation of vascular tissue, which can cause intraoperative or postoperative bleeding. Anesthesiologists play an important role in minimizing the risk of bleeding. They may use techniques such as controlled hypotension to reduce blood pressure and thereby reduce blood loss during surgery. Additionally, they may administer hemostatic agents such as desmopressin or tranexamic acid to increase blood clotting and prevent excessive bleeding. Careful monitoring of coagulation parameters and vital signs is essential to detect early bleeding and allow rapid intervention. [13-15]

Brain edema, or swelling of the brain, is another serious complication that can occur in children with SDH. This can be caused by several factors, including primary brain injury, bleeding, and an inflammatory response to trauma. Brain edema can cause increased intracranial pressure (ICP), which can compromise cerebral perfusion and cause further neurological damage. Anesthesiologists can help manage brain edema by optimizing the patient's physiological condition. They may use hyperosmotic agents such as mannitol or hypertonic saline to draw water out of the brain tissue and reduce swelling. Controlled ventilation is also important to maintain arterial carbon dioxide levels within the normal range, as hypercapnia can worsen brain edema. Additionally, the anesthesiologist may administer corticosteroids to reduce the inflammatory response and minimize brain edema. Seizures are a frequent neurological complication in children with SDH. This can be caused by irritation of the cerebral cortex due to hematoma, electrolyte imbalance, or changes in neurotransmitters. Seizures can cause further brain damage and interfere with postoperative recovery. An anesthesiologist can help prevent and manage seizures by administering anticonvulsant medications such as phenytoin or levetiracetam. Continuous electroencephalography (EEG) monitoring can be used to detect subclinical seizure activity and guide anticonvulsant therapy. Additionally, the anesthesiologist can optimize the patient's physiologic condition, such as maintaining normoglycemia and

normokalemia, to reduce the risk of seizures. Overall, anesthesiologists play an important role in reducing the risk of perioperative complications in children with SDH. By using proper anesthetic techniques, administering appropriate medications, and closely monitoring patients, anesthesiologists can help ensure optimal perioperative outcomes and increase the chances of a good neurological recovery. Apart from the complications mentioned above, anesthesiologists must also pay attention to other complications that may occur in children with SDH, such as infection, electrolyte disturbances, and organ dysfunction. They must work closely with the surgical team and other specialists to provide comprehensive perioperative care and ensure the best outcomes for these young patients.[15-17]

Children have different physiological characteristics than adults, which influence their response to anesthesia. The choice of anesthetic drug and dose must be adjusted to the child's age and weight. Anesthesia fast-track is a multimodal approach that aims to optimize postoperative recovery by minimizing surgical stress and accelerating patient mobilization. Principles of anesthesia fast-track includes: Rapid induction: The use of anesthetic drugs that have a rapid onset and short duration to speed induction and recovery of consciousness. Multimodal analgesia: Use of a combination of analgesic drugs from different classes to provide optimal analgesia with minimal side effects. Strict fluid management: Measurable administration of intravenous fluids to maintain fluid and electrolyte balance, and prevent brain edema. Close monitoring: Close monitoring of vital signs, ICP, and neurological function to detect and treat complications early. Early mobilization: Encourage patients to move and be active as early as possible after surgery to prevent postoperative complications such as deep vein thrombosis and pneumonia.[16-18]

Application of anesthesia *fast-track* Cito craniotomy for SDH in children requires careful planning and good coordination between the surgical and anesthesia teams. The following steps can be taken: Preoperative evaluation: Carrying out a comprehensive preoperative evaluation to assess the patient's condition, identify risk factors, and plan an appropriate anesthetic strategy, Rapid induction: Selecting anesthetic drugs that have a rapid onset and short duration, such as propofol or sevoflurane, to speed induction and recovery of consciousness, Multimodal analgesia: Using a combination of analgesic drugs from different classes, such as opioids, nonsteroidal anti-inflammatory drugs (NSAIDs), and local anesthetics, to provide optimal analgesia with minimal side effects, Fluid Management strict: Closely monitor fluid and electrolyte balance, use measured intravenous fluids, and avoid excessive fluid administration, Close Monitoring: Closely monitor vital signs, ICP, and neurological function during and after surgery, Early mobilization: encourage the patient to move and be active as early as possible after surgery, with the help of a physiotherapist if necessary.[17-19]

The presented case study shows an example of the application of anesthesia fast-track on cito craniotomy for SDH in children. In this case, rapid induction with propofol, multimodal analgesia with fentanyl and paracetamol, and strict fluid management allowed a quicker recovery and reduced postoperative complications. The patient can be extubated immediately after surgery and transferred to the intensive care unit (ICU) in stable condition. Anesthesia fast-track in cito craniotomy for SDH in children is a promising approach to improve clinical outcomes and reduce length of stay. However, its implementation requires a deep understanding of pediatric physiology, anesthetic drug pharmacology, and comprehensive perioperative management. Several studies have shown the benefits of anesthesia fast-track in craniotomy for brain tumors in children, including faster recovery, reduced postoperative pain, and shorter length of stay. However, further research is needed to evaluate the effectiveness and safety of anesthesia fast-track on cito craniotomy for SDH in children. Anesthesia fast-track Cito craniotomy for SDH in children is a challenge in itself, but with careful planning, selection of the right anesthetic drug, and careful monitoring, this approach can be successfully implemented. The case study presented shows that anesthesia fast-track can speed up

recovery, reduce postoperative complications, and shorten the length of stay in pediatric patients with SDH who undergo cito craniotomy. Further research is needed to evaluate the effectiveness and safety of anesthesia fast-track on cito craniotomy for SDH in children. Prospective randomized controlled studies with larger sample sizes are needed to compare clinical outcomes between anesthetists' fast-track and conventional anesthesia. Apart from that, research also needs to identify factors that can influence the success of anesthesia fast-track in this population. Application of anesthesia fast-track Cito craniotomy for SDH in children can provide significant benefits to patients, including faster recovery, reduced postoperative pain, and shorter length of stay. This can improve the patient's quality of life and reduce the burden of health care costs.[18-20]

4. Conclusion

This case report shows that fast-track anesthesia can be successfully applied in pediatric patients with SDH undergoing cito craniotomy. This approach has the potential to improve clinical outcomes and patient quality of life.

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