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# Anesthesia in a Pediatric Patient with Acyanotic Congenital Heart Disease: A Case Report

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**Abstract**

Anesthesia in pediatric patients with acyanotic congenital heart disease requires a specialized approach due to complex interactions between cardiac anatomy and physiology, as well as the risk of perioperative hemodynamic instability. A two-month-old, 5-kg infant presented with a congenital heart defect and a left eyelid anomaly present since birth. Physical examination revealed superior palpebral coloboma with symblepharon and exposure keratitis. The patient was scheduled for surgical repair, and preoperative assessment identified anemia and thrombocytosis. Anesthetic management included preoperative fasting, fluid calculation, and premedication with atropine sulfate 0.1 mg and intravenous fentanyl 15 mcg (2–3 mcg/kg body weight). Intubation was facilitated using atracurium, and anesthesia maintenance was achieved with sevoflurane and fentanyl. Intraoperative monitoring ensured adequate end-tidal $CO_2$ ($EtCO_2$) levels and oxygen saturation. The one-hour procedure addressed the eyelid defect, followed by postoperative analgesia. The patient was monitored for three days postoperatively and discharged on the fourth day. Previous studies have shown that children with congenital heart disease undergoing non-cardiac surgery face increased perioperative risks influenced by factors such as overall condition and disease severity. Accordingly, clinical outcomes are highly dependent on anesthesia management tailored to these physiological considerations. Pediatric patients with congenital heart disease can safely undergo general anesthesia for non-cardiac procedures when comprehensive preoperative preparation and meticulous intraoperative monitoring are implemented.

## INTRODUCTION

Anesthesia management for pediatric patients with acyanotic congenital heart disease (ACHD) requires a multidisciplinary approach involving pediatricians, cardiologists, and anesthesiologists. The primary goal is to ensure patient safety and comfort throughout the procedure, with careful consideration of the specific cardiac condition, including the type and severity of the defect as well as any associated extracardiac anomalies (Nasr et al., 2023). All anesthetic agents have the potential to cause hemodynamic compromise in children with ACHD, particularly in those with complex disease or poorly compensated physiology. This underscores the importance of close monitoring and meticulous management of hemodynamic status during anesthesia (Shah *et al.* 2024; Saleem *et al.* 2025; Mirrakhimov 2026). The choice of anesthetic technique depends on the patient's condition and the nature of the procedure (Capdevila *et al.* 2020; Wong *et al.* 2020). Non-operating room anesthesia: patient selection and special considerations. General anesthesia is commonly used for cardiac catheterization procedures, while monitored anesthesia care (MAC) may be preferred for less

invasive interventions. Regional anesthesia techniques, such as spinal anesthesia, may also be considered in selected cases (Xie & Yao, 2021).

**Case Report**

This study uses a case report, A two-month-old child weighing five kilograms came to Prof. Dr. I.G.N.G. Went to General Hospital with complaints of the left eyelid not closing correctly when sleeping due to the left eyelid not being intact. Complaints are said to have been experienced since birth. The patient's parents said the child could still respond if stimulated through colorful objects. Based on physical examination, it was discovered that the patient had superior palpebral coloboma with symblepharon and exposure keratitis. The patient was then scheduled to undergo surgical repair of superior palpebral coloboma with a cutler beard flap with simblepharon release and evaluation of the lacrimal system.

Previously, the patient was known to have a congenital heart disorder. Based on physical examination, it was found that the breathing frequency was 30 times per minute with an oxygen saturation of 97% at room air. Pulse 128 per minute, strong lifter, heart sounds 1 and 2 single, regular, systolic murmur ICS III PSL S grade III/6, no gallops. A complete blood test revealed that the patient had anemia with a hemoglobin level of 9.5 d/dL and thrombocytosis with a platelet level of 744,000 x 103 cells/ µL. Examination using echocardiography revealed atrial situs solitus, standard systemic & pulmonary vein drain, AV-VA concordant, balance 4 chamber, moderate PM VSD L to R shunt (right/left orifice 4.6 mm/4.4 mm), no ASD, no PDA, no CoA, left Ao arch, mild TR, standard mitral and semilunar valves, no pericardial effusion, normal LV and RV systolic function. The patient has been undergoing therapy with furosemide at a dose of 2.5 mg, spironolactone at 3.125 mg, and digoxin at 25 micrograms.

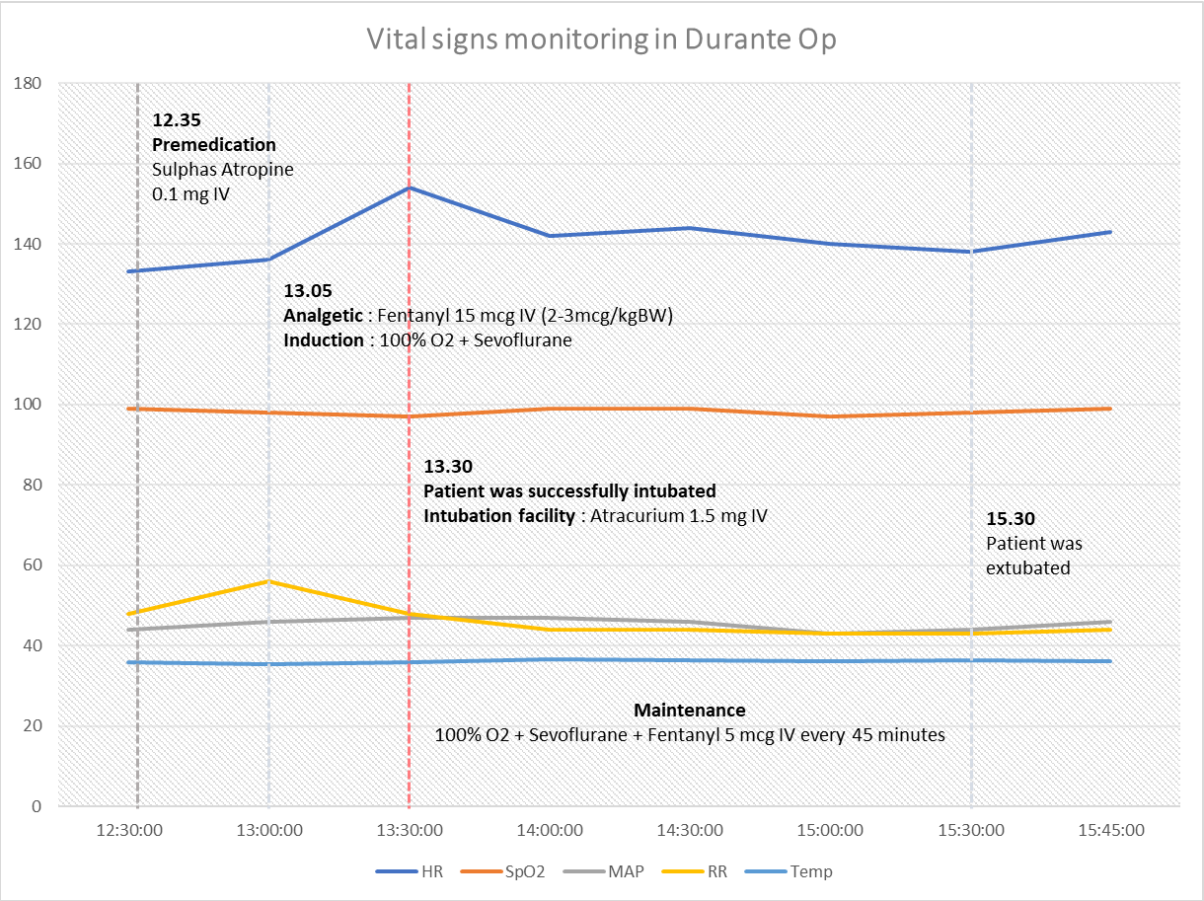


**Figure 1. Patient's hemodynamic monitoring**

Source: Patient medical record documents, 2026

Surgery is prepared by ensuring the patient fasts from solid food for at least eight hours before anesthesia and other standard monitoring. Apart from that, a pediatrician calculated the required fluids and doses, and an examination of the estimated tube depth was evaluated using a CT scan, an L-Connector with a silicone cap, and end-tidal CO2 (EtCO2) monitoring. Apart from that, temperature probes and ready-to-use blood components are also prepared for bleeding manipulation during surgery. The anesthesia procedure begins with premedication using 0.1-milligram atropine sulfate intravenously, then continues with preoxygenation with 100% oxygen for five minutes with sevoflurane until the patient is sedated. Induction of anesthesia was carried out by administering atracurium 1.5 milligrams intravenously. The anesthetic agent given was fentanyl 15 micrograms intravenously at a dose of 2-3 micrograms/KgBW before proceeding with intubation using a McGrath videolaryngoscope with a size 2 blade. A size 3.0 Endotracheal Tube (ETT) was inserted after the patient was ready to be intubated, with the position of the cuff balloon confirmed. It is located just on the inferior side of the vocal folds. The L-Connector is then installed on the tube.

During the operation process, monitoring is carried out by carrying out maintenance procedures by providing compressed air oxygenation with the addition of five micrograms of sevoflurane and fentanyl intravenously every 45 minutes. Monitoring is carried out with a standard monitor by ensuring EtCO2 is in the range of 30-45cmH2O with oxygen saturation maintained in the range of 96-100%. The surgical procedure takes one hour and is performed in the supine position. After the operation was completed, post-operative analgesia was

carried out by administering a combination of 30 micrograms of fentanyl in 10 milliliters of 0.9% NaCl with a titration speed of 0.4 ml/hour and paracetamol 75 milligrams every 8 hours intravenously. After being discharged from the operating room, the patient was monitored in the inpatient room for three days and discharged on the fourth postoperative day.

## METHOD

This study used a case report design. The subject was a two-month-old male infant weighing 5 kg with acyanotic congenital heart disease, specifically a moderate ventricular septal defect (VSD), who underwent non-cardiac surgery for repair of superior palpebral coloboma with symblepharon release at Prof. Dr. I.G.N.G. Ngoerah General Hospital, Indonesia. Clinical data were obtained from the patient's medical records, including demographic characteristics, medical history, physical examination findings, laboratory results, echocardiographic findings, anesthetic management, intraoperative monitoring, postoperative care, and clinical outcomes.

Perioperative anesthetic management was documented across the preoperative, intraoperative, and postoperative phases. Preoperative assessment included cardiac evaluation, laboratory investigations, fasting status, fluid management planning, and anesthetic preparation. Intraoperative data included anesthetic induction and maintenance, airway management, hemodynamic monitoring, oxygen saturation, end-tidal carbon dioxide ($EtCO_2$), and perioperative medications. Postoperative follow-up included pain management, inpatient monitoring, and discharge status.

Clinical findings were analyzed descriptively and interpreted by comparing the patient's perioperative management and outcomes with current evidence and published literature on anesthesia in pediatric patients with acyanotic congenital heart disease undergoing non-cardiac surgery. Patient confidentiality was maintained by anonymizing all identifiable information in accordance with ethical standards for case report publication.

## RESULT AND DISCUSSION

When managing anesthesia, heart failure, oxygenation, respiration, shunting, dysrhythmias, and other factors must be considered. As blood is monitored for oxygenation, hypoxemia might result from transporting this mixture to peripheral tissues and the systemic circulation, which mixes saturated and unsaturated blood (pulmonary circulation bypass). Since this often happens with right-to-left shunts, hypoxemia may worsen when anesthetic procedures increase the right-to-left shunt. Changes in the creation or conduction of cardiac impulses can result in dysrhythmias in cardiac rhythm monitoring. Problems of the induction system are more prevalent than problems of impulse formation in individuals with congenital cardiac defects. The three possible causes of the pathogenesis are damage from prolonged hypoxemia, inherent anatomical or physiological abnormalities, and surgical injuries (Aiyagari et al., 2020; Baehner et al., 2020; Morettini et al., 2020).

Maintaining appropriate oxygenation and ventilation, treating arrhythmias, and managing fluid overload are the primary objectives of intraoperative treatment for patients with congenital heart abnormalities having non-cardiac surgery, regardless of whether the defects are partially repaired (palliative) or not. While heart failure and fluid overload are issues for patients with left-to-right shunts and obstructive diseases, oxygenation is often

more crucial to monitor in patients with right-to-left shunts. In patients with reduced pulmonary blood flow and a right-to-left shunt, the goal is to minimize the shunt and reduce the volume of blood that hasn't been oxygenated to bypass the pulmonary circulation. Additionally, the patient should avoid circumstances that raise the systemic oxygen demand, such as 1) maintaining intravascular volume and adequate hydration to maintain systemic blood pressure, 2) preventing further increases in pulmonary vascular resistance, and 3) providing appropriate sedation and analgesia.

Adequate preoperative hydration is crucial. Choose anesthetics with minimal adverse effects on heart function and stable hemodynamics, and monitor vital signs closely. Careful consideration is needed when managing fluids in children with acyanotic congenital heart disease (CHD) to maximize cardiac function, avoid volume overload, and reduce the chance of consequences. To determine the severity of the congenital heart disease (CHD) and how it affects cardiac function, do a comprehensive preoperative evaluation of the child's cardiac state, including echocardiography. Fluid management should be customized based on each patient's unique demands, including their underlying cardiac architecture, hemodynamic state, and surgical requirements. Patients must drink enough water before surgery to maximize cardiac preload and sustain appropriate cardiac output (Xie & Yao, 2021).

However, excessive hydration should be avoided to minimize lung congestion and volume overload. During the intraoperative phase, carefully evaluate hemodynamic parameters and provide fluids as needed. To preserve intravascular volume and electrolyte balance, consider employing isotonic crystalloid solutions, such as normal saline or balanced electrolyte solutions. Keep a watchful eye on your fluid balance to avoid volume overload, which can worsen pulmonary congestion and impair heart function.1 Utilize dynamic indicators to direct the administration of fluids and prevent needless boluses, such as pulse pressure variation (PPV) and stroke volume variation (SVV). Under the supervision of a pediatric cardiac anesthesiologist or intensivist, consider the use of inotropes or vasopressors if hemodynamic instability persists even after fluid optimization to continually evaluate heart function and direct fluid management, use invasive or non-invasive monitoring techniques, such as arterial line installation or pulse contour analysis (Hanot et al., 2019).

Preanesthetic drug usage is determined by the child's age, psychological state, and cardiovascular health. Premedication aims to reduce cardiovascular and psychological stress. This may lessen sympathetic activation, which may increase the risk of congestive heart failure or cyanosis. The typical medication used is midazolam, 0.5 mg/kg. Constant close observation is required, along with oxygen saturation monitoring and availability of oxygen supplementation. Premedication was carried out using intravenous atropine sulfate of 0.1 milligrams in this patient. Atropine sulphate is a muscarinic receptor antagonist given as a premedication. It inhibits acetylcholine's action on muscarinic receptors in the heart and other organs innervated by the parasympathetic nervous system. Atropine sulfate may be administered as an adjuvant medicine during anesthesia in children with acyanotic congenital heart disease (CHD) to lessen the effects of bradycardia and enhance cardiac output. Vagal stimulation during the induction of anesthesia or manipulation of the heart or major vessels may affect children with congenital heart disease (CHD). Bradycardia and hemodynamic instability brought on by vagal stimulation might exacerbate the underlying heart disease. By acting as a muscarinic receptor antagonist, atropine sulfate prevents the parasympathetic

nervous system's heart-inhibiting actions. In particular, when vagal reflexes are heightened, atropine sulfate helps prevent or reverse bradycardia and sustains cardiac output by reducing vagal tone (Rajabi, 2023). Particularly in children with left-to-right shunting defects, bradycardia and decreased cardiac output can worsen hemodynamic instability in patients with congenital heart disease (CHD).

Atropine sulfate improves cardiac output by raising heart rate (positive chronotropic action) and myocardial contractility. This improvement in heart performance aids in the best possible tissue perfusion and oxygen delivery, especially when the body is undergoing an increase in metabolic demand, such as after surgery or other treatments (Yano et al., 2019). Children with congestive heart failure (CHD) may have hemodynamic instability during the perioperative phase as a result of anesthetic induction, surgical manipulation, or intravascular volume changes. To prevent bradycardia and maintain stable hemodynamics, as well as to facilitate perioperative care and improve outcomes, atropine sulfate can be used either as a preventative measure or as needed. Although atropine sulfate has the potential to help children with congestive heart failure manage bradycardia and improve cardiac output, cautious dosage and close observation are necessary.

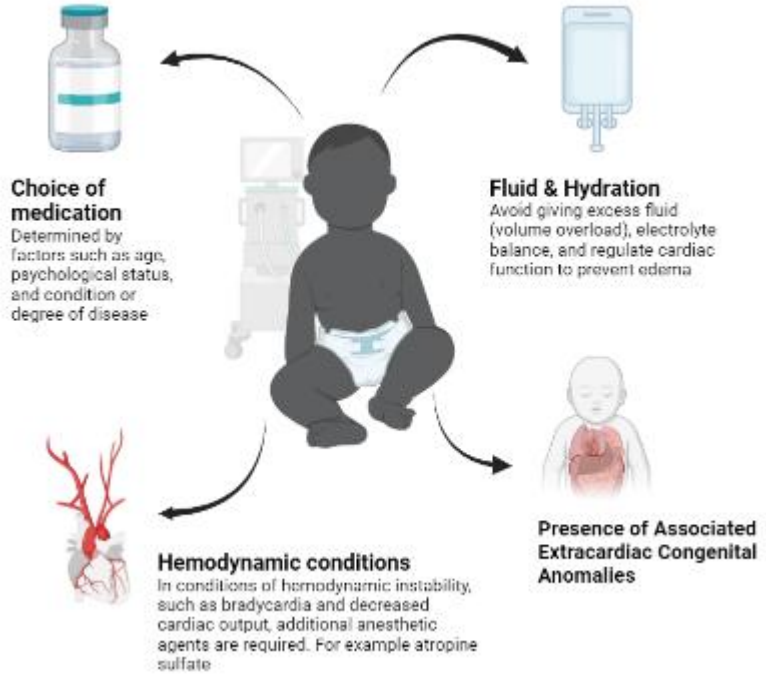


**Figure 1. Factors influencing the patient's condition during the perioperative period**

Source: Patient medical record documents, 2026

The study by Purwoko and Aji, 2021 provides an in-depth examination of the perioperative management of patients presenting with a complex combination of VSD, severe tricuspid regurgitation, and Gerbode defects. This triad of conditions poses significant challenges for surgical intervention due to the intricacies of managing multiple interrelated cardiac anomalies simultaneously. Detailed recommendations are provided for anesthetic management, focusing on agents and techniques that ensure hemodynamic stability and adequate oxygenation. This includes careful induction and maintenance of anesthesia, considering the altered hemodynamics caused by the cardiac defects. Continuous monitoring of cardiac output, pulmonary pressures, and systemic vascular resistance is critical.

Transesophageal echocardiography (TEE) intraoperatively is recommended to guide surgical repairs and assess immediate outcomes. Postoperative care involves intensive monitoring in a cardiac ICU setting to efficiently detect and manage potential complications such as arrhythmias, residual shunts, or worsening of tricuspid regurgitation. Strategies for managing common postoperative complications are discussed, including using inotropes for cardiac support, diuretics for controlling fluid balance, and antiarrhythmic medications as needed. This case report implied that a comprehensive guide for the perioperative management of patients with VSD, severe tricuspid regurgitation, and Gerbode defects is required. It highlights the complexity of these cases and the necessity for meticulous planning, advanced diagnostic techniques, customized surgical approaches, and a coordinated multidisciplinary effort to achieve the best possible outcomes (Purwoko & Aji, 2021).

Depending on the kind, length, and state of the patient's kidneys, children with congenital heart syndrome may or may not need cosmetic medicine. Even if there isn't a better anesthetic method for this specific problem, the following modifications in hemodynamic parameters are commonly observed:

**Table 1. Hemodynamic changes during surgery in children with acyanotic congenital heart disease**

| Type of CHD | Initial Load | PVR | SVR | Pulse Rate | Contractility |
|---|---|---|---|---|---|
| ASD | Increase | Increase | Decrease | Normal | Normal |
| VSD (LR) | Normal | Decrease | Increase | Normal | Normal |
| VSD (RL) | Increase | Increase | Decrease | Normal | Normal |
| PDA | Increase | Increase | Decrease | Normal | Normal |

*PVR: pulmonary vascular resistance; SVR: systemic vascular resistance.

Cardiovascular effects on anesthetics are well-known and require observation. Another factor that might impact anesthesia is the dispersion and assimilation of injection or inhalation drugs. The pace at which the anesthesia drug enters the bladder and exits into the arterial blood flow establishes the inhalation rate of anesthesia medicine. Patients with a right to left shunt benefit from prolonged inhalation induction times because the blood flow is redirected, which lowers the partial pressure of anesthetic in the blood traveling to the brain. The induction speed of the L-R shunt, however, remains constant (Hartawan, 2019).

The analgesic option used in this patient was intravenous fentanyl 15 micrograms at a dose of 2-3 micrograms/kgBW. Potent opioid analgesic fentanyl is frequently used to relieve pain during unpleasant treatments or surgical procedures for pediatric patients, especially those with acyanotic congenital heart disease (CHD). The synthetic opioid agonist fentanyl mainly affects the central nervous system's mu-opioid receptors. Children with acyanotic CHD undergoing surgery or other painful operations might benefit from its strong analgesic effects, which effectively relieve pain. Fentanyl has fewer hemodynamic effects than certain other opioids, especially when given as a bolus or brief infusion. Maintaining hemodynamic stability is essential in children with acyanotic congenital heart disease (CHD) to avoid worsening cardiac dysfunction or impairment (Baum et al., 2021; White & Peyton, 2020; Walker et al., 2022). In this patient population, fentanyl is the drug of choice for analgesia due to its comparatively neutral effect on cardiac function, particularly in cases when cardiovascular compromise is a concern. Although fentanyl is usually well taken, respiratory depression can occur, especially at larger dosages or with quick delivery. As a result of underlying respiratory pathologies or impaired pulmonary function, children with congestive

heart failure may be more susceptible to respiratory compromise. When giving fentanyl to children with acyanotic congestive heart failure, it is crucial to closely evaluate their respiratory status, oxygenation, and ventilation to identify and treat respiratory depression quickly. Individualized fentanyl dosage should be determined by the child's age, weight, level of discomfort, and underlying heart condition (Thompson et al., 2021).

## CONCLUSION

Pediatric patients with congenital heart disease can safely undergo general anesthesia for non-cardiac surgery when comprehensive preoperative preparation and careful intraoperative monitoring are provided. Anesthetic management in similar cases indicates that the complexity of patients with congenital heart disease requires thorough perioperative planning. Appropriate adjustments and close monitoring are essential in these patients to achieve favorable clinical outcomes and minimize complications related to their underlying cardiac condition.

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