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ANESTHESIA MANAGEMENT FOR BRAIN ABCESS AND HIDROCEPHALUS IN CHILDREN DURING EXTERNAL VENTRIKEL DRAINAGE WITH TETRALOGY OF FALLOT

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ABSTRACT

Background: Congenital heart defects occur due to abnormal changes in the structure of the heart that occur early in pregnancy and are present at birth. This defect is the most common congenital anomaly, occurring in approximately 1 in 125 births. Tetralogy of Fallot (TOF) is a defect in which there is an obstruction of blood flow from the heart to the lungs, resulting in low blood oxygen levels. Brain abscess is a rare, fatal complication, accounting for 5%–18.7% of the population with cyanotic congenital heart disease. This condition is often accompanied by headache, fever, seizures, altered mental status, focal neurologic deficits, nausea, and vomiting. Case: A 10 year old girl with brain abcess and hydrocephalus who will undergo external ventrikel drainage with tetralogy of fallot. Disscussion: The Anaesthetic goals for a case of uncorrected Tetralogy of Fallot posted for a non-cardiac surgery are to avoid hypoxemia, ensure adequate hydration, maintain systemic arterial blood pressure (SVR), minimise additional resistance to pulmonary blood flow (pulmonary vascular resistance) and avoiding sudden increase in systemic oxygen demand (cry, inadequate depth of an aesthesia, seizure, pain, etc). Conclution: Anesthesia management of children with TOF presenting for non-cardiac surgery requires a thorough understanding of the pathophysiology of this condition and the altered haemodynamics.

KEYWORDS *Anesthesia; Brain Abscess; External Ventrikel Drainage; Tetralogy Of Fallot*

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INTRODUCTION

Tetralogy of Fallot (TOF) is the leading cause of cyanotic congenital heart disease (CHD) (10% of total CHD) and accounts for 13-70% of all brain abscess events. Consists of four components: the presence of *ventricular septal defect* (VSD), *overriding aorta*, *right ventricular outflow tract obstruction* (RVOT), dan *right ventricular hypertrophy* (RVH).(Al-Jarshawi et al., 2023; Coffey et al., 2021; Vo et al., 2023) Most of the literature on the management of brain abscesses in patients with uncorrected ToF includes conservative or surgical management and very few reports have been found regarding the planning and management of anesthesia.(Perkowski & Oyama, 2024; Quinlan et al., 2021)

The management of anesthesia for cerebral abscess patients with uncorrected CHD in the pediatric population is a challenge for anesthesiologists. chronic hypoxemia and *shunting* Right-to-left causes significant changes in pathophysiology that make these patients more susceptible to perioperative complications such as hemodynamic instability, congestive heart failure, arrhythmias, cyanotics, acid-base imbalances, coagulation disorders, along with seizures caused by abscesses, meningitis, and increased intracranial pressure.(Abuzaid et al., 2020; Dwivedi et al., 2020; Nwigwe et al., 2022)

We reported on the management of anaesthesia in children with brain abscesses who had uncorrected ToF comorbidities. This case report shows the team's success in carrying out *External Ventricular Drainage* measures with good recovery.

RESEARCH METHOD

This research method uses case studies, with the following case examples: A 10-year-old girl, weighing 17 kg, 140 cm tall, came to the emergency room with complaints of decreased consciousness since one day before entering the hospital. Patients have seizures, high fever, and blue skin if they cry. The parents said that the patient had never undergone surgery before, the patient was known to suffer from CHD since the age of six months. Physical examination showed that the patient was in a somnolent state, blood pressure 137/97 mmHg, pulse 112 x/min, respiratory rate 26 x/min, oxygen saturation 40% with NRM 15 lpm, body temperature 38.2ºC. Generalist status was obtained in a heart examination. The patient's extremities are warm, red, dry, CRT < 2 seconds. There was no fever but cyanosis was obtained on the fingers.

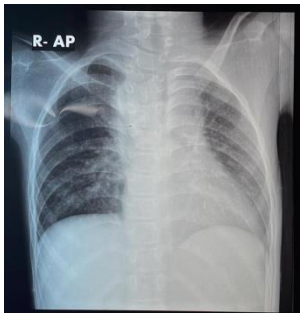

Figure 1. Thoracic photo examination results

Laboratory tests showed hemoglobin 23.3 gr/dL, leukocytes 9,170/µl, platelets 82,000//µl, hematocrit 77.6%, PT 41.2 seconds, INR 3.22, aPTT 43.0 seconds, albumin 3.1 gr/dL. Thoracic X-ray examination showed superior mediastinum dilation due to vascular mass. The patient underwent echocardiography examination with VSD findings, *L-R shunting* with *Aortic Overriding*, RA RV dilation, no PDA, PS of the Heavy Infundibular valve, PG 60 mmHg, systolic function LVEF 86%, FS 53%. Conclusion: *Tetralogy of Fallot*. A CT scan of the head supports the diagnosis of subarachnoid hemorrhage, cerebral abscess, and hydrocephalus.

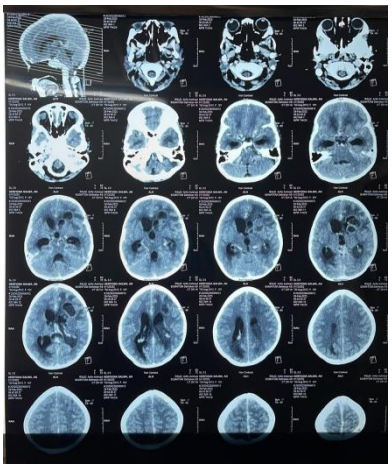

Figure 2. CT scan of the head

The patient's hemodynamics in the operating room include: blood pressure 109/77mmHg, pulse 98 x/min, oxygen saturation 82%. Preoxygenation was administered for 5 minutes and preremediation using midazolam 0.5 mg, then induced with ketamine 30 mg, fentanyl 50 mcg and rocuronium 10 mg. The airway was controlled with a face mask, then intubated with a 5.5 mm ETT at a depth of 15 cm with a ventilator used in the FiO2 pressure control mode of 50%, respiratory rate 14 x/min, Pi 15, tidal volume 160 cc, I:E ratio 1:2. Anesthesia is administered 0 2-Air 50:50, Flow 1 lpm, Sevoflurane 2vol%. After the induction of anesthesia is completed, the hemodynamic condition is relatively stable, with pulse rates ranging from 70-90x/minute. Systolic blood pressure ranges from 90-140mmhg, diastolic blood pressure ranges from 40-70mmhg, MAP 55-90mmhg. The operation lasted for 1 hour. The hemodynamic condition is relatively stable after the surgical procedure is completed. The patient was treated in the PICU room with a ventilator.

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RESULT AND DISCUSSION

The 10-year-old patient came with complaints of decreased consciousness, seizures, high fever, and bluish when crying. The patient was diagnosed with a cerebral abscess with ToF. *The tetralogy of Fallot* accounts for about 10% of CHDs and about 50% die during the first year of life Children who survive in this period come with hypoxia, cyanosis, polycythemia, coagulopathy, congestive heart

failure, and cyanotic attacks. Solitary cerebral abscesses make up only 0.5-6% of reported cerebral abscess cases.

The incidence of cerebral abscesses in populations with cyanotic CHD varies from 5 to 18.5%.(Dwivedi et al., 2020; Migo, 2023; Vo et al., 2023)

Cyanotic congenital heart disease has also been found to be an important predisposing factor for cerebral abscesses in 25-46% of cases. *Tetralogy of Fallot* (ToF) is the most common cyanotic CHD associated with intracranial suppuration, abscesses are mostly supratentorial.(Migo, 2023; Sengottian et al., 2023; Zipes et al., 2019) Patients with cyanotic CHD experience *shunting* blood from right to left that passes through the activity of lung phagocytosis, thus allowing blood to enter directly into the cerebral circulation.(Perkowski & Oyama, 2024; Schmitz et al., 2023) Low perfusion areas in the brain due to polycydia cause tissue hypoxia and acidosis. Microorganisms with blood that *shunting* scattered in the area causing a cerebral abscess.(Dwivedi et al., 2020; Fleisher LA & Beckam JA, 2011; Narayan et al., 2023)

The most important perioperative concern is the development of cyanosis due to hypertrophic infundibulum spasme. Factors that cause infundibular spasm are tachycardia, increased myocardial contractility, decreased SVR, increased *shunting* right to left through VSD and systemic blood pressure less than 60 mmHg.(Ayesha, 2022; Kamabu et al., 2024) The management of anesthesia for cases of uncorrected ToF planned for non-cardiac surgery is to avoid hypoxemia, ensure adequate hydration, maintain SVR pressure, minimize additional resistance to pulmonary blood flow (pulmonary vascular resistance) and avoid sudden increases in systemic oxygen requirements (crying, inadequate depth of anesthesia, seizures, pain, etc.).(Migo, 2023; Schmitz et al., 2023)

The oxygen saturation of the patients after preoxygenation increased to 82%, and the patients were preremediated using midazolam 0.5 mg and fentanyl 40 µg. Ketamine 30 mg i.v. is given for endotracheal induction and intubation using 10 mg rocuronium. ToF patients often experience dark blue skin, nails, and lips after crying or breastfeeding or when restless. This episode is called *tet spells*. *Tet spells* caused by a very rapid decrease in the amount of oxygen in the blood.(Lertkovit & Nivatpumin, 2021) The management of these conditions is to increase oxygenation, improve cardiac output, and reduce infundibular spasm and *shunting* Right-to-left.(Sengottian et al., 2023; Verma et al., 2023)

Give 100% oxygen, maintain depth of anesthesia and administer opiate bolus (e.g., morphine 0.1 mg/kg), fluid bolus, vasopressor therapy (e.g., phenylephrine 5 mcg/kg), β-blocker (e.g., propranolol 0.1-0.3 mg/kg), and knee-to-chest flexion position. Anesthesia induction can cause vasodilation and decreased SVR, thus worsening *shunting* Right-to-left.(Verma et al., 2023) Operating room temperature should be kept slightly higher and adequate hydration should be maintained with warm intravenous fluids as hypothermia and hypovolemia contribute to increasing viscosity as well as *shunting* Right-to-left.(Ayesha, 2022; Kamabu et al., 2024; Sengottian et al., 2023)

Blood gas analysis tests before induction and after extubation should be performed. This is due to the assessment of *pulse oxymetry* is not a reliable indicator of oxygenation because the patient in this case has severe cyanosis. We used

multimodal analgesia to manage pain because increased sympathetic activity due to pain can trigger cyanotic attacks in the perioperative period.(Kamabu et al., 2024; Mohammad, 2023).

Table 1. Anesthesia management

Preoperative	Intraoperative	Postoperaso
Generalized history of anamnesis	Goal: prevent significant right-to-left swerving - Avoiding increased lung resistance - Avoiding SVR degradation - Avoiding myocardium depression - Maintains full preload	Enter PICU
Continue with caution in children with uncorrected TOF	Induction of anesthesia: - Inhalation: Sevoflurane, IV insertion, then muscle relaxant, ETT insertion. - intravenously: Ketamine (2 mg/kg), muscle relaxant, ETT insertion - Avoid propofol/remifentanil to prevent decrease in SVR/contractility	Continue invasive monitoring with careful IV filling to minimize the residual effects of RVOTO
Prophylaxis of subacute bacterial endocarditis	Fully invasive monitoring including central venous and arterial access	Inotropic support after bypass (e.g. phosphodiesterase inhibitors such as enoximone or milrinone)
Always be vigilant and early detection of tet disease	Avoid hypothermia	
Preoperative preoperative pre-operative midazolam 0.5 mg/kg 30 minutes prior to surgery in children with a history of tet spell.	Pulse oximetry monitoring	Addition of norepinephrine may be necessary to address decreased SVR
Give antibiotic prophylaxis	Avoid prolonged fasting and dehydration	Continue ventilation until the child is warm with minimal bleeding and adequate peripheral perfusion.
	Avoid hypercarbia, hypoxemia, and acidosis	Maintain Potassium levels at 4.5-5.0 mmol/L and Magnesium levels at 1.5-2.0 mmol/L to Reduce cardiac arrhythmias.
	Pulse Oximetry Monitoring	

CONCLUSION

Management of anesthesia in children with ToF who will undergo non-cardiac surgery requires a thorough understanding of the pathophysiology of the condition and changes in hemodynamics. Success in such cases requires careful preoperative assessment of the patient to assess the severity of the underlying heart disease, patient optimization, careful administration of anesthesia with careful planning, judicious use of medications, accompanied by strict monitoring.

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