DOI: 10.7860/JCDR/2025/81255.21936

Case Report

Anaesthesia Section

Perioperative Challenges in Emergency Neurosurgery for a Paediatric Patient with Unrepaired Tetralogy of Fallot: A Case Report

AISHWARYA SANJAY BORODE[1], DHAWAL RAMESHPANT WADASKAR[2], KAUSTUV DAS[3]

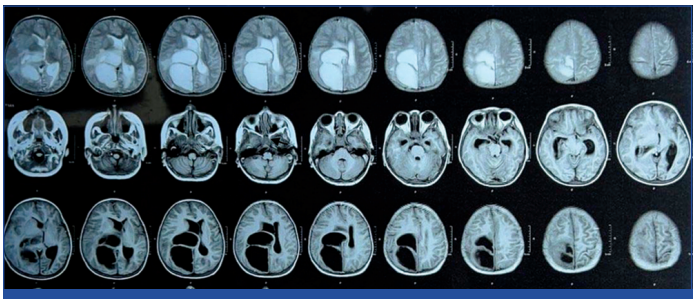
ABSTRACT

Paediatric patients with unrepaired Tetralogy of Fallot (TOF) presenting for emergency neurosurgery pose a unique perioperative challenge due to the delicate relationship between cyanotic heart disease physiology and elevated Intracranial Pressure (ICP). The anaesthetic management of an uncorrected six-year-old male with a lateral ventricular brain abscess, ventriculitis, hydrocephalus, and thrombocytopenia was presented. Preoperative evaluation revealed central cyanosis, a systolic murmur, and an aberrant coronary artery passing through the Right Ventricular Outflow Tract (RVOT), which posed a problem in anaesthetic management. Acute desaturation and hypotension during surgery after intracranial decompression were probably due to increased right-to-left shunting secondary to a decrease in Systemic Vascular Resistance (SVR). This was managed with phenylephrine boluses (10 mg) and 100% oxygen. A stable cerebral and cardiac status was achieved with an anaesthetic technique involving thiopentone, atracurium, and controlled sevoflurane administration. The patient recovered uneventfully postoperatively, without any new neurological deficit, and was haemodynamically stable on discharge. This case emphasises the importance of close perioperative care, anticipation of cyanotic spells, and individualised anaesthetic care in the management of complex neurosurgical emergencies in patients with cyanotic congenital heart disease. It reinforces that early therapy and understanding of cardiocerebral pathophysiology can optimise outcomes even in high risk children.

Keywords: Brain abscess, Cyanotic congenital heart disease, Intracranial pressure, Paediatric anaesthesia, Perioperative management, Phenylephrine, Right-to-left shunt, Ventricular septal defect

CASE REPORT

A six-year-old male, American Society of Anesthesiologists (ASA) II child, weighing 10 kg and measuring 100 cm, was brought to us with a one month history of headache, high-grade fever with chills, and decreased oral intake. He was drowsy but alert with no focal neurological deficit. Magnetic Resonance Imaging (MRI) of the brain [Table/Fig-1] showed a right lateral ventricular abscess with surrounding ventriculitis, hydrocephalus, and mass effect. The child was planned to undergo abscess drainage under general anaesthesia.



[Table/Fig-1]: MRI showing a right lateral ventricular abscess with ventriculitis around it, hydrocephalus, and mass effect.

[Table/Fig-2]: Showing signs of Grade 3 clubbing parrot beak appearance.

On pre-anaesthetic assessment, central cyanosis, grade 3 clubbing [Table/Fig-2], and an ejection systolic murmur over the left upper sternal border were present on clinical examination. The 2D echocardiogram confirmed TOF with a large subaortic VSD, right ventricular hypertrophy, overriding aorta, and pulmonary stenosis. In addition, a 5×4 mm ectopic vascular mass in the RVOT, most likely an aberrantly crossing coronary artery a rare finding from an anaesthetic perspective, particularly with regard to emergency line placements, catheterisation, or potential hemodynamic collapse in which cardiac support might become necessary. The patient had a history of hypertension controlled on oral propranolol 5 mg twice daily. Laboratory results consisted of haemoglobin 19 g/dL, leukocyte count 6300/mm^3, elevated C-Reactive Protein (CRP) 113 mg/L, and thrombocytopenia with a platelet count of 34,000/mm^3. Liver function, renal function, and electrolytes were normal. He was receiving intravenous vancomycin 240 mg every six hours, meropenem 480 mg every eight hours, and levetiracetam 480 mg every 12 hours.

Given the low platelet level and the need for neurosurgery, a preoperative transfusion of one unit of platelet concentrate was administered. The post-transfusion platelet count increased to 74,000/mm^3. The child was kept nil per os for six hours for solids and two hours for liquids. Routine ASA monitors were used intraoperatively. An 18G IV cannula was secured in the upper limb. Glycopyrrolate (0.04 mg/kg), fentanyl (2 mcg/kg), and slow increments of thiopentone (30 mg) were administered to induce anaesthesia, limit cerebral vasodilation, and reduce ICP. Muscle relaxation was achieved with atracurium (0.5 mg/kg). Bag-mask ventilation was uneventful, and the airway was secured with a 5 mm cuffed endotracheal tube. Anaesthesia was maintained with sevoflurane in a 50:50 oxygen-air mixture to avoid excessive pulmonary vasodilation and ensure adequate oxygenation.

The most critical intraoperative event was the decompression of the brain abscess. Once ICP was relieved, the child experienced sudden hypotension {Mean Arterial Pressure (MAP) decreased by 25%} along with a decrease in oxygen saturation to 82%. The anaesthesiology team immediately suspected an increase in right-to-left shunting due to the drop in SVR. Sevoflurane was titrated down, and oxygen was briefly raised to 100%. During this event, a titrated bolus of phenylephrine (1 mcg/kg) was administered to enhance SVR and reduce the shunt size. In a matter of minutes, oxygen saturation rose to more than 94%, and blood pressure normalised. The remainder of the intraoperative period was uneventful. The remaining procedure was conducted under close monitoring.

The child received 300 mL crystalloids and 100 mL colloids intraoperatively, with a urine output of 100 mL. Mannitol was omitted due to borderline platelets. Blood loss was minimal. Neuromuscular blockade at the end of surgery was reversed with neostigmine and glycopyrrolate (0.05 mg/kg + 0.01 mg/kg). The child was awake with intact airway reflexes and was successfully extubated on the table. He was shifted to the Intensive Care Unit (ICU) for neurological and haemodynamic monitoring. The child was monitored using electrocardiography and plethysmography for two days. The ICU stay was uneventful, and the child was shifted to the ward.

The child recovered without incident in the subsequent seven days. There were no new neurological deficits or cardiac incidents. He was kept on antibiotics-vancomycin 240 mg IV every eight hours, meropenem 480 mg IV three times daily and propranolol 5 mg twice daily in the postoperative period. He remained haemodynamically stable and was discharged after 20 days of hospital stay in a stable condition with follow-up by cardiology and neurology.

DISCUSSION

Children with uncorrected TOF undergoing neurosurgical procedures such as brain abscess drainage present formidable anaesthetic challenges because of the dynamic interaction between cyanotic congenital heart disease physiology and elevated ICP. In our case, a six-year-old child with TOF, lateral ventricular brain abscess, ventriculitis, hydrocephalus, and thrombocytopenia required emergent neurosurgical drainage. The existence of a large VSD with an overriding aorta and a possible coronary artery over the RVOT contributed to perioperative complexity, particularly with regard to haemodynamic stability. TOF causes chronic right-to-left shunting via infundibular and pulmonary stenosis, with shunting of deoxygenated blood past the lungs to the systemic circulation, resulting in hypoxemia. Conditions that increase Pulmonary Vascular Resistance (PVR) or decrease SVR can increase this shunting. Anaesthetic agents, surgical stress, pain, hypoxemia, hypercarbia, and acidosis in the perioperative period may precipitate cyanotic spells [1,2]. This is especially risky in neurosurgery due to acute ICP changes on decompression, as seen in our patient with acute desaturation and hypotension.

Anaesthetic goals in these cases were to maintain SVR, reduce PVR, support myocardial contractility, and manage intracranial dynamics without causing haemodynamic collapse [2]. A summary of these goals and the corresponding strategies employed in this patient is presented in [Table/Fig-3] [2-4]. During decompression, there was a sudden fall in MAP and saturation, possibly secondary to an acute fall in SVR augmenting right-to-left shunting, which was immediately addressed. Management and outcomes of similar cases are depicted in [Table/Fig-4] [3,5-7].

Physiological target	Potential risk	Anaesthetic strategy used
SVR	Decrease → ↑ Right-to-left shunt → Hypoxemia	Phenylephrine boluses, controlled thiopentone dosing, avoiding deep sevoflurane
PVR	Increase → ↓ Pulmonary flow → Cyanosis	50:50 O_2-air mix, avoidance of hypoxia, hypercarbia, acidosis
ICP	Increase → Reduced cerebral perfusion	Smooth induction, avoiding coughing/bucking, careful ventilation
Preload	Decrease → ↓ Cardiac output, ↑ Shunt fraction	Crystalloid and colloid balance, avoiding mannitol
Infundibular spasm/ cyanotic spells	Sudden cyanosis, hypotension	Beta-blocker continuation, phenylephrine, early recognition

[Table/Fig-3]: Objectives and strategy used.
SVR: Systemic vascular resistance; PVR: Peripheral vascular resistance; ICP: Intracranial pressure [2-4]

Author	Case history	Management	Takeaways
Present study	Six-year-old boy (ASA II) with unrepaired TOF, cyanosis, thrombocytopenia, and lateral ventricular brain abscess with ventriculitis and hydrocephalus. Rare aberrant coronary artery crossing the RVOT noted.	Emergency abscess drainage under general anaesthesia. Anaesthesia induced with thiopentone and atracurium, maintained with titrated sevoflurane. Intraoperative desaturation managed with phenylephrine and 100% oxygen. Full recovery without neurological or cardiac complications.	Demonstrates anaesthetic complexity in neurosurgical emergencies with TOF. Emphasises tailored anaesthetic strategy, haemodynamic vigilance, and integration of cardiocerebral physiology for successful outcomes.
Adebayo BE et al., [5]	Four-year-old girl with undiagnosed TOF with recurrent frontal headaches, fever, and generalised tonic-clonic convulsions. She was unconscious with signs of cyanosis, clubbing, and a systolic murmur. Blood film was positive for malaria, CSF showed Gram negative cocco-bacilli, and clinical picture mimicked cerebral malaria/ meningitis. Patient died shortly after admission; postmortem confirmed TOF and a large frontal lobe brain abscess.	Immediate treatment for meningitis (high-dose ampicillin) and cerebral malaria (intravenous artesunate). Despite treatment, patient died within an hour of admission.	Highlights fatal outcome of late diagnosis of TOF with brain abscess in resource-poor settings. Emphasises need for increased awareness, early diagnosis, and access to advanced diagnostic tools to reduce childhood mortality in developing countries.
Lakhani M et al., [6]	13-year-old boy with uncorrected TOF presented with fever, headache, seizures, and altered consciousness. Diagnosed with parieto-occipital abscess on Computed Tomography (CT). Blood culture showed *E. coli*. No endocarditis.	Managed with vancomycin, meropenem and anticonvulsants. Serial imaging showed improvement. Referred for cardiac surgery post-recovery.	Emphasizes risk of brain abscess in TOF. Conservative management viable for small abscesses. Importance of early cardiac repair.

Gupta P et al., [7]	24-year-old female with unrepaired TOF since infancy. Presented with altered sensorium, headache, vomiting, and fever. CT showed left perisylvian abscess with cerebral oedema and midline shift. Echocardiography confirmed TOF; no endocarditis.	Urgent surgical drainage. Culture grew *Streptococcus intermedius*. Treated with ceftriaxone and metronidazole.	Larger abscesses in TOF patients require prompt surgery. Highlights the role of timely diagnosis, pathogen identification, and prolonged targeted antibiotic therapy. Importance of early TOF correction.
Kamabu LK et al., [3]	three-year-old male with known TOF on propranolol, presented with convulsions, cyanosis, difficulty breathing, and left facial nerve palsy. CT showed multiple ring-enhancing brain abscesses, cerebral oedema, midline shift, subacute subdural hematoma, and pneumocranium. SPO2 was 55% on room air.	Emergency craniotomy with surgical drainage plus ceftriaxone for 6 weeks. Patient improved clinically and radiologically; discharged after 3 months.	Demonstrates complex management of multiple brain abscesses in TOF. Early multidisciplinary approach, combining surgery and prolonged antibiotics, is vital for good outcomes in paediatric TOF patients with brain abscesses.

[Table/Fig-4]: Management in similar cases [3,5-7].

Anaesthetic management of a case like this demands a delicate balance between maximising cerebral and cardiac physiology. Careful preoperative planning, dynamic intraoperative care, and early intervention of haemodynamic alterations are the cornerstones for favourable outcomes in neurosurgical emergencies in patients with coexisting uncorrected cyanotic heart disease [8]. Tailoring anaesthetic strategies to the unique cardiocerebral interplay is essential in such high risk paediatric cases. Vigilant multidisciplinary collaboration can significantly improve perioperative safety and long term outcomes.

CONCLUSION(S)

This case underlines the paramount need for prompt recognition and holistic management of neurological complications in children with cyanotic congenital heart disease, TOF in this instance. The favourable outcome in this child with multiple brain abscesses emphasises the benefit of a multidisciplinary strategy incorporating early neuroimaging, early neurosurgical intervention, and focused antimicrobial treatment. It also highlights the requirement for regular follow-up and coordinated care in specialised centres that can handle both the cardiac and neurological sequelae. Raising clinical suspicion and bolstering paediatric cardiac and neurosurgical facilities are the most important factors that can decrease morbidity and increase survival in such complicated presentations, especially in resource constrained environments where delayed diagnosis continues to be a major problem.

REFERENCES

[1] Sengottian MP, Ajanth S, Baliarsing LA, Deshpande C. Anesthetic management of adult patients with tetralogy of Fallot: A case series. Anaesth Pain Intensive Care. 2023;27(3):429-33.
[2] Dwivedi P, Kumar S, Ahmad S, Sharma S. Uncorrected tetralogy of Fallot's: Anesthetic challenges. Anesth Essays Res. 2020;14(2):349-51.
[3] Kamabu LK, Sikakulya FK, Kataka LM, Vivalya BNM, Lekuya HM, Obiga DOD, et al. Tetralogy of Fallot complicated by multiple cerebral abscesses in a child: A case report. J Med Case Reports. 2024;18(1):183.
[4] Wilson R, Ross O, Griksaitis MJ. Tetralogy of fallot. BJA Educ. 2019;19(11):362-69.
[5] Adebayo BE, Ogunkunle OO, Ayun FO. Meningitis and brain abscess: First but fatal presentation in a child with tetralogy of Fallot. J Cardiol Cases. 2016;13(3):72-74.
[6] Lakhani M, Memon RS, Khan F. Brain abscess: A rare complication in a child with tetralogy of Fallot. IDCases. 2020;22:e00954.
[7] Gupta P, Singh H, Vashisht N, Dhingra GS, Sharma V. A rare confluence: Brain abscess in an adult with tetralogy of Fallot. Cureus. 2024;16(7):e63860.
[8] Junghare S, Desurkar V. Congenital heart diseases and anaesthesia. Indian J Anaesth. 2017;61(9):744.

PARTICULARS OF CONTRIBUTORS:
1. Junior Resident, Department of Anaesthesiology, Jawaharlal Nehru Medical College, Datta Meghe Institute of Higher Education and Research, Wardha, Maharashtra, India.
2. Associate Professor, Department of Anaesthesiology, Jawaharlal Nehru Medical College, Datta Meghe Institute of Higher Education and Research, Wardha, Maharashtra, India.
3. Junior Resident, Department of Anaesthesiology, Jawaharlal Nehru Medical College, Datta Meghe Institute of Higher Education and Research, Wardha, Maharashtra, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Aishwarya Sanjay Borode,
Shivneri, Prasad Colony, Gopal Nagar Square, Badnera Road, Amravati, Maharashtra, India.
E-mail: aishwaryaborode7@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Jun 30, 2025
- Manual Googling: Jul 24, 2025
- iThenticate Software: Jul 26, 2025 (5%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Jun 11, 2025**
Date of Peer Review: **Jul 12, 2025**
Date of Acceptance: **Jul 29, 2025**
Date of Publishing: **Nov 01, 2025**