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Case Report

Anaesthesia Section

Intraoperative Ventricular Tachycardia during Neonatal Tracheoesophageal Fistula Repair: An Anaesthetic Challenge

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ABSTRACT

The anaesthetic risk for neonate Tracheoesophageal Fistula (TEF) repair is high due to immature physiology, airway abnormalities, frequent congenital anomalies, limited cardiovascular reserve in the early neonatal period, and the emergency nature of the surgical intervention, which usually allows only a short time for complete preoperative optimisation. This case is a report of a four-day-old male neonate weighing 2.5 kg posted for emergency TEF repair who developed sudden intraoperative ventricular tachycardia and cardiac arrest with successful resuscitation. The neonate was brought to the hospital exhibiting excessive salivation and feeding intolerance since birth. Along with dextrocardia, thrombocytopenia, indirect hyperbilirubinaemia, and periventricular hyper-echogenicity, other abnormalities were also found during the preoperative workup. Being a physical status IV E patient according to the American Society of Anaesthesiologists classification, the child was put under general anaesthesia with ketamine, fentanyl, propofol, and atracurium. Intubation was performed with a 2.5 mm uncuffed endotracheal tube. About an hour into the operation, close to the end of the procedure, the patient suddenly experienced cardiovascular collapse with ventricular tachycardia, which eventually led to intermittent asystole. Immediate Cardiopulmonary Resuscitation (CPR), including defibrillation and adrenaline administration, led to the return of spontaneous circulation after one cycle. The neonate was stabilised with a noradrenaline infusion and is currently under the care of the Neonatal Intensive Care Unit (NICU) following the surgery. Additional investigations revealed alterations in cardiac conduction and transient metabolic derangements, which were assumed to be the cause of the incident. Such scenarios underscore the critical importance of patient safety during neonatal TEF repair. This includes vigilant perioperative monitoring, thorough preparedness for the potential development of malignant arrhythmias, and the availability of advanced resuscitation equipment at all times.

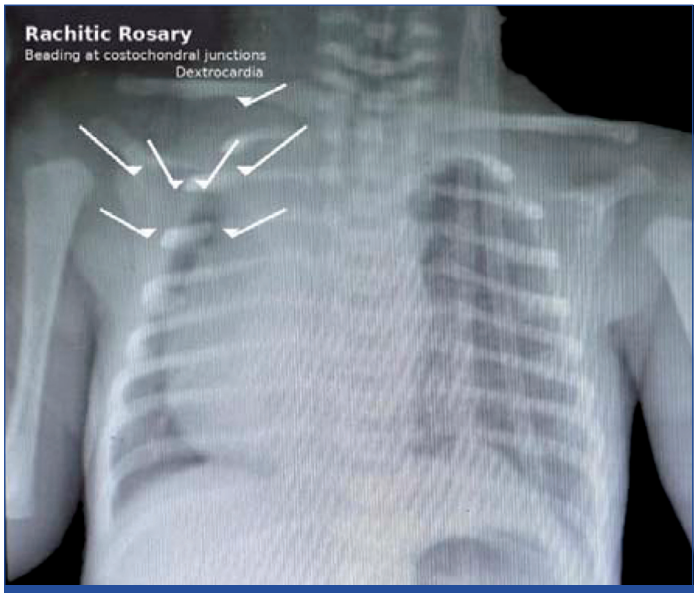
Keywords: Anaesthesia complications, Cardiac arrest, Cardiopulmonary resuscitation, Dextrocardia, Neonate, Perioperative monitoring, Sudden arrhythmia

CASE REPORT

A four-day-old male baby weighing 2.5 kg was planned for an emergency TEF repair for type C-TEF. The neonate was brought in with the history of excessive salivation, choking, and feeding intolerance from birth. Upon general examination, the infant was lethargic but responded to stimulation, exhibited mild jaundice, and had stable baseline vital signs. The respiratory examination revealed equal air entry on both sides, with transmitted sounds noted on systemic examination. During the cardiovascular examination, the heart sounds were best heard on the right-side. No gross external congenital anomalies were visible.

Preoperative blood tests showed haemoglobin 18.3 g/dL, platelet count of 88,000 platelets/mm^3, urea 22 mg/dL, serum creatinine 1.1 mg/dL, sodium 141 mEq/L, potassium 4 mEq/L, and total bilirubin 7.3 mg/dL with indirect bilirubin 7 mg/dL. Chest X-ray revealed dextrocardia [Table/Fig-1]. The sonogram showed periventricular hyper-echogenicity around the lateral ventricles. Due to the patient's age, the emergency nature of the surgery, the presence of dextrocardia, thrombocytopenia, and the possibility of multisystem involvement, the patient was assigned the American Society of Anaesthesiologists physical status IV, E (ASA IV, E) category. High-risk consent was taken. The neonate was kept nil per os as per standard fasting guidelines.

Standard monitoring, including electrocardiography, pulse oximetry, and non-invasive blood pressure monitoring, was initiated in the operating room. After premedication with glycopyrrolate injection 0.01 mg (0.004 mg/kg), the induction of anaesthesia was made by ketamine injection 2.5 mg (1 mg/kg), fentanyl 2.5 mcg (1 mcg/kg), and propofol 5 mg (2 mg/kg). Neuromuscular blockade was obtained with atracurium 1 mg (0.4 mg/kg), and an additional 0.1 mg bolus was administered for maintenance. Hydrocortisone 5 mg (2 mg/kg) was given. On laryngoscopy, a Cormack-Lehane grade II view was obtained, and the trachea was intubated with a 2.5 mm uncuffed endotracheal tube. Tube placement was confirmed by capnography and auscultation. Proper padding and warming blankets were used to prevent hypothermia. Ventilation was carried out with a Jackson-Rees circuit using an air-oxygen mixture with FiO2 of 50% and sevoflurane.



[Table/Fig-1]: Preoperative chest X-ray showing dextrocardia.

About one hour after surgery was started, the neonate unfortunately went into sudden cardiovascular collapse with non-recordable blood pressure and non-palpable pulses. The electrocardiogram showed ventricular tachycardia at 220 bpm, followed by intermittent asystole. At this stage, the fistula had been successfully ligated, and the chest was not yet being closed. Immediate CPR was initiated according to the neonatal advanced life support guidelines. A 6 J DC shock was delivered for ventricular tachycardia. Intravenous adrenaline (0.1-0.3 mcg/kg/dose) was administered in two doses during the asystole episodes, as per protocol. After only one cycle of CPR, return of spontaneous circulation was achieved, as evidenced by an end-tidal carbon dioxide of about 35. To maintain the patient's blood pressure, a noradrenaline infusion (0.1-0.3 mcg/kg/min) was commenced. Maintenance fluids consisted of dextrose 10% in water, administered at an intraoperative rate of 4 mL/kg/hr. A total of 60 mL was administered during surgery. The estimated blood loss was 8 mL, and the total urine output was 4 mL during the procedure.

After stabilising the patient, the infant was moved to the Neonatal Intensive Care Unit (NICU) with the endotracheal tube left in place for an elective postoperative ventilation and close monitoring. In the NICU, the baby was haemodynamically stable on inotropic support, which was slowly discontinued. After surgery, the series of examinations, such as echocardiography and metabolic workup, revealed that the patient had a displaced heart with conduction abnormalities along with transient metabolic derangements. These findings were considered factors leading to the occurrence of malignant arrhythmia during the operation in the setting of neonatal myocardial immaturity and mediastinal surgical manipulation. The infant was subsequently removed from the ventilator and made a gradual clinical recovery. Upon subsequent check-ups over the next few months, the infant was found to be thriving, with normal weight gain and feeding, without any recurrence of arrhythmias or cardiovascular instability.

DISCUSSION

Neonates presenting for TEF repair constitute an extremely high-risk group for anaesthesiologists due to the combination of immature physiology, altered airway anatomy, and frequent association of these infants with congenital anomalies. The primary issue is airway management, as a fistulous communication between the trachea and oesophagus causes the stomach to inflate during positive-pressure ventilation. This, in turn, results in diaphragmatic splinting, decreased lung compliance, hypoxia, and sudden cardiovascular collapse. The exact placement of the endotracheal tube beyond the fistula and the use of a ventilating technique with the lowest possible pressure are necessary, especially before fistula ligation. The presence of associated anomalies, such as cardiovascular ones, can greatly increase the risk during the perioperative period [1,2]. The neonate had a confirmed diagnosis of dextrocardia, but the exact cardiac pathology was not initially evident. The malignant arrhythmia was likely related to conduction abnormalities associated with dextrocardia, rather than dextrocardia itself, which does not directly cause arrhythmias.

Congenital heart disease, abnormal cardiac position like dextrocardia, and conduction system abnormalities may not be evident from clinical examination before surgery. Thus, they may be overlooked, but they can lead to the occurrence of malignant arrhythmias and haemodynamic collapse that can be sudden in neonates under anaesthetic and surgical stress. The neonatal myocardium is highly sensitive due to its limited capacity to tolerate changes in preload, afterload, oxygenation, and acid-base balance. So, these patients become extremely vulnerable during periods of hypoxia, acidosis, and electrolyte imbalance, and when there is intense surgical manipulation in the mediastinum [3,4]. The current case highlights how myocardial immaturity and congenital cardiac anomalies, like dextrocardia, can predispose a neonate to such arrhythmic events. Despite the absence of clear structural heart disease, the underlying conduction abnormalities likely contributed to the ventricular tachycardia observed in this patient.

Infants with TEF often have pulmonary compromise secondary to repeated aspiration, retained secretions, and pre-existing lung disease, which leads to decreased respiratory reserve. The changes in ventilation and perfusion due to surgical exposure of the chest, lung retraction, and altered intrathoracic pressure can be sudden and can result in hypoxemia and cardiovascular instability. Also, neonates are susceptible to hypothermia, hypoglycaemia, and metabolic derangements, which, in turn, can worsen myocardial instability and cause perioperative arrhythmias [5-7].

Anaesthetic management during surgery should be meticulous, with close monitoring, temperature control, fluid management, and early recognition of instability. Hypoxia, vagal stimulation, electrolyte disturbances, and cardiac conduction abnormalities have been linked to sudden arrhythmias during TEF repair, which can cause such situations. It is crucial to be able to initiate resuscitative actions quickly, have vasoactive drugs readily available, and be prepared for defibrillation in these cases [8-10]. As per the case presented by Yıldırım SV et al., (2008), where arrhythmias were observed in 8.8% of children post-cardiac surgery, and with young age and high-risk surgery being identified as significant factors, this case aligns with the findings that early and aggressive intervention is critical in managing arrhythmias in such fragile neonates [5].

NICU monitoring should be sustained after the operation, as cardiorespiratory events delayed in time can still happen because of pulmonary pathology, myocardial dysfunction, or metabolic abnormalities. Thorough postoperative assessment, including cardiac and metabolic investigations, may reveal contributory factors that were not apparent before surgery. It is important to have a diligent, multidisciplinary follow-up for these high-risk neonates. In this case, close monitoring and postoperative ventilation were crucial in stabilising the neonate, and follow-up assessments showed favourable recovery. Postoperative monitoring is essential in detecting potential complications, including delayed arrhythmias, that may arise in the hours and days after the surgery [11,12].

[Table/Fig-2] summarises reported neonatal and paediatric perioperative arrhythmias in TEF repair and congenital cardiac surgery to highlight evolving understanding of risk factors and management [5,9,13].

Author	Case description	Management	Takeaway
Mainzer G et al., (2007, Israel) [9]	Neonate with normal cardiac morphology underwent TEF repair with oesophageal atresia at 2 days of life and developed atrial fibrillation 16 days postoperatively-an extremely rare finding in neonates without structural heart disease.	Managed medically; authors also reviewed 35 paediatric AF cases over 22 years, all associated with underlying cardiac disease except this neonate.	Atrial fibrillation is exceedingly rare in neonates without heart disease; perioperative stress after TEF repair may precipitate delayed arrhythmias, warranting ongoing cardiac surveillance.
Yıldırım SV et al., (2008, Turkey) [5]	Observational study of 580 children after cardiac surgery; arrhythmias occurred in 8.8%, most commonly supraventricular tachycardia, junctional ectopic tachycardia, and complete AV block, with the highest incidence in infants <6 months and after complex procedures.	Managed in paediatric cardiac ICU with antiarrhythmics, pacing when required, and supportive care; mortality was 29.4% among those with arrhythmias, with some deaths directly arrhythmia-related.	Early postoperative arrhythmias are common and potentially fatal after paediatric cardiac surgery; younger age and type of surgery are major risk factors, even with normal electrolytes.

Öztürk E et al., (2021, Turkey) [13]	Retrospective cohort of 670 paediatric patients undergoing congenital heart surgery; early postoperative arrhythmias occurred in 8.1%, most commonly junctional ectopic tachycardia and AV block.	Medical therapy included amiodarone, dexmedetomidine, and flecainide; permanent pacemakers were required in some cases. Risk factors included age <1 year, high inotropic scores, prolonged surgery, and high Aristotle scores.	Postoperative arrhythmias are frequent after congenital heart surgery, with risk influenced by patient age, surgical complexity, and perioperative haemodynamic stress.
Present case	A 4-day-old term neonate with TEF and dextrocardia developed sudden intraoperative ventricular tachycardia progressing to intermittent asystole during TEF repair.	Immediate neonatal CPR, DC shock, IV adrenaline, noradrenaline infusion, elective postoperative ventilation, and intensive monitoring led to recovery.	Neonates undergoing non-cardiac surgery may develop malignant arrhythmias due to myocardial immaturity, occult cardiac anomalies, and surgical stress, underscoring the need for high vigilance and preparedness for advanced resuscitation.

[Table/Fig-2]: Summary of perioperative arrhythmias in neonatal and paediatric surgery [5,9,13].

CONCLUSION(S)

This patient illustrates how extremely sensitive to anaesthesia young children can be when they have to undergo surgical repair of a TEF, especially if other abnormalities are present and their physiological reserve is limited. Such a situation can develop if the cardiovascular system suddenly gives up during surgery, even though anaesthesia seems to be stable. It is therefore highly important that the patient be closely monitored not only during but also before and after surgery. Additionally, the medical team must be prepared to perform advanced resuscitation at all times, and a thorough evaluation must be conducted to identify the underlying factors and improve long-term outcomes.

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