https://jncca.org

ScientificScholar [®] Knowledge is power

Journal of Neonatal Critical Care and Anesthesia



Case Report

A Novel Intervention for Refractory Bradycardia and Desaturation in a Neonate Undergoing Tracheoesophageal Repair Under General Anesthesia

Pratibha Jain Shah, MD, FICA, FIPM.¹, Ahana Bose, MD.¹

¹Department of Anaesthesiology, Pandit Jawaharlal Nehru Memorial Medical College, Raipur, Chhattisgarh, India.

ABSTRACT

A 3-day-old preterm neonate, with esophageal atresia and tracheoesophageal fistula (TEF) type C, American Society of Anesthesiologists grade 3, was posted for a right thoracotomy, ligation of fistula, and end-to-end anastomosis of esophagus under general anesthesia. Following induction, recurrent bradycardia and desaturation occurred during fistula ligation unresponsive to injection atropine, fluid boluses, release of lung retractor, and intermittent bilateral lung inflation. A decision to transiently block the cardiac vagal fibers through the surgical site stabilized the vitals allowing the surgery to proceed uneventfully. This case highlights the challenges faced by the anesthesiologist while managing neonates with TEF in the peri-operative period owing to associated VACTREL anomalies, vascular access, airway management, risk of hypothermia, and immature hemodynamic response that could lead to arrhythmias and cardiac arrest.

Keywords: Bradycardia, Cardiopulmonary resuscitation, Lidocaine, Neonate, Regional block, Submucosal, Tracheoesophageal fistula

INTRODUCTION

Bradycardia in neonates is defined as a heart rate (HR) of <100 beats per minute (bpm). In this age group, HR is the dominant factor determining cardiac output. Hypoxemia and hypervagotonia predispose to bradycardia and its sequelae - fall in cardiac output, arrhythmias, and desaturation. In preterm neonates, the lung reserve for oxygen is low with greater oxygen consumption. The immature physiology added to preexisting pneumonitis secondary to disease pathology, use of anesthesia drugs, application of lung retractors, and difficulties in ventilation constantly poses a risk of hypoxia in neonates undergoing thoracotomy and tracheoesophageal fistula (TEF) repair. Manipulation of the airway and esophagus during surgical repair further triggers vagal-mediated bradycardia. This reflex is sensitive in neonates due to a primitive autonomic system, wherein parasympathetic activity predominates. In profound vagal-mediated bradycardia, asystole and death may ensue.^[1-3]

CASE REPORT

A 3-day-old preterm male baby (birth weight – 1600 g) with a history of respiratory distress, choking with feeds, frequent regurgitation, and failure to advance the orogastric tube beyond 10 cm was diagnosed with TEF. A right thoracotomy and fistula ligation with end-to-end esophageal anastomosis was planned under general anesthesia.

On Day 5, at the time of pre-anesthetic checkup, the baby appeared pink, HR - 160/min, respiratory rate (RR) - 40/min, oxygen saturation (SPO₂) - 98% on continuous positive airway pressure (CPAP) - 5 cm of H₂O, fraction of inspired oxygen 0.3. On auscultation, there were mild crepitations bilaterally. S1–S2 was heard with no murmur. On head-to-toe examination, polydactyly with club foot was noted.

Blood investigations were unremarkable. Hemoglobin - 16 g/dL, total leukocyte count - 22,000/mm³, platelet count - 2 Lakh/mm3, sodium - 138 mmoL/L, potassium - 4.8 mEq/L, and creatinine - 0.6 mg/dL.

Arterial blood gas analysis was normal. pH - 7.36, partial pressure of carbon dioxide - 38 mmHg, partial pressure of oxygen - 150 mmHg, bicarbonate - 24 mEq/L.

Echocardiography was done to rule out cardiac anomalies, showing a 60% ejection fraction, normal valvular function, and no abnormal connections. Chest X-ray was suggestive of mild pneumonitis.

*Corresponding author: Ahana Bose, Department of Anaesthesiology, Pandit Jawaharlal Nehru Memorial Medical College, Raipur, Chhattisgarh, India. ahanaria.bose@gmail.com

Received: 13 February 2025 Accepted: 22 April 2025 Epub ahead of print: 29 May 2025 Published: XXXXXX DOI: 10.25259/JNCCA_3_2025

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 License, which allows others to remix, transform, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms. ©2025 Published by Scientific Scholar on behalf of Journal of Neonatal Critical Care and Anesthesia

He was kept nil orally in a 45° head-up position and received broad-spectrum antibiotics, salbutamol nebulization, oxygen by hood, intermittent CPAP, and intravenous fluids. Given the high risk, informed consent for surgery and the need for post-operative ventilation were obtained. The baby was shifted to the operation theater in a warm incubator with an oxygen hood.

The Standard American Society of Anesthesiologists monitors were applied and pre-operative vitals were recorded.

Baby had a heart rate of 160 beats/min with normal sinus rhythm on electrocardiography (ECG), non-invasive blood pressure (NIBP) of 96/56 mmHg and arterial saturation of 96% on face mask at oxygen flow of 5 L/min. A forced air warmer was placed under the drapes, intravenous access patency was confirmed, and premedication with intravenous glycopyrrolate 0.01 mg was administered followed by induction of general anesthesia with inhalational agent 6% sevoflurane and intravenous 2 mg ketamine.

The tracheal intubation was performed using a 3.0 mm oral uncuffed endotracheal tube (ETT). The ETT was advanced right endobronchial, and then, gradually, the tube was withdrawn till B/L ventilation was confirmed by auscultation, to ensure that the tube was distal to the fistula. The tube was then anteriorly rotated and secured away from the fistula. Gentle manual ventilation with the Jackson Rees circuit was opted to deliver small tidal volumes to prevent gastric distension and minimizing mediastinal movements. The anesthesia was maintained with 2% sevoflurane in 100% oxygen, with IV rocuronium 0.2 mg for muscle relaxation and a paracetamol suppository 50 mg was applied for analgesia. After positioning the baby in the left lateral decubitus position, tube placement was rechecked.

Thirty minutes into the surgery, the monitor signaled a sudden drop in HR accompanied by arterial saturation declining from 96% to 92%. Hypoxia was suspected and the surgeons were requested to release the lung retractors and positive pressure ventilation was given. The ETT patency, position, and circuit connections were verified.

While SpO₂ was improved to 96%, the HR further declined to 90 bpm after 30 s. Promptly, a fluid bolus of 20 mL was administered to compensate for intraoperative losses. HR further declined to 30 bpm. Immediately, 0.2 mL of IV adrenaline (1:10000 dilution) was administered in view of near cardiac arrest situation. On inquiry, a vagal-mediated reflex bradycardia was suspected as the surgeon confirmed esophageal manipulation for anastomosis. The surgeon was requested to stop, and IV atropine 0.02 mg was administered. Three additional doses were administered up to 0.08 mg in the next 5 min. Despite these measures, the HR remained low, and peripheries turned cold with non-recordable SpO₂. No arrhythmias were detected on ECG. A regional block was considered to counter vagal tone. A single injection of 1.5 mL of 0.25% lignocaine was infiltrated into the esophageal submucosa through the surgical site. Within 1 min of the block, the HR rose to 100 bpm; 120 bpm in the next 3 min, and by 5 min, baseline HR and saturation were restored. Thereafter, surgery was completed uneventfully within 30 min and the baby was transferred to the neonatal intensive care unit with ETT *in situ* for elective ventilation. In the first 24 h post-operative period, the baby remained hemodynamically stable, with no recurrence of bradyarrhythmia or requirement for vasopressor support.

DISCUSSION

Unexpected cardiac arrest in the perioperative period is a devastating complication. Owing to the immaturity of organ systems and the presence of congenital malformations, morbidity, and mortality are higher in neonates compared to older children.

There is abundant literature about early recognition and management of perioperative adverse events in children, but similar data and guidelines for surgical neonates remain scarce. The current neonatal resuscitation guidelines are framed for a newborn undergoing intrauterine to extrauterine physiology transition, which differs from a preterm neonate undergoing the stress of anesthesia and surgery.^[4]

Bradycardia, a common pre-arrest condition, was encountered in this case. Factors that could have possibly led to bradycardia such as hypoxia, acidosis, hypotension, and hypothermia, were promptly addressed. Effective communication with the surgical team helped identify profound vagal stimulation due to surgical manipulation as the likely cause. Neonates exhibit well-developed cholinergic innervation at birth, making them highly susceptible to vagally mediated cardiac reflexes, even in preterm infants. The first-line treatment for symptomatic bradycardia, IV atropine (0.02 mg/kg, max single dose 0.1 mg), was administered. However, repeated doses require caution, as even the minimum recommended dose (0.1 mg in babies <5 kg) can lead to acute anticholinergic syndrome.^[5]

This condition may cause delayed emergence, diminished responsiveness, and bilaterally dilated pupils without any other identifiable cause.^[6]

A simple yet effective intervention with lidocaine proved beneficial by blocking both initiation and conduction of afferent vagal impulses from the surgical site, in combination with other corrective measures.

This approach aligns with existing evidence. A study on strabismus surgery in 53 patients demonstrated that a combination of intravenous atropine to block peripheral muscarinic receptors at the heart and retrobulbar lidocaine to block afferent conduction at the ciliary ganglion effectively prevented oculocardiac reflex activation.^[7] Similarly, both IV lidocaine and topically applied lidocaine gel or spray have been shown to reduce vagally mediated laryngospasm during extubation in pediatric surgeries under general anesthesia.^[8]

The evidence of using esophageal submucosal lidocaine infiltration successfully to counter vagal-mediated bradycardia in a preterm neonate, in our case, is valuable in the practice of future anesthesiologists when faced with similar high-risk situations.

CONCLUSION

In this neonate, undergoing TEF repair, intraoperative infiltration of lidocaine at the surgical site along with IV anticholinergic as premedication effectively blocked vagalmediated bradycardia and improved patient outcome. Further studies can be conducted in a larger group of neonates to find the utility of this intervention in the management of hemodynamic instability during TEF reconstruction surgeries.

Ethical approval: Institutional Review Board approval is not required.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship: Nil.

Conflicts of interest: There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation: The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

REFERENCES

- 1. Broemling N, Campbell F. Anesthetic Management of Congenital Tracheoesophageal Fistula. Paediatr Anaesth 2011;21:1092-9.
- 2. Doyle DJ, Mark PW. Reflex Bradycardia during Surgery. Can J Anaesth 1990;37:219-22.
- Walker I, Wouters K. Neonatal Anaesthesia 1: Physiology. Anaesthesia Tutorial of the Week 65. Great Ormond Street Hospital. Available from: https://www.wfsahq.org/ components/com-virtuallibrary/media/53c0764516757 6a16990425944111306-neonatal-anaesthesia-physiology-iwalker.pdf [Last accessed on 2023 Nov 15].
- 4. Jafra A, Jain D, Bhardwaj N, Yaddanapudi S. Neonatal Perioperative Resuscitation (NePOR) Protocol-an Update. Saudi J Anaesth 2023;17:205-13.
- Kumar SS, Jain N, Prakash S, Pawar M. Central Anticholinergic Syndrome in a Neonate Operated for Tracheoesophageal Fistula. Indian J Anaesth 2015;59:330-1.
- Misurya VK, Singh SP, Kulshrestha VK. Prevention of Oculocardiac Reflex (O.C.R) During Extraocular Muscle Surgery. Indian J Ophthalmol 1990;38:85-7.
- 7. Prakash S, Mullick P. Is a Minimum Dose of Atropine in Children Justified? J Anaesthesiol Clin Pharmacol 2017;33:282-3.
- Qi X, Lai Z, Li S, Liu X, Wang Z, Tan W. The Efficacy of Lidocaine in Laryngospasm Prevention in Pediatric Surgery: A Network Meta-analysis. Sci Rep 2016;6:32308.

How to cite this article: Shah PJ, Bose A. A Novel Intervention for Refractory Bradycardia and Desaturation in a Neonate Undergoing Tracheoesophageal Repair Under General Anesthesia. J Neonatal Crit Care Anesth. doi: 10.25259/JNCCA_3_2025