Journal of Society Medicine
Research & Review Articles on Diseases
Journal of Society Medicine. 2025; 4 (10)

Anesthesia Management for Esophageal Atresia

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ARTICLE INFO

Article history:
Received
02 July 2025

Revised
02 October 2025

Accepted
31 October 2025

Manuscript ID:
JSOCMED-020731-410-3

Checked for Plagiarism: Yes

Language Editor:
Rebecca

Editor-Chief:
Prof. Aznan Lelo, PhD

ABSTRACT

Introduction: Esophageal atresia (EA), a congenital anomaly characterized by esophageal discontinuity, often accompanied by tracheoesophageal fistula (TEF), necessitates urgent surgical intervention. This report outlines the anesthesia management for a 9-day-old male infant with EA treated at Zainoel Abidin General Hospital, Banda Aceh.

Case Description: The patient presented with clinical symptoms including swallowing difficulty, excessive salivation, and vomiting during feeding, confirmed by nasogastric tube insertion and radiological examination. Initial management involved emergency gastrostomy and esophagostomy for decompression, followed by thoracotomy and esophageal repair using the Foker technique. General anesthesia combined with caudal regional anesthesia was employed to ensure hemodynamic stability and minimize intraoperative opioid requirements. Key anesthetic challenges included the risk of aspiration, difficult airway management, and maintenance of fluid balance and body temperature in a neonate. Postoperatively, the patient was admitted to the neonatal intensive care unit (NICU) with ventilator support, rigorous hemodynamic monitoring, and antibiotic therapy to prevent complications such as infection and respiratory distress.

Conclusion: A multidisciplinary anesthetic approach was critical to the successful surgical correction of EA. Early and comprehensive management resulted in a favorable prognosis, highlighting the importance of tailored anesthesia strategies in neonatal surgery.

Keywords

Esophageal Atresia, Tracheoesophageal Fistula, Neonatal Anesthesia, Foker Technique, Caudal Anesthesia, Surgical Correction.

How to cite: Feryadi R, Riswandi. Anesthesia Management for Esophageal Atresia. *Journal of Society Medicine*. 2025; 4 (10): 320-324. **DOI: https://doi.org/10.71197/jsocmed.v4i10.261**

INTRODUCTION

Esophageal atresia (EA) is a congenital anomaly characterized by discontinuity of the esophagus, frequently accompanied by a tracheoesophageal fistula (TEF) [1]. This condition arises from the disrupted separation of the trachea and esophagus during the 4th to 6th weeks of gestation [2]. With a prevalence of 1 in 2,500–4,500 live births, EA is often associated with maternal polyhydramnios and other congenital anomalies, such as VACTERL syndrome [3,4].

Neonates with EA typically present with hypersalivation, vomiting during feeding, and aspiration-induced cyanosis [5]. Diagnosis is confirmed by the inability to pass a nasogastric tube beyond the proximal esophagus, corroborated by chest radiography, which reveals air in the stomach or intestines in cases of distal TEF [4]. Anesthetic management of EA, particularly in neonates, is complex because of their immature physiology and high risk of aspiration [6]. Narrow airways, an anterior larynx, and reduced lung capacity predispose patients to hypoxemia [7]. Preoperative stabilization involves esophageal decompression, respiratory monitoring, and echocardiography to evaluate associated cardiac anomalies [2-4].

Careful anesthetic induction is critical, and positive pressure ventilation should be avoided prior to intubation to minimize the risk of aspiration [6]. Regional anesthesia, such as caudal block, is often used for postoperative pain management. Postoperatively, patients require intensive care in the neonatal intensive care unit (NICU) with vigilant monitoring of respiratory function, hemodynamics, and complications such as anastomotic leaks [8]. This report aims to provide a comprehensive overview of anesthesia management in EA, emphasizing the importance of a multidisciplinary approach to optimize the clinical outcomes.

CASE DESCRIPTION

A 9-day-old male neonate was referred to the Anesthesiology and Intensive Care Department at Zainoel Abidin General Hospital, Banda Aceh, from Subulussalam Hospital with complaints of persistent hypersalivation, vomiting during feeding, and interrupted suckling, which had worsened over the past three days. The patient was born full-term via spontaneous vaginal delivery assisted by a midwife, with a birth weight of 2,250 g, Apgar scores of 7/8, and clear amniotic fluid. No history of allergies, diabetes, hypertension, or any other relevant medical conditions was reported. Four days prior, the patient had undergone emergency gastrostomy and esophagostomy for decompression, with a planned thoracotomy and esophageal repair for esophageal atresia (EA).

Physical examination revealed a moderately ill neonate with compos mentis consciousness, a respiratory rate of 55 breaths/min, oxygen saturation of 96% on a 3 L/min simple mask, and a temperature of 36.7°C. The hemodynamic parameters included blood pressure of 89/62 mmHg and heart rate of 169 beats/min, with no murmurs or gallops. Abdominal examination revealed normal bowel sounds without distension, and urine output was adequate (>0.5 cc/kg/h). Laboratory findings indicated anemia (hemoglobin 11.4 g/dL, hematocrit 31%), elevated liver enzymes (SGOT 85 U/L, SGPT 160 U/L), and mild metabolic disturbances (ureum 57 mg/dL, creatinine 0.63 mg/dL), with normal electrolyte levels (Table 1). Radiological imaging confirmed a gastric tube halting at the T2 vertebra, consistent with EA, while echocardiography revealed a patent foramen ovale (PFO) and a 6.5 mm patent ductus arteriosus (PDA), suggesting a VACTERL association. The patient was classified as ASA III.

Table 1: Laboratory Findings

Parameter	Result	Normal Range	Interpretation
Hemoglobin (Hb)	11.4 g/dL	13.5–18 g/dL	Low
Hematocrit (Ht)	31%	38–52%	Low
Leukocytes	11.43 x10³/µL	4–11 x10³/µL	Elevated
Platelets	205 x10³/µL	150–400 x10³/µL	Normal
SGOT	85 U/L	10–40 U/L	Elevated
SGPT	160 U/L	10–40 U/L	Elevated
Urea	57 mg/dL	15–45 mg/dL	Elevated
Creatinine	0.63 mg/dL	0.2–0.5 mg/dL	Elevated
Sodium (Na)	140 mmol/L	135–145 mmol/L	Normal
Potassium (K)	4.6 mmol/L	3.5–5.0 mmol/L	Normal
Chloride (Cl)	105 mmol/L	98–107 mmol/L	Normal

Notably, laboratory results indicated anemia, hepatic dysfunction, and mild renal impairment, consistent with neonatal stress and esophageal atresia (EA). Normal electrolytes support the preoperative stability.

Preoperative management included 4-hour fasting, fluid optimization, and NICU Level 3 monitoring. General anesthesia was selected, with induction using sulfas atropine (0.05 mg), midazolam (1 mg), fentanyl (6 mcg), propofol (3 mg), and ketamine (3 mg) to maintain hemodynamic stability. Intubation was performed using a 2.5 mm uncuffed endotracheal tube, which was carefully positioned to ensure equal bilateral breath sounds. A central venous catheter (CVC No. 3) was placed in the right subclavian vein of the patient. The patient was positioned in the right lateral decubitus position for thoracotomy and esophageal repair using the Foker technique. Intraoperative warming maintained a temperature of 37°C, with 40 cc of fasting replacement fluid and 10 cc/h of maintenance fluid. Anesthesia was maintained with sevoflurane (1–2%) in 45–60% oxygen

at a fresh gas flow of 2 L/min. The 3-hour procedure resulted in 30 cc blood loss, managed with 100 cc 1% dextrose and 30 cc of packed red cells. The urine output was 25 cc, indicating adequate renal perfusion.

Table 2: Postoperative Follow-Up (Selected Days)

Day	Therapy	Vital Signs	Laboratory Findings
1	IVFD NS 5 cc/h, Aminosteril 10% 5 cc/h, Lipid 20% 2.1 cc/h, Midazolam 2 cc/h, Dobutamine 1 cc/h, Epinephrine 1 cc/h, Amikacin 65 mg/30h, Metronidazole 20 mg/8h, Vancomycin 30 mg/12h, Metamizole 40 mg/8h, Paracetamol 40 mg/8h, Furosemide 1.5 mg/24h	BP: 84/44 mmHg, HR: 165 bpm, SpO_2: 100% (Vent: PIns 20 cmH_2O, FiO_2 80%, PEEP 5), Temp: 37.1°C, Urine: 6.8 cc/h	Hb/Ht: 13.1/36, Urea/Cr: 6/0.29, Na/K/Cl: 140/3.0/110, Albumin: 2.38, Ca: 7.3, SGOT/SGPT: 39/20, pH: 7.443, PCO_2: 33, PO_2: 165
3	As Day 1, Midazolam 0.3 mg/kg/h, Dobutamine 0.375 mg/kg/h, Epinephrine 3.75 mcg/kg/h	BP: Stable, HR: 130 bpm, SpO_2: 93–94% (Vent: FiO_2 70%), Temp: 37.3°C, Urine: 4.08 cc/h	Not reported
7	As Day 6, Albumin 20% 15 cc/24h	BP: Stable, HR: 116 bpm, SpO_2: 98–99% (Vent: PIns 18 cmH_2O, FiO_2 70%), Temp: 37.1°C, Urine: 5.49 cc/h	Urea/Cr: 39/0.34, Na/K/Cl: 138/2.8/106, SGOT/SGPT: 9/3, pH: 7.456, PCO_2: 28.8, PO_2: 147
11	As Day 10, Fluconazole 30 mg/24h, Tigecycline 3 mg/12h, Dexamethasone 0.2 mg/12h	BP: Stable, HR: 98 bpm, SpO_2: 94% (Vent: FiO_2 50%), Temp: 36.4°C, Urine: 195 cc/h	Not reported

Postoperative management ensured hemodynamic stability and adequate renal perfusion. The transient desaturation on day 2 was managed with ventilator adjustments. Antibiotic and inotropic support minimized complications, with improved laboratory parameters by day 7.

Postoperatively, the patient was transferred to NICU Level 3 in stable condition (blood pressure 84/44 mmHg, heart rate 138 beats/min, oxygen saturation 99%) on pressure-controlled ventilation (inspiratory pressure 21 cmH_2O, PEEP 5 cmH_2O, FiO_2 50%). Norepinephrine (0.1 mcg/kg/min) was administered on day 2 of admission. Desaturation to 83% with bilateral ronchi prompted an increase in FiO_2 to 60% and further ventilator adjustments. Parenteral nutrition (NS+KCl+Ca, aminosteril 10%, lipid 20%) and broad-spectrum antibiotics (amikacin, meropenem, and metronidazole) were administered along with midazolam for sedation. Follow-up over 11 days showed stable hemodynamics, adequate urine output, and gradual ventilator weaning (Table 2), with no complications.

DISCUSSION

The anesthetic management of esophageal atresia (EA) with tracheoesophageal fistula (TEF) in a 9-day-old neonate, as detailed in this case, requires meticulous coordination among anesthesiology, pediatric surgery, neonatology, and intensive care teams to address the inherent complexities of this condition [9]. The presence of associated congenital anomalies, such as patent foramen ovale (PFO) and patent ductus arteriosus (PDA), classified the patient as ASA III, necessitating comprehensive preoperative evaluation due to the frequent association with VACTERL syndrome, which includes vertebral, anorectal, cardiac, tracheoesophageal, renal, and limb anomalies [10]. This case highlights the critical need for tailored perioperative strategies to mitigate the risks of aspiration, hemodynamic instability, and pulmonary complications.

Preoperative stabilization focuses on minimizing the risk of aspiration and optimizing the physiological status. The patient's symptoms of hypersalivation and regurgitation, driven by air entry into the gastrointestinal tract via the TEF, were managed with nasogastric tube decompression to prevent aspiration pneumonia [6]. Intravenous fluid therapy ensured electrolyte and hydration balance, and echocardiography confirmed PFO and PDA, which could exacerbate systemic perfusion challenges during anesthesia [4]. A 4-hour fasting period was strictly enforced to reduce the risk of secondary aspiration [7]. The choice of induction agents—fentanyl, propofol, and ketamine—was deliberate, with ketamine's cardioprotective properties minimizing myocardial depression in the context of PDA and PFO, thus maintaining hemodynamic stability [9].

Intraoperative management prioritizes airway and ventilatory precision. Intubation with a 2.5 uncuffed endotracheal tube was performed cautiously to avoid gastric insufflation through the TEF, using assist/control

pressure ventilation with a PEEP of 5 cmH_2O to maintain alveolar stability and prevent atelectasis [7]. Sevoflurane (1–2%) ensures safe maintenance of anesthesia with minimal cardiodepressant effects, which is suitable for neonatal physiology [2]. During thoracotomy and Foker technique repair, hemodynamic stability was supported with 1% dextrose and blood transfusion for a 30 cc blood loss, while active warming to 37°C prevented hypothermia, which could exacerbate coagulopathy and delay anesthetic drug metabolism [3].

Postoperative care in the NICU involved mechanical ventilation (initial settings: inspiratory pressure 21 cmH_2O, PEEP 5 cmH_2O, FiO_2 50%) to support oxygenation and prevent alveolar collapse, with arterial blood gas monitoring to assess the ventilatory efficacy [7]. Norepinephrine titration maintains systemic perfusion despite PDA-related circulatory challenges [2]. On postoperative day 2, desaturation to 83% with bilateral ronchi suggested aspiration pneumonia or pulmonary complications, which are common in EA due to esophageal tissue fragility or residual secretions [3,4]. Increasing the FiO_2 to 60% and optimizing ventilation improved oxygenation, while broad-spectrum antibiotics (amikacin, meropenem, and metronidazole) addressed potential sepsis and secondary infections [2-4]. Continuous monitoring for anastomotic leaks, indicated by increased secretions or abdominal distension, is critical [4]. The complexity of EA underscores the necessity of multidisciplinary approaches. Comprehensive preoperative planning, precise ventilatory management, rigorous hemodynamic monitoring, and intensive postoperative care were pivotal in reducing morbidity in this neonate [6]. This case exemplifies the importance of understanding neonatal physiology, managing aspiration risks, and implementing vigilant ventilatory strategies to achieve favorable outcomes in this life-threatening condition.

CONCLUSION

Anesthetic management of esophageal atresia with tracheoesophageal fistula in a 9-day-old neonate required a multidisciplinary approach. Preoperative esophageal decompression and fluid correction ensured patient safety. Intraoperative general anesthesia with a caudal block and optimized ventilation supported the Foker technique repair, maintaining hemodynamic stability. Postoperative NICU care with ventilation and antibiotics managed complications such as desaturation. Comprehensive planning and vigilant monitoring minimized morbidity and achieved favorable outcomes.

DECLARATIONS

None

CONSENT FOR PUBLICATION

The Authors agree to be published in the Journal of Society Medicine.

FUNDING

None

COMPETING INTERESTS

The authors declare no conflicts of interest in this case report.

AUTHORS' CONTRIBUTIONS

All authors made substantial contributions to the case report. RF was responsible for patient management, data collection, and the initial drafting of the manuscript. All authors reviewed and approved the final version of the manuscript, ensuring its accuracy and integrity, and are accountable for all aspects of the work.

ACKNOWLEDGMENTS

None

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