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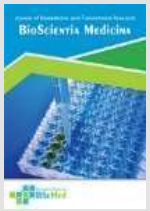

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Anesthesia Management in a Neonate with Esophageal Atresia Undergoing Esophagotomy and Thoracotomy: A Case Report

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A B S T R A C T

Background: Esophageal atresia (EA) and tracheoesophageal fistula (TEF) are congenital anomalies requiring surgical repair in the neonatal period. Anesthetic management for these cases is complex, involving careful planning and execution to ensure a safe perioperative course. This case report details the anesthetic challenges and management of a neonate with EA undergoing thoracotomy and esophagotomy. **Case presentation:** A five-day-old male infant presented with EA, pneumonia, and sepsis. After preoperative optimization, the neonate underwent thoracotomy and esophagotomy under general anesthesia with invasive monitoring. The perioperative course was complicated by the patient's comorbidities, requiring meticulous airway management, hemodynamic monitoring, and temperature regulation. **Conclusion:** Successful anesthetic management of neonates with EA undergoing thoracotomy necessitates a multidisciplinary approach, addressing the unique challenges posed by the condition and associated comorbidities. This case highlights the importance of preoperative optimization, careful intraoperative management, and vigilant postoperative care in achieving a positive outcome.

1. Introduction

Esophageal atresia (EA) and tracheoesophageal fistula (TEF) are congenital anomalies of the foregut that disrupt the continuity of the esophagus and often create an abnormal connection with the trachea. This spectrum of malformations poses significant challenges to neonatal care, requiring prompt diagnosis and timely surgical intervention to restore digestive tract function and prevent life-threatening complications. The incidence of EA/TEF is estimated to be between 1 in 3000 and 4500 live births, representing a relatively common congenital anomaly encountered by pediatric surgeons and anesthesiologists. The precise etiology of EA/TEF remains incompletely understood, but it is thought to arise from a complex interplay of genetic and environmental factors during early embryonic development. The insult is believed to occur around the fourth week of gestation when the trachea and esophagus should separate from a common foregut tube. Disruptions in this process can lead to a variety of anatomical configurations, with the most common type being EA with a distal TEF. The clinical presentation of EA/TEF is often evident shortly after

birth. Newborns may exhibit excessive salivation, drooling, and choking episodes, particularly during feeding attempts. Aspiration of saliva or milk can lead to respiratory distress, including coughing, cyanosis, and tachypnea. In some cases, the diagnosis may be suspected prenatally based on ultrasound findings, such as polyhydramnios (excessive amniotic fluid) or the absence of a fluid-filled stomach.[1-4]

Definitive diagnosis of EA/TEF is typically confirmed by the inability to pass a nasogastric or orogastric tube into the stomach. Radiographic imaging further delineates the anatomy of the malformation, revealing the presence of a blind-ending esophageal pouch and any associated fistulous connections with the trachea. Surgical repair of EA/TEF is the mainstay of treatment and is usually performed within the first few days of life. The surgical approach often involves a thoracotomy, which provides access to the chest cavity to ligate the TEF and restore esophageal continuity. In some cases, a staged repair may be necessary, particularly in the presence of prematurity, low birth weight, or other significant comorbidities.[5-7]

Anesthetic management for EA/TEF repair is complex and requires a thorough understanding of the pathophysiology, associated anomalies, and potential complications. Neonates with EA/TEF often present with respiratory compromise due to aspiration, making airway management a critical concern. The presence of other congenital anomalies, such as cardiac defects or gastrointestinal malformations, can further complicate anesthetic planning and execution. Thoracotomy itself poses additional challenges, including hemodynamic instability, lung collapse, and the potential for significant blood loss. Careful monitoring and meticulous attention to detail are essential to ensure a safe perioperative course. Adequate pain relief is also paramount to facilitate recovery, prevent complications, and minimize the adverse effects of surgical stress on the neonate.[8-10] This case report describes the anesthetic management of a neonate with EA undergoing thoracotomy and esophagotomy, highlighting the unique challenges and strategies employed to achieve a positive outcome.

2. Case Presentation

This case report presents a 5-day-old male neonate admitted to Dr. Moewardi General Hospital with a primary diagnosis of esophageal atresia (EA). The infant's clinical presentation and initial evaluation findings are detailed below, drawing upon the information provided in Table 1. The patient, a 5-day-old male neonate, presented with a primary complaint of vomiting and respiratory distress following feeding attempts. These symptoms are highly suggestive of EA, as the inability to pass milk into the stomach due to the esophageal anomaly can lead to regurgitation and aspiration, causing respiratory compromise. Born at 37 weeks gestation via spontaneous vaginal delivery, the infant's birth history reveals a meconium-stained amniotic fluid, which can be indicative of fetal distress. Although no initial respiratory distress was reported, the presence of meconium necessitates careful monitoring for potential respiratory complications. The patient had no prior medical history and no family history of congenital anomalies. On examination, the neonate's vital signs showed some deviations from the typical range for this age group. His temperature was within the normal range (36.5°C), but his heart rate was slightly elevated at 124 bpm, likely reflecting a physiological response to stress and potential respiratory distress. The respiratory rate was also elevated at 42 breaths per minute, further supporting the presence of respiratory compromise. Oxygen saturation fluctuated between 81% and 98%, indicating intermittent hypoxemia, which is concerning and warrants close monitoring and oxygen supplementation as needed. The neonate's general appearance was notable for moderate respiratory distress with minimal chest retractions, suggesting increased work of breathing. His head was normocephalic, and his neck was supple without masses. Mild chest retractions and clear breath sounds bilaterally were noted on respiratory examination, indicating that while there was evidence of respiratory effort, air entry was present in both

lungs. Cardiovascular examination revealed normal heart sounds with no murmurs, suggesting no immediate cardiac abnormalities. The abdomen appeared icteric, with a Kramer score of 5, indicating moderate jaundice. This finding could be related to various factors, including prematurity, sepsis, or potential liver dysfunction. The extremities were warm, with no cyanosis and normal motor function, suggesting adequate peripheral perfusion. Hematological investigations revealed a hemoglobin level of 17.3 g/dL, which falls within the normal range for this age group. The hematocrit was not reported in the table. Platelet count was 205 x 10^3/µL, also within the normal range, indicating adequate clotting potential. White blood cell count was 6.2 x 10^3/µL, which could be considered slightly low but may not be clinically significant in the absence of other signs of infection. Blood glucose was 94 mg/dL, within the acceptable range. However, a significantly elevated total bilirubin level of 19.5 mg/dL was noted, confirming the clinical observation of jaundice. This hyperbilirubinemia requires further investigation to determine the underlying cause and guide appropriate management. C-reactive protein (CRP) was elevated at 3.5 mg/dL, suggesting an inflammatory process, likely related to the diagnosed pneumonia and sepsis. Arterial blood gas analysis revealed a pH of 7.548, indicating alkalosis. The PCO_2 was low at 19 mmHg, suggesting respiratory alkalosis, which could be attributed to the patient's tachypnea and increased work of breathing. The PO_2 was 118.8 mmHg, indicating adequate oxygenation under the current conditions. Bicarbonate (HCO_3-) was 16.7 mmol/L, and base excess (BE) was -5.9 mmol/L, both suggestive of a metabolic acidosis component. These findings indicate a mixed acid-base disorder, with a primary respiratory alkalosis partially compensated by metabolic acidosis. This complex picture likely reflects the combined effects of respiratory distress, sepsis, and potential metabolic disturbances. Chest X-ray confirmed the diagnosis of bilateral pneumonia, explaining the respiratory symptoms and contributing to the observed acid-base imbalance. An echocardiogram revealed a patent foramen ovale (PFO), a common finding in neonates, which may or may not have clinical significance in this case. However, it is crucial to monitor for potential right-to-left shunting, particularly in the context of respiratory distress and hypoxemia. Based on the clinical presentation, physical examination, laboratory investigations, and imaging findings, the primary diagnosis of EA was established. Secondary diagnoses included pneumonia, sepsis, and PFO. These comorbidities significantly increase the complexity of the case and necessitate careful preoperative optimization and vigilant intraoperative management. Given the neonate's critical condition, preoperative optimization focused on stabilizing his respiratory status, managing sepsis, and correcting any fluid and electrolyte imbalances. Oxygen therapy was initiated to maintain adequate oxygenation, and antibiotics were administered to address the sepsis. Fluid management aimed to correct dehydration and optimize electrolyte levels. Close monitoring of vital signs, oxygen saturation, and acid-base status was crucial during this phase. The presence of pneumonia and sepsis posed significant challenges to anesthetic management, requiring a multidisciplinary approach to ensure optimal preoperative conditions before proceeding with surgical intervention. The anesthetic plan for this neonate with EA undergoing thoracotomy and esophagotomy required careful consideration of several factors. The presence of pneumonia and sepsis increased the risk of respiratory complications and hemodynamic instability. Airway management was particularly crucial, given the potential for aspiration and the need for controlled ventilation during the procedure. The surgical approach, involving a thoracotomy, posed additional challenges, including the potential for lung collapse, blood loss, and hemodynamic fluctuations. Pain management was also essential to minimize the physiological stress of surgery and facilitate postoperative recovery. This detailed preoperative evaluation provides a comprehensive understanding of the neonate's condition, highlighting the complexities and

challenges associated with EA and its comorbidities. The subsequent sections of this case report will delve into the specific anesthetic management strategies employed during the perioperative period and discuss the outcomes and lessons learned from this case (Table 1).

The preoperative management of this neonate with esophageal atresia (EA) focused on stabilizing his condition and optimizing his health before surgical intervention. This involved a multi-pronged approach, addressing his respiratory compromise, sepsis, and nutritional needs, as detailed in Table 2. Recognizing the risk of aspiration and the need for controlled ventilation, endotracheal intubation was performed in the neonatal intensive care unit (NICU) two days before surgery. To prevent aspiration during intubation, an orogastric tube (OGT) was placed to decompress the stomach and minimize the risk of gastric contents entering the airway. This proactive airway management strategy aimed to secure the airway, prevent aspiration, and improve ventilation, especially given the presence of pneumonia. In addition to intubation, the neonate was placed on continuous positive airway pressure (CPAP) with a positive end-expiratory pressure (PEEP) of 6 cmH_2O and an FiO_2 of 30%. This respiratory support aimed to improve oxygenation, reduce the work of breathing, and optimize lung function before surgery. Intravenous fluids were administered to maintain hydration and electrolyte balance. The neonate received dextrose 10% at a rate of 8 ml/hr to provide free water and calories. Fluid management was crucial to ensure adequate tissue perfusion and support the infant's metabolic needs. To address the sepsis and pneumonia, intravenous antibiotics were initiated. Cefotaxime, a broad-spectrum antibiotic, was administered at a dose of 140 mg every 12 hours. This antibiotic therapy aimed to control infection and prevent further deterioration of the neonate's condition. Due to the infant's inability to feed orally, parenteral nutrition was initiated to provide essential nutrients. Amino acids were infused at a rate of 1.8 ml/hr to support protein synthesis and growth. Nutritional support was vital to maintain the infant's metabolic needs and optimize his overall health before surgery. Continuous monitoring of vital signs, oxygen saturation, and blood glucose levels was implemented to assess the infant's clinical status and response to treatment. This close monitoring allowed for timely detection and management of any potential complications. Calcium gluconate was administered at a dose of 1.5 ml every 12 hours to replete calcium levels. A peripherally inserted central catheter (PICC) line was placed to provide central venous access for fluid and medication administration. Blood transfusion with fresh frozen plasma (FFP) was performed at 220 ml/kg/day for three days, likely to address potential clotting factor deficiencies or hypovolemia. Premedication with dexamethasone 0.4 mg and furosemide 2 mg was given post-transfusion, possibly to reduce inflammation and prevent fluid overload. This comprehensive preoperative management plan aimed to stabilize the neonate's condition, address his comorbidities, and optimize his health before surgery. The successful implementation of these interventions played a crucial role in preparing the infant for the challenges of anesthesia and surgical repair of his esophageal atresia (Table 2).

The anesthetic management of this neonate with esophageal atresia (EA) undergoing thoracotomy and esophagotomy was complex and required meticulous planning and execution. The presence of comorbidities, including pneumonia and sepsis, further increased the challenges. The anesthetic approach, as detailed in Table 3, focused on maintaining hemodynamic stability, ensuring adequate ventilation and oxygenation, providing effective analgesia, and preventing complications. Standard monitoring modalities were employed throughout the perioperative period, including electrocardiography (ECG), pulse oximetry, and non-invasive blood pressure monitoring. These allowed for continuous assessment of the neonate's vital parameters, including heart rate, oxygen saturation, and blood pressure. In addition to standard monitors, an arterial line was placed for continuous blood

pressure monitoring and arterial blood gas analysis. This invasive monitoring provided real-time information on the patient's hemodynamic status, ventilation, and acid-base balance, facilitating prompt detection and management of any physiological derangements. An inhalational induction technique was chosen for this neonate. Sevoflurane 1% in a mixture of oxygen and nitrous oxide (FiO_2 80%) was used to induce anesthesia smoothly and rapidly, minimizing airway irritation and the potential for laryngospasm. This approach is often preferred in pediatric patients due to its ease of administration and relatively rapid onset of action. Anesthesia was maintained with sevoflurane in oxygen/nitrous oxide, and titrated to achieve the desired depth of anesthesia. Inhalational anesthesia offers the advantage of rapid adjustments in anesthetic depth and minimal cardiovascular depression, making it suitable for this critically ill neonate. A multimodal approach to analgesia was employed. Fentanyl 5 mcg IV was administered to provide analgesia and blunt the stress response to surgery. Opioids like fentanyl are commonly used in pediatric anesthesia due to their potent analgesic properties and ability to attenuate the hormonal and metabolic responses to surgical stress. In addition to opioids, metamizole 40 mg IV was given to provide non-opioid analgesia. Metamizole, a non-steroidal anti-inflammatory drug (NSAID), offers analgesic and antipyretic effects, contributing to a balanced analgesic regimen. Ondansetron 0.3 mg IV was administered to prevent postoperative nausea and vomiting, a common complication in pediatric anesthesia. Dexamethasone 0.3 mg IV was given to reduce inflammation and help prevent postoperative airway edema. Dexamethasone, a corticosteroid, has anti-inflammatory and immunosuppressive properties, potentially reducing the risk of airway complications in this patient with pre-existing respiratory compromise. A 3.5 mm non-cuffed endotracheal tube (ETT) was used to secure the airway. The ETT was placed to a depth of 9 cm, ensuring proper positioning and minimizing the risk of endobronchial intubation. This allowed for controlled ventilation and protection of the airway from aspiration. Mechanical ventilation was employed throughout the procedure. The ventilator was set in pressure control mode with a FiO_2 of 40%, a respiratory rate of 40 breaths/min, a PEEP of 5 cmH_2O, and a pressure control above 10 cmH_2O. These settings were chosen to ensure adequate oxygenation and ventilation while minimizing the risk of barotrauma. Warming measures were implemented to maintain normothermia throughout the perioperative period. Maintaining normothermia is crucial in neonates and infants, as they are more susceptible to hypothermia, which can lead to various complications, including increased oxygen consumption, metabolic acidosis, and coagulopathy. The anesthetic management of this neonate presented several challenges. The presence of pneumonia and sepsis increased the risk of respiratory complications and hemodynamic instability. Meticulous attention to airway management, ventilation, and fluid balance was crucial to ensure a safe perioperative course. The surgical procedure itself, involving a thoracotomy, posed additional challenges, including the potential for lung collapse, blood loss, and hemodynamic fluctuations. Close monitoring and prompt intervention were essential to manage these potential complications (Table 3).

The postoperative management of this neonate with esophageal atresia (EA) focused on maintaining respiratory support, ensuring adequate pain control, facilitating wound healing, and preventing complications. This section outlines the key interventions and monitoring strategies employed during this phase, as detailed in Table 4. Continued mechanical ventilation was provided to support the neonate's respiratory function until he was able to breathe independently. The ventilator settings were adjusted as needed to maintain adequate oxygenation and ventilation. Once the infant's respiratory status improved, extubation was performed, allowing for spontaneous breathing. Multimodal analgesia was implemented to provide adequate pain relief and facilitate recovery. Metamizole, a non-opioid analgesic,

was administered every 8 hours to provide baseline pain control. Fentanyl, an opioid, was administered intravenously via a syringe pump at a rate of 0.5 mcg/kg/hour for continuous pain control. This combination approach aimed to provide effective analgesia while minimizing the risk of opioid-related side effects. An orogastric tube (OGT) was kept in place for 10 days to decompress the stomach and prevent aspiration. The OGT also allowed for intermittent suctioning of gastric contents to reduce the risk of infection and promote healing. Once the esophagram confirmed no leak, oral feeding was gradually introduced, starting with small volumes of breast milk or formula. Intravenous fluids were continued to maintain hydration and electrolyte balance. A PICC line was inserted to provide central venous access for fluid administration and minimize the risk of infection. The fluid regimen was adjusted based on the neonate's clinical status, urine output, and electrolyte levels. Parenteral nutrition was initiated to provide essential nutrients while oral feeding was not possible. Aminosteril 10% and lipid emulsion 20% were infused to meet the infant's nutritional needs. As oral feeding progressed, the amount of parenteral nutrition was gradually reduced. Antibiotic therapy was continued to treat and prevent infection. Ampicillin and gentamicin were administered intravenously at appropriate doses for the duration of the antibiotic course. Blood and sputum cultures were obtained periodically to monitor for the presence of infection. Meticulous wound care was provided to prevent infection and promote healing. The surgical site was cleaned and dressed regularly, and drains were monitored for signs of infection or bleeding. Incubator care was used to maintain a stable body temperature. This was essential to prevent hypothermia, which can increase the risk of infection and other complications. Close monitoring of vital signs, oxygen saturation, blood glucose, urine output, and drain output was essential to assess the neonate's progress and identify any potential complications. Regular monitoring allowed for timely intervention and adjustment of treatment as needed. Additional interventions as needed were implemented to address any specific needs of the neonate. These interventions might include medications to prevent seizures, blood transfusions to correct anemia, and physical therapy to promote lung function and mobility. This comprehensive postoperative management plan ensured the neonate's recovery and facilitated a smooth transition to home. The multidisciplinary approach, including the collaborative efforts of physicians, nurses, respiratory therapists, and other healthcare professionals, played a crucial role in achieving a successful outcome (Table 4).

3. Discussion

The successful management of any surgical procedure, especially in the fragile neonatal population, hinges significantly on meticulous preoperative optimization. This is even more critical in neonates with esophageal atresia (EA) who often present with additional physiological challenges. In this case report, the neonate presented not only with EA but also with pneumonia and sepsis, significantly escalating the complexity of the case and underscoring the pivotal role of preoperative optimization in ensuring a safe perioperative journey. Preoperative optimization in this context served as the cornerstone for a successful outcome. It involved a multi-pronged strategy aimed at stabilizing the neonate's physiological status, mitigating the risks imposed by comorbidities, and priming the infant for the physiological stressors of anesthesia and surgery. This process necessitated a multidisciplinary approach, with seamless collaboration between neonatologists, anesthesiologists, and surgeons, each contributing their expertise to ensure the infant was in the optimal condition possible before embarking on the surgical intervention. The neonate's pneumonia posed a significant threat to his respiratory function, making it a primary focus of preoperative optimization.

Table 1. Preoperative evaluation.

Parameter	Value	Unit	Reference range
Demographics			
Age	5	days	-
Gender	Male	-	-
Weight	2.6	kg	2.5-4.0
Length	48	cm	45-55
Anamnesis			
Presenting complaint	Vomiting and respiratory distress after feeding attempts	-	-
Birth history	Born at 37 weeks gestation via spontaneous vaginal delivery. Amniotic fluid was meconium-stained. No initial respiratory distress.	-	-
Past medical history	None	-	-
Family history	No family history of congenital anomalies	-	-
Vital signs			
Temperature	36.5	°C	36.5-37.5
Heart rate	124	bpm	120-160
Respiratory rate	42	breaths/min	40-60
Oxygen saturation	81-98	%	>95
Physical exam			
General appearance	Moderate respiratory distress with minimal chest retractions	-	-
Head	Normocephalic	-	-
Neck	Supple, no masses	-	-
Respiratory	Mild chest retractions, clear breath sounds bilaterally	-	-
Cardiovascular	Normal heart sounds, no murmurs	-	-
abdomen	Icteric, Kramer score 5	-	-
extremities	Warm, no cyanosis, normal motor function	-	-
laboratory investigations			
hemoglobin	17.3	g/dL	14.9-23.7
hematocrit	46	%	47-75
platelets	205	10^3/µL	150-450
white blood cells	6.2	10^3/µL	5.0-19.5
blood glucose	94	mg/dL	50-80
Bilirubin (total)	19.5	mg/dL	4.0-8.0
hs-CRP	3.5	mg/dL	<0.5
pH	7.548	-	7.350-7.450
PCO_2	19.0	mmHg	27.0-41.0
PO_2	118.8	mmHg	71.0-104.0
HCO_3	16.7	mmol/L	21.0-28.0
BE	-5.9	mmol/L	-2-+3
Imaging			
Chest X-ray	Bilateral pneumonia	-	-
Echocardiogram	Patent foramen ovale	-	-
Diagnosis			
Primary diagnosis	Esophageal atresia (EA)	-	-
Secondary diagnoses	Pneumonia, Sepsis, Patent foramen ovale	-	-

Table 2. Preoperative management.

Category	Intervention	Details	Rationale
Airway management	Endotracheal intubation	Performed in the NICU two days before surgery. OGT was placed to prevent aspiration during intubation.	Secures the airway and prevents aspiration. Improves ventilation in the setting of pneumonia.
Respiratory support	Continuous Positive Airway Pressure (CPAP)	PEEP 6 cmH_2O, FiO_2 30%	Provides respiratory support and improves oxygenation.
Fluid management	Intravenous fluids	Dextrose 10% 8ml/hr	Maintains hydration and electrolyte balance.
Antibiotic therapy	Intravenous antibiotics	Cefotaxime 140mg every 12 hours	Treats suspected sepsis and pneumonia.
Nutritional support	Parenteral nutrition	Amino acids 1.8 ml/hr	Provides essential nutrients due to the infant's inability to feed orally.
Monitoring	Vital signs, oxygen saturation, blood glucose	Continuous monitoring	Assesses the infant's clinical status and response to treatment.
Other interventions	Calcium gluconate 1.5 ml every 12 hours	Repletes calcium	-
PICC line placement	Provides central venous access for fluid and medication administration	-	-
Blood transfusion	Fresh Frozen Plasma 220 ml/kg/day for 3 days	-	-
Premedication	Dexamethasone 0.4mg and furosemide 2mg post-transfusion	-	-

Table 3. Anesthetic management.

Category	Intervention	Details	Rationale
Monitoring	Standard monitors	ECG, pulse oximetry, non-invasive blood pressure	Continuous monitoring of vital parameters
Invasive monitoring	Arterial line for blood pressure monitoring and blood gas analysis	Allows for accurate blood pressure measurement and assessment of ventilation and acid-base status	-
Induction	Inhalational induction	Sevoflurane 1% in oxygen/nitrous oxide (FiO_2 80%)	Smooth and rapid induction with minimal airway irritation
Maintenance	Inhalational anesthesia	Sevoflurane in oxygen/nitrous oxide	Maintains adequate depth of anesthesia
Analgesia	Opioids	Fentanyl 5 mcg IV	Provides analgesia and blunts the stress response
Non-opioid analgesics	Metamizole 40 mg IV	Provides multimodal analgesia	-
Anti-emetics	Ondansetron 0.3 mg IV	Prevents postoperative nausea and vomiting	-
Other medications	Dexamethasone 0.3 mg IV	Reduces inflammation and helps prevent postoperative airway edema	-
Airway management	Endotracheal tube	ETT 3.5 non-cuffed, depth 9 cm	Maintains airway patency and allows for controlled ventilation
Ventilation	Mechanical ventilation	Mode: Pressure Control, FiO_2 40%, RR 40 breaths/min, PEEP 5, PC Above 10	Ensures adequate oxygenation and ventilation
Temperature management	Warming measures	Maintain normothermia	Prevents hypothermia, which can lead to complications

Table 4. Postoperative management.

Category	Intervention	Details	Rationale
Respiratory care	Continued mechanical ventilation	Mode: Pressure Control, FiO_2 40%, RR 40 breaths/min, PEEP 5, PC Above 6	Maintains adequate oxygenation and ventilation until the infant can breathe independently
Extubation	When respiratory status allows	Transition to spontaneous breathing	-
Pain management	Multimodal analgesia	Metamizole 40 mg every 8 hours	Provides adequate pain relief and facilitates recovery
Syringe pump fentanyl 0.5 mcg/kg/hour	Continuous infusion for consistent pain control	-	-
Gastrointestinal care	OGT maintenance	Kept in place for 10 days	Allows for gastric decompression and prevents aspiration
Feeding	Nil per os (NPO) initially	A gradual introduction of oral feeding after an esophagogram confirms no leak	-
Fluid management	Intravenous fluids	PICC line: 189 cc, D12% (GIR 6), calcium gluconate, KCl, glikofosfat	Maintains hydration and electrolyte balance
Nutritional support	Parenteral nutrition	Aminosteril 10%, lipid emulsion 20%	Provides essential nutrients while oral feeding is not possible
Infection control	Antibiotic therapy	Ampicillin 130 mg twice daily, gentamicin 12 mg once daily	Treats and prevents infection
Monitoring for infection	Blood and sputum cultures	Detects possible nosocomial infections	-
Other interventions	Wound care	Drain observation	Monitors for bleeding or other complications
Thermoregulation	Incubator care	Maintains stable body temperature	-
Monitoring	Vital signs, oxygen saturation, blood glucose, urine output, drain output	Close monitoring for signs of complications	-

The compromised respiratory status, characterized by tachypnea, increased work of breathing, and intermittent hypoxemia, necessitated immediate intervention to improve oxygenation and reduce the burden on the respiratory system. Continuous positive airway pressure (CPAP) was instrumental in achieving these goals. By providing a constant level of positive pressure in the airways, CPAP helped to stent open the alveoli, improve gas exchange, and reduce the work of breathing. The addition of oxygen therapy further augmented oxygenation, ensuring adequate tissue perfusion. Recognizing the potential for aspiration in EA, securing the airway was paramount. Endotracheal intubation, performed in the neonatal intensive care unit (NICU) before surgery, provided a definitive airway, protected against aspiration, and facilitated controlled ventilation. This proactive measure was crucial in this case, given the infant's pneumonia and the increased risk of aspiration during anesthesia induction. Sepsis, a systemic inflammatory response to infection, presented another major challenge in this neonate. Its presence not only increased the risk of perioperative complications but also had the potential to destabilize the infant's delicate physiological balance. Prompt initiation of broad-spectrum intravenous antibiotics was crucial in combating the sepsis and preventing further deterioration. The selection of antibiotics was guided by the suspected pathogens and the infant's clinical condition. Continuous monitoring of the infant's response to antibiotic therapy, including clinical signs, laboratory parameters, and cultures, was

essential to guide treatment and ensure effectiveness. Addressing sepsis also involves supportive measures to maintain organ function and prevent complications. This included fluid management to maintain adequate perfusion and electrolyte balance, as well as nutritional support to meet the infant's metabolic demands and support immune function. Maintaining fluid and electrolyte balance is critical in any surgical patient, but it is particularly crucial in neonates who have a higher risk of dehydration and electrolyte disturbances. This neonate's condition was further complicated by sepsis and the potential for fluid shifts due to inflammation. Intravenous fluids were administered to correct any existing dehydration and maintain adequate hydration. The choice of fluid and the rate of administration were guided by the infant's clinical status, electrolyte levels, and urine output. Close monitoring of electrolyte levels was essential to detect and correct any imbalances. Calcium gluconate was administered to address potential hypocalcemia, a common finding in critically ill neonates. Adequate nutrition is vital for any infant, but it takes on added significance in the context of surgery and critical illness. This neonate's inability to feed orally due to EA necessitated alternative means of providing essential nutrients. Parenteral nutrition, delivered intravenously, provided a balanced mix of amino acids, glucose, and lipids to meet the infant's metabolic needs and support growth and development. This nutritional support was crucial in optimizing the infant's overall health and preparing him for the physiological stress of surgery. The success of preoperative optimization in this case was largely attributed to the coordinated efforts of a multidisciplinary team. Neonatologists, anesthesiologists, and surgeons worked in tandem, sharing their expertise and collaborating to achieve the best possible outcome for the infant. Provided expert care in managing the infant's overall health, addressing the pneumonia and sepsis, and stabilizing the respiratory status. Assessed the infant's anesthetic risk, planned the anesthetic management, and ensured safe airway management and hemodynamic monitoring during the perioperative period. Planned and performed the surgical repair of the EA, working closely with the anesthesiologists to ensure the infant's safety and optimize surgical conditions. This collaborative approach ensured that all aspects of the infant's care were addressed, from managing the comorbidities to preparing for anesthesia and surgery. It highlights the importance of teamwork and communication in the care of complex neonatal surgical patients.[11-14]

Airway management in neonates with esophageal atresia (EA) presents a unique set of challenges for the anesthesiologist. These challenges stem from the anatomical anomaly itself, which disrupts the continuity of the esophagus and often creates an abnormal connection with the trachea, increasing the risk of aspiration. Furthermore, these infants often present with respiratory compromise due to associated anomalies, prematurity, or complications like pneumonia, as seen in this case. Therefore, meticulous airway management is paramount to ensure a safe and successful anesthetic course. In this case report, the neonate presented with EA and pneumonia, both of which significantly impacted the airway management strategy. The presence of pneumonia, with its associated inflammation and potential for airway obstruction, further heightened the need for careful planning and execution of airway interventions. Recognizing the potential for aspiration and the need for controlled ventilation, the decision was made to secure the airway with endotracheal intubation before surgery. Intubation in a controlled environment, before the induction of anesthesia, reduced the risk of aspiration of gastric contents or secretions. This was particularly important in this case, as the infant had pneumonia and was at an increased risk of aspiration during anesthesia induction. Endotracheal intubation allowed for controlled ventilation, ensuring adequate oxygenation and ventilation while minimizing the risk of respiratory complications. This was crucial in the context of pneumonia, where respiratory support was essential to maintain oxygenation and prevent further

deterioration. Securing the airway before surgery allowed for optimization of the infant's respiratory status through measures like CPAP and oxygen therapy. This ensured that the infant was in the best possible respiratory condition before undergoing anesthesia and surgery. The risk of aspiration remained a concern even after intubation, necessitating additional strategies to minimize this risk. An orogastric tube (OGT) was placed to decompress the stomach and prevent the accumulation of gastric contents. This reduced the risk of regurgitation and aspiration, particularly during intubation and surgical manipulation. Proper positioning of the infant during intubation and surgery was crucial to prevent aspiration. The head-up position helped to minimize the risk of passive regurgitation of gastric contents. Readily available suction apparatus was essential to promptly clear any secretions or regurgitated material from the airway. The choice of anesthetic agents and techniques also reflected the need for careful airway management. Sevoflurane, a volatile anesthetic with minimal airway irritation, was selected for induction and maintenance of anesthesia. Its smooth and rapid induction minimized the risk of laryngospasm and bronchospasm, which can compromise airway patency. Inhalational anesthesia with sevoflurane offered the advantage of rapid adjustments in anesthetic depth and minimal cardiovascular depression, making it suitable for this critically ill neonate. While not explicitly mentioned in the case report, the use of neuromuscular blocking agents may have been considered to facilitate intubation and ensure optimal surgical conditions. However, the choice and dosage of these agents would have required careful consideration, given the potential for respiratory complications in this patient population. Postoperatively, continued vigilance was necessary to ensure adequate airway patency and ventilation. The timing of extubation was carefully considered, taking into account the infant's respiratory status, level of consciousness, and ability to protect the airway. Close monitoring of the infant's respiratory status after extubation was crucial to detect any signs of respiratory distress or airway obstruction. Airway management in neonates with EA requires constant vigilance and attention to detail. The anesthesiologist must be prepared to anticipate and manage potential complications, such as laryngospasm, bronchospasm, and aspiration. Continuous monitoring of vital signs, oxygen saturation, and end-tidal carbon dioxide levels is essential to ensure adequate ventilation and oxygenation.[15-17]

Hemodynamic stability, the maintenance of adequate blood pressure and tissue perfusion, is a cornerstone of safe anesthesia management, particularly in the fragile neonatal population. Neonates undergoing surgical procedures, especially those with comorbidities like the infant in this case report, are at an increased risk of hemodynamic instability due to a multitude of factors, including immature cardiovascular systems, limited physiological reserve, and potential for significant fluid shifts and blood loss during surgery. In this case, the neonate presented with esophageal atresia (EA) along with pneumonia and sepsis. These comorbidities further heightened the risk of hemodynamic instability. Pneumonia can lead to respiratory distress and hypoxemia, which can strain the cardiovascular system, while sepsis can cause systemic inflammation and vasodilation, potentially leading to hypotension and impaired tissue perfusion. Recognizing these risks, invasive blood pressure monitoring via an arterial line was deemed essential in this case. This provided a continuous, real-time assessment of the infant's hemodynamic status, enabling prompt detection and management of any instability. The arterial line provided a continuous waveform and digital readout of the infant's blood pressure, allowing for beat-to-beat monitoring of systolic, diastolic, and mean arterial pressures. This real-time information was crucial for detecting subtle changes in blood pressure that might herald hemodynamic instability. By closely monitoring blood pressure trends, the anesthesiologist could gauge the adequacy of tissue perfusion. Hypotension, if left

unaddressed, can lead to inadequate oxygen delivery to vital organs, resulting in organ dysfunction and potential long-term sequelae. The arterial line facilitated early detection of hemodynamic instability, allowing for prompt intervention before significant consequences occurred. This was particularly important in this neonate with comorbidities, who was at an increased risk of rapid deterioration. The arterial line also provided convenient access for repeated arterial blood gas sampling. This allowed for frequent assessment of the infant's ventilation, oxygenation, and acid-base status, providing crucial information for guiding respiratory support and fluid management. The information obtained from the arterial line played a crucial role in guiding management decisions throughout the perioperative period. Blood pressure trends and arterial blood gas analysis helped to guide fluid management, ensuring adequate intravascular volume and tissue perfusion. Hypotension could be promptly addressed with fluid boluses, while signs of fluid overload could be detected and managed accordingly. Arterial blood gas analysis provided real-time information on the infant's ventilation and oxygenation, allowing for adjustments in ventilator settings to maintain optimal respiratory support. In the event of persistent hypotension despite adequate fluid resuscitation, the arterial line allowed for close monitoring of the response to inotropic support, if needed. The use of an arterial line for hemodynamic monitoring was instrumental in maintaining physiological stability throughout the perioperative period. By providing continuous feedback on the infant's cardiovascular status, it enabled the anesthesiologist to anticipate, detect, and promptly address any hemodynamic derangements. This proactive approach to hemodynamic management was particularly crucial in this neonate with comorbidities, who was at an increased risk of instability. The ability to closely monitor blood pressure and tissue perfusion, along with frequent blood gas analysis, allowed for individualized and targeted interventions to maintain physiological homeostasis. The benefits of arterial line monitoring extended beyond the operating room. In the postoperative period, the arterial line continued to provide valuable information on the infant's hemodynamic status, guiding fluid management, and ensuring adequate tissue perfusion during recovery. While the arterial line provided invaluable objective data, it is important to emphasize that hemodynamic monitoring should always be interpreted in conjunction with the clinical picture. The anesthesiologist must consider the infant's overall clinical status, including heart rate, perfusion, capillary refill, and urine output, to form a comprehensive assessment of hemodynamic stability.[18-20]

4. Conclusion

This case report details the successful anesthetic management of a 5-day-old neonate with esophageal atresia (EA) undergoing thoracotomy and esophagotomy. The neonate presented with significant comorbidities, including pneumonia and sepsis, further increasing the complexity of the case. Meticulous attention to detail was paid to preoperative optimization, including respiratory support, antibiotic therapy, and fluid management, to ensure the neonate was in the best possible condition before surgery. Intraoperatively, careful consideration was given to airway management, hemodynamic monitoring, and temperature regulation. The use of an arterial line allowed for real-time monitoring of blood pressure and blood gas analysis, facilitating prompt detection and management of any physiological derangements. Inhalational induction with sevoflurane 1% in oxygen/nitrous oxide provided a smooth and rapid induction with minimal airway irritation. A multimodal approach to analgesia, including fentanyl and metamizole, ensured adequate pain relief and blunted the stress response to surgery. Postoperatively, the focus was on maintaining respiratory support, ensuring adequate pain control, and preventing complications. The neonate's recovery was closely monitored, and interventions were adjusted as needed to ensure a successful outcome. This case highlights the importance of a

multidisciplinary approach in managing neonates with EA undergoing thoracotomy. The successful outcome was attributed to the collaborative efforts of neonatologists, anesthesiologists, surgeons, nurses, and respiratory therapists. The case underscores the crucial role of preoperative optimization, careful intraoperative management, and vigilant postoperative care in achieving a positive outcome in this challenging patient population.

5. References

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