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Anesthesia Management of Patients with Esophageal Atresia/ Traceoesophageal Fistula undergoing Thoracostomy and Esophagostomy Procedures

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Abstract

Esophageal atresia is a congenital disorder characterized by a disruption in the continuity of the esophageal lumen. Esophageal atresia may be accompanied by tracheoesophageal fistula, which is a lumen connection between the proximal and or distal part of the esophagus and the airway (trachea). Type C atresia is the most prevalent, which is approximately 88.5% to 90% of cases, where there is proximal esophageal atresia with distal tracheoesophageal fistula. In this case, a 9-day-old infant was admitted to Arifin Ahmad Hospital for thoracostomy and esophagostomy surgery due to continuous mucus discharge. The patient underwent awake intubation and was positioned intraoperatively, with a tilt to the right when an orogastric tube was placed. During surgery, the patient maintained stable hemodynamic and was subsequently admitted to the NICU using a ventilator. Infants with esophageal atresia often show symptoms of hypersalivation and shortness of breath caused by aspiration pneumonia. When the nasogastric tube cannot pass through the esophagus, atresia can be suspected. Radiology studies play an important role in diagnosing esophageal atresia, confirming esophageal atresia with or without fistula and diagnosing other anomalies associated with VACTERL.

Introduction

Esophageal atresia is defined as a congenital disorder in which the continuity of the esophageal lumen is impaired. Esophageal atresia may be accompanied by a tracheoesophageal fistula, which is the connecting lumen between the proximal and/or distal part of the esophagus and the airway (trachea). This condition, first introduced by Thomas Gibson in 1967, affects 1 in every 2,400-4,500 live births. Despite its rarity, the morbidity and mortality associated with TEF require serious attention (Van Lennep et al., 2019; Spitz, 2007).

TEF congenital abnormalities are linked with high morbidity. The primary symptoms, called the Helmsworth-Pryles triad, include coughing and aspiration during feeding, abdominal distension, cyanosis, and recurrent pneumonia (Marthendro et al., 2024; Marik, P., 2001). Recurrent aspiration is the most common complication of TEF. Patients with TEF will have impaired feeding, developmental issues, and increased care needs. Other complications of TEF are esophageal dysmotility, gastroesophageal reflux, and absence of cilia in the tracheal epithelium (Hanggorowati et al., 2018; Van Lennep et al., 2019; Koumbourlis et al., 2020; O'Shea et al., 2023).

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Single cases of esophageal atresia tend to exhibit a higher tendency toward comorbid abnormalities compared to single tracheoesophageal fistula cases (Comella et al., 2023; Evanovich et al., 2022). The most common comorbidities associated with tracheal fistula and oesophageal atresia can be remembered by the acronym VACTERL, namely Vertebrae, Anorectal, Cardiac, Tracheal, Esophageal, Renal, and Limb (Sunarya et al., 2017).

Methods

A 9 day old baby boy was admitted to Arifin Ahmad Hospital with a chief complaint of vomiting after feeding, which had been occurring continuously since the patient was born. The vomit contained milk and mucus. On physical examination, vital signs were within normal limits, but there were rhonchi during auscultation. A complete blood count revealed normal results, and thoracic radiology showed no abnormalities in the chest cavity. Surgical operation was planned for the patient.

Figure 1. Chest X-ray

For the surgery, the awake intubation technique was used with the patient positioned tilted to the right. An orogastric tube (OGT) was inserted, and endotracheal tube (ETT) retention was confirmed. During surgery, hemodynamics remained stable. Anesthesia was maintained using sevoflurane at 2% MAC, fentanyl and rocuronium.

When desaturation occurred, a pause was prompted during the procedure. The positioning and placement of tubes were checked, and adequate ventilation was ensured. After a while, oxygen saturation levels improved, and the surgical procedure was resumed. However, esophageal anastomosis could not be performed due to the significant distance between the defects. The duration of surgery was approximately 4 hours, and TEF type C was found. After surgery, the patient was admitted to the NICU. Upon arrival at the NICU, the baby was on a ventilator.

Result and Discussion

Esophageal atresia is a congenital disorder in which the esophagus (the digestive tract that connects the throat to the stomach) does not form properly. In this condition, the esophagus is disconnected or poorly connected, preventing it from performing its normal function of passing food and fluid from the mouth to the stomach. Esophageal atresia generally occurs during fetal development and may be accompanied by a tracheoesophageal fistula (TEF), which is an abnormal connection between the esophagus and trachea (airway). Symptoms of esophageal atresia usually appear soon after birth and include difficulty swallowing, vomiting and coughing during meals. The condition requires prompt diagnosis and medical treatment,

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usually through surgery to repair or reconnect the severed parts of the oesophagus (Van Lennep et al., 2019; Gordon, 2024).

Esophageal atresia is a congenital malformation that occurs in 2500-3000 live births, with a higher incidence in twins, occurring two to three times more frequently. In the United States, the incidence of esophageal atresia is approximately 1 in 4500 births, while Finland has a higher incidence of 1 in 2440 births (Hanggorowati et al., 2018).

Esophageal atresia is more common in males than females, and while some cases are sporadic, a family history of esophageal atresia has been reported. About 6% of infants with esophageal atresia are twins. If parents have an infant with esophageal atresia, the subsequent child has a 0.5-2% risk of esophageal atresia. If there is more than one family member with esophageal atresia, the risk of recurrence increases to about 20% (Hanggorowati et al., 2018).

Radiological examination plays an important role in diagnosing esophageal atresia and detecting associated abnormalities often found in VACTERL syndrome (Tonni et al., 2023; Scott et al., 2021). The diagnosis process usually begins with thoracic x-rays in the anterior-posterior and lateral positions, as well as abdominal or babygram x-rays to assess the condition of the oesophagus and trachea. On this examination, the neck and trachea should be clearly visible. The proximal oesophageal pouch often appears filled with air or secretions, seen as a mass behind the trachea that curves towards the front of the trachea. If a tracheoesophageal fistula is present, the stomach will appear distended with air, whereas if no fistula is present, the intestinal system will appear empty. In addition, about 5% of babies with oesophageal atresia may show additional abnormalities of the heart, intestinal system or spine, which can be seen on plain X-rays (Armyda & Kurniyanta, 2021; Serrao et al., 2010).

Examination with barium is not recommended for the diagnosis of oesophageal atresia due to the high risk of tracheobronchitis from chemical aspiration (Bongiovanni et al., 2020). Instead, routine pre-operative cardiac assessment, including echocardiography, aims to detect congenital heart defects that may accompany oesophageal atresia. Echocardiography helps to ensure that the baby's heart condition is thoroughly examined before surgery, reducing the risk of complications and guiding more effective treatment strategies (Hanggorowati et al., 2018; Taneja & Saxena, 2014). Surgical repair is the definitive therapy for esophageal atresia and TEF. Surgery is generally performed within 24-72 hours of birth in well-conditioned neonates. The surgical procedure aims to separate and close the fistula on the tracheal side and connect the ends of the esophageal segment. Surgery is performed under general anesthesia with endotracheal tube insertion (Hanggorowati et al., 2018; Taneja & Saxena, 2014; Baar et al., 2024; Kolani, 2024).

Placing an endotracheal tube (ETT) in patients with Esophageal Atresia (EA) and trachea-esophageal fistula (TEF) presents challenges, particularly for seasoned anesthesiologists. Failure to properly position the tube may result in severe complications if not promptly identified. Successful insertion hinges on a clear understanding of the anatomy and configuration of the fistula. When managing neonates with EA and TEF, the primary goal is to ventilate the lungs while preventing air from entering the fistula. Priority is given to cautiously intubating the trachea beyond the fistula, avoiding muscle relaxants and positive pressure ventilation until the fistula is surgically addressed. Particular attention must be given to ensuring the correct placement of the endotracheal tube in the trachea to prevent morbidity associated with ineffective ventilation caused by the tube migrating into the fistula. In this patient, there was retention during ETT insertion (Filston et al., 1982; Alsunaid et al., 2021).

Infants with esophageal atresia require early resuscitation, particularly if respiratory distress occurs, requiring ventilatory support. In this patient, respiratory distress occurred during surgery, so the surgery was stopped, and the patient was immediately transferred to the

Neonatal Intensive Care Unit (NICU) for ventilator placement (Filston et al., 1982; Hanggorowati et al., 2018).

Endotracheal tube (ETT) insertion in patients with Esophageal Atresia (EA) and trachea-esophageal fistula (TEF) presents challenges, especially for experienced anesthesiologists (Robalino et al., 2021). Failure to position the tube correctly can result in severe complications if not identified promptly. Successful insertion relies on a clear understanding of the anatomy and configuration of the fistula. When managing neonates with EA and TEF, the primary goal is to ventilate the lungs while preventing air from entering the fistula. Priority is given to carefully intubating the trachea outside the fistula, avoiding muscle relaxants and positive pressure ventilation until the fistula is surgically managed. Special care should be taken to ensure correct placement of the endotracheal tube in the trachea to prevent morbidity associated with ineffective ventilation caused by tube displacement into the fistula. In this patient, there was retention at the time of ETT insertion (Ebenebe et al., 2023; Hammoodi et al., 2022).

Anesthetic management in a patient with esophageal atresia with tracheoesophageal fistula undergoing thoracostomy and esophagostomy procedures requires special attention due to the unique challenges associated with this condition. The patient had been vomiting milk and mucus since birth, but vital signs remained within normal limits, although auscultation revealed ronchi. Complete blood work and thoracic radiology were normal, but preparation for surgery had to be done carefully (Syed et al., 2020).

The anesthesia technique used was awake intubation with the patient in the right oblique position. During the procedure, an orogastric tube (OGT) was inserted to manage gastric contents, and the position of the endotracheal tube (ETT) was checked to ensure adequate ventilation. Anesthesia was maintained with sevoflurane at 2% MAC concentration, fentanyl administered at a dose of 1 µg/hour, and rocuronium at a dose of 0.5 mg/hour to control the depth of anesthesia and muscle relaxation.

During surgery, oxygen desaturation occurred, so a temporary pause was requested to check the position and placement of the tubes and ensure adequate ventilation. After correction, the oxygen saturation level improved and the operation continued. However, esophageal anastomosis could not be performed as the distance between the defects was too great. The duration of surgery was about 4 hours, and during the procedure, TEF type C was identified. Post-surgery, the baby was admitted to the NICU and immediately put on a ventilator for respiratory support.

The anesthesia management in this case required special attention to ventilation, hemodynamics, and anesthesia management to ensure patient stability during and after the surgical procedure. Infants with esophageal atresia require early resuscitation, especially in the event of respiratory distress, which requires ventilatory support. In this patient, respiratory distress occurred during surgery so surgery was stopped and the patient was immediately transferred to the Neonatal Intensive Care Unit (NICU) for ventilator placement (Sridharan et al., 2018).

The use of anesthesia management such as “awake intubation” and ensuring effective ventilation was essential in this case. The operation lasted four hours with stable hemodynamics. Despite stable hemodynamics during the four-hour operation, surgical attempts to correct the defect proved unsuccessful, resulting in a futile postoperative outcome.

Conclusion

Esophageal atresia is a congenital condition where the esophagus fails to form properly, leading to severe complications in newborns. This disorder, often associated with tracheoesophageal fistula (TEF), requires prompt surgical intervention to restore normal esophageal function. The

incidence of esophageal atresia varies globally, with a higher occurrence in males and twins, and a familial history may increase the risk.

Diagnosis typically involves radiological imaging, though caution is necessary to avoid complications such as tracheobronchitis. Surgical repair is the primary treatment, usually performed shortly after birth, with careful anesthetic management critical due to the complexity of the condition. Despite meticulous planning, challenges such as ineffective ventilation or difficult intubation can arise during surgery, particularly in patients with associated anomalies. In cases where the esophageal defects are too extensive, complete surgical correction may not be feasible, leading to continued reliance on intensive care post-surgery.

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