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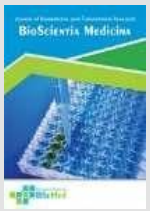

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Anesthesia Management in A Newborn Baby with Tracheoesophageal Fistula: A Case Report

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A B S T R A C T

Background: In infants with esophageal atresia/tracheoesophageal fistula, excessive salivation, coughing, choking, cyanosis, and regurgitation associated with attempts to eat may be seen, as well as aspiration of gastric contents. Thus difficulties encountered during anesthetic management include ineffective ventilation due to an endotracheal tube placed in the fistula, massive gastric dilatation, preexisting severe lung disease from aspiration of gastric contents and/or respiratory distress syndrome of prematurity, and associated anomalies, especially cardiac. This study aimed to discuss the anesthetic management of neonates with tracheoesophageal fistula. **Case presentation:** The patient was a 12-day-old baby girl with type C tracheoesophageal fistula. Anesthesia was performed using general anesthesia. The procedure lasts 3 hours 15 minutes. The patient underwent closure of the esophageal fistula, repair of the trachea in the distal part of the tracheoesophageal fistula, and performed end-to-end anastomosis proximal and distal esophagus. Postoperatively the patient was treated at the neonatal intensive care unit on a ventilator and given a combination of opioid and non-opioid analgesics. **Conclusion:** The key to successful anesthetic management in the operation of a patient with a tracheoesophageal fistula is airway management, where the ETT must be properly placed on the trachea and try not to get the ETT into the fistula.

1. Introduction

Esophageal atresia is defined as a congenital abnormality in the form of disruption of continuity in the lumen of the esophagus. Esophageal atresia can be accompanied by a tracheoesophageal fistula, which is the connecting lumen between the proximal and/or distal parts of the esophagus and the airway (trachea).[1,2] The classification of esophageal atresia can be divided based on two different classification categories as proposed in the Gross classification and Vogt classification.[1] The overall worldwide prevalence of esophageal atresia, as calculated from national and international databases of congenital anomalies, is 2.4 (with a range of 1.3-4.6) per 100,000 births. The wide variation in prevalence may be due to ethnic, environmental, or geographic differences. Most patients born with esophageal atresia are born alive.[3,4] Esophageal atresia, and transesophageal fistula have an incidence of approximately 1:2500 live births. Based on the classification, the majority of cases, namely around 68.6%, were reported as esophageal atresia accompanied by fistulas, while esophageal atresia without fistulas was reported in 25.5% of cases.[3] The most common esophageal atresia with a distal transesophageal fistula is found in approximately 85% of cases.[2]

The esophagus and trachea originate from the foregut (foregut embryonic), which occurs during

gestation between the 4th and 6th weeks of gestation when the separation of the two systems is taking place.[5] About one-third of fetuses with esophageal atresia and tracheoesophageal fistula will be diagnosed before birth. The most common ultrasound finding for esophageal atresia is polyhydramnios, which occurs in approximately 60% of pregnancies.[6,7] In newborns with esophageal atresia, saliva, and food cannot pass through the esophagus. If a proximal transesophageal fistula is present, saliva may reach the lungs. Thus, patients with esophageal atresia/transesophageal fistula may experience excessive bubbly saliva, breathing problems, and difficulty swallowing during the first feeding attempts.[1] Prematurity and severe related congenital abnormalities continue to be the largest contributors to TEF-related mortality. Advances in technique and monitoring of pediatric anesthesia, neonatology, and pediatric surgery have resulted in reduced mortality and survival is now higher than 90%. Consideration of perioperative anesthesia in esophageal atresia/transesophageal fistula is very important for the anesthesiologist. Aspiration of gastric contents causes atelectasis and pneumonitis in neonates with EA and TEF. Because preterm delivery occurs in 30% to 40% of these neonates, respiratory distress of prematurity may also contribute to pulmonary compromise. Several difficulties were encountered during anesthetic management, including ineffective ventilation due to endotracheal tube placement in the fistula, massive gastric dilatation, preexisting severe lung disease from aspiration of gastric contents and/or respiratory distress syndrome of prematurity, and associated anomalies, especially cardiac.[8] The initial key to successful anesthetic management is securing the airway and correct ETT placement. Proper ETT placement is to position the ETT with its tip distal to the fistula to avoid gastric distension. The tube is initially positioned over the carina and then into the right main bronchus. The tube is withdrawn if unilateral breath sounds are confirmed by auscultation until the breath sounds become bilateral. For more precise placement, a fiberoptic bronchoscope can be used for guidance or by placing the end of the gastrostomy tube under a water seal and observing its bubbling.[9] This study aimed to discuss the anesthetic management of neonates with tracheoesophageal fistulas undergoing TEF repair thoracotomy.

2. Case Presentation

A 12-day-old baby girl was referred from a private hospital with complaints of drooling a lot since birth. It was also said that at the previous hospital, the patient could not have an OGT installed. Then the patient was diagnosed with tracheoesophageal fistula and planned to undergo fistula repair surgery. The patient had a gastrostomy operation when she was 3 days old at our hospital. Denied complaints of cough, runny nose, and fever. The patient is said to have no history of drug allergies. Patients with a history of preterm birth of their first child (BKB) (34-35 weeks), born spontaneously sectio caesarea because of premature rupture of membranes (PROM), when the patient was born, the patient immediately cried with rapid breathing, APGAR score 7-8, with a birth weight of 2130 grams and a baby born 43 cm long. History of the patient's mother did antenatal care (ANC) in a clinic with an obstetrician in a clinic in the area where they live. From the results of the last ultrasound examination, it was concluded that there were no abnormalities. History of other congenital diseases, asthma, and heart disease was denied. The patient has a history of surgery, namely gastrostomy, when the patient was 3 days old in general anesthesia (GA) and treated at the neonatal intensive care unit (NICU) with a ventilator. While being treated in the NICU, the patient uses non-invasive ventilation (NIV) fashion pressure control-continuous mandatory ventilation (PC-CMV) with a fraction of inspired oxygen (FiO_2) 35%, Pinsp 15, respiratory rate (RR) 40, positive end-expiratory pressure (PEEP) 6**.**

From the physical examination, the patient's weight was 2130 grams, and body length was 43 cm. The patient's axillary temperature is 37.1^{0}C, pulse 150 - 170 times per minute regular, respiratory rate 40 times per minute type thoracoabdominal, oxygen

saturation 95 - 98% with NIV Mode PC-CMV FiO_2 35% Pinsp 15 RR 40 PEEP 6, with NIPS 0/10. Patients with activity tonus reflex (ATR) medium. No retractions, rhonchi, and wheezing. Heart sounds 1 and 2 sounded single, regular, with no murmurs and nothing gallop. Abdomen feels supple, normal bowel sounds, attached gastrostomy decompression size 12 Fr well maintained, good function with a production of 5 cc/24 hours yellowish. The patient urinates spontaneously using a diaper urine output as much as 2.39 cc/kgBB/hour. Good neck flexion and deflection, difficult to evaluate Mallampati, oral mucosa is wet and does not look bluish, good skin turgor, warm acral, fingernails do not look bluish, looks yellow on the patient's body but not visible on the patient's hands and feet, capillary refill time (CRT) <2 seconds. Vertebral defects (-), anal atresia (-), cardiac defects (-), tracheo-oesophageal fistula (+), renal anomalies (-), and limb abnormalities (-).

A complete blood count showed a leukocyte count of 12.85 x 10^3/µL (6.0 - 14.0); hemoglobin 13.70 g/dL (12.0 - 16.0); hematocrit 39.70 % (36.0 - 49.0); platelets 565.00 x 10^3/µL (140 - 440); MCV 101.30 fL (78.0 - 102.0); MCH 34.90 pg (25.0 - 35.0); MCHC 34.50 g/dL (31 - 36). The hemostasis indicator shows PPT 16.4 seconds (10.8 - 14.4); APTT 41.2 seconds (24 - 36); INR 1.16 0 (0.9 - 1.1). Examination of liver function showed total Bilirubin 11.20 mg/dL (0.3 - 1.2); direct bilirubin 0.55 mg/dL (0 - 0.5); indirect bilirubin 10.65 mg/dL; SGOT 18.10 U/L (5.00 - 34.00); SGPT 6.10 U/L (11.00 - 34.00). Examination of kidney function showed a BUN rate of 5.0 mg/dL (8.00 - 23.00); creatinine 0.46 mg/dL (0.57 - 1.11). Electrolyte examination showed a K number of 4.8 mmol/L (3.50 - 5.10); Na 143 mmol/L (136 - 145); Cl 109.7 mmol/L (94 - 110); Calcium (Ca) 8.3 mg/dL (8.40 - 10.40). Albumin examination results showed hypoalbuminemia with a number of 2.78 g/dL (3.8 - 4.2); Quantitative CRP 10.5 mg/dL (<5); Triglycerides 161.4 mg/dL (<150).

From inspection, babygram obtained a picture of pneumonia; the cast does not appear abnormal with a cardio-thoracic ratio (CTR) of 56 %; gastric dilatation accompanied by gastric tube with circular distal tip projecting at the level of the third thoracic paravertebral on the left side, suspected esophageal atresia with TEF type C; Currently, there is no ileus or pneumoperitoneum.

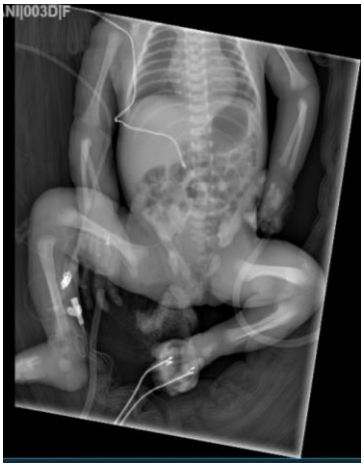

Figure 1. Babygram.

The patient was planned to undergo TEF repair thoracotomy. Consent for surgery and anesthesia was obtained from the family. Total parenteral nutrition according to the directions from the pediatric department. Installation of intravenous access was ensured smoothly. STATICS (scope, tube, airway, tape,

introducer, connector, suction) pediatric, ETT 2.5 - 3.0 - 3.5, anesthetic drugs, emergency drugs, infusion fluid warmers and mattress warmer, plastic wrapping, EtCO2, thermistor probe temperature sensor, precordial stethoscope, ready-to-use blood and fluid calculations and doses in neonates have been prepared. In the patient, 1 peripheral infusion line was installed on the left hand, and the right leg was attached central venous catheter (CVC) in the right femoral vein. A room in the NICU has been prepared for post-surgical care. The patient is positioned supine on the operating table and premedicated with atropine sulfate 0.1 mg intravenously and the analgesic fentanyl 3 mcg intravenously. Induction of anesthesia was performed with sevoflurane and O_2 given to hypnotize the patient. Then intubation was performed with ETT number 3, followed by confirmation of the location of the ETT and symmetrical bilateral auscultation (no air entering the stomach). After confirming the location of the ETT, proceed with ETT fixation. Then the gastrostomy has flowed, and it is confirmed that it is not there air bubble. Maintenance of anesthesia was carried out by administering O_2, compressed air, sevoflurane, fentanyl 0.25 mcg/kgBB intermittently every 45 - 60 minutes; atracurium 0.1 mg/kg intermittently every 30 - 45 minutes (given after the fistula is closed). During the surgical procedure, the hemodynamic fluctuations experienced by the patient are as follows: HR 130 - 142 beats per minute; RR 40 - 50 times per minute; SpO_2 92 -97%. The surgical procedure lasted 3 hours and 15 minutes. Closing of the esophageal fistula, repair of the trachea in the distal part of the tracheoesophageal fistula, an end-to-end anastomosis proximal and distal esophagus. Postoperative patient care is carried out in the neonatal intensive care unit (NICU) using a ventilator and given the analgesic fentanyl 15 mcg in 10 ml of 0.9% NaCl at a rate of 0.4 cc/hour and paracetamol 30 mg every 8 hours intravenously.

3. Discussion

Atresia is defined as a congenital disorder in the form of the absence of the normal opening of a channel in the body. Fistula means an abnormal connection between two epithelial structures in the body. Esophageal atresia and tracheoesophageal fistula are congenital abnormalities characterized by incomplete formation of esophageal tubules or by an abnormal connection between the esophagus and the trachea.[1,2] Approximately 55% of patients born with esophageal atresia are found with birth defects or other anomalies. Approximately 10% of patients with esophageal atresia have an association with VACTERL (consisting of vertebral defects, anal atresia, cardiac defects, TEF, renal anomalies, and extremity abnormalities).[10,11] In addition, approximately 1% of patients born with esophageal atresia also have CHARGE syndrome, which is characterized by coloboma (an eye malformation affecting the lens, iris, or retina), heart defects (e.g., Tetralogy of Fallot, atrial and ventral septal defects, coarctation of the aorta or aberrant subclavian arteries), atresia choanae (failure to recanalize the nasal fossa during development leading to obstruction), stunted growth and development, genital hypoplasia and/or ear anomalies and/or deafness. CHARGE syndrome is caused by an inherited autosomal dominant mutation of the CHD7 gene, which has a role in encoding the DNA-binding protein chromodomain helicase 7, which is involved in chromatin regulation during development.[12] In addition, patients born with esophageal atresia were also found to have associations with other anatomical abnormalities, such as 6% having trisomy 18 (Edward's syndrome) and 1-3% of patients having trisomy 21 (Down's syndrome).[1,2]

In many cases, esophageal atresia is not diagnosed before birth. Infants with esophageal atresia will display symptoms soon after birth, with increased secretions of copious bubbly saliva, which causes choking, vomiting, respiratory distress, or episodes of cyanosis during feeding. If accompanied by a proximal tracheoesophageal fistula (Gross type B), aspiration of milk into the lungs can occur because all the milk swallowed by the baby will end up in the lungs so that the baby looks short of breath and cyanosis. The presence of breast milk (food/foreign objects) in the

lungs can cause pneumonia. Abdominal distention may occur if there is airflow from the trachea to the stomach through a distal tracheoesophageal fistula (Gross types C and D). Type D esophageal atresia, apart from the presence of a distal tracheoesophageal fistula, there is also a fistula in the proximal part and is a type that is difficult to diagnose. Clinical symptoms may include asthma or persistent cough due to aspiration for several years. However, in Gross type D the presence of a fistula allows milk and food to reach the stomach through the fistula proximal to the trachea and through the fistula distal back to the esophagus and finally to the stomach.[6,7] In the case report, the patient came for a referral from a private hospital with complaints of drooling a lot since birth. It was also said that while in a private hospital, the patient could not have an OGT installed. When an oral catheter cannot enter the esophagus by more than 10-12 cm, the diagnosis of esophageal atresia should be considered.[1]

The patient's mother's ANC history at the obstetrician's clinic on the last ultrasound examination did not find any abnormalities. History of other congenital diseases, asthma, and heart disease was denied. About one-third of fetuses with esophageal atresia or transesophageal fistula will be diagnosed before birth. The most common sonographic clue to esophageal atresia is polyhydramnios, which occurs in approximately 60% of pregnancies. If diagnosed before birth, families can be counseled about expectations after delivery. Furthermore, delivery can occur if a dedicated team consisting of a fetomaternal specialist, neonatal intensivist, and pediatric surgeon is available.[6,7]

Anesthesia management of this type of surgery in patients with esophageal atresia includes perioperative and postoperative attention. Careful examination should be performed of the respiratory, cardiovascular, gastrointestinal, musculoskeletal, and haematological systems. From the respiratory point of view, neonates with transesophageal fistulas generally have insufficient lung capacity problems caused by prematurity or aspiration pneumonia. Chest X-ray and blood gas analysis should be done before surgery.[13] Assessment of comorbidities associated with esophageal atresia should be considered preoperatively to assess preoperative risk and the possibility of combining other surgical procedures. Echocardiography should be performed before surgery to detect such cardiac or vascular anomalies Tetralogy of the Fallot or right-sided aortic arch, which may change the surgical or anesthetic approach.[14]

In this case, the examination carried out is babygram with the results obtained a picture of pneumonia, gastric dilatation accompanied by a gastric tube with a circular distal tip projecting at the level of the third thoracic paravertebral on the left side, suspected esophageal atresia with TEF type C and no ileus or pneumoperitoneum was seen. In no case was blood gas analysis or examination carried out by echocardiography. The classification of esophageal atresia can be divided based on two different classification categories as proposed in the Gross classification and Vogt classification. Atresia without tracheoesophageal fistula is categorized into Gross type A and Vogt type II classification, which is found in approximately 7%-8% of cases. Esophageal atresia accompanied by a proximal tracheoesophageal fistula is classified as Gross type B and Vogt type IIIa which is found in approximately 1-4% of cases. Esophageal atresia with distal tracheoesophageal fistula was classified into Gross type C and Vogt type IIIb which were found to be dominant compared to the other types in 82%-85% of cases. Esophageal atresia with a tracheoesophageal fistula on both distal and proximal sides is classified as Gross Type D and Vogt type IIIc which is found in 3-4% of cases. In addition, esophageal atresia without tracheoesophageal fistula was also found, which was included in the Gross classification type E and Vogt type IV, which was found in 3-4% of cases. Multiple fistulas may occur but are rare. Esophageal atresia can also be classified based on the length of the gap between the proximal and distal esophageal pouches. Esophageal atresia long-gap is generally considered the most difficult to repair, but the definition differed between studies, and

the cut-off was in the range of 2-3 cm or 2-4vertebral bodies.[15] In addition, esophageal atresia long-gap may refer to esophageal atresia without fistula (Gross type A and Vogt type II) or defined in the surgical literature as irreparable esophageal atresia with primary anastomosis. The International Network of Esophageal Atresia recommends that esophageal atresia long-gap should be defined as esophageal atresia of any classification with no intra-abdominal air, adjusted according to the Gross classification, including all type A and type B abnormalities, regardless of the exact size of the esophageal cleft.[1,15]

Urgent surgical intervention is indicated according to the type of TEF, often planned within the first 48 hours to prevent aspiration, which can cause severe respiratory distress. On the other hand, a stepwise approach giving time to growth is more often chosen if the neonate is < 1 kg or there is isolated EA, or there are more critical comorbidities. The gradual improvement allows the baby to grow so that the distance between the proximal pouch and stomach becomes shorter to allow for esophageal anastomosis. During this period, a gastrostomy tube to provide gastric drainage and a central catheter to receive parenteral nutrition are required. Neonates should be cared for in a 30° head tilt, prone or lateral position, with section 10-F placed in a blind proximal esophageal pouch to reduce aspiration of secretions into the lungs. Constant suctioning before surgery reduces secretion accumulation. In H-type TEF, because recurrent pneumonia may appear later in life, the lungs may become congested compliance, which may require optimization of respiratory function prior to surgery.[16]

Anesthetic management in the operating room should include routine monitoring (ECG, blood pressure cuffs, end-tidal CO_2, temperature check, and one pulse oximeter unless there is a duct-dependent cardiac lesion in which case two are required pulse oximeter for measurement pre- and post-ductal). If available, arterial line for continuous hemodynamic monitoring and blood gas analysis. Intra-arterial access should preferably be located in the left upper extremity because the right arm is elevated with limited access during a right thoracotomy. At least two patients with peripheral infusions and matching blood should be available in the operating room. If there is a high probability of needing postoperative parenteral nutrition, central access can be installed.[9,17] Suction is used on the upper esophageal pouch and oropharynx, and the neonate can be positioned semi-upright. The precordial stethoscope is placed in the left axilla. Awake intubation or inhalational induction with spontaneous ventilation may be used to facilitate airway management.[8]

In case, prepare STATICS (scope, tube, airway, tape, introducer, connector, suction) pediatric, ETT 2.5 - 3.0 - 3.5, anesthetic drugs, emergency drugs, infusion fluid warmers and mattress warmer, plastic wrapping, $EtCO_2$, thermistor probe temperature sensor, precordial stethoscope, ready-to-use blood and fluid calculations and doses in neonates have been prepared. In the patient, 1 peripheral infusion line was installed on the left hand, and the right leg was attached central venous catheter (CVC) in the right femoral vein. The goal during induction is to intubate the baby while minimizing gastric distension. If measures are not taken to avoid gastric distension, it can make it difficult, if not nearly impossible, to ventilate the infant and can lead to hemodynamic collapse. There are several ways to secure the airway. A conservative approach involves awake intubation to avoid ventilation mask positive pressure. However, attention should be paid to the possibility of increased intracranial pressure and intraventricular hemorrhage in premature infants. Another technique is to induce general anesthesia via the inhalation route while maintaining spontaneous ventilation, and then the surgeon performs a bronchoscopy. The role of the bronchoscope is to determine the exact location and size of the fistula and to assist in the placement of an endotracheal tube (ETT) distal to the fistula but above the carina. If fiber-optic bronchoscopy (FOB) is available, FOB can be used to position the ETT pipe correctly. The carina is identified, and then the ETT is retracted (with the FOB inside the ETT) until the

fistula is exposed. Then, the ETT is advanced just distal to the fistula. ETT placement can be challenging, especially when the TEF is large and located at the level of the carina. In such cases, a Fogarty catheter may be placed into the fistula until the fistula is ligated or neonatal cuffed Also may help to seal the TEF and help prevent gastric aspiration and accidental ventilation through the fistula. After the surgeon ligates the fistula, relaxes the muscle, and gentle, positive pressure ventilation can be given.[8,9,17] Previously, it was suggested that positive pressure ventilation should be avoided until the fistula was ligated. However, this technique can limit ventilation and increase the risk of gastric perforation. Recent studies have shown that positive-pressure controlled ventilation is relatively safe and can be performed in patients with fistulas ≤3mm.[18]

Once positioned, there are various methods of ensuring proper positioning of the ETT tube distal to the fistula by means of auscultation of breath sounds; right (or left) primary intubation with gradual withdrawal until bilateral ventilation is established, ideally about 1 cm above the carina; chest radiography; ultrasound; if there is a gastrostomy, bubbling or non-bubbling when the ETT is above or below the fistula connection.[9] In patients with type C TEF, special care must be taken to the intubation technique because the fistula lies just above the carina, and the tip of the ETT tube can easily enter into the fistula.[18] Induction in these patients was performed with sevoflurane and oxygen according to the neonatal dose of this agent. The depth of anesthesia was maintained using O_2, compressed air, sevoflurane, fentanyl 0.25 mcg/kgBB intermittently every 45-60 minutes, atracurium 0.1 mg/kgBB intermittently every 30-45 minutes (given after the fistula is closed). Pediatric induction of anesthesia is preferable to inhalational agents because of the high minute ventilation that can improve drug distribution and a quicker clearance period. Sevoflurane was chosen because it does not cause an increase in airway secretion production, thereby reducing the possibility of aspiration.[17]

Currently, the need for gastrostomy varies depending on the state of the resource. In developed countries, gastrostomy is not performed routinely because gas from the trachea can pass through the lungs and exit through the stomach, causing a loss of effective ventilation. However, in resource-limited settings, where bronchoscopy may not be available, after inhalational induction and spontaneous breathing, surgeons routinely perform a gastrostomy. This condition is then followed by ETT intubation by deep inhalation technique or using muscle relaxant techniques and gentle manual ventilation. Placement of the gastrostomy tube below the water seal will show an air bubble. If the ETT is above the fistula, slight retraction is required, and then insert the ETT until the bubbles stop. Monitoring End-tidal carbon dioxide ($etCO_2$) can also help to confirm correct ETT placement. If the analyzer attached to the gastrostomy tube showed traces of $etCO_2$, then it indicates that the tube is over the fistula, so withdrawal followed by insertion of the ETT must be performed. Early gastrostomy allows gas to be expelled, thereby preventing gastric distension and minimizing the risk of aspiration. In this patient, a gastrostomy operation was performed previously using a well-maintained and functioning 12 Fr tube, which functions to prevent distension of the abdomen due to air entering the stomach through a fistula with a yellowish production of 5 cc/24 hours. Once the airway is secured and appropriate intravenous and arterial access is obtained, the patient is positioned in the lateral decubitus position, and pressure points are carefully cushioned. Maintenance of adequate oxygenation can be a major problem intraoperatively. Accumulation of blood or secretions in the endotracheal tube can cause airway obstruction, requiring frequent tracheal suctioning. Surgical airway manipulation and upper lung collapse due to the use of retractors can also cause episodes of hypoxemia. Close communication with the surgical team is essential, and intubation equipment must be readily available in the event of accidental extubation and the need for emergency re-intubation.[9,16,17] Traditionally, esophageal atresia/TEF

was managed by a stepwise procedure, and the anesthetic literature frequently mentions preoperative gastrostomy. Although a gastrostomy rules out the life-threatening complications of gastric rupture, placement of a gastrostomy can lead to further ventilation instability, as it provides a low-pressure leak through the fistula, 'broncho cutaneous', with ineffective ventilation results. During spontaneous ventilation, there is slight gastric insufflation, even with lung compliance the bad one; Positive pressure ventilation institutions impose this risk, especially in situations with pulmonary pathology. When faced with inadequate ventilation intraoperatively, the anesthesiologist must consider a broad differential diagnosis that includes gastric distention but also other common causes, including ETT obstruction.[17]

During the surgical procedure, the hemodynamic fluctuations experienced by the patient are as follows: HR 130 - 142 beats per minute; RR 40 - 50 times per minute; SpO_2 92 -97%. The surgical procedure lasted for 3 hours 15 minutes. Several difficulties were encountered during anesthetic management, including ineffective ventilation due to the endotracheal tube placed in the fistula, gastric dilatation, and other comorbid congenital disorders, especially cardiac and previous pulmonary aspiration. Anesthetic management focuses on lung ventilation without fistula ventilation. The principle of ventilation in these patients is to provide a slightly higher respiratory rate with a smaller tidal volume. This is so that minute ventilation is still achieved as needed without applying excessive pressure so as not to obstruct the operator's view of the operating field. This technique includes tracheal intubation and avoidance of muscle paralysis, and excessive positive ventilation until the fistula is corrected, as was done in this patient.[9,17]

Because these patients remain intubated for a limited time postoperatively, the neonatal intensive care unit (NICU) must be prepared preoperatively. However, this time period is recommended as short as possible to protect the anastomosis from prolonged exposure to the pressure exerted by the ETT. On the other hand, infants often require reintubation due to secretions or tracheobronchomalacia. The process of reintubation exposes the neonate to hyperextension of the neck, causing stretching of the anastomotic line, which must be protected during this period. Because reintubation is not a desirable intervention, the timing of tracheal extubation should be decided by a team of anesthetists, surgeons, and neonatologists/intensivists.[16] In this patient, postoperative care was carried out in the neonatal intensive care unit (NICU) on a ventilator for 12 days without complications. Then the patient was treated in the usual room and sent home. Fentanyl is used as an analgesic in the operative and postoperative periods. The patient was given fentanyl 3 mcg IV during surgery and 15 mcg fentanyl in 10 ml of 0.9% NaCl at a rate of 0.4 cc/hour, and paracetamol 30 mg every 8 hours IV postoperatively. This is because fentanyl does not cause worsening of blood circulation in the liver and oxygen supply with an average dose of 1-2 mcg/kgBW. Fentanyl is metabolized to nor fentanyl and excreted in the urine. The half-life of fentanyl may be prolonged in infants with abnormal liver function and hypoalbuminemia. This is because fentanyl is mostly bound to circulating proteins (79% to 87%).[19]

4. Conclusion

Anesthesia management for neonates who will undergo fistula repair thoracotomy surgery must be well prepared, considering the high risk that can occur with general anesthesia. The most important thing to do in airway management is to place the ETT correctly on the trachea and try not to get the ETT into the fistula. Or even provide ventilation to the stomach, which is very vulnerable and causes dilatation of the stomach which will suppress the diaphragm or perforation of the stomach.

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