Addis Ababa University

College of Health Sciences

Thesis Report

Determinants of Postoperative Outcomes of Newborns with Tracheoesophageal Fistula at Tikur Anbessa Specialized Hospital, Addis Ababa University, Addis Ababa, Ethiopia

Submitted to the Department of Anesthesiology, Critical Care, and Pain Medicine in Partial Fulfillment of the Requirements for the Specialization Degree in Anesthesiology, Critical Care, and Pain Medicine.

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Abstract

Background: Esophageal Atresia with Tracheoesophageal Fistula (EA/TEF) is a potentially life-threatening condition that causes serious complications unless prompt surgical intervention is done to restore normal breathing and nutrition. Despite advances in surgical techniques and perioperative care, EA/TEF remains a challenging condition to manage as the postoperative results fluctuate significantly between various hospitals and geographical areas. In Ethiopia, large-scale studies are scarce on identifying determinants of postoperative outcomes in newborns with EA/TEF.

Objectives: To identify the determinants of postoperative outcomes in EA/TEF newborns. It examined the interplay between patient-related factors, surgical factors, and anesthetic-related factors in determining postoperative outcomes, including mortality, length of hospital stay, and the incidence of complications.

Methods: A single-center retrospective cross-sectional hospital-based study was conducted at the Tikur Anbessa Specialized Hospital (TASH). The pediatric HMIS database was used to manually abstract the data of operated newborns with the diagnosis of EA/TEF. The collected data was analyzed and presented as descriptive statistics and regression methods were run to assess statistically significant outcome-predicting factors.

Results: Our retrospective cross-sectional study of 122 operated EA/TEF patients identified electrolyte abnormalities (AOR: 0.081, 95% CI: 0.007 – 0.887, p-value: 0.040) and postoperative complications (AOR: 0.126, 95% CI: 0.052 – 0.303, p-value: 0.000) have a significant association to determine the postoperative outcome of EA-TEF newborns.

Conclusion and Recommendation:

The study underscores standardized preoperative preparation and the implementation of protocols for thorough assessment and optimization. Vigilant postoperative monitoring, infection prevention, and comprehensive management strategies are imperative for enhancing patient survival rates.

Acknowledgment

I would like to express my sincere gratitude to Addis Ababa University, School of Medicine, Department of Anesthesiology, Critical Care, and Pain Medicine for providing me the opportunity to pursue my postgraduate studies. The resources and facilities provided by the university were instrumental in carrying out my research project. I would also like to extend my heartfelt thanks to my research advisors, Dr. Blen Ayele and Dr. Semira Indris, for their guidance, support, and invaluable insights throughout my research journey. I am truly grateful for their mentorship, and for the knowledge and skills I have gained under their guidance.

Table of Contents

Lists Acronyms and Abbreviations

EA: Esophageal Atresia

TEF: Tracheoesophageal Fistula

EA/TEF: Esophageal Atresia with Tracheoesophageal Fistula

VACTERL: Vertebral, Anal, Cardiac, Tracheoesophageal, Renal, and Limb association

CHARGE: Coloboma, Heart, choanal Atresia, Retardation, Genital, and Ear abnormality

NICU: Neonatal Intensive Care unit

LMIC: Low- and Middle-Income Countries

RDS: Respiratory Distress Syndrome

HMIS: Health Management Information System

ASA: American Society of Anesthesiologists

SPSS: Statistical Package for Social Sciences

ACCPM: Anesthesiology, Critical Care, Pain Medicine

SOM: School of Medicine

CHS: Collage of Health Sciences

TASH: Tikur Anbessa Specialized Hospital

AAU: Addis Ababa University

List of Tables and Figures

1. Introduction

1.1. Background

Esophageal Atresia (EA) is a congenital anomaly that occurs when the esophagus does not develop properly and ends in a blind pouch. Tracheoesophageal fistula (TEF) is a birth defect that occurs in nearly 90% of EA newborns in which the trachea and the esophagus are abnormally connected[1]. These two conditions collectively are referred to as Esophageal Atresia with Tracheoesophageal Fistula (EA/TEF). The incidence of EA/TEF is about 1 in 2500 to 1 in 4500 live births[2–4].

EA/TEF is classified into different types according to their anatomic variations. Type C EA/TEF is the most common (84%) case of EA variant with a proximal esophageal pouch with a distal TEF. Type E (H-type fistula) accounts for 4% of TEF without EA. Type D is EA with proximal and distal TEF that occurs in 3% of the cases. Type A is EA without TEF happens in 8% of the cases. Furthermore, Type B is the least common (1%) case of distal EA with proximal TEF[5,6].

About 50% of cases of EA/TEF have concurrent anomalies of VACTERL association or CHARGE syndrome. VACTERL association includes a birth defect of the vertebrae, anus, cardiac, TEF, renal, and limbs. Whereas the CHARGE syndrome consists of a group of coloboma, heart defect, atresia of the choanae, retardation of growth, genital anomalies, and ear deformities. In most instances, there is no recognized etiology or compelling evidence for genetic factors in the pathogenesis of EA/TEF with the associated anomalies. Thus, the recurrence risk of EA in a family with a previous history of the condition is low, at around 1%[7–9].

Postoperative outcomes include mortality rate, morbidity rate, length of hospital stay, need for reoperation or reintubation, and incidence of complications such as an anastomotic leak or recurrent fistula. These outcomes are influenced by patient-related factors: such as prenatal diagnosis, gestational age at birth, birth weight, associated anomalies, type of EA/TEF, or preoperative ventilation, surgery-related factors: such as surgical approach (thoracotomy or thoracoscopy), and timing of surgery (early or delayed), anesthesia-related factors as well[10].

1.2. Statement of the Problem

EA/TEF is a potentially life-threatening condition that can cause serious complications such as aspiration pneumonia, respiratory distress, feeding difficulties, gastroesophageal reflux disease (GERD), esophageal strictures, and dysmotility. Thus, prompt surgical intervention is necessary to restore normal breathing and nutrition[1].

The standard treatment for EA/TEF is surgical intervention involving repair of the defect and closure of the fistula. The surgical procedure requires a team of specialists in pediatric surgery, anesthesiology, neonatology, and respiratory therapy. Despite advances in surgical techniques and perioperative care, EA/TEF remains a challenging condition to manage as the postoperative results fluctuate significantly between various hospitals and geographical areas. Survival as high as 95% has been achieved in facilities with advanced neonatal intensive care units (NICU)[11,12]. However, the mortality rate in low-middle-income countries (LMIC) ranges from 30% to 72%[13–15]. In Ethiopia, large-scale studies are scarce on identifying determinants of postoperative outcomes in newborns with EA/TEF[16,17].

It is still not fully understood what determinants influence postoperative outcomes in newborns with EA/TEF. Previous studies have focused on certain elements that may have an impact on postoperative outcomes, such as the type of surgical technique or the presence of associated anomalies. However, there is a lack of comprehensive studies that have examined the interplay between patient, surgical, and anesthetic-related factors in determining postoperative outcomes in EA/TEF.

There is a lack of consensus on the optimal management of EA/TEF newborns among different centers and regions. This leads to variability in the quality of care and survival rates for EA/TEF patients. Optimizing the treatment of EA/TEF requires a better understanding of the factors that influence postoperative outcomes. Discerning these determinants can help identify patients who are at higher risk of complications and guide the development of individualized perioperative care plans that improve outcomes.

1.3. Significance of the Study

The study aimed to identify the determinants of postoperative outcomes in EA/TEF newborns. It examined the interplay between patient-related factors, surgical factors, and anesthetic-related factors in determining postoperative outcomes, including mortality, length of hospital stay, and the incidence of complications.

The findings of this study could help identify patients who are at higher risk of complications, allowing for personalized perioperative care plans that optimize outcomes. The study could also inform the development of guidelines for the management of EA/TEF, improving the consistency and quality of care provided to these patients. Furthermore, the results of this study could guide future research into the pathophysiology of EA/TEF and inform the development of new interventions that may improve outcomes.

In conclusion, this study is of great importance as it addresses a gap in the literature regarding the determinants of postoperative outcomes in EA/TEF newborns.

1.4. Literature Review

Different theories have sought to explain the etiology of EA/TEF, and the formation of an aberrant epithelial-lined link between the two tubes, the esophagus, and the trachea, is thought to be the cause of TEF[18]. A portion of the esophagus may become incorporated into the posterior wall of the trachea as a result of the excessive tissue development[19]. Thus, the esophagus can be stretched and damaged by excessive mesenchymal development, leading to EA[18].

Around 25% of newborns with EA/TEF have associated congenital anomalies. Approximately 35% cardiac, 24% genitourinary and gastrointestinal, 13% skeletal, and 10% CNS anomalies were the most commonly associated birth defects with EA/TEF[18]. VACTERL association is a non-random association as a result of faulty midline blast differentiation[20]. A variety of associations with CHARGE syndrome, Down syndrome, Pierre-robin sequence, and DiGeorge syndrome were also reported in EA/TEF newborns[21–24].

The surgical repair of EA/TEF is either by division of the TEF and primary esophageal anastomosis or delayed anastomosis depending on the gap length between the proximal and distal segment of the esophagus. Intraoperative anastomosis under tension is a significant indicator of postoperative anastomosis leak and stricture[25]. A France national retrospective cohort study showed: that long gap EA, the type of EA/TEF, thoracoscopic surgery, and the presence of gastrostomy were the independent risk factors that affected the surgical strategy and resulted in anastomotic complications[26].

Several studies have revealed that gastrointestinal and respiratory complications are the postoperative outcome determinants of EA/TEF[28,29]. The early post-repair anastomosis leak resolves with a pleural drain or spontaneously in about 50% of the cases, while the other can be followed by esophageal stricture or recurrence of TEF[27]. Gastroesophageal reflux is observed in up to 35 to 58% of EA/TEF-repaired patients which may lead to aspiration pneumonitis, recurrent pneumonia, hyperactive airway disease, and esophageal stricture[28,29].

The literature has shown mixed results on whether early surgical repair of EA/TEF can improve postoperative outcomes for the neonate. Systematic reviews and follow-up studies indicate the risk of respiratory complications, such as respiratory distress syndrome(RDS) and pneumonia is reduced with early surgical repair of EA/TEF[30,31]. However, early repair is not without risk as anastomosis leaks or stenosis are the challenges of postoperative complications. On the other hand, a study on delayed primary repair of EA/TEF to assess the worth of waiting, showed esophagus preservation to proceed with a staged approach improves postoperative outcomes of newborns with associated cardiac defects and premature neonates with RDS[32].

While several studies on the outcomes of newborns with EA/TEF have been undertaken in developed countries delineated survival rates have greatly improved over the past few decades. Mortality rates vary from 30% to 72% in LMIC and the determinant factors attributing to the low survival rate in sub-Saharan Africa are still some unknowns[14,17]. There are uncertainties in the surgical repair time for premature newborns with RDS, pneumonia, sepsis, and associated severe congenital anomalies[30–32]. Furthermore, after EA/TEF repair chest tube placement to diagnosis and conservatively treat postoperative anastomosis leak is debatable[33].

Thus, the management of certain postoperative complications such as anastomosis leak or stenosis are areas where a clear approach has not been identified yet[34,35].

There is a need for more research on postoperative outcomes of EA/TEF in LMICs like Ethiopia as there are gaps in the literature on the surgical management challenges of EA/TEF repair. The lack of representative studies on postoperative disposition, multidisciplinary optimal strategies, and complication management in a resource-limited setup is another gap. Overall, further research is required to address these knowledge gaps in the literature and improve the outcomes of newborns with EA/TEF in LMIC.

1.5. Objectives

1.5.1. General Objective

- To assess the determinants of postoperative outcomes of newborns with tracheoesophageal fistula.

1.5.2. Specific Objectives

- To assess the preoperative outcome determinants of EA/TEF newborns.
- To assess the intraoperative outcome determinants of EA/TEF newborns.
- To assess the postoperative outcome determinants of EA/TEF newborns.

2. Methods and Materials

2.1. Study Area and Period

The study was conducted at the Tikur Anbessa Specialized Hospital (TASH). TASH is one of the largest specialized referral and teaching hospitals located in the nation's capital city, Addis Ababa, Ethiopia. The hospital provides tertiary-level referral care with 24-hour emergency services for all patients coming from different corners of the country. The hospital has 700 inpatient beds capacity and outpatient units to provide both diagnostic and treatment services for close to 400,000 patients per year. The unit divisions in the hospital are internal medicine, surgery, gynecology and obstetrics, pediatrics, anesthesiology, radiology, oncology, pathology,

dermatology, psychiatry, laboratory, pharmacy, and referral clinics. It is also a college of health science, comprising four schools: the School of Medicine, the School of Pharmacy, the School of Public Health, and the School of Allied Health Sciences.

The study was conducted from April - December 2023.

2.2. Study Design

A single-center retrospective cross-sectional hospital-based study.

2.3. Source Population

The source population was all newborns with the diagnosis of esophageal atresia.

2.4. Study Participants

The study participants were all esophageal atresia newborns with tracheoesophageal fistula who fulfilled the inclusion criteria.

2.5. Inclusion and exclusion criteria

2.5.1 Inclusion Criteria

- All esophageal atresia newborns with tracheoesophageal fistula during the study period.

2.5.2 Exclusion Criteria

- Non-operated esophageal atresia newborns with TEF.
- Medical records with missing data

2.6. Sampling technique and sample size

A single-centered observational study done in Dakar, Senegal from 2010 to 2013 reported that surgical mortality was 72% at a 95% confidence interval and a 5% margin of error[15]. The sample size was calculated using the single population proportion formula. The sampling fraction (n/N) is > 5% thus, the estimate of standard error used in the sample size formula was corrected with a finite population correction (FPC), as the n=N. The required sample size after the correction formula for the study was 155 participants.

At 95% CI, z = 1.96, d = 0.05, p = 0.72, 1-p = q = 0.28, Non response Rate = 0.05 (5%)

$$n = \frac{Z\alpha_{/2}{}^{2}P(1-P)}{d^2} \quad n = \frac{(1.96)^2 0.72(0.28)}{(0.05)^2} = 309.78 \sim 310$$

$$FPC: n' = \left(\frac{N(z^2)P(1-P)}{(d^2)(N-1)+(z^2)P(1-P)}\right) = 155.19 \sim 155$$

$$where, \quad n = Sample\ Size,$$

N = The Population size

n' = The sample size with finite population correction

$P = the\ proportion\ of$ surgical mortality

$d = Margin\ of\ error$

$Z = Standard\ proportion\ population$

$at\ 95\%\ confidence\ interval\ (1.96),$

2.7. Study Variables

2.7.1. Dependent Variable

- Determinants of postoperative outcomes of EA/TEF newborns

2.7.2. Independent Variables

- Socio-demographic characteristics
- Maternal indicators
- Newborn's associated anomalies and comorbidities
- Anesthesia and surgery-related characteristics

2.8. Operational Definitions

- Newborns/Neonates: a child in the first 30 days of extra-uterine life.
- Esophageal Atresia: is a birth defect of the esophagus that fails to tabularize to connect the oral cavity to the stomach.
- Tracheoesophageal Fistula: is an anomalous communication between the esophagus and trachea.
- Esophageal atresia with tracheoesophageal fistula: is a variant of esophageal atresia with abnormal connection with the trachea.
- Maternal risk factors for neonatal EA/TEF: include being over 35 years old, smoking, diabetes, hypertension, epilepsy, or exposure to teratogenic drugs.
- Short gap: the gap length between the esophageal pouches is <1 cm or <1 vertebral body.
- Intermediate gap: the gap length between the esophageal pouches is 1-3 cm or 1-3 vertebral bodies.
- Long gap: the gap length between the esophageal pouches is >3 cm or >3 vertebral bodies.
- Complete Preoperative Preparation: includes pre-anesthetic assessment, complete metabolic panel, chest x-ray, echocardiography, type and cross match of blood, and preoperative consent for the surgery and anesthesia.

- Incomplete Preoperative Preparation: is lack of one or more of the components of complete preoperative preparation.
- Electrolyte abnormalities: are determined through laboratory tests and are characterized by one or more abnormalities of electrolytes, such as hypokalemia, hyponatremia, hypomagnesemia, or hypocalcemia.
- Postoperative Outcome: The status of a patient at hospital discharge following surgery, categorized as either improved or died. "Improved" indicates the patient is discharged with stabilized or improved health, no major complications, and no need for immediate readmission. "Died" indicates the patient did not survive the postoperative period and is pronounced dead prior to discharge.

2.9. Data Collection Procedures

The Pediatric Health Management Information System (HMIS) database was used to identify admitted newborns with the diagnosis of EA/TEF. Baseline socio-demographics, maternal indicators, neonatal-associated anomalies, comorbidities, and preoperative predictors of postoperative outcomes were examined up to the post-operative endpoints. The post-operative endpoints include in-hospital mortality and improved discharge.

The questionnaire was formulated in the English language. The main body of the questionnaire had four sections. The first section was the socio-demographic information of study participants. The second section was about maternal-related characteristics. The third section was about the newborn's preoperative indicators such as the age at diagnosis, the type of EA/TEF variant, feeding history, associated anomalies, comorbid conditions, preoperative preparations, ASA classification, anesthesia management, level of surgeon's experience, type of surgery, and intraoperative incidence. The fourth section included postoperative complications, reoperation, length of hospital stays, and in-hospital outcomes.

Data was collected using Google Forms, an online electronic method by trained data collectors under the supervision of the principal investigator. The Google Form is a part of the

Google web-based apps suite, which is free online software that allows the creation of survey questionnaires, and the collection and analysis of information from study participants.

2.10. Data Analysis

The collected data was exported to Microsoft Excel; incomplete data was cleaned. The cleaned data was coded and entered to be analyzed using IBM SPSS Statistics, Version 25.0. Continuous and categorical variables were presented as the medians with means and ranges or frequencies and percentages respectively. Determinants and associated factors were analyzed by binary logistic regression. Variables that predict the dependent variable during the binary logistic regression were further analyzed into a multivariate logistic regression to adjust for any confounding effect finally adjusted odds ratio was reported. A p-value < 0.05 is used to confirm a significant association between independent and dependent variables.

2.11. Data Quality Control

To ensure the data's quality, a pre-test was carried out, involving 10% of the total sample size calculated. The steadiness and clarity of the data collection tool were revised after the pre-test. The Google Forms online survey tool was configured to administer the prepared questionnaire in the English language. The collected data was examined for thoroughness and incomplete data was excluded from the analysis.

2.12. Ethical considerations

A written Ethical approval letter was obtained from the Ethical Review Board of the Department of Anesthesiology, Critical Care, Pain Medicine (ACCPM), School of Medicine (SOM), College of Health Sciences (CHS), Addis Ababa University (AAU). Permission to access the medical charts of the patients was sought from the hospital administration. Every piece of information collected from the patient’s medical record was kept confidential to respect patients' rights and to comply with the regulations of the hospital where the study was conducted. Information obtained from data collected during the study was only handled by the research team. Confidentiality was maintained by avoiding study participants' identifiers (name, phone number, etc.) and data was analyzed in aggregate.

3. Result

3.1. Sociodemographic Characters

Our study comprised 122 patients diagnosed with EA/TEF who underwent surgery between 2019 and 2023. Among them, 68 (55.7%) were male and 54 (44.3%) were female, resulting in a male-to-female ratio of 1.26:1. The majority of patients were from Addis Ababa 48 (39.3%), followed closely by the Oromia region 47 (38.5%). Diagnosis occurred within 48 hours of age for 54 (44.3%) patients and after 48 hours of age for 68 (55.7%) patients, with no antenatal diagnoses. Subsequent to diagnosis, 27 (22.1%) patients were admitted to the NICU within the first day of life, 25 (20.5%) within one to two days, and 70 (57.4%) after two days of age. The most prevalent type of EA/TEF was Type C, characterized by proximal atresia with distal fistula, diagnosed in 113 (92.6%) of the patients.

Table 1. Demographic Data

Demographic	Number of Patients	Percent
Sex		
Male	68	55.7%
Female	54	44.3%
Time of Diagnosis		
< 48 Hours of age	54	44.3%
> 48 Hours of age	68	55.7%
Age at Admission to NICU		
< 24 Hours of age	27	22.1%
24 – 48 Hours of age	25	20.5%
> 48 Hours of age	70	57.4%
Type of EA/TEF		
Type A	7	5.7%
Type C	113	92.6%
Type D	2	1.6%
Birth Weight		
Low Birth Weight	31	25.4%
Normal Birth Weight	91	74.6%
Gestational Age		
28 to 36 Weeks	7	5.7%
37 to 42 Weeks	110	90.2%

Above 42 Weeks	5	4.1%
Maternal Risk Factors		
Yes	27	22.1%
No	95	77.9%

Out of the total, 110 (90.2%) patients were born full term, while 7 (5.7%) were preterm and 5 (4.1%) were post-term. Among them, 91 (74.6%) had normal birth weight, and 31 (25.4%) had low birth weight. Approximately 27 (22.1%) of the patients exhibited at least one identified risk factor for EA/TEF, including GDM (2.6%), Polyhydramnios (12.3%), and Pre-eclampsia (3.3%).

3.2. Preoperative Factors

The majority of patients had a history of oral feeding, accounting for 100 (82.0%) patients. Preoperatively, all patients received oxygen-supportive therapy, with 117 (95.9%) utilizing intranasal oxygen, 4 (3.3%) using CPAP, and 1 (0.8%) receiving face mask oxygen. Additionally, 83 (68.0%) patients were found to have at least one associated congenital anomaly (Table 2). Cardiac anomaly was the most prevalent congenital anomaly, observed in 71 (58.2%) patients.

Preoperative complications were diagnosed in at least one patient in 120 (98.4%) cases (Table 2). The most frequent complication observed was aspiration pneumonia, affecting 116 (95.1%) patients, followed by neonatal sepsis, which was identified in 29 (23.8%) patients. Preoperative echocardiography was performed for 110 (90.2%) of the patients, while complete preoperative preparation was carried out for 112 (91.8%) individuals.

Multivariate analysis revealed that electrolyte abnormalities with (AOR: 0.081, 95% CI: 0.007 – 0.887, p-value: 0.040) emerged as a significant predictor of the postoperative outcome following surgery for EA/TEF.

3.3. Intraoperative Factors

The majority of patients, 100 (82.0%), underwent surgical repair after reaching 72 hours of age. The duration of anesthesia averaged 197.3±62.368 minutes, and the duration of surgery was 154.14±54.286 minutes (Figure 1). The lowest recorded intraoperative oxygen saturation was '88 to 94 %' for 60 (49.2%) patients, '80 to 87 %' for 31 (25.4%), '70 to 79 %' for 12 (9.8%), and 'less than 70 %' for 19 (15.6%) patients.

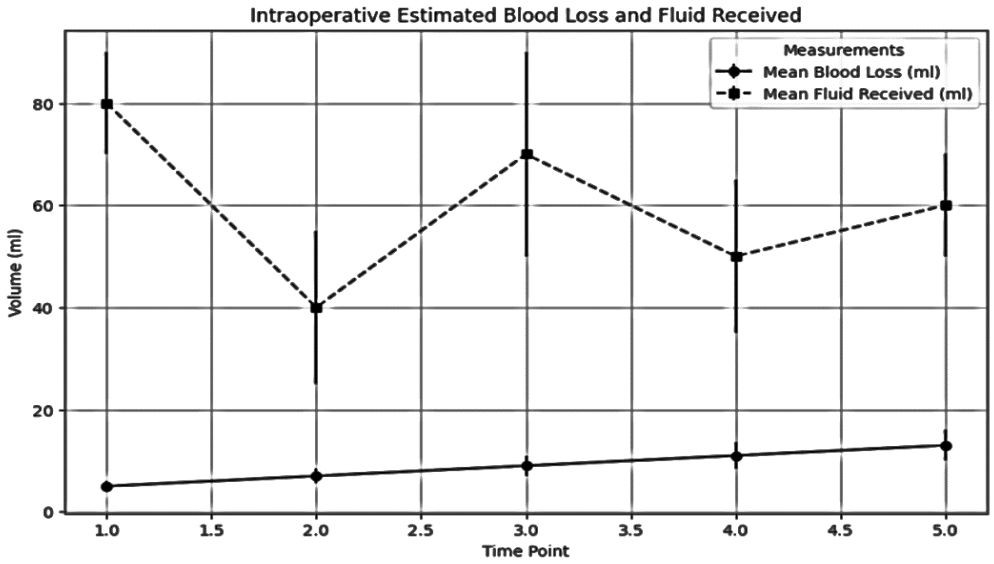

Figure 1: Mean Intraoperative Estimated Blood loss and Fluid Recived

For intraoperative pain management, paracetamol was administered to 121 (99.2%) patients, fentanyl to 77 (63.1%), and intercostal block to 22 (18.0%) individuals. Primary surgical repair and anastomosis were done for 100 (82.0%) patients, while gastrostomy and esophagostomy were performed for the remaining 22 (18.0%) patients. The gap length between the esophageal pouches was classified as a short gap for 77 (63.1%) patients, intermediate gap for 18 (14.8%), and a long gap for 27 (22.1%).

Among the patients, 84 (68.9%) experienced at least one intraoperative complication (Table 2). The most common intraoperative complication was hypoxia, affecting 75 (61.5%) patients. The mean intraoperative estimated blood loss was 11.39±7.421 ml, and patients

received an average intraoperative fluid of 56.84±23.524 ml. Additionally, the vasoactive agent epinephrine was administered to 26 (21.3%) patients intraoperatively. At least one blood product was given to 22 (18.0%) patients, with 12 (9.8%) receiving platelets, 12 (9.8%) receiving packed red blood cells, and 2 (1.6%) receiving fresh frozen plasma. Following surgery, 114 (93.4%) patients were immediately extubated, while 8 (6.6%) patients were admitted to the NICU without extubation.

3.4. Postoperative Factors

Postoperatively, 45(36.9%) patients were transfused with at least one blood product, with platelets being the most common, 36 (29.5%). Additionally, 105 (86.1%) patients experienced at least one postoperative complication (Table 2). Hospital-acquired infections were the most frequent postoperative complication, occurring in 65 (53.3%) patients, with the chest being the most common site of infection. Seven (5.7%) patients underwent reoperation, with recurrent TEF being the most common reason.

Preoperative Factors	N (%)	Intraoperative Factors	N (%)	Postoperative Factors	N (%)
Feeding History		**Age at Surgical Repair**		**Blood Products**	
Yes	100 (82%)	≤ 72 Hours of Age	24 (19.7%)	At Least One Blood Product	45 (36.9%)
No	22 (18%)	> 72 Hours of Age	98 (80.3%)	No Blood Products	77 (63.1%)
Preoperative Oxygen Therapy		**Intraoperative Monitoring**		**Types of Blood Products**	
Intranasal	117(95.9%)	Standard	25 (20.5%)	Platelets	36 (29.5%)
CPAP	4 (3.3%)	Not Standard	97 (79.5%)	PRBC	32 (26.2%)
Face Mask	1 (0.8%)	**Lowest Intraoperative Oxygen Saturation**		FFP	6 (4.9%)
Congenital Anomalies		Less than 70	19 (15.6%)	**Postoperative Complications**	
No Associated Anomalies	39 (32%)	70 to 79	12 (9.8%)	ALOPOC^*	105(86.1%)
At Least One Anomalies	83 (68%)	80 to 87	31 (25.4%)	No Postoperative Complications	17 (13.9%)
Types of Congenital Anomalies		88 to 94	60 (49.2%)	**Types of Postoperative Complications**	
Cardiac Anomaly	71 (58.2%)	**Intraoperative Pain Management**		Hospital Acquired Infection: Chest	57 (46.7%)
Gastrointestinal Anomaly	13 (10.7%)	Paracetamol	121(99.2%)	Hospital Acquired Infection: GI	2 (1.6%)
Genitourinary Anomaly	6 (4.9%)	Fentanyl	77 (63.1%)	Hospital Acquired Infection: Meningitis	6 (4.9%)
Musculoskeletal	7 (5.7%)	Intercostal Block	22 (18%)	IV Site Infection	2 (1.6%)
CNS Anomaly	2 (1.6%)	Paravertebral Block	2 (1.6%)	Surgical Site Infection	15 (12.3%)
VACTERL	9 (7.4%)	**Type of Surgical Repair**		Bacterial Sepsis	22 (18%)
Choanal Atresia	1 (0.8%)	Primary Repair	100 (82%)	Fungal Sepsis	8 (6.6%)
Preoperative Complications		G&E**	22 (18%)	Postoperative Apnea	25 (20.5%)
ALOPRC*	120(98.4%)	**Gap Length**		Postoperative Bleeding	1 (0.8%)
NPC^	2 (1.6%)	Short Gap	77 (63.1%)	Severe Anemia	11 (9%)
Types of Preoperative Complications		Intermediate Gap	18 (14.8%)	Severe Thrombocytopenia	25 (20.5%)
Aspiration Pneumonia	116(95.1%)	Long Gap	27 (22.1%)	Hypoalbuminemia	5 (4.1%)
Neonatal Sepsis	29 (23.8%)	**Intraoperative Complications**		Acute Kidney Injury	5 (4.1%)
Neonatal Jaundice	17 (13.9%)	ALOIOC^^	84 (68.9%)	Pneumothorax	11 (9%)
Thrombocytopenia	19 (15.6%)	NIOC*^	38 (31.1%)	Cardiac Arrest	5 (4.1%)

Electrolyte Abnormalities	10 (8.2%)	**Types of Intraoperative Complications**		Postoperative Intubation	14 (11.5%)
Perinatal Asphyxia	6 (4.9%)	Hypoxia	62 (50.8%)	Postoperative Anastomosis Leak	20 (16.4%)
HIE	6 (4.9%)	Hypotension	20 (16.4%)	Other Surgical Complications	38 (31.1%)
Preoperative Echocardiography		Bradycardia	29 (23.8%)	**Reoperation**	
Done	110(90.2%)	Tube Blockage	2 (1.6%)	Taken to OR for Reoperation	7 (5.7%)
Not Done	12 (9.8%)	Hypothermia	4 (3.3%)	Not Reoperated	115(94.3%)
Preoperative Preparation		Cardiac Arrest	11 (9%)	**Reason for Reoperation**	
Complete	112(91.8%)	Massive Transfusion	1 (0.8%)	Recurrent TEF	3 (2.5%)
Incomplete	10 (8.2%)	Delayed Awakening	28 (23%)	Missed TEF	1 (0.8%)
		Difficult Intubation	32 (26.2%)	Gastric Wall Perforation Repair	1 (0.8%)
		Tube Dislodgement	6 (4.9%)	Fistula Ligation Failure	1 (0.8%)
		Vasoactive Agent		Staged Primary Repair	1 (0.8%)
		Epinephrine Used	26 (21.3%)		
		No Vasoactive Agent Used	96 (78.7%)		
		Blood Products			
		At Least One Blood Product	22 (18%)		
		No Blood Products	100 (82%)		
		Types of Blood Products			
		Platelets	12 (9.8%)		
		PRBC	12 (9.8%)		
		FFP	2 (1.6%)		
		End of Case			
		Extubated	114(93.4%)		
		Admitted to NICU	8 (6.6%)		

*ALOPRC: At Leas One Preoperative Complications, **G&E: Gastrostomy and Esophagostomy, ^NPC: No Preoperative Complications, ^^ ALOIOC: At Least One Intraoperative Complications, *^NIOC: No Intraoperative Complication, ^*ALOPOC: At Least One Postoperative Complications. Table 2. Preoperative, Intraoperative, and Postoperative Factors

3.5. Outcome

Out of the 122 neonates included in this study, 62 (50.8%) died, while the remaining 60 (49.2%) were discharged with improvement. Sepsis was identified as the most common cause of death, affecting 35 (28.7%) patients, followed by postoperative apnea, which accounted for 21 (17.2%) patients.

Table 3. Final Outcome of Patients

Final Outcome	Number of Patients	Percent
Discharged Improved	60	49.2%
Died	62	50.8%
Cause of Death		
Sepsis	35	28.7%
Postoperative Apnea	21	17.2%
Hypoxia	6	4.9%

Moreover, subsequently conducted multivariate logistic regression on the discerned factors from each group revealed several variables emerged as noteworthy predictors of the surgical outcome among EA-TEF patients. Specifically, postoperative complications (AOR: 0.126, 95% CI: 0.052 – 0.303, p-value: 0.000) was identified as a significant predictor.

Table 4. Logistic Regression Model for Factors of Postoperative Outcomes

	OR	95% CI		p-value	AOR	95% CI		p-value
		Lower	Upper			Lower	Upper	
Thrombocytopenia	0.288	0.097	0.859	0.026	0.310	0.074	1.292	0.108
Electrolyte Abnormalities	0.093	0.011	0.758	0.027	**0.081***	0.007	0.887	**0.040**
Type of Surgical Repair	4.156	1.422	12.141	0.009	1.358	0.100	18.541	0.818
Gap Length	6.481	2.335	17.991	0.000	8.056	0.707	91.854	0.093
Platelet Transfusion	0.198	0.087	0.596	0.028	0.942	0.086	10.278	0.961
At least one Postoperative Complication	0.718	0.544	0.946	0.019	**0.126***	0.052	0.303	**0.000**

***** *Significant association with surgical outcome of neonates with EA-TEF with p-values < 0.05*

4. Discussion

A retrospective cross-sectional study of 122 patients investigated how preoperative, intraoperative, and postoperative factors influence the determinants of postoperative outcomes, encompassing mortality, length of hospital stays, and the occurrence of complications in EA/TEF newborns. The study revealed a slight male predominance, with a male-to-female ratio of 1.26:1. This observation aligns with existing literature indicating a slightly higher incidence of EA/TEF among males[3,36–39]. Approximately (22.1%) of patients exhibited at least one identified risk factor, including GDM, Polyhydramnios, and Pre-eclampsia. However, the absence of antenatal diagnoses shows the challenges in early detection and highlights the need for enhanced prenatal screening strategies to identify at-risk mothers and improve diagnostic rates.

Our study found that EA/TEF diagnosis was made within 48 hours of age for (44.3%) of patients, yet we observed no significant association with postoperative outcomes. However, Ammar et al. identified delayed diagnosis as a predictor linked to mortality, highlighting the importance of timely diagnosis in optimizing patient outcomes[40]. Subsequent to diagnosis, a significant proportion of patients (57.4%) were admitted to the NICU after > 48 hours of age, indicating delayed presentation or referral pathways. While our study did not find a significant association between late presentation and postoperative outcome, Nagdeve et al. demonstrated that late presentations after seven days of age are linked to elevated mortality rates[36]. Type C EA/TEF, characterized by proximal atresia with distal fistula, was the most prevalent subtype, diagnosed in (92.6%) of patients. This finding is consistent with previous studies documenting Type C as the most common variant of EA/TEF[14,41].

While our study found no significant association between low birth weight (< 2500g) or early Gestational Age (< 37 weeks GA) and postoperative outcomes, contradicting some previous findings, it's essential to acknowledge the heterogeneity in the literature. For instance, Okata et al. supported our findings, suggesting no significant association[25], while studies by Li et al., Fallahi et al., and Lawrence et al. indicated a significant relationship between both low birth weight and early GA with postoperative outcomes in EA/TEF repair patients[37,41,42]. Conversely,

Kamrani et al., Misganaw et al., and Narasimman et al. reported conflicting results, with only low birth weight showing a significant association while early GA did not correlate with postoperative outcomes[17,38,43]. This diversity in findings indicates the complexity of factors influencing postoperative outcomes in EA/TEF repair patients, spotlighting the need for further research to elucidate these relationships comprehensively taking into consideration the advances in anesthesia, surgical techniques, and intensive care unit care.

The data discovery of associated congenital anomalies in (68.0%) of patients, predominantly cardiac anomalies at (58.2%), emphasizes the syndromic character inherent in EA/TEF. This finding aligns closely with the existing literature[39,41,43–45], reinforcing the imperative of conducting screening echocardiograms in neonates diagnosed with EA/TEF. Furthermore, electrolyte abnormalities (AOR: 0.081, 95% CI: 0.007 – 0.887, p-value: 0.040) emerged as significant predictors of postoperative outcome, indicating preoperative electrolyte disturbance in EA/TEF patients increased postoperative mortality by (91.9%), underscores the importance of hematological and metabolic parameters in risk stratification and preoperative optimization.

In our study, preoperative complications were prevalent and diagnosed in nearly all cases (98.4%), with aspiration pneumonia and neonatal sepsis being the most frequently encountered issues. Surgical repair was conducted with the majority of patients (82.0%) after reaching 72 hours of age. Most patients fell into the category of delayed repair, having the surgery after surpassing 48 hours of age. Interestingly, our analysis did not find a correlation between delayed repair and postoperative mortality. This finding is consistent with the research of Narasimman et al., who similarly demonstrated that early primary repair within 24 hours of age did not affect postoperative outcomes[38]. Furthermore, this is supported by Davari et al., indicating that whether primary repair is performed early or delayed, there is no significant association with postoperative complications or mortality[46]. These findings call into question the classification proposed by Waterson et al. and Spitz et al., which recommend timing of surgery based on risk

factors such as birth weight, associated congenital anomalies, and pneumonia[47,48]. This approach appears questionable in current practice, given the advancements in perioperative care.

The mean intraoperative estimated blood loss was 11.39±7.421 ml, indicating minimal variation and suggesting a consistent surgical environment or technique for controlling blood loss. In contrast, the mean intraoperative fluid received was 56.84±23.524 ml, showing significant variability (Figure 1). This indicates that fluid management was adjusted during the procedure to meet different needs at various stages of the surgery or due to patient-specific factors. The significant variability for fluid received suggests that patients were given varying amounts of fluid, likely reflecting individualized patient care requirements. Intraoperative complications were common, (68.9%) experienced at least one intraoperative complication (Table 2). Hypoxia was the most frequent complication affecting (61.5%) of patients, yet there is no correlation with the postoperative outcome.

An overwhelming majority of patients (86.1%) experienced at least one postoperative complication (Table 2), with chest-focused hospital-acquired infections being the most frequent (46.7%). The multivariate analysis revealed that patients with postoperative complications had a significantly increased mortality rate by 87.4% (AOR: 0.126, 95% CI: 0.052 – 0.303, p-value: 0.000). Consistent with our findings, existing literature highlights pneumonia as the predominant postoperative complication linked to mortality[39,43].

Our study reveals a mortality rate of (50.8%), with sepsis emerging as the primary cause, accounting for (28.7%) of deaths. This observation resonates with literature from LMICs, where mortality rates range between (30.4%) and (85.3%)[15,16,51,52]. These findings highlight the importance of vigilant monitoring for signs of infection and respiratory compromise in the postoperative period. Strategies aimed at preventing and promptly treating sepsis and respiratory complications are essential for improving survival rates and reducing morbidity in neonates undergoing surgical repair for EA/TEF.

4.1. Limitation of Study

Due to the retrospective nature of the study and the rarity of EA/TEF, the data might not be sufficient to paint a complete picture of these patients' outcomes across the nation. Only patients with a shorter follow-up period were included. Thus, it is not possible to provide information on long-term outcomes. Our study was conducted at a single center, which may limit the diversity of patient characteristics and treatment practices.

5. Conclusion

In this retrospective cross-sectional study involving 122 patients, we delved into how preoperative, intraoperative, and postoperative factors influence the determinants of postoperative outcomes in neonates with esophageal atresia and tracheoesophageal fistula (EA/TEF). Our findings shed light on several crucial aspects of this complex condition. The identification of risk factors such as gestational diabetes, polyhydramnios, and pre-eclampsia stress the challenges in early detection, emphasizing the need for improved prenatal screening strategies. Despite nearly half of the patients being diagnosed with EA/TEF within 48 hours, we found no significant association with postoperative outcomes. However, delayed presentation to the NICU after 48 hours of age was common, highlighting potential issues in referral pathways.

Our study also revealed the prevalence of Type C EA/TEF, with proximal atresia and distal fistula being the most common variant. While some previous studies have suggested associations between low birth weight or early gestational age and postoperative outcomes, our findings did not support these relationships, highlighting the heterogeneity in the literature.

The high prevalence of associated congenital anomalies, particularly cardiac anomalies, underlines the syndromic nature of EA/TEF and the necessity of screening echocardiograms in affected neonates. Additionally, preoperative complications, including aspiration pneumonia and neonatal sepsis, were prevalent, emphasizing the importance of perioperative management.

Postoperative complications were common, with chest-focused hospital-acquired infections being predominant. Notably, patients with postoperative complications had

significantly increased mortality rates, emphasizing the need for vigilant monitoring and prompt management. Our study also highlighted sepsis as a leading cause of mortality, emphasizing the importance of infection prevention and management strategies.

Overall, our study provides valuable insights into the sociodemographic characteristics, the critical role of preoperative care and optimization, and the postoperative course and outcomes of patients undergone surgical repair for EA/TEF. The findings spotlight the multifactorial nature of EA/TEF etiology and emphasize the importance of early recognition, timely intervention, and comprehensive multidisciplinary management strategies to optimize patient outcomes. Addressing electrolyte abnormalities, optimizing preoperative preparation, and tackling postoperative complications are crucial steps in improving the postoperative survival rates of the patients.

6. Recommendations

Given the challenges in early detection highlighted by the absence of antenatal diagnoses in our study, there is a clear need to improve prenatal screening strategies. We should focus on identifying and monitoring risk factors such as gestational diabetes, polyhydramnios, and pre-eclampsia to facilitate early diagnosis and timely interventions.

Our findings stress the importance of timely diagnosis and referral pathways. Efforts should be made to streamline the diagnostic process and ensure prompt referral to specialized care facilities, particularly for neonates presenting with symptoms of EA/TEF within the first 48 hours of life. It is imperative to involve healthcare administrators, policymakers, and the Ministry of Health in implementing strategies to improve the diagnostic process and referral pathways for this patient population.

Complete preoperative preparation and optimization emerged as a significant predictor of surgical outcomes. Standardized protocols for preoperative assessment and optimization should be established to ensure all patients receive comprehensive care tailored to their individual needs.

The high prevalence of associated congenital anomalies, particularly cardiac anomalies, highlights the syndromic nature of EA/TEF. Screening echocardiograms should be routinely performed in affected neonates to facilitate early detection and appropriate management of cardiac anomalies.

Considering the common occurrence of preoperative complications like aspiration pneumonia and neonatal sepsis, it's crucial to optimize patients' conditions before surgery. This involves implementing strategies aimed at minimizing the risk of complications. One key approach is to prepare a dedicated, highly dependent unit to provide specialized care tailored to the needs of EA/TEF patients before they undergo surgical intervention.

Vigilant monitoring for postoperative complications, particularly hospital-acquired infections such as sepsis, is essential. Prompt recognition and management of complications can help reduce mortality rates and improve overall outcomes.

Further research should prioritize establishing causal relationships between predictor variables and postoperative outcomes in EA/TEF patients. It is important to conduct prospective studies with robust methodologies to confirm the significance of identified predictors and elucidate their causal mechanisms

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9. Annexes

9.1. Annex I: Declaration of the Principal Investigator

The undersigned agrees to accept responsibility for the scientific ethical and technical conduct of the research project and for provision of required progress reports as per terms and conditions of the Department and College, in effect at the time of grant is forwarded as the result of this application.

Name of the Student: _____

Date: _____ Signature: _____

Approval of the First Advisor

Name of the First Advisor: _____

Date: _____ Signature: _____

Approval of the Second Advisor

Name of the Second Advisor: _____

Date: _____ Signature: _____

Ethical Clearance Letter

0910849052 (Dr. Amanuel)

ጥቁር አንበሳ
TIKUR ANBESSA COLLEGE OF HEALTH SCIENCES
DEPARTMENT OF ANESTHESIOLOGY AND CTITICAL CARE
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ጉዳዩ፡ ካርድ ስለማውጣት

ዶ/ር አማኑኤል ይስሀቅ በአንስቴዝዮሎጂና ፅኑ ህክምና ት/ክፍል ተማሪ ሲሆኑ በልጆች እና ህፃናት ቀዶ ህክምና ት/ክፍል ውስጥ በ (Pediatrics surgery) ተኝቶ ታካሚ ከነበሩት ህሙማን ለጥናትና ምርምር ካርዳቸውን እንዲያገኙ ክፍላችሁ አስፈላጊውን ትብብር እንዲያደርግላቸው በትህትና እየጠየቅን የካርድ ቁጥራቸውም አያይዘን ልከናል፡፡

ከሰላምታ ጋር

የአዲስ አበባ ዩኒቨርሲቲ
Dept. of Anesthesiology Medical Faculty A. A.
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ብርሃን ተስፋይ /ዶ/ር/
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18-01-16

Tesfaye

9.2. Appendix II: Tools

9.2.1. Information Sheet

Hello,

This is a research questionnaire on "Determinants of Postoperative outcomes in newborns with Tracheoesophageal Fistula", by Dr. Amanuel Yishak, who has granted permission from Addis Ababa University, College of Health Science, School of Medicine, Department of Anesthesiology Critical Care Pain Medicine to conduct the study.

This tool was designed to gather data on sociodemographic, neonatal clinical comorbidities, treatments, and outcomes crucial for determining the prognosis of neonates with tracheoesophageal fistulas admitted to neonatal critical care units TASH, Addis Ababa, Ethiopia.

All the information will be taken from the individual patient card without using the patient's name. Code numbers (medical record numbers) will be used to keep the patient confidential. Under the supervision of the primary investigator, a trained healthcare provider will gather the data.

For further information contact address:

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Phone No.: +251910849052

1. Does the newborn have TEF?

☐ If yes, proceed to the questionnaire
☐ If not, please stop filling out the questionnaire

2. Medical Record Number

_____

9.2.2. Sociodemographic Characteristics

3. Region *

Mark only one oval.

- ◯ Addis Ababa
- ◯ Oromia
- ◯ Amhara
- ◯ Tigray
- ◯ SNNPR
- ◯ SWEPR
- ◯ Somali
- ◯ Afar
- ◯ Sidama
- ◯ Benishangul-Gumuz
- ◯ Gambela
- ◯ Dire Dawa
- ◯ Harari

4. Postnatal age at admission *

Mark only one oval.

- ◯ < 1 day
- ◯ 1 - 2 days
- ◯ > 2 days

5. Gestational age (GA) *

Mark only one oval.

- ◯ < 28 wks
- ◯ 28 - 36 wks
- ◯ 37 - 42 wks
- ◯ > 42 wks

6. Sex *

Mark only one oval.

- ◯ Male
- ◯ Female

7. Weight in grams *

Mark only one oval.

- ◯ < 1000g (ELBW)
- ◯ 1000 - 1499g (VLBW)
- ◯ 1500 - 2499g (LBW)
- ◯ 2500g - 4500g (NBW)
- ◯ > 4500g

8. Height in centimeters *

_____

9.2.3. Maternal Characteristics

9. Maternal age *

Mark only one oval.

- ◯ < 18 yrs
- ◯ 18 - 35 yrs
- ◯ > 35 yrs

10. History of maternal chronic medical illness *

Mark only one oval.

- ◯ Yes
- ◯ No

11. History of maternal risk factors for TEF *

Tick all that apply.

	Epilepsy	Diabetics	Chronic HTN	Pre-eclampsia	CKD	Alcoholic	Smoker	Histor Polyhydra
Yes	☐	☐	☐	☐	☐	☐	☐	☐
No	☐	☐	☐	☐	☐	☐	☐	☐

12. Maternal medication history *

_____

13. Place of delivery *

Mark only one oval.

- ◯ Home
- ◯ Health facility

14. Mode of delivery *

Mark only one oval.

- ◯ Spontaneous vaginal delivery
- ◯ Assisted vaginal delivery
- ◯ Cesarian Section

15. Mode of anesthesia / pain management (if applicable) *

Tick all that apply.

	SA	GA	Epidural	NSAIDs	Opioids
Yes	☐	☐	☐	☐	☐
No	☐	☐	☐	☐	☐

9.2.4. Preoperative Neonatal Characteristics

16. Time of diagnosis *

Mark only one oval.

- ◯ < 48 hrs
- ◯ > 48 hrs

17. Tye of variants of the TEF *

Mark only one oval.

- ◯ Type A
- ◯ Type B
- ◯ Type C
- ◯ Type D
- ◯ Type E/H

18. Feeding history *

Mark only one oval.

- ◯ Yes
- ◯ No

19. Associated Congenital Anomalies *

Tick all that apply.

	Cardiac anomaly	GI anomaly	GU anomaly	MSK anomaly	CNS anomaly	Chromosomal abnormality	VACTERL association
Yes	☐	☐	☐	☐	☐	☐	☐
No	☐	☐	☐	☐	☐	☐	☐

20. Comorbid conditions *

Tick all that apply.

	Neonatal Spesis	Aspiration Pneumonia	Malnutrition	GERD	Thrombocytopenia	Dehydration
Yes	☐	☐	☐	☐	☐	☐
No	☐	☐	☐	☐	☐	☐

21. Preoperative Preparation *

Tick all that apply.

	Pre-anesthetic assessment	Pre-operative consent for the surgical procedure	Pre-operative consent for the anesthesia	Type and crossmatch blood preparation	Ix: CBC	Ix: CMP	Ix: CXR
Yes	☐	☐	☐	☐	☐	☐	☐
No	☐	☐	☐	☐	☐	☐	☐

22. ASA Classification *

Mark only one oval.

- ◯ Class I
- ◯ Class II
- ◯ Class III
- ◯ Class IV
- ◯ Class V

23. Time of surgical repair *

Mark only one oval.

- ◯ </= 72 hrs of age
- ◯ > 72 hrs of age

24. Surgical Safety Checklist *

Mark only one oval.

- ◯ Yes
- ◯ No

25. Premedication before induction *

Mark only one oval per row.

	Ceftriaxone	Ampicillin	Atropine
Yes	◯	◯	◯
No	◯	◯	◯

26. Induction of anesthesia *

Mark only one oval per row.

	inhalational	Intravenous	combined	Halothane	Isoflurane	Sevoflurane
Yes	◯	◯	◯	◯	◯	◯
No	◯	◯	◯	◯	◯	◯

27. Duration of Anesthesia in minutes *

_____

28. Duration of Sugery minutes *

_____

29. Intra-operative monitors used during the case. *

Mark only one oval per row.

	ECG	NIBP	Pulse oximetery	ETCO2	radiant warmer	warm blanket	IV warmer	Urinary Catheter
Yes	◯	◯	◯	◯	◯	◯	◯	◯
No	◯	◯	◯	◯	◯	◯	◯	◯

30. Maintenance of Anesthesia *

Mark only one oval per row.

	Propofol	Ketamine	Halothane	Isoflurane	Fentanyl	Morphine	Meperidine
Yes	◯	◯	◯	◯	◯	◯	◯
No	◯	◯	◯	◯	◯	◯	◯

31. Analgesia *

Mark only one oval.

- ◯ PCM
- ◯ Fentanyl
- ◯ Morphine
- ◯ Intercostal block
- ◯ Other

32. Type of surgical repair *

Mark only one oval.

- ◯ Primary repair
- ◯ Gastrostomy
- ◯ Other

33. Levels of Experience of the Surgeon

Mark only one oval.

- ◯ Level 1: trainee
- ◯ Level 2: less experienced (< 5yrs of practice)
- ◯ Level 3: experienced (> 5yrs of practice)
- ◯ Level 4: highly experienced (leading participant)
- ◯ Level 5: Expert (pioneer)

34. Intraoperative incidence *

Tick all that apply.

	Hypoxia	Hypothension	Bradycardia	Arrythmia	Shunt reversal	Hypothermia	Cardiac arrest
Yes	☐	☐	☐	☐	☐	☐	☐
No	☐	☐	☐	☐	☐	☐	☐

35. Incidence management

_____

36. Use of Vasoactive agent

Tick all that apply.

	Epinephrine	Norepinephrine	Phenylephrine	Dpamine	Dobutamine	Milrinone
Yes	☐	☐	☐	☐	☐	☐
No	☐	☐	☐	☐	☐	☐

37. Intraoperative blood loss

38. Intraoperative fluid given.

39. Blood transfusion

Tick all that apply.

	Whole blood	PRBC	Platlate	FFP
Yes	☐	☐	☐	☐
No	☐	☐	☐	☐

40. Neuromuscular reversal

Tick all that apply.

	Neostigmine	Atropine
Yes	☐	☐
No	☐	☐

41. End of case *

Tick all that apply.

	Extubated	admitted to NICU unextubated
Yes	☐	☐
No	☐	☐

42. Surgical related complication *

Mark only one oval.

- ◯ Yes
- ◯ No

43. Postoperative complication

44. Postoperative complication management

9.2.5. Newborns Outcomes Characteristics

45. The newborn taken to OR for reoperation. *

Mark only one oval.

- ◯ Yes
- ◯ No

46. Reason for reoperation

47. Postoperative length of hospital stay in days *

48. Final outcome *

Mark only one oval.

- ◯ discharged improved
- ◯ discharged against medical advice
- ◯ Lost to follow-up
- ◯ Died

9.3. Appendix III: Concept Note

Tracheoesophageal fistula (TEF) is a spectrum of complex congenital deformities brought on by improper foregut separation. Newborns with TEF are not able to live with the condition unless surgical repair is done. In Western countries, the survival rate is nearly 100% after surgical repair in TEF patients without other congenital anomalies. To enhance surgical results for neonates with TEF, the study aims to identify the preoperative, intraoperative, and postoperative factors that contribute to poor surgical outcomes in our facility.

The research question is what are the determinants of postoperative outcome in newborns with a tracheoesophageal fistula at Tikur Anbessa Specialized Teaching Hospital? The main objective is to assess the determinants of postoperative outcomes in newborns with a TEF. The specific objectives are: to assess the preoperative, intraoperative, and postoperative outcome determinants in newborns with TEF, and to assess the time to death of operated newborns with TEF.

A descriptive institution-based cross-sectional study will be conducted. The study will be conducted in Tikur-Anbessa specialized tertiary hospital. The study participants will be post-operative newborns who underwent TEF repair. Retrospective data will be collected using a structured electronic questionnaire. The collected data will be organized, analyzed, and presented using descriptive and inferential statistics.