ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCES

SCHOOL OF MEDICINE TIKUR ANBESA SPECIALIZED HOSPITAL,

DEPARTMENT OF ANESTHESIOLOGY

THE INCIDENCE AND ASSOCIATED RISK FACTORS OF ENDOTRACHEAL AND TRACHEOSTOMY TUBE BLOCKAGE IN INTENSIVE CARE UNIT AT TIKUR ANBESA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA

Investigator: Dr. Shimelis Mengistie (Anesthesiology resident)

Advisor: Dr. Ananya Abate, MD
Assistant Professor of Anesthesiology

A RESEARCH THESIS SUBMITTED TO COLLEGE OF HEALTH SCIENCES, ADDIS ABABA UNIVERSITY SCHOOL OF MEDICINE, DEPARTMENT OF ANESTHESIOLOGY FOR PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR ANESTHESIOLOGY SPECIALITY CERTIFICATE

October 2018

Addis Ababa

Ethiopia

Approved by the Examining Board

_____ _____

Head, Department of Anesthesiology

Advisors

Dr. Ananya Abate, MD, Assistant professor of Anesthesiology

_____

Examiner

1. _____ _____
2. _____ _____

Acknowledgement

My sincerest and heart-felt gratitude goes to my advisor Dr. Ananya Abate for unflagging support, concrete and expert advice, suggestions and assistance in all aspects of this research work.

I would like to offer my great respect and appreciation to all instructors who shaped me to the circumstances they would like to be for their immeasurable assistance and creating conducive situation during my study.

Lastly, I would like to say thanks to Tikur Anbesa Specialized Hospital ICU ward staffs, Management Office, Health staffs, Study participants, Data collectors & supervisors and all my friends who helped me doing this thesis.

Table of Contents

Abbreviations and Acronyms

BET- **Blocked Endotracheal Tube**

BTT- **Blocked TT**

CCU- **Critical Care Unit**

ENT- **Ear, Nose and Throat**

EPI- **Epidemiology**

ETT- **Endotracheal Tube**

HME- **Heat and Moisture Exchanger**

HMEF- **heated humidifiers or heat and moisture exchange filters**

ICU- **Intensive Care Unit**

IRB- **Institutional Review Board**

LTI- **Long Term Intubation**

SIMV- **Synchronized Intermittent Mandatory Ventilation**

SPSS- **Statistical Package for Social Sciences**

STI- **Short Term Intubation**

TASH - **Tikur Anbessa Specialized Hospital**

TD'S- **Tube Day's**

TT - **Tracheostomy Tube**

UE- **Unplanned Extubation**

Abstract

Background: Endotracheal (ETT) and tracheostomy tube (TT) blockage is a common airway accident in Intensive Care Unit (ICU). Although tube blockage is rarely fatal, it has a major impact on the quality of ICU care and the family of the patient[12]. The present study is aimed to assess the incidence of ETT/TT tube blockage and associated risk factors including the tube size, shift of tube blockage, type of tube blockage, duration of intubation and frequency of suctioning. The causes of tube blockage and outcome of tube blockage.

Objective: To assess the incidence and associated risk factors of endotracheal tube and tracheostomy tube blockage in pediatric, adult surgical and medical intensive care units in Addis Ababa University School of health science Tikur Anbesa specialized hospital.

Materials and Methods: After the department of Anesthesiology research committee approval, Institutional based prospective cross sectional study was conducted from March to August, 2018 to assess the incidence and associated risk factors of endotracheal and tracheostomy tube blockage in pediatric, adult medical and surgical ICUs. Data was collected using formatted questionnaire in ICU patients admitted to pediatric, adult medical and surgical ICU during the study period. All admitted patients in ICU who were intubated with ETT or TT had been included in this study whose consent was taken from the family. The collected data was entered, coded using Epi – info software and analyzed through SPSS software 23 version. **Result:** A total of 276 patients were admitted in ICU, surgical 129, medical 81 and pediatric 66 ICU from this patient 122 were intubated, from those tube blocked, medical 5 (25%), surgical 9 (45%) and pediatric ICU 6 (30%) respectively. The Incidence of ETT/TT blocked was 20(16.4%). From those ETT was16 (80%) and TT blocked was 4(20%) (P=0.042), most cause of tube blocked was mucus 11(55%) then debris 4(20%), and 1(5%) kinked from pediatric ICU. Greater than 7 TDS' 7(35%) were blocked, so tube blockage higher in number. The degree of ETT/TT blocked was similar between in partial and complete blocked which was 10(50%) vs 10(50%) consecutively (P=0.025), so it is statistical significant. During the night shift tube blockage was 11(55%) slightly high in number, but during day shift, it was 9(45%). **Conclusion:** The overall incidence of tube blocked was 20(16.4%), so it was higher compare to other studies might been higher setup.

Keywords: Endotracheal tube blockage, tracheostomy tube blockage, **ETT or TT** suctioning**.**

1.Introduction

1.1 Background

The history of airway management has become an issue of concern for clinicians because of the remarkable advances that have occurred in airway management in recent years. Endotracheal intubation became a routine medical practice in the second half of the 20th century. Thereafter, progress was made in modern anesthesia and thoracic surgery. As the number of intubated patients increased, the need for a more effective placement of the tube also increased[1]. The use of tracheostomy dates back to old times; however, the passage of endotracheal tubes (ETTs) through the glottic opening has been performed in recent times. In Greece, Hippocrates (460-380 BC) described tracheal intubation in humans for supporting ventilation.[1]

Intubation and ventilation in Intensive Care Unit (ICU) are needed for a number of reasons. Tracheal tube, either an endotracheal tube (ETT) or a tracheostomy tube (TT), is an essential device for controlling and protecting airway in the critical care unit (CCU). The use of tracheal tubes, however, is associated with complications such as unplanned extubation (UE) (both accidental and self□extubation [SE]), displacement, blockage (both ETT blockage and TT blockage), endobronchial intubation, kinking of tube, and leaking cuffs[2]. Patients often need to be discharged to either recovery wards or to their homes along with tracheostomy tube (TT). Endotracheal tube (ET) or TT blockage is a common airway accident in ICU[3]. The longer a tube stays in situ, greater in the chance of the airway accidents[4, 5].

These airway accidents can lead to life□threatening hypoventilation and hypoxia. It usually occurs due to a large plug of inspissated mucus or a piece of crusted secretion and presents as an airway emergency. Their presence is often vague and nonspecific in ICU settings, where patient's disease condition itself shares same signs and symptoms many times. Although the majority of blockage is partial and can be detected early, sudden, and/or unnoticed progressive, and complete blockage can lead to cardiac arrest and death of the patient. There are multiple risk factors in ICU for tube blockage. Surveys suggest that there is significantly more that could be done to manage latent risk and achieve institutional preparedness, much of which is inexpensive

and easy to implement.[4] Implementation of preventive measures can probably prevent unwanted deaths.

Control of the airway with the help of a tracheal tube is an important aspect of intensive care. The use of tracheal tubes however is not without complications. The longer a tube stays in-situ, the greater the chances of kinking, blockage and unplanned extubations. All of the above can lead to hypoventilation and hypoxia which are potentially life threatening. The few studies on unplanned extubations have reported an incidence ranging from 0.3- 30%.[2, 5]

Advances and improvements in treatment of critical illness is result in more patients who require prolonged airway and ventilatory support[6]. Many of these patients will benefit from prolonged support programs and will eventually be weaned from mechanical ventilation[7, 8]. Management of respiratory failure due to worsening chronic obstructive pulmonary disease and congestive heart failure, without an artificial airway, using noninvasive ventilation, is often successful, avoiding the need for invasive airway support[9]. In selected patients, noninvasive ventilation is well-tolerated and carries a lower mortality than invasive ventilation[10]. Early extubation to noninvasive ventilation as part of a weaning strategy has been suggested as a way of avoiding prolonged intubation, but this approach is not always successful[11]. Despite the advances in noninvasive ventilation, most patients with respiratory failure will require intubation, and the question of whether (and when) to perform tracheostomy will need to be addressed.

Patients were usually intubated orotracheally using polyvinyl ET except few ENT postoperative cases where oral surgery was done. Tubes were fixed with adhesive and were checked regularly and changed as required whenever adhesive tape was found to be peeling out of the skin. Tracheostomy was usually done between 5th and 7th ICU day for expected long□term ventilation patients except for a few postoperative and trauma patients who were tracheostomized from very 1st day. Galileo Gold (Hamilton Medical, Switzerland) and Puritan Bennett 840 (Covidien) ventilators were used for ventilation. More than 90% time, the ventilation mode was SIMV and pressure□SIMV and <10% assist – control, adaptive support ventilation, and airway pressure release ventilation. HME filter was used in almost all patients.

Patients were weaned off from ventilator alternately by reducing mandatory breaths and pressure support by a measure of two. Spontaneous breathing trial was initiated when pressure support 8 cmH2O, mandatory breaths 8/min, FiO2 <50%, positive end□expiratory pressure 5–6 cmH2O,

Pao_2/Fio_2 >200, rapid shallow breathing index <105, hemodynamically stable, and other condition fulfilled as per our ICU protocol. If the patient passed through Spontaneous breathing trial, they were put on direct oxygen catheter through ETT trial, and extubation was done if the patient tolerated for repeated time of trial along with fulfillment of extubation criteria. Analgesia and sedation were provided usually by injection Fentanyl or morphine and injection lorazepam as required. Infusion of injection dexmedetomidine, midazolam, and propofol was used when continuous and relatively long period sedation was required. Violent/dangerously agitated patients were also restrained using soft roller bandage around the wrists with restricted range of movement.

Critically ill patients are often dependent on airway devices to provide respiratory support and to protect their airways. Airway devices, particularly tracheal and tracheostomy tubes, are associated with significant risks, both during initial placement, at tracheal intubation or tracheostomy, and during subsequent use. Incidents relating to tracheal intubation or tracheostomy which occurred on the critical care unit or at the time of admission to the unit, or where the procedure was performed by staff from the unit. We also included incidents where the performance of a tracheostomy in theatre, or a delay in the procedure, caused a problem with the patient's care on ICU.[24]

Patency of an endotracheal tube (ETT) during mechanical ventilation is often compromised by the accumulation of luminal debris. A flexible catheter is generally used to remove these secretions by suctioning, a maneuver that can be performed either in a closed or open fashion according to local clinical practice.[25] Nevertheless, evidence suggests that, even if periodically repeated during mechanical ventilation, standard suctioning is not sufficient to preserve the ETT's original lumen size and nominal function.[26] Abrupt occlusion is rare but can be life-threatening, potentially requiring emergency airway restoration. ETT exchange may be required to ventilate and oxygenate the patient, a high-risk procedure in an emergency ICU setting.[27] In contrast, partial occlusion due to secretion accumulation is ubiquitous and recklessly ignored, with an average estimated loss of intraluminal ETT volume of between 9 and 15%.[28, 29] Occlusion increases the air-flow resistance within the ETT, thereby imposing additional work of breathing on critically ill patients.[30, 31]

1.2. Statement of the Problem

The incidence of tube blockage is significant in patients admitted to ICU who required short-term intubation (STI) and long-term intubation (LTI). Most of the tubes are blocked either by blood clot, biting of the ETT, kinking of the ETT/TT and inspissated secretions (mucus) that made it difficult to pass a suction catheter down these tubes [22]. The patients are allowed to breathe spontaneously with an endotracheal tube or TT tube in situ, received oxygen via catheter and intermittent saline/water nebulization to humidify the inspired gases. Obstruction of the ETT/TT may manifest as increased resistance to ventilation, high airway pressure and low tidal volume as well as clinical feature of tube blockage. ETT obstruction may be prevented by careful attention to the type of ETT/TT, inspection and checking of the ETT and TT tube prior to use, and by humidification of inspired gases.

The severity of the blocked tube is graded as partial tube blocked and complete tube blocked. The duration for which the tube is in situ, date and time of tube blockage, description of the type of tube blocked, severity of the blocked tube and its impact on the course of the patient's illness, whether preventable and if needed to be reintubated are noted. Patency of an endotracheal tube (ETT) during mechanical ventilation is often compromised by the accumulation of luminal debris. Nevertheless, evidence suggests that, even if periodically repeated during mechanical ventilation, standard suctioning is not sufficient to preserve the ETT's original lumen size and nominal function. Sudden occlusion is rare but can be life-threatening, potentially requiring emergency airway restoration.

If patency tube cannot be restored, the ETT/TT should be removed and replaced, if necessary over a tube exchanger. At extubating some endotracheal tubes are noted to have a significant narrowing of the lumen due to encrustations. We attribute this to inadequate humidification and have started using continuous saline/water nebulization's in STI. In LTI, heated humidifiers or heat and moisture exchange filters (HMEF) are used. HMEF's are known to provide efficient humidification with no tracheal tube occlusion for up to 48 hours and in some studies for up to7 days without changing the filter [18, 19]. ETT exchange may be required to ventilate and oxygenate the patient, a high-risk procedure in an emergency ICU setting [20, 21]. The theoretical benefits of preserving the ETT's original function include

1. Reducing the likelihood of sudden hazardous ETT occlusions and the subsequent need for emergency interventions;

2. Decreasing airway resistance and work of breathing in intubated critically ill patients, eventually facilitating their weaning process, which might ultimately lead to reduced mechanical ventilation time; and
3. Reducing the incidence of ventilator associated events by preventing pathogens from forming bacterial biofilm within the ETT

1.3. Rationale of the Study

This study was designed to assess the incidence and associated risk factors of ETT or Tracheostomy tube blockage in ICU. There were no researches done on the incidence and associated risk factors of ETT and Tracheostomy tube blockage in TASH as well as in Ethiopia, It can cause disability of the patient as well as death in ICU patients who are intubated. The associated risk factors of ETT and Tracheostomy tube blockage in ICU is partial or complete blocked to the intubated patient in ICU, so at the end of this research; the patient will be benefited because of the improvement of ETT and TT tube care to prevent tube blockage, then it can avoid or minimized intubated patient from disability and death caused by ETT and TT tube blockage. To have ETT and TT tube care guideline and management protocol. The patient family will be benefited because of intubated patient will be prevented from disability and death secondary to ETT and TT tube blockage. Also the staff members in the hospital will be benefited from the research result will be show the significant of ETT & TT tube blockage, because of the incidence & associated risk factors of the research will be improved the cause of disability and death of ICU patient who is intubated by improving ETT and TT tube care. To have ETT and TT tube blockage management protocol for ICU patient and improving skill and knowledge of health provider how to care intubated patients with ETT and TT tube.

2. Literature Review

A retrospective study was done in India, to assess Endotracheal or Tracheostomy Tube Blockage and their Impact among the patients in an ICU**,** Data were collected retrospectively from the ICU assessment record of patients admitted from November 2012 to October 2014. The result showed that**,** a total of 975 intubated patients (mean standard deviation 46.32 [18.21] years of age; 515 medical and 460 surgical patients) were evaluated for the study. The cause of tube blockage was mostly because of inspissated secretions (92.15%), followed by blood clotting (7.85%) among

the noted cases. Although the exact number of partial and complete blockage could not be figured out because of incomplete data (51%) entry; it was noted that the number of partial/near complete blockage cases were more than those of complete blockage (92.8 vs. 7.2%) among the mentioned cases. Complete blockages were predominantly because of blood clot (80%) and two out of five episodes (40%) occurred in postoperative head and neck surgery Out of 161 tube‐related accidents noted, there were 105 (65.2%) episodes of tube blockage in 72(7.38%) out of 975 intubated patients during 3797 tube days (2.76/100 TDS). Twenty‐one (29.17%) patients had two to four episodes of tube blockage during and such repeated episodes of tube blockage were because of inspissated secretions during their ongoing on‐tube airway management ranging up to 69 days. Hypoxia and hypercapnia were the predominant impact (67.9%), and there were five cardiac arrests (0.13/100 TDS) from inspissated secretions and blood clot resulting in one death (0.026/100 TDS). The mean duration before tube blockage was 7. 23 days. ET tubes often got blocked earlier than TT tubes (6.30 vs. 8.09 days), and the difference was statistically significant (P = 0.0002)[12].

A study was done Tata Memorial Hospital, Mumbai, to assess airway accidents in an ICU between June 2001 and January 2002, all adult patients admitted to the ICU with either an endotracheal tube or tracheostomy were included in the study. The Result showed that, 781 patients (1440 tube days) were studied. 665 patients (951 tube days) required an endotracheal tube. 116 patients (489 tube days) had a tracheostomy. 697 patients (697 tube days) required STI while 84 patients (743 tube days) required LTI. Overall there were 55 airway accidents with an incidence of 7.04% of patients and 3.82 /100 tube days. The airway accident rate was 4.02 / 100 TD's and 3.63/ 100 TD's for STI and LTI, respectively, and 4.21 / 100 TD's and 3.07 /100 TD's for endotracheal intubation and tracheostomy, respectively. Blocked tubes (2.15 per 100 TD's) and unplanned extubations (1.32 per 100 TD's) were the most common airway accidents[13].

A case report on 11/01/2017G.C, about masked blocked tracheostomy tube in Malaysia, The patient remained well until the next morning; when he complained of dyspnea. Pulse oximeter showed 90% saturation. Testing the patency of the tube, there was blow to the cotton wool test applied, indicating a patent lumen. After a gentle suction, the oxygen picked up to 95% but constantly remained at the level. On the next morning, it desaturated again to 90%. Minimal clot was suctioned out from the tube. Owing to the recurring desaturations and presence of clot at the

suction tip, the decision to change to a new tube was made even though it was just 48 hours after procedure. The tip of the tube was 75% blocked with clot, and the whole-length of the tube was filled with blood. After the successful change, the saturation picked up to 98% and the patient was comfortable throughout the day on wards[14]. In the present case, the neck was operated for thyroidectomy more than 10 years prior, and the amount of scarred tissue cannot be underestimated (Mohamad et al., 2015). Most of the complications occur in the early post-operative period (Lee et al., 2016).

A retrospective study was done to assess all tracheal tube related accidents over 3 years (January 2012–December 2014) in a 5-bedded CCU (medical and surgical) under the Department of Anesthesiology public Teaching Hospital of Eastern India. The total accident rate was 19 in 233 intubated and/or tracheostomized patients over 1657 tube days (TDs) during 3 years. Fourteen occurred in 232 endotracheally intubated patients over 1075 endotracheal tube (ETT) days, and five occurred in 44 tracheostomized patients over 580 tracheostomy TDs. Fifteen accidents were due to blocked tubes. Rest four were unplanned extubations, all being accidental extubations. All blockages occurred during night shifts and all UEs during day shifts. Five accidents were mild, the rest moderate. No major accident led to cardiorespiratory arrest or death. All blockages occurred after 7^{th} day of intubation. The outcome of accidents were more favorable in tracheostomy group compared to ETT group ($P = 0.001$)[15]. The proportion of moderate outcomes was higher ETT blockage compared to tracheostomy blockage (90% vs. 20%) (P = 0.007).

A prospective study was done to assess critical events was performed in a 13-bedded multidisciplinary ICU of Dr. RML Hospital, New Delhi over a period of 6 months, i.e., from January to June 2006. These events can be classified into mechanical errors and human errors. In this study, 29.62% events were due to mechanical errors and 70.37% due to human errors. Endotracheal tube blockade, which could be because of thick secretions or kinking and it accounted for 7.40% of total human errors observed[16].

The study was done to identify airway-associated patient safety incidents submitted to the UK National Patient Safety Agency from critical care units in England and Wales. They identified 1085 such airway incidents submitted in the two years from October 2005 to September 2007.

Three hundred and twelve incidents (28.8%) involved neonates or babies. Of the total 1085 incidents, 200 (18.4%) were associated with tracheal intubation, 53 (4.9%) with tracheostomy and 893 (82.3%) were post-procedure problems. One hundred and ten incidents (10.1%) were associated with more than temporary harm. Eighty-eight intubation incidents were associated with equipment problems. Partial displacement of tubes resulted in more than temporary harm to the patient more frequently than complete tube displacement (15.7% vs 3.8%) [17]. The number of incidence ETT and TT blockage has 28(11%) babies & 51(8%) adults/children. ETT blockage has 26(98%) babies and 7(14%) adults/children, TT blockage has 1(4%) babies and 42(82%) adults/children.

A prolonged observational study of tracheal tube displacements: Benchmarking an incidence <0.5-1% in a medical-surgical adult intensive care unit, 14-may-2014, India. This was a prospective observational study of Intubated and ventilated patients in a General Medical-Surgical Adult ICU. The incidence of accidental extubation, self extubation, partial displacement and blockages of tracheal tubes were recorded. The Results was overall tracheal tube displacement rate was 61/10,112 (0.6%) per patient and 61/28,464 (0.22%) per tracheal tube day. There were **30** additional incidents of blockage, kinking or biting of the tracheal tube. Physiological consequences-69 were mild, 10 moderate, 12 major and one death. Of the 91 accidents, 30 were partly and 30 were completely preventable. 76 incidents involved an endotracheal tube (54 displaced, 12 blocked and 10 bitten-kinked) and 15 a tracheostomy tube (seven displaced and eight blocked). Accidents were more common in medical than surgical patients (medical = 48, cardiac surgical = 17 and other surgical/trauma = 26)[23].

3. OBJECTIVES

3.1. General objectives

- To assess the Incidence and Associated risk factors of ETT and TT blockage in ICU patients at TASH.

3.2. Specific objectives

- To assess the incidence of ETT and TT blockage in ICU patients.

- To identify the associated risk factors of ETT and TT blockage in ICU patients.
- To identify cause of ETT and TT blockage in ICU.
- To assess the degree of ETT and TT blockage in ICU.
- To assess the outcome of ETT and TT blockage

4. Methodology

4.1. Study area/setting and period

The study was conducted at TASH which is found in Addis Ababa (capital city of Ethiopia). TASH is the largest referral hospital in the country, with 700 beds, was established in 1972 and serving as a teaching specialized hospital for medical students'/health science. In 1998, TASH was transferred to Addis Ababa University from the Federal Ministry of Health, and it has since become a University teaching specialized hospital. TASH is now the main teaching specialized hospital for both clinical and preclinical training of most disciplines. It is also an institution where specialized clinical services that are not available in other public or private institutions are rendered to the Ethiopia. It serves about 250,000 patients per year in its outpatient department and about 24,000 in the inpatient and same number in the emergency departments.

The first ICU has started since 1970s with a separate discipline like adult surgical ICU, medical ICU and pediatric ICU but there were not as such organized and also has lack monitors. After a time the multidisciplinary ICU has started since 2000 at 4th floor which has pediatric, surgical and medical ICU with a total of 16 beds from those 4 beds are to pediatric patients, 12 beds are for adult surgical and medical. During the study time there are a total of 61 nurses from them, there is one overall coordinator and 3 of them are coordinator on each discipline. 58 nurses are actively working on each disciplinary ICU and there are 4 groups working by shift during day and night. The nurse to patient ratio is 1:3-4 there shift time. There are consultants on each discipline who has a weekly base Rota round of Anesthesiologists and monthly Rota round from Internists and pediatrician. If there is consultation from ICU to any department who are consulted come to ICU to managing patients. There are Anesthesiology residents who are

monthly Rota from Anesthesiology department and attaching residents who come from other departments'. There are also cleaner from outsource, 3 porters', 2 Bio technician, 2 oxygen technician. The ICU has its own admission and discharge protocol and also essential drug list for ICU. There are guidelines of ICU on infection prevention and human trafficking. The study was conducted from March to August, 2018.

4.2. Study design

A prospective cross-sectional study was done in pediatric and adult medical/surgical ICU from Marchs to August, 2018 at TASH.

4.3. Source of population

The source of population was all pediatric and adult patients admitted in ICU at Tikur anbesa specialized hospital during the study period.

4.4. Study Population

All intubated patients in ICU during the time of study period.

4.5. Sample size determination

The Sample size was calculated using EPI info version 7 statistical package for sample size calculation. Taking an assumption the incidence of ETT and TT blockage in Intubated ICU patients to be 50% to obtain a confidence interval of 95% (z = 1.96) and a power of 80%. There for, the sample size is calculated to be **384**.

$$n = \frac{z^2 p(1-p)}{w^2}$$

n = required sample size

p = incidence of ETT and TT blockage

w = margin of error

Finite population formula n=no/ (1+no/N) = **217**

Patients who satisfy the inclusion criteria and those who will be found during the data collection period will be included in the study until the sample size reaches up to **239** after we add 10%.

4.6. Sampling technique

All admitted patients who were intubated by ETT and TT during time of data collected and those who were included in inclusion criteria that had consent taken from family.

4.7. Inclusion and Exclusion Criteria

- **Inclusion criteria**
  - ✓ Admitted patient in Pediatric, Adult surgical and medical ICU who were intubated that had consent.
- **Exclusion criteria**
  - ✓ Patients who are not included in the inclusion criteria.

4.8. Data collection tools and materials

Six Anesthesiology residents who were working in ICU during the time of study at TASH were recruited as data collectors and perform the assessment of ETT and TT blockage in the pediatric ICU, surgical and medical ICU of the hospital. After the questionnaires were pre- tested to assess clarity, sequence, consistency, understandability and for total time it takes before the actual data collection.

Finally necessary comments and feedbacks were incorporated for the final instrument. A supervisor and the principal investigator were supervising the overall data collection process and consistency of the questionnaires and corrected immediately.

4.9. Study variables

Dependent variables

- Partial or complete ETT/TT blockage

Independent variables

- Socio-demographic data

- Age,
- Sex,
- Wards
- Diagnosis

- Risk factors of ETT or TT blockage
  - Frequency of suctioning
  - Size of ETT or TT
  - Duration of ETT or TT in placed
  - Type of tube
  - Indication for mechanical ventilator
  - Mode of ventilation
  - Humidification
  - Cigarette smoking
  - Comorbid diseases
  - Flow of oxygen through tube which was not on mechanical ventilator

4.10. Data Quality Assurance

After structured and formatted questionnaire was developed, then pre tested questionnaire was used to collected data. .All the data collectors were received one day training on the purpose of the study, how to effectively collected data and how to approach families to took consent. In addition, the completeness of each collected data was assessed by the principal investigator.

4.11. Data analysis and Interpretation

After data cleaning and entry, analysis was done using the Statistical Package for Social Sciences (SPSS) 23 version. Descriptive and analytical statistics was used as applicable. Statistically significant association will be taken for p values of <0.05.

4.12. Operational definition

Blocked endotracheal tube [BET]: The tube is blocked partially or completely by mucus, debris or food particles. The patient has unable to breathe through ETT and the ETT tube has unable to pass suction catheter during suctioning. To diagnosed ETT blockage, if manual bag

ventilation became difficult or mechanical ventilation showed high airway pressure or by noting that the lumen of the replaced tracheal tube was occluded requiring reintubation. Clinically tube blockage define as agitation, diaphoresis, tachypnea of the patient and also there was no chest rising. The last confirmation of tube blocked was watch the tube lumen after extubated the patient whether the blockage was partial or complete, the other way the tube was blocked without extubation was rollout disease condition look mechanical ventilator alarming and clinical signs of tube blockage. The ETT or TT blockage can lead to life□threatening hypoventilation and hypoxia. It usually occurs due to a large plug of inspissated mucus or a piece of crusted secretion and presents as an airway emergency. Their presence is often vague and nonspecific in ICU settings, where patient's disease condition itself shares same signs and symptoms many times.

Blocked TT [BTT]): The patient has unable to breathe through TT and the TT tube has unable to pass suction catheter during suctioning. To diagnosed ETT blockage, if manual bag ventilation became difficult or mechanical ventilation showed high airway pressure or by noting that the lumen of the replaced tracheal tube was occluded requiring reintubation. The last confirmation of tube blocked was watch the tube lumen after extubated the patient whether the blockage is partial or complete, the other way the tube was blocked without extubation is rollout disease condition look mechanical ventilator alarming and clinical signs of tube blockage.

Partial blocked: Partial blocked was the tube pass suction catheter through it or may not passed the suction catheter and may have respiratory destress like agitation, diaphoresis, and high air way pressure or not. The blockage was confirmed after extubating the patient.

Complete blocked: It was a blockage which cannot pass suction catheter through the tube and also desaturation, agitation, diaphoresis, and high airway pressure. The blockage was confirmed after extubating patient by looking the ETT/TT tube.

Pre-oxygenation – refers to the administration of oxygen before suctioning.

Humidification –defined as increasing the moisture content of the inspired air.

Heat Moisture Exchanger (HME) –a cylindrical device (passive humidifier) that is attached to the ETT tracheostomy tube to trap heat and moisture from the patient's exhaled gas and a proportion of it delivered during inspiration.

Displacement of tracheal tube: The intubated tube has miss place out of the tracheal lumen or deep in to the bronchus.

Kinked tubes: The tube has flexed or tied by the fixing tube material.

Tracheal Suctioning: It is a means of clearing the airway of secretions or mucus through the application of negative pressure via a suction catheter.

4.13. Ethical considerations

Ethical clearance was obtained from the Department of Anesthesiology Research committee and the Institutional Review Board (IRB) of the College of Health Science. The attendants were clearly informed about the purpose of the study and the information required from them. The families were also be told that the patient has the full right of non-involvement and the right to stop the interview at any point in time. Written assent was obtained from all the study participants' families. Participant confidentiality was assured. Patients who refuse to take part in the study were received the same quality of health care service as the participants. All participants included in the study were kept anonymous during subsequent analysis and dissemination.

4.14. Dissemination of findings

The result of the study will be presented on the research defense day and a formal report will be submitted to the Department of Anesthesiology. The research output will also be disseminated to all responsible bodies in the study area, for the hospital where the study is conducted, surgical and medical ICU, pediatric ICU and Addis Ababa University, college of health sciences, school of medicine anesthesiology and, MOH. The research output will also be published on scientific journals.

5. Results

5.1. Socio-Demographic Characteristics

A total of 276 patients were admitted to medical, surgical and pediatric ICU from those 122 patients were intubated with ETT/ TT over 6 months of study period. Those intubated patients were 30 medical ICU, 40 pediatric ICU and 52 surgical ICU Patients were evaluated. From those intubated patients the incidence of ETT and TT blockage were 20 (16.4%), and from those patients were surgical ICU 9 (17.3%), medical ICU 5 (16.7%) and pediatric ICU 6 (15%)

developed tube blockage either partial or complete. The minimum age of developed tube blockage were 5 months and the maximum age was 70 years, with mean age of 29.9 years ± 21.4years. The cause of tube blockage was more by mucus which was 11 (55%) and one tube kinking was occurred in pediatric ICU 1 (5%). Tube blockage according to sex was male and female 12(60%) vs 8(40%) respectively, but it was not statistically significant. Males were greater number compare to females which was 12(60%) Vs 8(40%) respectively. (See table 1 & fig. 2)

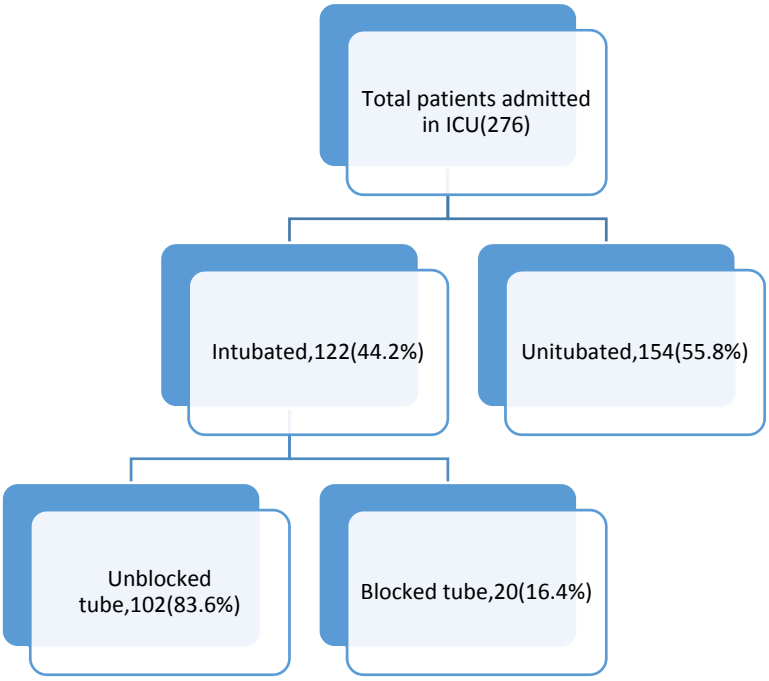

Figure1. Hierarchy chart of collected data and analyzed data

Table 1: descriptive of Socio-demographic Characteristics of ETT/TT tube blockage who were admitted in ICU at TASH from March to august, 2018.

Variable	Frequency	Percentage	P – value	Remark
Age group				
5months- 8years	6	30		
18-41 years	8	40	.896	
42-70 years	6	30		
Sex				
Male	12	60	.669	
Female	8	40		
Ward				
Surgical ICU	9	17.3		
Medical ICU	5	16.7	.806	

Paediatric ICU	6	15		
Specific dx GBS Respiratory disease Stroke Trauma	 2 10 2 6	 10 50 10 30	.013	Trauma (TBI, chest inj.), RD (ARDS, CAP, sepsis)

5.2. The incidence of ETT/TT blockage and degree of blockage

From a total of 122 intubated patients 20 were developed ETT/TT blockage, with the incidence of 16.4% (table-2). The incidence of blocked was higher in endotracheal tube were intubated patients than tracheostomy tube (80% vs 20%) (P=0.042), so It is clinically significant. Five ETT blocked were occurred in medical ICU, nine in surgical ICU and six in pediatric ICU patients, from those ETT blockage16 (80%) and TT blockage were 4(20%). The TT blockage was occurred 2 in medical ICU and 2 in surgical ICU patients. (See table 2).

The severity of ETT/TT tube blockage was higher in the ETT group compared to the TT group (Table 2). The degree of blocked was similar ether partial blocked 10 (50%) and complete blocked 10(50%). The high number of tube blockage were occurred during the night shift accounts 11 (55%), but relatively lower in number during the day shift were accounts 9(45%), even though it was not statistically significant, so the reason behind the difference between night and day shift tube blockage, during night shift might been smaller in number that means the ratio of nurse to patient ratio was 1:3/4 during night shift but during day shift ratio was 1:2/3 and also more health provides were managing patients in ICU. (See table 2 & figure 3). According to the time of ETT/TT tube days, higher in number which had seven and more tube days which was 7(35%) otherwise the rest of tube days has similar in number.(see table 2)

Table 2: Description of ETT/TT blockage who were admitted in ICU and intubated at TASH from March to august, 2018.

Variable	Frequency	Percentage	P - value
Type of tube blocked ETT TT	 16 4	 80 20	.042
Degree of tube blocked Partial Complete	 10 10	 50 50	
Episode 1 episode 2 episode 3 and above	 16 3 1	 80 15 5	.884
When blocked Day shift	 9 11	 45 55	.833

Night shift			
Mode of ventilation CMV/ A/c SIMV CPAP Spontaneous breathing	 7 10 3 0	 35 50 15 0	.076

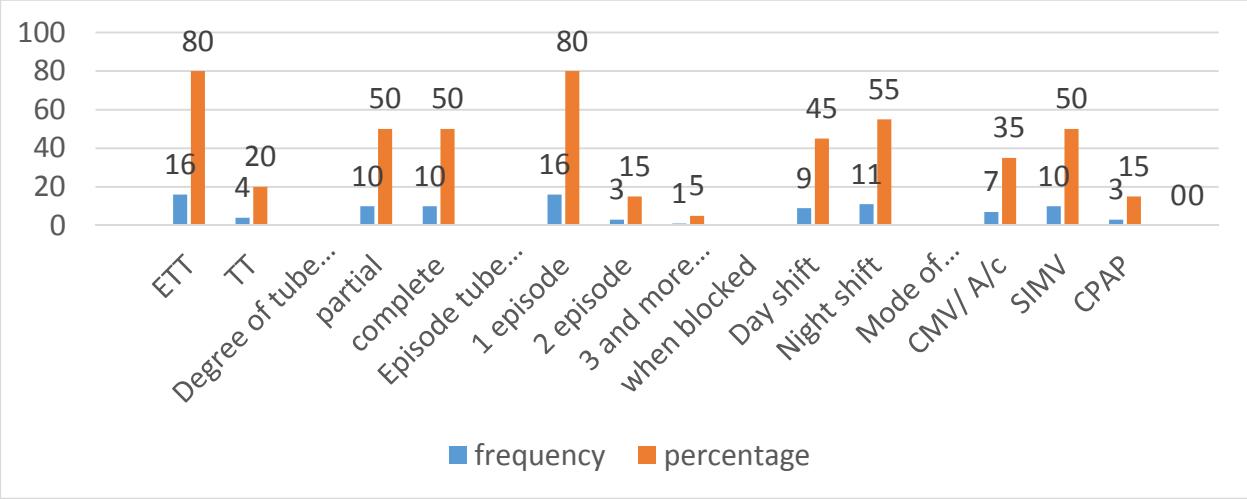

Figure 2: Description of ETT/TT blockage who were admitted in ICU at TASH from March to august, 2018.

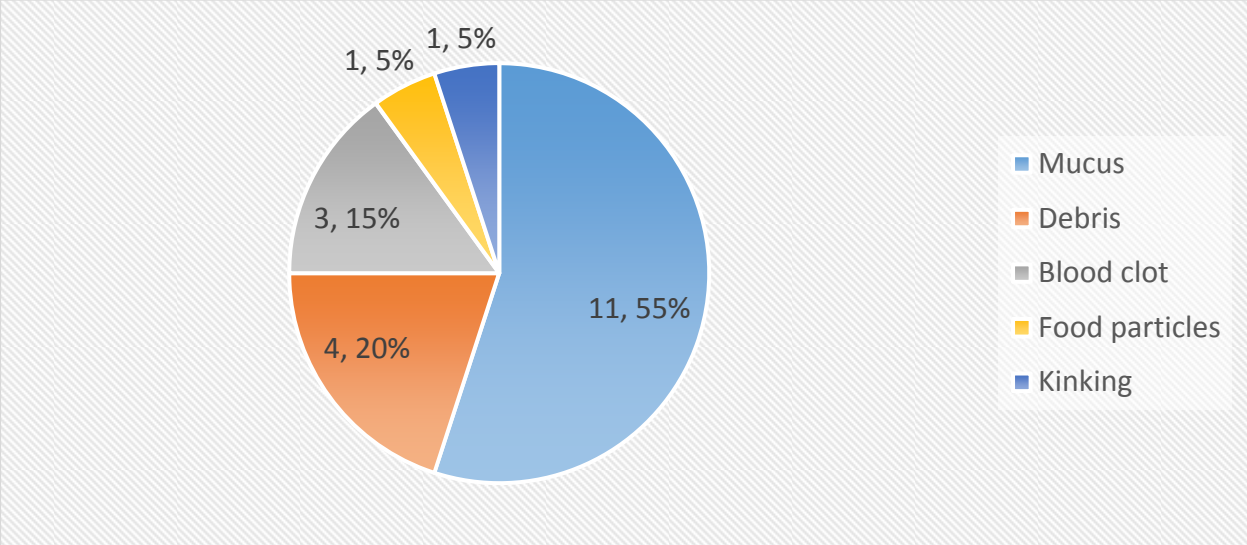

Figure 3: The cause of ETT/TT blockage were admitted in ICU at TASH, March to august 2018.

5.3. The risk factor of ETT/TT tube blockage

There was association risk factor between ETT/TT blockage and respiratory disease even through there were clinical significant because from specific Diagnosis respiratory disease 10 (50%) (P=.013), GBS 2(10%), stroke 2(10%) and trauma 6(30%). The most cause of tube blockage was mucus accounts 11(55%), followed 4(20%). Smoking was accounted 3(15%) and non-smokers were 17(85%) with P value of .028, so It is clinically significant. The ETT/TT tube day had higher number, which the ETT/TT tube day greater than seven days was higher tube blockage 7(35%) (See table 3 & figure 4). The frequency of suctioning was high number between 2_4 hours which accounts 10(50%) even those, it is not statistical significant (P-.227).

Table 3. The risk factors tube blocked in ICU patients, March to august, 2018.

Variable	Frequency	Percentage	P – value	Remark
Smoking				
Yes	3	15	.028	
No	17	85		
Comorbid				Down's 2, HTN 2,DM, CHD
Yes	9	45	.395	
No	11	55		
Suctioning				
Every <2 hr	2	10		
2-4 hr	10	50	.227	
4-6 hr	3	15		
When needed	5	25		
Hole of suction catheter				
Tip of tube	6	30		
Side of tube	5	25	.320	
Both sides	9	45		
Size of ETT/TT				
7-7.5	9	45		
6-6.5	5	25	.682	
4.5-5.5	4	20		
3-4	2	10		
Cause of tube blocked				
Mucus	11	55		
Debris	4	20		
Blood clot	3	15	.523	
Food particles	1	5		
kinking	1	5		
Duration on ETT/TT				
<24 hr	2	10		
24 hr-3days	5	25		
3-5 days	5	25	.294	
5-7 days	1	5		
➢ 7 days	7	35		
Gas heat/moisture				
Yes	3	36.1	.374	

No	17	65.2		
Use of N/S during suction Use of N/S When need N/s Never use N/s	 3 15 2	 60.6 36.8 6.6	 .833	

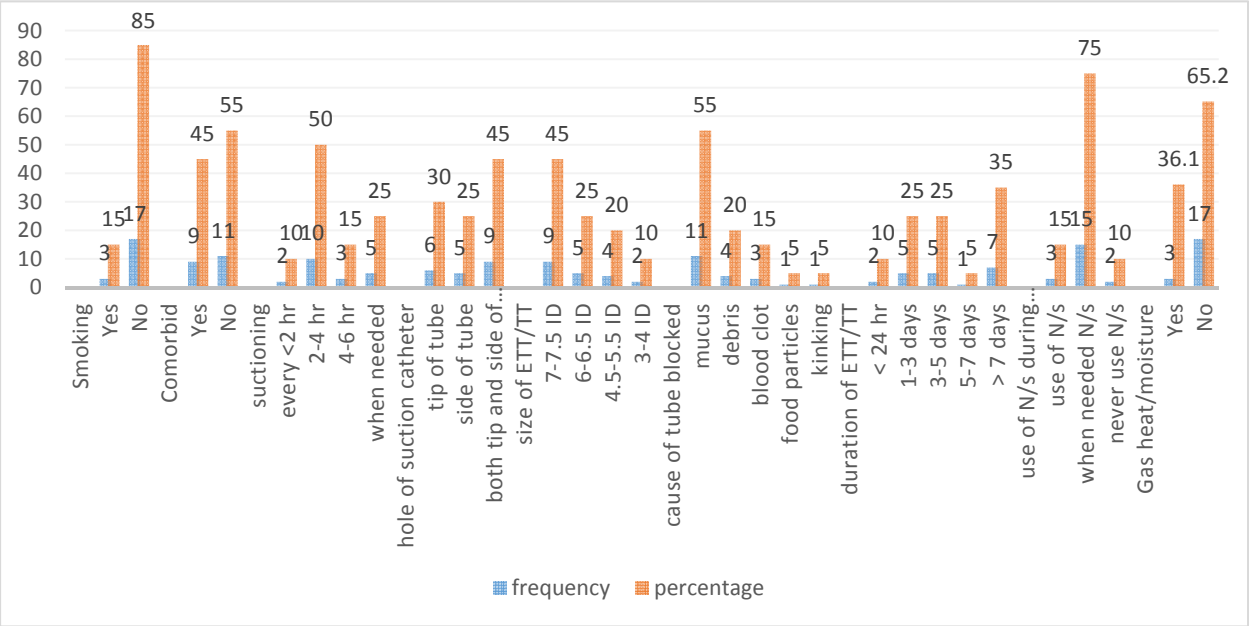

Figure 4. Descriptive statistics of risk factors to developed ETT/TT blockage variables who were admitted at TASH ICU ward, Addis Ababa, Ethiopia

5.4. The outcome of ETT/TT tube blockage

The outcome of ETT/TT blockage had a sign of agitation, high RR and high airway pressure as the same time most of patients whose account 10(50%). Hypoxia was the most complication of ETT/TT tube blocked patients. There were 3(15%) cardiac arrest patients, and from them 2(10%) death, those were from ETT blockage, but no cardiac arrest and death from TT tube blockage. The death was high number even those statistically no significant which was P value of .418. (See table 4 and figure 5). From 20(16.4%) of tube blockage 5 of them had removed blocked material during suctioned and 15 of them had not removed blocked material, so the patient was extubated and re intubated with new ETT tube. The TT blockage material was removed during suctioned.

Table 4. Descriptive statistics of ETT/TT tube blockage of patient outcome

Variable	Frequency	Percentage	P – value
Sign of tube blockage			
Agitation	2	10	.418
High RR	4	20	
High airway pressure	4	20	
Respiratory destress	10	50	
Impact of ETT/TT blockage			
Bradycardia	2	10	.482
Hypoxia	20	100	
Cardiac arrest	3	15	
Death	2	10	
Re-intubation	15	75	

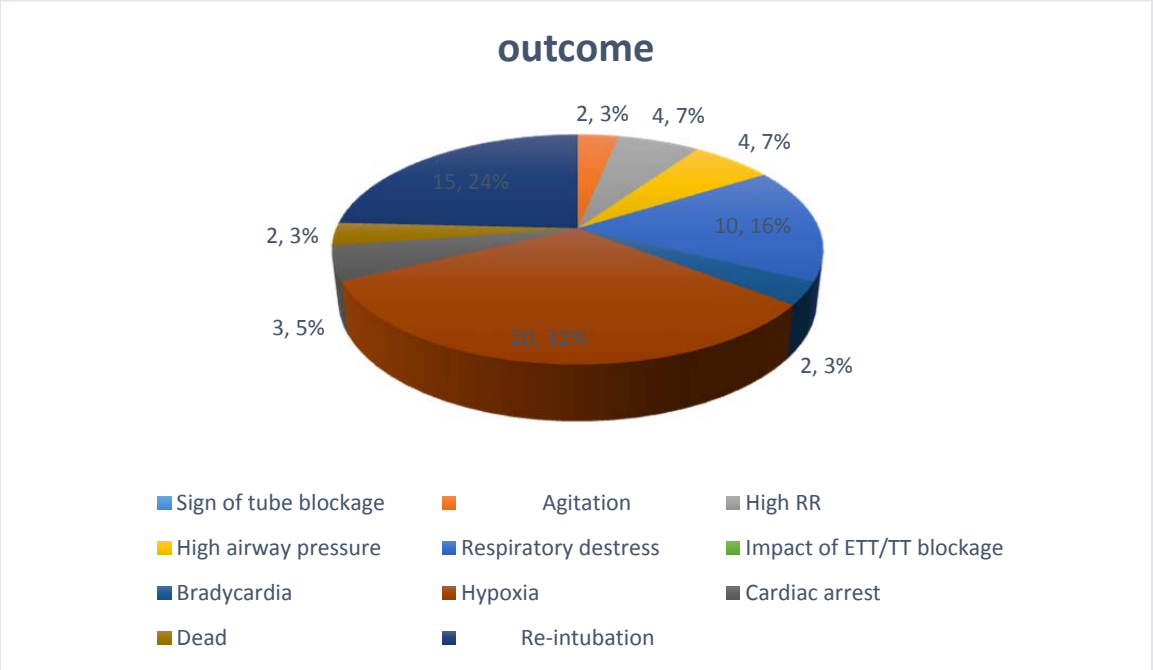

Figure 5. Descriptive statistics of ETT/TT tube blockage of patient outcome

6. Discussion

This research was done from a total of 276 admitted patients, of these 154 (55.8%) unintubated and 122(44.2%) patients were intubated. From intubated patients the incidence of ETT/TT tube blockage were 20(16.4%) among patients admitted in ICU at TASH from March to august 2018. Tube blockage is frequently encountered problem in patients on ET and TT which was typically manifested by either high airway pressures or inability to pass a suctioning catheter.

In my study, the incidence of ETT/TT tube blockage was 20(16.4%) from a total of 122 patients with mean and standard deviation of 29.9 ± 24.4 years of age. The most cause of ETT/TT blocked was mucus 11(55%) and followed by debris 4(20%). The degree of blocked which was partial and complete tube blocked (50% vs 50%) that means, it is similar. (See table 5)

Table 5. Description data of incidence and associated risk factors of ETT/TT tube blockage from March to august 2018.

Variable	Frequency	Percentage	P value
Type of tube blocked			
ETT	16	80	.042
TT	4	20	
Degree of tube blocked			
Partial	10	50	.025
Complete	10	50	
When blocked			
Day shift	9	45	.833
Night shift	11	55	
Smoking			
Yes	3	15	.028
No	17	85	
Cause of tube blocked			
Mucus	11	55	.523
Debris	4	20	
Blood clot	3	15	
Food particles	1	5	
kinking	1	5	
Duration on ETT/TT			
<24 hr	2	10	
24 hr-3days	5	25	

3-5 days 5-7 days ➢ 7 days	5 1 7	25 5 35	.294

My result was slightly lower because of small data was collected and short time of data collected, which was blocked by mucus was 11(55%), debris 4(20%), blood clot 3(15%), food particles 1(5%), kinking 1(5%), so compared to a retrospective study was done in India, to assess Endotracheal or Tracheostomy Tube Blockage and their Impact among the patients in ICU**,** Data were collected retrospectively from the ICU assessment record of patients admitted from November 2012 to October 2014 The result showed that**,** a total of 975 intubated patients (mean standard deviation 46.32 [18.21] years of age; 515 medical and 460 surgical patients) were evaluated for the study. The cause of tube blockage was mostly because of inspissated secretions (92.15%), followed by blood clotting (7.85%) among the noted cases. The degree of blocked tube was partial/near complete blockage cases were more than those of complete blockage (92.8 vs. 7.2%) among the mentioned cases[12]. And also the study was done to identify airway-associated patient safety incidents submitted to the UK National Patient Safety Agency from critical care units in England and Wales, from October 2005 to September 2007. The number of incidence ETT and TT blockage has 28(11%) babies & 51(8%) adults/children. ETT blockage has 26(98%) babies and 7(14%) adults/children, TT blockage has 1(4%) babies and 42(82%) adults/children[17]. The other study also done in India, a prospective study was done to assess critical events was performed in a 13-bedded multidisciplinary ICU of Dr. RML Hospital, New Delhi over a period of 6 months, i.e., from January to June 2006. Endotracheal tube blockade, which could be because of thick secretions or kinking and it accounted for 7.40% of total human errors observed[16].

The incidence of tube blockage higher in my study. The discrepancy between this studies may be the size of data difference between two studies done in Indian ICU and TASH in ICU, Ethiopian.

A study was done Tata Memorial Hospital, Mumbai, to assess airway accidents in an ICU between June 2001 and January 2002, all adult patients admitted to the ICU with either an endotracheal tube or tracheostomy were included in the study. The Result showed that, 781 patients (1440 tube days) were studied. 665 patients (951 tube days) required an endotracheal

tube. 116 patients (489 tube days) had a tracheostomy. 697 patients (697 tube days) required STI while 84 patients (743 tube days) required LTI. Overall there were 55 airway accidents with an incidence of 7.04% of patients and 3.82 /100 tube days. The airway accident rate was 4.02 / 100 TD's and 3.63/ 100 TD's for STI and LTI, respectively, and 4.21 / 100 TD's and 3.07 /100 TD's for endotracheal intubation and tracheostomy, respectively. Blocked tubes (2.15 per 100 TD's) and unplanned extubations (1.32 per 100 TD's) were the most common airway accidents[13].

In my study, the Incidence of ETT/TT tube blockage was 20(16.4%) from 122 intubated patients and the duration of tube day less than 1 day 2(10%), 1-7 day 5(25%) and greater than 7 tube 7(35%), so the tube blockage more in those intubated time was increased as a study was done in Tata Memorial Hospital, Mumbai, to assess airway accidents in an ICU between June 2001 and January 2002, all adult patients admitted to the ICU with either an endotracheal tube or tracheostomy were included in the study. All most similar result between this studies.

A case report on 11/01/2017G.C, about masked blocked tracheostomy tube in Malaysia, The patient remained well until the next morning; when he complained of dyspnea. Pulse oximeter showed 90% saturation. Testing the patency of the tube, there was blow to the cotton wool test applied, indicating a patent lumen. After a gentle suction, the oxygen picked up to 95% but constantly remained at the level. On the next morning, it desaturated again to 90%. Minimal clot was suctioned out from the tube. Owing to the recurring desaturations and presence of clot at the suction tip, the decision to change to a new tube was made even though it was just 48 hours after procedure. The tip of the tube was 75% blocked with clot, and the whole-length of the tube was filled with blood. After the successful change, the saturation picked up to 98% and the patient was comfortable throughout the day on wards[14]. In the present case, the neck was operated for thyroidectomy more than 10 years prior, and the amount of scarred tissue cannot be underestimated (Mohamad et al., 2015). Most of the complications occur in the early post-operative period (Lee et al., 2016).

In my study done for 6 months the Incidence of ETT/TT tube blockage and associated risk factor in pediatric, adult surgical and medical ICU patients at TASH, so the pulse oximeter reading showed 55% to 88% saturation, after intervention the oxygen saturation improved 92% to 100%, It was similar results, but the desaturation was more in my study compared to with to a case

report on 11/01/2017G.C, about masked blocked tracheostomy tube in Malaysia, (Mohamad et al., 2015) because the setup and nurse-patient ratio was higher in Malaysia.

A retrospective study was done to assess all tracheal tube related accidents over 3 years (January 2012–December 2014) in a 5-bedded CCU (medical and surgical) under the Department of Anesthesiology public Teaching Hospital of Eastern India. The total accident rate was 19 in 233 intubated and/or tracheostomized patients over 1657 tube days (TDs) during 3 years. Fourteen occurred in 232 endotracheally intubated patients over 1075 endotracheal tube (ETT) days, and five occurred in 44 tracheostomized patients over 580 tracheostomy TDs. Fifteen accidents were due to blocked tubes. Rest four were unplanned extubations, all being accidental extubations. All blockages occurred during night shifts and all UEs during day shifts. Five accidents were mild, the rest moderate. No major accident led to cardiorespiratory arrest or death. All blockages occurred after 7^{th} day of intubation. The outcome of accidents were more favorable in tracheostomy group compared to ETT group ($P = 0.001$)[15]. The proportion of moderate outcomes was higher ETT blockage compared to tracheostomy blockage (90% vs. 20%) (P = 0.007).

In my study cardiac arrest was happened from 20 ETT/TT tube blocked 3 were cardiac arrest and 2 of them were dead from cardiac arrested patients. All of them were ETT tube blocked, so similar outcome, but there were no death in India because of the difference between the setup and tube care in my study area was lower than a retrospective study was done to assess all tracheal tube related accidents over 3 years (January 2012–December 2014) in a 5-bedded CCU (medical and surgical) under the Department of Anesthesiology public Teaching Hospital of Eastern India. Also there were two studies done in UK and New Delhi had lower result compared to my study which was 20(16.4%). The discrepancy was significant because of a higher setup and higher ETT/TT tube care compared to my study area.

A prolonged observational study of tracheal tube displacements: Benchmarking an incidence <0.5-1% in a medical-surgical adult intensive care unit, 14-may-2014, India. This was a prospective observational study of Intubated and ventilated patients in a General Medical-Surgical Adult ICU. The incidence of accidental extubation, self extubation, partial displacement and blockages of tracheal tubes were recorded. The Results was overall tracheal tube

displacement rate was 61/10,112 (0.6%) per patient and 61/28,464 (0.22%) per tracheal tube day. There were **30** additional incidents of blockage, kinking or biting of the tracheal tube. Physiological consequences-69 were mild, 10 moderate, 12 major and one death. Of the 91 accidents, 30 were partly and 30 were completely preventable. 76 incidents involved an endotracheal tube (54 displaced, 12 blocked and 10 bitten-kinked) and 15 a tracheostomy tube (seven displaced and eight blocked). Accidents were more common in medical than surgical patients (medical = 48, cardiac surgical = 17 and other surgical/trauma = 26)[23].

In my study time, there were TT tube blocked 4(20%) developed and the impact was hypoxia, but no cardiac arrest as well as death. So the discrepancy of this study may be the smaller data was collected, the short duration of the study period and low setup compared to a prolonged observational study of tracheal tube displacements, in India.

7. Conclusion and recommendation

7.1. Conclusion

- ✓ In my study the incidence of ETT/TT tube blockage was 20 (16.4%). The ETT/TT tube blocked cause by mucus 11 (55%) higher than the rest of causes next to mucus was debris. One tube kinking was developed in pediatric ICU.

7.2. Recommendation

- ✓ Standard operating procedures should be available, like ETT/TT tube suctioning service for intubated patients.
- ✓ Heat/moisture should be available for all mechanical ventilators.
- ✓ Researchers should better to do a research using design and methods for longer period to have adequate data.
- ✓ Most of the ETT/TT blocked occur during night shift, so health care provider must increase in number during night shift (nurse to patient ratio 1:1 or 1:2).

8. Strength and Limitation of the study

8.1. Strength of the study

- ✓ The first time to study ETT/TT blockage in ICU at TASH.

- ✓ A prospective cross sectional study.
- ✓ Data regarding quality was good.

8.2. Limitation of the study

- ✓ The sample size was small.
- ✓ There is no standard definition of ETT/TT tube blockage.
- ✓ The study period was short.
- ✓ This study was not done by using regression data analysis.

9. References

1. Szmuk P, Ezri T, Evron S, Roth Y, Katz j. A brief history of tracheostomy and tracheal intubation, from the Bronze Age to the Space Age. Intensive Care Med 2008; 34: 222-8.

2. Kapadia FN, Bajan KB, Raje KV. Airway accidents in intubated Intensive Care Unit patients: An epidemiological study. Crit Care Med 2000;28:659□64.

3. Aparna C, Saeeda I, Divatia JV. Airway accidents in an Intensive Care Unit. Indian J Crit Care Med 2004;8:36□9.

4. Husain T, Gatward JJ, Hambidge OR, Asogan M, Southwood TJ. Strategies to prevent airway complications: A survey of adult intensive care units in Australia and New Zealand. Br J Anaesth 2012;108:800□6.

5. Amato MRP, Barbas CSV, Medeiros DM, et al. Effect of protective ventilator strategy on mortality in acute respiratory distress syndrome. N Eng J Med 1998;338:347-54.

6. Vallverdu I, Mancebo J. Approach to patients who fail initial weaning trials. Respir Care Clin N Am 2000;6(3):365–384.

7. Gracey DR. Options for long-term ventilatory support. Clin Chest Med 1997;18(3):563–576.

8. Scheinhorn DJ, Chao DC, Stearn-Hassenpflug M. Approach to patients with long-term weaning failure. Respir Care Clin N Am 2000; 6(3):437–461.

9. Girault C, Briel A, Hellot MF, Tamion F, Woinet D, Leroy J, Bonmarchand G. Noninvasive mechanical ventilation in clinical practice: a 2-year experience in a medical intensive care unit. Crit Care Med 2003;31(2):552–529.

10. Esteban A, Frutos F, Tobin MJ, Alia I, Solsona JF, Valverdu I, et al. A comparison of four methods of weaning patients from mechanical ventilation. N Engl J Med 1995;332(6):345–350.

11. Keenan SP, Powers C, McCormack DG, Block G. Noninvasive positive-pressure ventilation for postextubation respiratory distress: a randomized controlled trial. JAMA 2002;287(24):3238–3244.

12. Habib Md. Reazaul Karim, Md. Yunus, Prithwis Bhattacharyya Department of Anesthesiology and Critical Care, North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences, Shillong, Meghalaya, India.

13. Airway accidents in an intensive care unit Aparna Chatterjee, Saeeda Islam, J. V. Divatia; Tata Memorial Hospital, Mumbai.

14. Masked blocked tracheostomy tube Irfan Mohamada, Anuar Idwan Idris, Ikhwan Hakimi Mohamad in Department of Otorhinolaryngology-Head & Neck Surgery, School of Medical Sciences, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia.

15. Airway accidents in critical care unit: A 3□year retrospective study in a Public Teaching Hospital of Eastern India, Sugata Dasgupta, Shipti Shradha Singh, Arunima Chaudhuri1, Dipasri Bhattacharya, Sourav Das Choudhury.

16**.** A prospective study of critical events was performed in a 13-bedded multidisciplinary ICU of Dr. RML Hospital, New Delhi over a period of 6 months, i.e., from January to June 2006.

17.Patient safety incidents associated with airway devices in critical care: a review of reports to the UK National Patient Safety Agency: A. N. Thomas and B. A. McGrath, Intensive Care Unit, Hope Hospital, Salford, UK.

18. Markowicz P, Richard JD, et al. Safety, efficacy and cost-effectiveness of mechanical ventilation with humidifying filters changed every 48 hours: A prospective randomized study. Crit Care Med 2000;28:665-71.

19. Thomachot L, Leone M, Razzouk K. Randomized clinical trials of extended use of a hydrophobic condenser humidifier: 1 vs 7 days. Crit Care Med 2002;30:232-7.

20. Adair CG, Gorman SP, Feron BM, Byers LM, Jones DS, Goldsmith CE, et al. Implications of endotracheal tube biofilm for ventilatorassociated pneumonia. Intensive Care Med 1999;25(10):1072-1076.

21. Gil-Perotin S, Ramirez P, Marti V, Sahuquillo JM, Gonzalez E, Calleja I, et al. Implications of endotracheal tube biofilm in ventilatorassociated pneumonia response: a state of concept. Crit Care 2012; 16(3):R93.

22. INDIAN JOURNAL OF ANAESTHESIA, AUGUST 2005 312 PG ISSUE: AIRWAY MANAGEMENT

23. Farhad N. Kapadia, Pandurang C. Tekawade, Shruti S. Nath, Sharad S. Pachpute, Sanjay S. Saverkar, Rupali A. Bhise, Aarti C. Chavan, Sholly J. Varghese, Vidya U. Kantak, Rohini V. Kshirsagar, VaishalA.Neve, SamonO.D'souza, Hinduja Hospital, Mahim, Mumbai, Maharashtra, India

24. N. Thomas and B. A. McGrath, Intensive Care Unit, Hope Hospital, Salford, UK, Patient safety incidents associated with airway devices in critical care

25. American Association for Respiratory Care. AARC Clinical Practice Guidelines. Endotracheal suctioning of mechanically ventilated patients with artificial airways 2010. Respir Care 2010; 55(6):758-764.

26. Glass C, Grap MJ, Sessler CN. Endotracheal tube narrowing after closed-system suctioning: prevalence and risk factors. Am J Crit Care 1999;8(2):93-100.

27. Nolan JP, Kelly FE. Airway challenges in critical care. Anaesthesia 2011;66(Suppl 2):81-92.

28. Boque´ MC, Gualis B, Sandiumenge A, Rello J. Endotracheal tube intraluminal diameter narrowing after mechanical ventilation: use of acoustic reflectometry. Intensive Care Med 2004;30(12):2204-2209.

29. Shah C, Kollef MH. Endotracheal tube intraluminal volume loss among mechanically ventilated patients. Crit Care Med 2004;32(1): 120-125.

30. Heyer L, Louis B, Isabey D, Lofaso F, Brochard L, Fredberg JJ, Harf A. Noninvasive estimate of work of breathing due to the endotracheal tube. Anesthesiology 1996;85(6):1324-1333.

31. Villafane MC, Cinnella G, Lofaso F, Isabey D, Harf A, Lemaire F, Brochard L. Gradual reduction of endotracheal tube diameter during mechanical ventilation via different humidification devices. Anesthesiology 1996;85(6):1341-1349.

10 I. Annex

10.1. Individual consent form

Greeting

Hello, my name is _____ and I'm a data collector for the study entitled "the incidence and association risk factors of ETT and TT blockage in ICU at Tikur Anbessa Hospital". It is a study aimed to assess the incidence of ETT and TT blockage and their associated factors in this hospital.

Being a part of this study will not affect in any way the service you are getting in this hospital. You are selected to participate in the study just because your family admitted and intubated in ICU. You are free to withdraw your family from the study. In the study any assessment you are confidential and in addition your family name, address or any information that identifies your family will not be used.

Do you agree to participate in the study?

Principal investigator- Dr. Shimelis Mengitie

Mob. No. +251911583365

We would appreciate your response to us and I like to thank you for giving your time Name and signature of data collector ……

10.2. Questionnaire

ADDIS ABABA UNIVERSITY SCHOOL OF MEDICINE COLLEGE HEALTH SCIENCE

DEPERTEMENT OF ANESTHESIOLOGY

To study the incidence and associated risk factors of ETT or tracheostomy tube blockage in ICU.

Part I. SOCIO DEMOGRAPHIC CHARACTERISTICS

1. Age of the patient ……..

2. Sex a) Male b) Female

3. The admitted Ward of the patient

a) Surgical ICU b) Medical ICU c) Pediatrics ICU

4. Does the patient has history of smoking?

a) Yes b) no

5. Specific diagnosis of the patient_____, _____

6. Does the patient has comorbid diseases?

a) Yes b) no

7. Question no.6 if yes, specified it_____

8. Vital sign of the patient during ETT or TT blockage: Bp_____, PR_____, RR_____, Sao2_____

Part II. ETT and TT blockage and the risk factors of ETT or TT blockage

1. How frequent tube suctioning?
   a) Every 0-2 hr. b) 2-4 hrs. c) 4-6 hrs. d) When the patient has secretion
2. Is the patient pre oxygenated before suctioning?
   a) Yes b) no
3. The total episodes of ETT or TT blocked during the time of tube days ---
   a) 1 episode b) 2 episodes c) 3 episodes d) 4 & greater episodes
4. Does the oxygen supply has heat and moisture exchanger/moisture?
   a) Yes b) no
5. The hole of the suctioning catheter tube is---
   a) on the tip of tube b) on the side of the tube c) both on the tip & side of tube
6. The size of the ETT or TT (internal diameter) that has blocked_____
   a) ID 7-7.5 b) 6-6.5 c) 4.5-5.5 d) 3-4 e) 8 & above
7. What Type of intubated tube does the patent has?
   a) ETT b) TT c) others
8. What is the degree of ETT or TT tube blockage?
   a) Partial blocked b) complete blocked
9. What was the etiology of tube blocked?

a) Mucus b) debris c) blood clot d) food particle e) kinked by tied tube

10. What sign has the patient during tube blocked? Circle more than one.

a) Agitation b) high RR c) high air way pressure d) respiratory destress e) other list it_____

11. What was the duration of intubation?

a) <24 hrs. b) 24hrs-3daysc) 3-5 days d) 5-7 days e) > 7days

12. The indication of mechanical ventilator is -------

a) Respiratory failure b) airway protection c) other specified

13. Does the mechanical ventilator the gas supply tube has heat and moisture exchanger/moisture?

a) Yes b) no

14. Is the patient on feeding (NG tube)?

a) Yes b) no

15. What type of tube blockage does the patient has?

a) ETT blocked b) TT blocked

16. Is the blocked material in the tube has removed during suctioning?

a) Yes b) no

17. From Q.15, the answer is no, is the patient extubated?

a) Yes b) no

18. What was the adverse impact of the tube blockage?

a) Bradycardia (HR<60bpm) b) Hypoxia (sao2<92% with o2) c) cardiac arrest d) death

19. When the time of tube blockage was happened?

a) During day shift b) During night shift

20. Which vital sign has been affected during (ETT or TT) tube blocked? More than one circle.

a) High RR b) Drop in Sao2 c) tachycardia d) high Bp e) all

21. If a patient is on oxygen support through ETT or TT tube by oxygen catheter, specify the oxygen flow per liters _____

22. Is the patient on mechanical ventilator?

a) Yes b) no

23. If Q. no. 21 is yes, what mode of ventilator is the patient on?
    a) CMV/AC b) SIMV c)CPAP d) other mode
24. What medication is the patient taking? Specify it _____
25. How to suctioning the ETT or TT tube was done?
    a) Suctioning by N/S all the time b) suctioning by N/S when need c) Never use N/S suctioning

Thank you for your time and feedback

Contact information of the Principal investigator: **Shimelis Mengistie**

Tel. +251911583365

Email: shime4@gmail.com

Annex II. Declaration

I, the undersigned, graduating class of Anesthesiology residence student declared that this thesis is my original work in partial fulfillment of the requirement for specialty.

Name: - _____ Signature: - _____

Place of submission: Addis Ababa University, College Health sciences, School Medicine, Department of Anesthesia**.**

Date of Submission: _____

This thesis work has been submitted for examination with my/ our approval as university advisor(s).

Advisors

Name Signature

_____ _____