COLLEGE OF MEDICINE AND HEALTH SCIENCES

DEPARTMENT OF ANESTHESIA

MAGNITUDE AND PREDICTORS OF DIFFICULT TRACHEAL INTUBATION IN PATIENTS WHO UNDERWENT ELECTIVE THYROID SURGERY AT SELECTED ADDIS ABABA PUBLIC HOSPITALS, ETHIOPIA

INVESTIGATOR: HENOK YESHITILA (MSC STUDENT)

ADVISOR: SENAYIT AWOKE (BSC, MSC IN ANESTHESIA)

MISRAK W/YOHANES (BSC, MSC IN ANESTHESIA)

A RESEARCH THESIS SUBMITTED TO ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCE SCHOOL OF MEDICINE DEPARTMENT OF ANESTHESIA IN PARTIAL FULFILLMENT FOR THE REQUIREMENTS OF MASTER DEGREE IN ADVANCED CLINICAL ANESTHESIA

AUGUST, 2023

ADDIS ABABA, ETHIOPIA

ADDIS ABABA UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCES

DEPARTMENT OF ANESTHESIA

PRINCIPAL INVESTIGATOR	HENOK YESHITILA (MSC STUDENT) TEL: +251-912-758-441 E-MAIL: heniethi24@gmail.com
ADVISORS	1) SENAIT AWEKE (M.SC) 2)MISRAK W/YOHANES (M.SC) TEL: +251-911-356-468 TEL: +251-928-114-926 E-MAIL: senaweke@gmail.com E-MAIL: dzewege@yahoo.com
TITLE	MAGNITUDE AND PREDICTORS OF DIFFICULT TRACHEAL INTUBATION IN PATIENTS WHO UNDERWENT ELECTIVE THYROID SURGERY. MULTICENTER CROSS SECTIONAL STUDY.
STUDY PERIOD	DEC- 2022 – MAR- 2023
STUDY AREA	AT SELECTED PUBLIC HOSPITALS, IN ADDIS ABABA, ETHIOPIA
THE TOTAL COST OF THE PROJECT	26913.6 ETHI BIRR

ADDIS ABABA UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCES

DEPARTMENT OF ANAESTHESIA

MAGNITUDE AND PREDICTORS OF DIFFICULT TRACHEAL INTUBATION IN PATIENTS WHO UNDERWENT ELECTIVE THYROID SURGERY AT ADDIS ABABA SELECTED PUBLIC HOSPITAL, ETHIOPIA, 2023.

Submitted by

	Signature	Date
Henok Yeshitila (MSc student)	__________	___________

Approved by Advisors:

	Signature	Date
1. Mrs. Senait Aweke (MSc. Lecturer)	__________	_____________
2. Mrs. Misrak W/Yohanes (MSc. Lecturer)	__________	_____________

Approved by board of examiners:

Name	Signature	Date
____	__________	________________

Name	Signature	Date
____	__________	________________

ABBREVIATIONS AND ACRONYMS

ASA: American Society of Anesthesiology

BMI: - Body Mass Index

DTI: - Difficult Tracheal Intubation

DMH: - Dagmawi Minilik hospital

IIG: - Inter Incisor Gap

IDS: - Intubation Difficulty Score

JS: - Jaw Slide

MMC: -Modified mallampati class

NC: - Neck Circumference

NM: - Neck Mobility

SPH: - Saint Peter Hospital

SPMMC: - Saint Paulo's Millennium Medical College

SMD: - Sternomental distance

TASH: - Tikur Anbessa Specialized Hospital

TDCXR:-Tracheal Deviation on Chest X-Ray

TMD: - Thyromental Distance

ULBT: - Upper Limp Bite Test

Y12H:- Yekatit 12 Hospital

ZMH: - Zewditu Memorial Hospital

ABSTRACT

Background: Thyroid surgery has got variety of anesthesia concerns. One of the anesthetic concerns is airway related problems which is difficult tracheal intubations that lead to devastating complications or may increase morbidity and mortality of the patients. Airway assessment can have significant importance to anticipate a difficult airway before anesthetic administration and help us to prepare for treating difficulty and to avoid life-threatening complications related to difficulty in tracheal intubation.

Objective: To assess the magnitude and predictors of difficult tracheal intubations in patients who underwent elective thyroid surgery at selected Addis Ababa public hospitals, Ethiopia, From Dec, 2022 to Mar, 2023.

Methods: A hospital-based multicenter cross-sectional study design was used. The study comprised 196 ASA I and II thyroid patients aged 18 to 65 were included. Descriptive statistics were done on socio-demographic variables to obtain frequency distributions. The analysis was done by using binary logistic regression while data in univariate analysis with p-value < 0.2 was entered into multivariate logistic regression. Finally, variable with p value < 0.05 in multivariate logistic regression is considered statistically significant association with difficult tracheal intubations.

Result: A total of 196 patients were included in the study. From which 26(13.3%) patients had DTI. In addition to these the presence of tracheal deviation on chest x-Ray and increase in mass duration from 161 to 240 month was found to be a strong association with DTI on multivariate logistic regression analysis with ($p < 0.001$, OR=14.4, and $p < 0.001$, OR= 16.4) respectively.

Conclusion and recommendations: We conclude that patients with increased duration of mass and presence of tracheal deviation on chest X-ray have a strong association with difficult tracheal intubation. So that such patients with goiter need thorough pre-operative evaluation as considering duration of the mass and tracheal deviation. We recommend anesthesia professionals to give due attention for thyroid patient with long duration of mass and tracheal deviation to do x-ray as a preoperative test modality for thyroid patients.

KEY WORDS: Difficult tracheal intubation, Intubation difficulty score and Thyroid surgery

ACKNOWLEDGMENT

I would like to express my deepest gratitude to my advisors, Mrs. Senait Awoke and Mrs. Misrak W/Yohanes for their meticulous professional comments and constructive ideas.

I would like to extend my appreciation to my friends Mr. Siraj Ahmed, Mr. H/Mariam Getachew, Mr. Kuchulo Germu, and Mr. Mesfin Gurmu for their invaluable comments and advice

I also want to use this opportunity to express my special gratitude to Addis Ababa University College of Medicine and health science and the Department of Anesthesia incorporating research in the curriculum and giving me a chance to conduct these studies.

Finally, my grass root gratitude also goes to my data collectors for their cooperation in collecting the data.

TABLE OF CONTENTS

Contents page

LIST OF TABLE

LIST OF FIGURES

CHAPTER ONE: BACK GROUND

1.1 INTRODUCTION

The thyroid is an endocrine gland that is found anterior to the neck, which envelops the trachea; normally, the gland can't be seen by looking at the neck, but in specific medical conditions, these glands become enlarged, and thyroid surgery continues to be an important option for the treatment of goiter (1–3).

Several pathologic mechanisms cause goiters most commonly caused by iodine deficiency disorders. Goiter is thought to affect 15.8% of the world's population on average, which can vary from 4.7% in America to 28.3% in Africa. In Ethiopia more than 35 million people are in potential danger of iodine deficiency and about 28 million individuals have goiter with prevalence rates vary greatly from region to region, with some locations having a prevalence rate as high as 71%, but the overall prevalence of goiter were 35.8%, of which 24.3% had palpable goiter and 11.5% had observable goiter (4–6).

Patients with such thyroid disorders require medical and surgical intervention. Most thyroid surgery can be performed under general anesthesia with endotracheal intubation. Endotracheal intubation is the most valuable skill required from medical professionals to save the lives of patients by securing a patient's airway to provide oxygen after direct laryngoscopy or video laryngoscopy to allow visualization of the vocal cords or direct placement of the endotracheal tube into the trachea via cricothyrotomy, or fiberoptic visualization of the vocal cords via the nasal or oral route to secure the patient's airway (7).

There is no common ground definition of a difficult airway in literature across the world with expert guidelines, difficult airway is defined by the American Society of Anesthesiologists as "difficulty with facemask ventilation, laryngoscopy, and ventilation using a supraglottic airway, tracheal intubation, extubation, or surgical airway" as well as difficult tracheal intubation is when tracheal intubation requires multiple attempts to secure the airway (8,9).

Patients with thyroid disease are more vulnerable to difficult tracheal intubation these are because of its considerable changes in anatomy and its mass effect. One of the mechanical results of goiter is deviation and compression of the trachea which cause DTI, as well DTI is caused by increase in goiter's size, diagnosis (benign or malignant), and infiltration into the surrounding tissue those result in inability to manage airway which cause morbidity and mortality in anesthetized patients. One of the most vital areas of thyroid patients in anesthetic management is maintaining the airway (10–14).

Difficult intubation is one of the perioperative challenges in the management of patients with an enlarged thyroid gland. Difficult intubation is an undesirable situation particularly if it is not anticipated. Ear–nose–throat and thyroid surgery is considered a risk factor for difficult intubation. Due to the close anatomical relationship of thyroid surgery with the larynx, laryngopharynx, and trachea, the airway may be obstructed during surgery in the presence of a large or invasive mass. This elevates the risk of anesthesia-related complications and death (15–18).

There are several specific clinical airway assessments tools used to predict difficult tracheal intubation such as the modified Mallampati test, sternomental distance, thyromental distance, inter incisor gap, chest X-ray studies, extension at the atlantoaxial joint and grades of mandibular protrusion are some of the tests used frequently even though their reliability and predictive ability vary widely (19,20).

Preoperative prediction of the potential difficulty of intubation can help reduce the incidence of catastrophic complications by alerting anesthesia personnel to take additional precautions before anesthesia and establishing an artificial airway (21).

Thyroid surgery is usually considered a risk factor for difficult intubation, but this has not been widely studied so that predicting difficult intubation is the most important factor that would help anesthesia professionals to plan and prepare for the management of difficult airway management (22).

1.2 STATEMENT OF THE PROBLEMS

Difficult tracheal intubation in thyroid patients is one the common complications with the magnitude of 4.4% to 14.3% (11,23,24). This problem is even higher with patients like thyroid neoplasm, long standing thyroid, and patients with tracheal deviation.

Difficult endotracheal intubation under general anesthesia may result in intubation delay or failure, if not identified quickly, it might have fatal consequences. As a result, numerous researches have been published on various criteria for airway assessment to anticipate difficult endotracheal intubation before anesthesia (25).

Difficulty of tracheal intubation leads to esophageal intubation, sore throat, hypoxia, brain damage, cardiovascular dysfunction, significant cost burden, increased postoperative length of hospital stay, and death, also the adverse outcomes associated with respiratory events constitute the single largest class of injury in the American Society of Anesthesiology Closed Claims Study (522 of 1541 cases; 34%) (12,13,26–28).

Another aspect of DTI is aspirations which might end up with aspiration pneumonia, aspiration pneumonitis, lung abscess, lung collapse and ARDS (29).

Multiple attempts to secure patient airway will cause patients to exacerbate atrial fibrillation and cardiac arrest which is caused by vagal stimulation, hypoxia and atrial fibrillation (30).

Limited mouth opening, limited mandibular protrusion, decreased TMD, MMC 3 or 4, decreased submandibular compliance, decreased SMD, limited head and neck extension, and increased NC have all been linked to DTI. To overcome these difficult airway conditions, several airway manipulation techniques, positioning maneuvers, and alternative devices have been developed (31).

Avoidance of airway management complications requires careful assessment; good planning, teamwork, and use of a range of techniques and devices are required. Technology advancements like rigid video laryngoscopes and flexible fiber optic intubation have substantially increased our ability to safely manage patients with anatomically challenging airways. Additionally, advancements in oxygenation techniques like noninvasive positive pressure ventilation and highflow nasal oxygenation have made it possible for apnea to last longer without desaturation, reducing the stress on these difficult airways and providing more time to safely complete intubation (27,32,33). Besides the advancement of these technologies, the equipment is not available in most of our operation rooms while we are working with patients having a high risk for such difficulties.

In thyroid patients, the presence of high MMC, shorter TMD, low IIG, tracheal deviation, obesity, age extreme, NC greater than 40cm, thyroid cancer, and male gender can predict the difficulty of tracheal intubation; while thyroid gland size, patient symptoms, and degree of airway involvement on preoperative imaging, the difficulty of intubation is not related to the size or presence of a malignant goiter. The only independent predicting risk factor for difficult airways in goiter patients was tracheal deformity (tracheal deviation > 1 cm on chest x-ray) (11,18,24,34–36).

Preoperative airway evaluation is one of the commonly performed procedures to predict difficult tracheal intubation to reduce the chance of unanticipated difficult tracheal intubation consequences in addition to routine preoperative evaluation Recent literature adds different predicting factors than the commonly performed clinical airway assessment tools to predict difficult tracheal intubation which is not applicable in our clinical setup such as NC, HT/TMD, NC/TMD (11,24,34,37–39).

1.3 JUSTIFICATION

The first crucial event to take a suitable intervention is assessing the severity and identifying the predicting factors of difficult tracheal intubation in thyroid surgery. Adding other predicting variables during airway evaluation improves the predicting capacity of difficult endotracheal intubation further more prediction of the most important variable would help professionals form legal suit and patients from such devastating complication (40).

Most anesthesia professionals discuss the difficult challenge they faced when they do patients with anterior neck swelling like goiter among all difficulties difficult tracheal intubation was the most commonly happened complication.

Several studies done over the world showed that the incidence of difficult tracheal intubation was much higher in thyroid patients than the general surgical patients. But those studies were conducted in developed countries where equipment that is needed for difficult airways is easily accessible.

The findings of many studies on determining the incidence and identification of predictive factors of difficult tracheal intubation were inconsistent with each other due to the variety of population difference, and terms they used to define difficult airways.

As far as our search there is no study conducted in the study area even though the study area is the national referral hospitals.

Suggestion from literatures to conduct setup based study

CHAPTER TWO: LITERATURE REVIEW

2.1 MAGNITUDE AND PREDICTORS OF DIFFICULT TRACHEAL INTUBATION

Tracheal intubation is an essential safeguard procedure for surgical procedures conducted under general anesthesia.

A retrospective cohort study conducted in the Bronx, New York (2014) on 112 consecutive patients who underwent hemithyroidectomy or total thyroidectomy for thyroid goiter surgery revealed that patient age was substantially linked with difficult intubation overall, with 13 patients (11.9%) experiencing difficulty. Patients with airway difficulties were on average 60.7 ± 3.7 years old, while those without it were 52.1 ± 1.5 years old (P =.04) (36).

In a prospective observational study conducted in France (2006) on 324 patients undergoing thyroid surgery, the overall rate of difficult intubation (IDS >5) in thyroid surgery was 11.1% (95% CI: 7.6–14.5). Classical predictive criteria (mouth opening <35 mm, Mallampati III or IV, short neck, neck mobility <80°, thyromental distance <65 mm, and a retrognathic mandible) were significantly reliable in the univariate analysis as risk factors for difficult intubation (22).

In a prospective observational study conducted in Israel (2003) on 50 morbidly obese patients, we quantified the neck soft tissue from the skin to the anterior aspect of the trachea at the vocal cords using ultrasound. Thyromental distance <6 cm, mouth opening <4 cm, limited neck mobility, Mallampati score >2, abnormal upper teeth, neck circumference >45 cm, and sleep apnea were considered predictors of difficult laryngoscopy in obese patients these may be due to the presence of abundant soft neck tissue in the pharynx, oropharynx, suprascapular region, and lateral neck region (41).

A meta-analysis of a controlled trial study conducted in Italy (2020) on eight studies that evaluated the accuracy of clinical findings for identifying difficult intubation in thyroid patients were reviewed (5853 patients), the difficult intubation incidence from this meta-analysis is (7.21% [95% CI: 6.57-7.91%]) and when compared with women, men were more difficult to intubate (positive OR, 1.54 [95% CI: 1.21-1.95], P<0.001) and Mallampati score of ≥ 3 had strong accuracy for predicting DI (OR, 4.75 [95% CI: 2.22-10.12], P <0.001), both when CL grade was ≥ 3 (I^2=81%) or when IDS was >5 (I^2=75%) and they were concluded that the presence of high Mallampati Score, shorter thyromental distance, inter incisor gap, tracheal deviation (the unique thyroid pathology linked parameter), obesity and male gender were risk factors for difficult intubation (11).

In a five-year observational single-center prospective study done in Belgrade, Serbia (2016) on 2379 patients the result showed that the incidence of DI is 7% with tracheal deviation while 5% are without tracheal deviation on CXR while male gender, older patients, poor dentition are contributing factors for DI while Neck circumference and neck length are the most important and independent predictors for DTI (42).

A prospective observational study conducted in Serbia (2009) on 2000 adult patients scheduled for thyroid surgery were included in the study, the incidence of difficult intubation was observed in 110/2000 patients (5.5%) and it was higher in males (26/295, 8.8%) than females (84/1 705, 4.9%) ($p < 0.01$) (43).

A study conducted in China (2022) stated that the Risk factors for difficult tracheal intubation include being male, height, weight, BMI, ratio of height to thymic distance, and the ratio of height to sternum distance, neck circumference, NC/TM ratio, and Mallampati score can serve as predictors of airway difficulties (16).

In a prospective study conducted in India (2022) carried out on 104 patients the diagnostic accuracy of ULBT is 95.19% ($p<0.001$) is greater than MMT (69.23%), both tests had high NPV suggesting these tests were good predictors of easy intubation (10).

A prospective study conducted in Turkey (2017) on 200 patients stated that a primary outcome, in patients with thyroid disorders, thyromental distance <6.5 cm (P=0.046, OR= 2.326, CI =95%), the presence of a palpable goiter and thyroid weight >40 g (p=0.031, OR= 2.232, CI=95%1) were found to be the risk factors for difficult intubation. The increase in the likelihood of difficult intubation associated with the increase in thyroid weight was considered to be objective data supporting the findings. The presence of a goiter in the preoperative stage would constitute a serious risk for a difficult airway and difficult intubation. With or without the pressure symptoms, the enlarged neck circumference and increased thyroid weight in goiter have been evaluated as potential risk factors for difficult airways (44).

A prospective observational study conducted in Nigeria (2018) on 215 patients with goiter scheduled for elective thyroidectomy shows that the Incidence of DI was 13.6% with 2 (1.6%) cases of failed intubation. Comparing DI and easy intubation, the duration of illness was 4.28 ± 3.78 years in DI versus 7.44 ± 7.63 years in easy intubation, p = 0.1353. Neck circumference was 41.42 ±5.30 cm in DI versus 37.43±2.68 cm in easy intubation, p = 0.0200. Tracheal deviation, narrowing and retrosternal extension, and surgical diagnosis were not significantly different between DI and easy intubation (18).

In a prospective observational study conducted in Gonder Ethiopia (2015) on 91 consecutive patients undergoing thyroidectomy the incidence of the difficult laryngoscope is 13.4% while the incidence of difficult tracheal intubation was 14.3% and only a jaw slide of B and C was identified from bedside airway parameters as being associated with difficult intubation and laryngoscopy (p=0.047, OR=3.383 for DI & p=0.027, OR=4.130 for DL), and an X-ray report of tracheal deviation >1 cm (14 out of 33) was identified as a statistically significant determinant factor of both difficult laryngoscopy and intubation (p<0.001, OR=14.4 for DL and p<0.001, OR=11.833 for DI) and It was determined that airway distortion and thyroid enlargement are risk factors for difficult laryngoscopy and intubation. However in another study conducted in France (2006) tracheal deviation was observed on the chest radiography in 38 cases (17%, 95% CI: 12.1–22) and it was not associated with difficult intubation, even when compressive signs were present (20 cases, 8.9%, 95% CI: 5.5–13.5) as well they concluded that thyroid surgery was not associated with an increased incidence of difficult intubation (22,24).

2.2 CONCEPTUAL FRAMEWORK

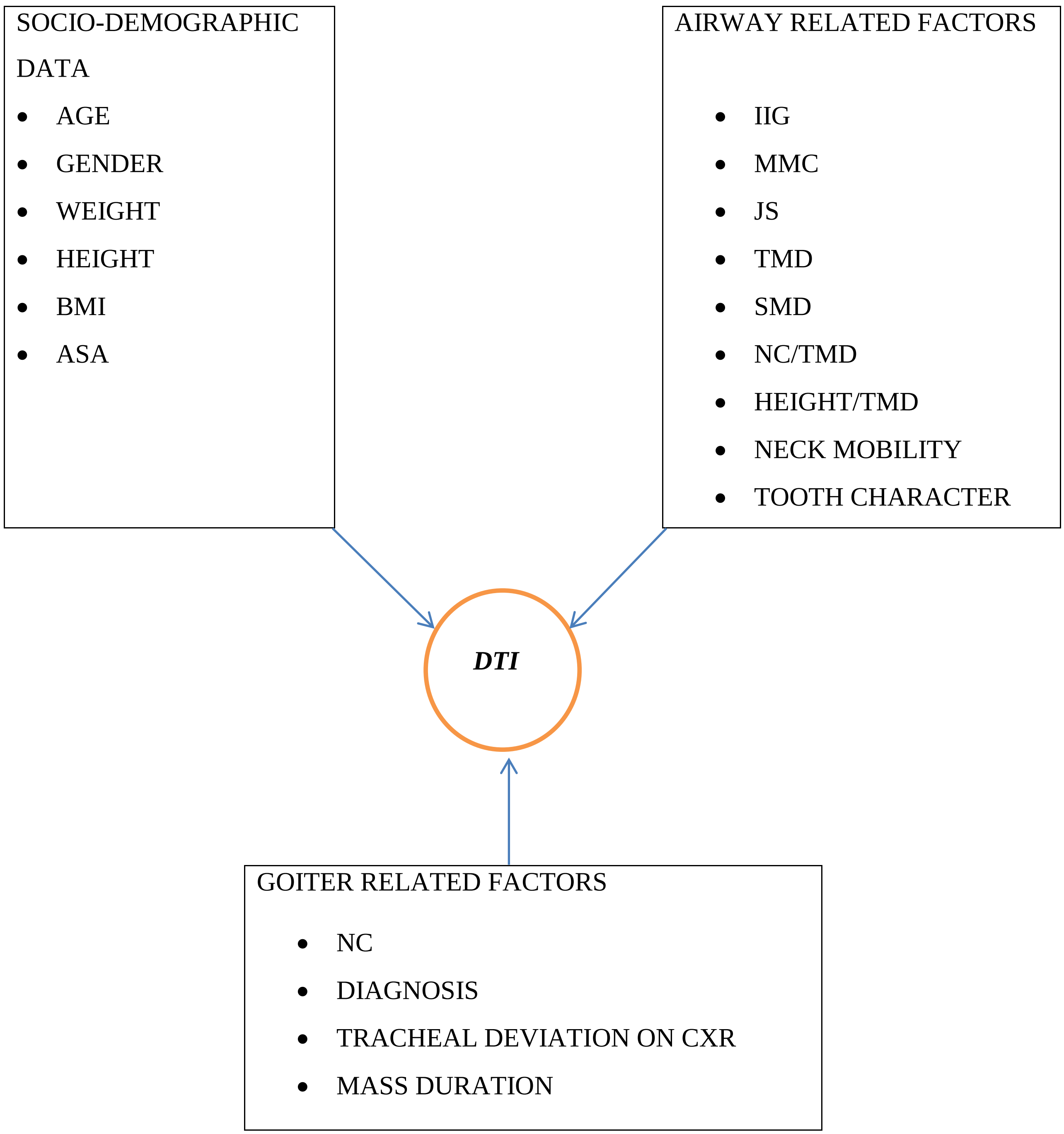

Figure 1: The relationship between difficult tracheal intubation and its predictive factors (18–20,36)**.**

CHAPTER THREE: OBJECTIVE

3.1 GENERAL OBJECTIVES

- Ω To assess magnitude and predictors of difficult tracheal intubation in patients who underwent elective thyroid surgery at Addis Ababa public hospitals, Ethiopia, From Dec 2022 to March 2023.

3.2 SPECIFIC OBJECTIVES

- Ω To assess the magnitude of difficult tracheal intubation in patients who underwent elective thyroid surgery at Addis Ababa public hospitals, Ethiopia, From Dec- 2022 – Mar- 2023.
- Ω To assess predictive factors of difficult tracheal intubation in patients who underwent elective thyroid surgery at Addis Ababa public hospitals, Ethiopia, From Dec- 2022 – Mar- 2023.

CHAPTER FOUR: METHODS AND MATERIALS

4.1 STUDY AREA

The study was conducted in Addis Ababa, the capital city of Ethiopia with an average elevation of 2400 meters above sea level. The city has a geographic and territorial possession with an area of 540sq. km (46).

Addis Ababa city administration has 11 governmental (public) teaching hospitals. The study was conducted at six hospitals namely: Tikur Anbessa Specialized Hospital, Saint Peter's Hospital, Zewditu Memorial Hospital, Saint Paulus Millennium Medical College, Dagmawi Minilik Hospital, and Yekatit12 Hospital. Those hospitals were selected purposively due to high thyroid patient follow when compared to other hospitals.

4.2 STUDY DESIGN AND PERIOD

A hospital-based multicenter cross-sectional study design was conducted from Dec - 2022 – Mar- 2023.

4.3 POPULATION

4.3.1 SOURCE OF POPULATION

All adult patients aged 18 – 65 years who underwent elective thyroid surgery under general anesthesia at Addis Ababa government hospitals.

4.3.2 STUDY POPULATION

All adult patients aged 18 – 65 years who underwent elective thyroid surgery under general anesthesia and who fulfilled the inclusion criteria during the study period were included from the study area.

4.4 INCLUSION AND EXCLUSION CRITERIA

4.4.1 INCLUSION CRITERIA

- All adult patients aged 18- 65 years ASA class I and II who had elective thyroid surgery under general anesthesia and endotracheal intubation using a conventional laryngoscopy.

4.4.2 EXCLUSION CRITERIA

- Patients who had DM
- Patients who had trauma to the neck
- Patients with airway-related congenital malformation.
- Patients with a previous history of tracheostomy
- Obese patients BMI $\geq 25 kg/m^2$
- Patients with limited cervical mobility
- Intubation experience of less than 1 year

4.5 STUDY VARIABLES

4.5.1 DEPENDENT VARIABLE

- Ω The magnitude of difficult tracheal intubation

4.5.2 INDEPENDENT VARIABLES

- Ω Socio-demographic factors: Age, Gender, Height, Weight, BMI, and ASA.
- Ω Patient-related factors: IIG, ULBT, JS, TMD, SMD, NC/TMD, Height /TMD, Neck mobility, Neck length, and Tooth characteristics.
- Ω Goiter-related factors: NC, diagnosis, tracheal deviation on CXR, and mass duration.

4.6 SAMPLE SIZE DETERMINATION

The sample size was determined by using the single population proportion formula assuming the p =14.3% from a study done on thyroid patients at the University of Gondar northwest Ethiopia (24) with a 5% margin of error (d) and 95% confidence interval of certainty (alpha = 0.05), non-response rate 10%. Where,

$$n = \frac{\left(\frac{Z\alpha}{2}\right)^2 \mathbf{p}(1 - \mathbf{p})}{d^2}$$

Where: n= minimum sample size required for the study

Z= standard normal distribution (Z=1.96) with confidence interval of 95% and α=0.05

We took P= 14.3% (0.143) since the overall incidence of difficult tracheal intubation was 14.3 % in the previous study.

d= Absolute precision or tolerable margin of error (d) = 5%=0.05

Applying the formula: $n = \frac{(Z\alpha/2)^2 \times p(1-p)}{(d)^2}$ Then, $n = \frac{(1.96)^2 \times (0.143) \times (1-0.143)}{(0.05)^2} = 188$

The calculated sample size is 188

By adding a 10% non-response rate the final sample size will be=207. The number of total thyroid surgery done at selected public hospitals for 3-month log book review showed 36 at TASH, 32 at DMH, 40 at Y12MC, 40 at SPH, 52 at ZMH, and 40 at SPMMC. The total Surgery done for 3 months is 240.

4.7 SAMPLING TECHNIQUE

Convenience sampling technique was used. During the study period, all daily operation schedule list was taken to get the required sample size. A 3-month period log book review and situational analysis showed that a total of 240 patients underwent elective surgery. During data collection 204 thyroid surgeries were done and 8 of them don't fulfill the inclusion criteria.

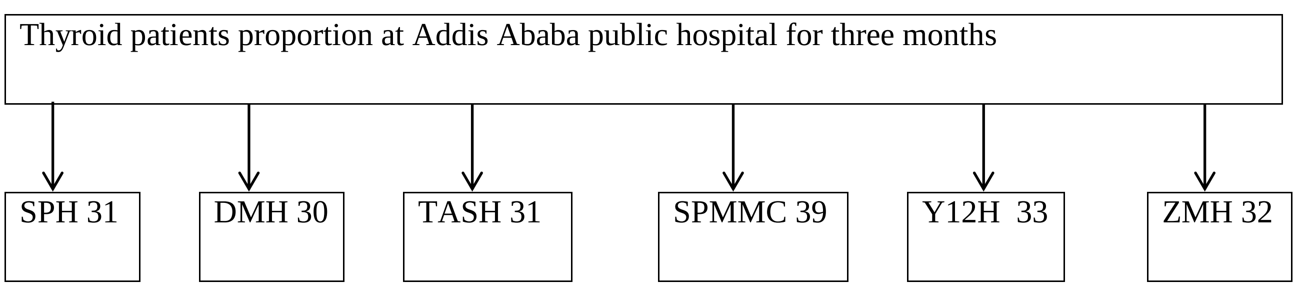

Figure 2: thyroid patient proportion over the study period from the calculated sample size at Addis Ababa public hospitals.

From these the number of total schedules from Dec 2022 to March 2023 at SPH is 32, TASH is 33, ZMH is 33, Y12H is 33, SPMMC is 42, and DMH is 31. From these 1 patient from SPH, 2 patients from TASH, 1 patient from ZMH, 3 patients from SPMMC, and 1 patient from DMH don't fulfill the inclusion criteria, finally, 196 patients were included in the study.

4.8 DATA COLLECTION PROCESS AND TECHNIQUE

A structured questionnaire was created, and a pretest was done on 5% of the total sample size. Before data collection, each patient's informed consent was obtained orally. Age, sex, ASA status, height, weight, and BMI among the socio-demographic variables were obtained. A flexible meter was used to measure the patient's height and NC. Inter incisor gap (IIG) was assessed by putting the patient's finger to mouth while fingers are in the upright position. MMC was recorded by visualizing the oropharyngeal structure while maximal mouth opening with no tongue protrusion and no words. Thyromental and sternomental Distance was measured in the sitting position, with the head completely stretched on the neck and the mouth closed, using a rigid ruler from mentum to thyroid notch and from mentum to sternal notch respectively. Tooth character was assessed by asking and looking at the patient's tooth.

Variables related to goiter were evidence of tracheal deviation which is assessed using chest x-ray, and mass duration was assessed from the onset to the presence of patient to hospital expressed using month and year. The data for dependent variables were collected during the induction of anesthesia. After the patient is induced and relaxed with anesthetic drugs tracheal intubation was performed with an experienced anesthesia professional after these bilateral auscultation over the lung field were used to confirm effective intubation. Difficult tracheal intubation is determined based on IDS score where 0, 1 to 5, >5, and ∞ indicated easy, slight difficulty, moderate to major difficulty, and impossible tracheal intubation. Anesthesiologists conducted 32 tracheal intubations, MSC anesthetists performed 67, and BSC anesthetists performed 97. This study used an observational data collection technique.

4.9 DATA QUALITY CONTROL

To verify the quality of the data, data collectors were fully trained on the study's objectives and relevance, as well as brief orientations on the assessment tools. Before collecting data, a pretest was performed on 10 patients at ALERT hospital to ensure accuracy, clarity, and consistency of questionnaire. It was decided to create an organized questionnaire. During data collection, the investigator reviewed each questionnaire to determine that it was comprehensive and suitable.

4.10 DATA PROCESSING AND STATICAL ANALYSIS

Data with complete information was exported to SPSS version 25 for analysis. Descriptive statistics were done on variables to obtain frequency distributions. The mean (±SD) was used for socio-demographic variables.

Associations of socio-demographic characteristics, airway-related parameters, and goiter-related factors with difficult tracheal intubation were analyzed by using binary logistic regression with odds ratio and 95% CI in the univariate analysis. Airway-related factors area under the curve of a receiver-operator curve analysis with a confidence interval of 95% and p-value <0.05 were checked for the association between airway-related factors with dependent variables. All variables with a $p<0.2$ in the univariate analysis were entered into the binary logistic regression model odds ratios (OR) and 95% confidence intervals were calculated. A p-value in multiple logistic regressions less than 0.05 was considered significant. Model fitness was checked by using the Hosmer and Lemeshow goodness of fit test and multicollinearity was checked by Variance Inflation Factor (VIF<10 and tolerance >0.1). Sensitivity, specificity, false negative rate, and false positive rate were calculated for bedside airway parameters.

4.11 ETHICAL CONSIDERATION

Ethical clearance was obtained before the start of the study.

The research was carried out after receiving ethical approval from Addis Ababa University College of Health Science Faculty of Medicine Department of Anesthesia. The hospital management received a formal letter outlining the study's goals. Data collectors acquired informed consent orally from each patient after receiving authorization from hospital managers. Patients' standards, values, and morals were respected by data collectors during the data collection procedure. Participants' involvement in the study was based on voluntary bases.

4.12 DISSEMINATION OF RESULTS

The result of the study would be presented to the Department of Anesthesia College of health science Addis Ababa University as part of the MSc in advanced clinical anesthesia, communicated through the annual students and staff research conference, annual national conference of Ethiopian Anesthetists Association (EAA) and an attempt would be made to publish on the reputable journal.

4.13 OPERATIONAL DEFINITION

- **Difficult Tracheal Intubation (DTI)**: is defined as an intubation difficult scale (IDS) score > 5. The intubation difficulty scale (IDS) score is derived from an objective assessment of seven parameters that are known to be associated with DI. The sum of points given for each parameter can be calculated soon after intubation, allowing it to be categorized as being easy, slightly difficult, or moderate to major difficult and impossible intubation. The total IDS range from zero to infinity (47). It has five grades as shown below.

IDS Score	Degree of Difficulty
0	Easy
$0 < IDS \leq 5$	Slight Difficulty
$5 < IDS$	Moderate to Major Difficulty
$IDS = \infty$	Impossible intubation

Figure 3: IDS Score range from 0 to infinity

- Cormack-Lehane grading(CLG) of laryngoscopy

  Grade I - full view of the entire glottis. Grade II- partial glottis view

  Grade III - visualization of the epiglottis Grade IV - inability to visualize even the epiglottis

- **Modified Mallampati class (MMC):** A visualization of the oropharyngeal structure of the patient upon mouth is fully opened and the tongue is protruded in a sitting position and the head in a neutral position. The patient is not allowed to phonate. It has four classes

  Class I: fauces, anterior and posterior tonsillar pillars, uvula, and soft palate are visible

  Class II: fauces, the base of the uvula, and the soft palate are visible

  Class III: only the soft palate and hard palate are visible

  Class IV: only the hard palate is visible

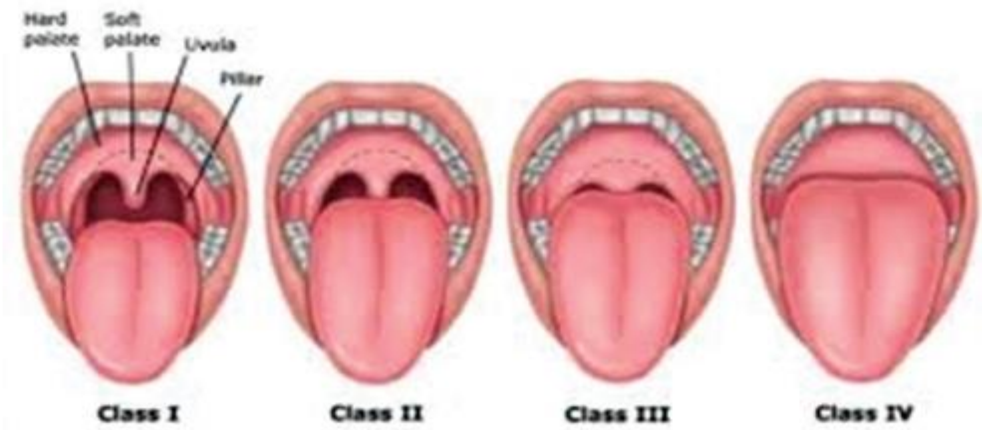

Figure 4: image for Modified Mallampati class classification (48)**.**

- **Body mass index (BMI):** is defined as the body mass (in kilogram) divided by the square of patients` height (in meters).
- **Neck circumference (NC):** the circumference of the neck (in centimeters) measured at the level of maximal bulge.
- **Thyromental Distance (TMD)**: the distance between the mentum (chin) and the superior thyroid notch measured in cm after the neck is fully extended.
- **Sternomental Distance (SMD):** a distance between the sternal notch and the mentum (chin) measured in cm after the neck is fully extended.
- **Jaw slide (JS):** the ability patient to protrude the lower incisors forward beyond the upper incisors. It has three classes

  Class A: protrusion of lower incisors forward beyond upper incisors.

  Class B: protrusion of lower incisors up to upper incisors

  Class C: inability to protrude the lower incisors.

- **Interincisor gap (IIG):** assessed by putting three patient's finger to mouth with maximal mouth opening.

  Class A: <3 patients' finger

  Class B: ≥3 patient's finger

- **Upper Lip Bite Test (ULBT):** which was graded as

  Class A - lower incisors can bite the upper lip above the vermilion line

  Class B - lower incisors can bite the upper lip below the vermilion line

  Class C - the lower incisors cannot bite the upper lip

Sensitivity (Sn): the conditional likelihood of screening tools properly identifying difficult airways (difficult intubation) or how well screening tools diagnose the presence of difficult intubation. $\frac{true\ postive}{true\ positive+false\ negative}$

Specificity (Sp): the chance of screening tools successfully diagnosing or identifying where no difficult tracheal intubation exists. $\frac{true\ negative}{true\ negative+false\ postive}$

False negative rate (FNR): the probability that a true positive will be missed by the test (FN/FN+TP)

False positive rate (FPR): the proportion of true negatives that is misclassified as positives (FP/FP+TN)

CHAPTER FIVE: RESULT

Socio-demographic data

Our study included 196 thyroid surgery patients ranging in age from 18 to 65 years old who underwent surgical procedures under general anesthesia with endotracheal intubation at selected government hospitals. From the total sample majority of patients were female, 175(89.3%) (See Table 1)

Table 1: Distribution of Socio-demographic characteristics of the study population from Dec, 2022 to Mar, 2023

Variable		Frequency	Intubation			
			Difficult (Mean ± SD)		Easy (Mean ± SD)	
Gender	Male	21(10.7)	6 (28.6)	1.77 ± 0.43	15(71.4)	1.79 ± 0.411
	Female	175(89.3)	20 (11.4)		155(88.6)	
Age	Between 18-34	68(34.7)	9(13.2)	41.15± 13.8	59(86.8)	39.06± 12.25
	Between 35-49	63(32.1)	7(11.1)		5689.9()	
	Above 50	65(33.2)	10(15.3)		55(84.7)	
BMI	18.6 – 20.6	34(17.3)	12(46.2)	22.18 ± 1.9	22(30.0)	21.42 ± 1.5
	20.7 - 22.7	82(41.8)	8(30.8)		74(51.8)	
	22.7 - 24.9	80(40.8)	6(23.0)		74(18.2)	
SD= standard deviation, Age=age of the patient in years, BMI=Body mass index of the patients in kg/m^2 and number in parenthesis are in percentage.						

Graph showing where there is no difference in difficult tracheal intubation based on ASA physical status.

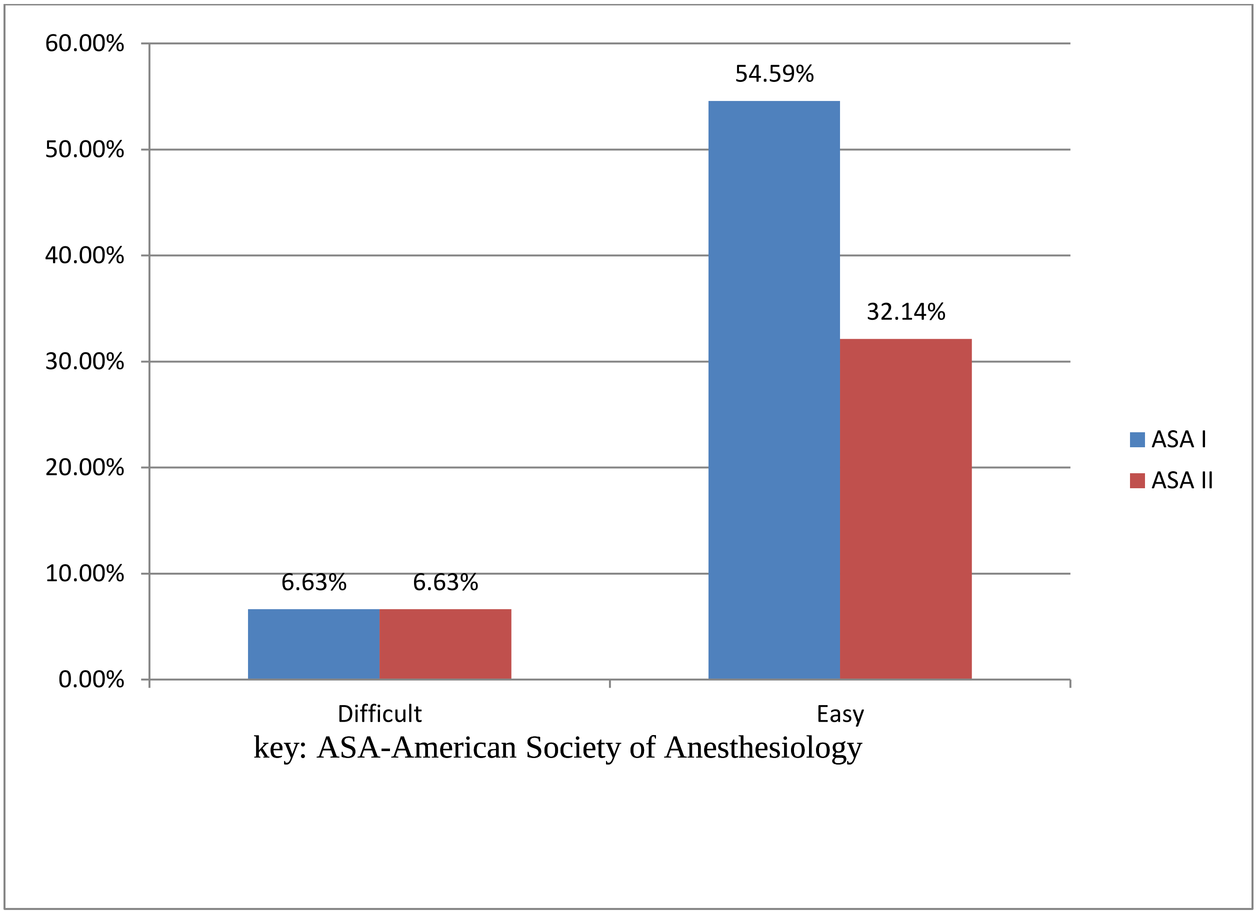

Figure 5: Distribution of study population per ASA physical status from Dec, 2022 to Mar, 2023

Table 2: Distribution of study population per preoperative airway parameters with difficult tracheal intubation explained by DTI from Dec, 2022 to Mar, 2023

Variable	Categories	Tracheal intubation		P value
		Difficult	Easy	
IIG	≥3 patients' finger	4	69	0.019
	<3 patients finger	22	101	
MMC	Class I	9	86	0.029
	Class II	3	39	
	Class III	8	21	
	Class IV	6	24	
ULBT	Class I	21	135	0.848
	Class II	3	20	
	Class III	2	15	
JS	Class A	17	140	0.141
	Class B	6	15	
	Class C	3	15	
TMD	≥6.5 cm	8	46	0.694
	<6.5 cm	18	124	
SMD	≥12..5 cm	10	64	0.936
	<12.5 cm	16	106	
NM	≥ 90	5	28	0.726
	< 90	21	142	
TC	normal tooth	17	90	0.309
	mobile tooth	4	38	
	lost upper incisor tooth	5	42	
RNCTMD	3.8 - 5.0 cm	12	42	0.659
	5.1 - 6.3 cm	6	121	
	6.4 – 7.6 cm	8	7	
RHTTMD	12.8 – 20.8 cm	7	32	0.537
	20.9 – 26.1 cm	13	98	
	26.2 – 33.6 cm	6	40	

Key: *IIG-Inter-incisor gap, MMC- Modified mallampati class, ULBT- Upper limb bite test, JS- Jaw slide, TMD- Thyromental distance, SMD- Sternomental distance, NM- neck mobility, TC- tooth character, RNCTMD- Ratio of neck circumference to thyromental distance, RHTTMD- Ratio of height to thyromental distance.*

Airway related variables like IIG, MMC and JS with p-value less than 0.2 in univariate analysis.

Table 3: Distribution of study population per perioperative airway variables and AUC from Dec, 2022 to Mar, 2023

Variable	Sn	Sp	FNR	FPR	Area	P-value	95% C.I	
							Lower	Upper
IIG	84.6%	40.6%	15.4%	59.4%	.626	0.039	.521	.731
MMC	53.8%	73.5%	46.2%	26.5%	.619	0.051	.498	.739
ULBT	19.2%	79.4%	80.8%	20.6%	.493	0.904	.374	.611
JS	34.6%	82.4%	65.4%	17.6%	.580	0.191	.457	.703
TMD	69.2%	27.1%	50.8%	72.9%	.481	0.761	.361	.602
SMD	61.5%	37.6%	38.5%	62.4%	.496	0.947	.376	.616
NM	80.8%	16.5%	19.2%	83.5%	.486	0.821	.365	.607
TC	34.6%	52.9%	65.4%	47.1%	.440	0.327	.323	.558
RNCTMD	57.7%	24.7%	42.3%	75.3%	.427	0.233	.300	.555
RHTMD	73.3%	18.8%	26.9%	81.2%	.467	0.590	343	.595

Key: *IIG-Inter-incisor gap, MMC- Modified mallampati class, ULBT- Upper limb bite test, JS-Jaw slide, TMD- Thyromental distance, SMD- Sternomental distance, NM- neck mobility, TC-tooth character, RNCTMD- Ratio of neck circumference to thyromental distance, RHTTMD-Ratio of height to thyromental distance. Sn=Sensitivity, Sp=specificity, FNR=false negative rate, FPR=false positive rate, CI-Confidence interval*

IIG and NM was highly sensitive test while JS was the highest specific test to diagnose DTI for thyroid patients.

The accuracy of preoperative airway tests for the prediction of difficult tracheal intubation was compared using the receiver operating characteristic (ROC) curve.

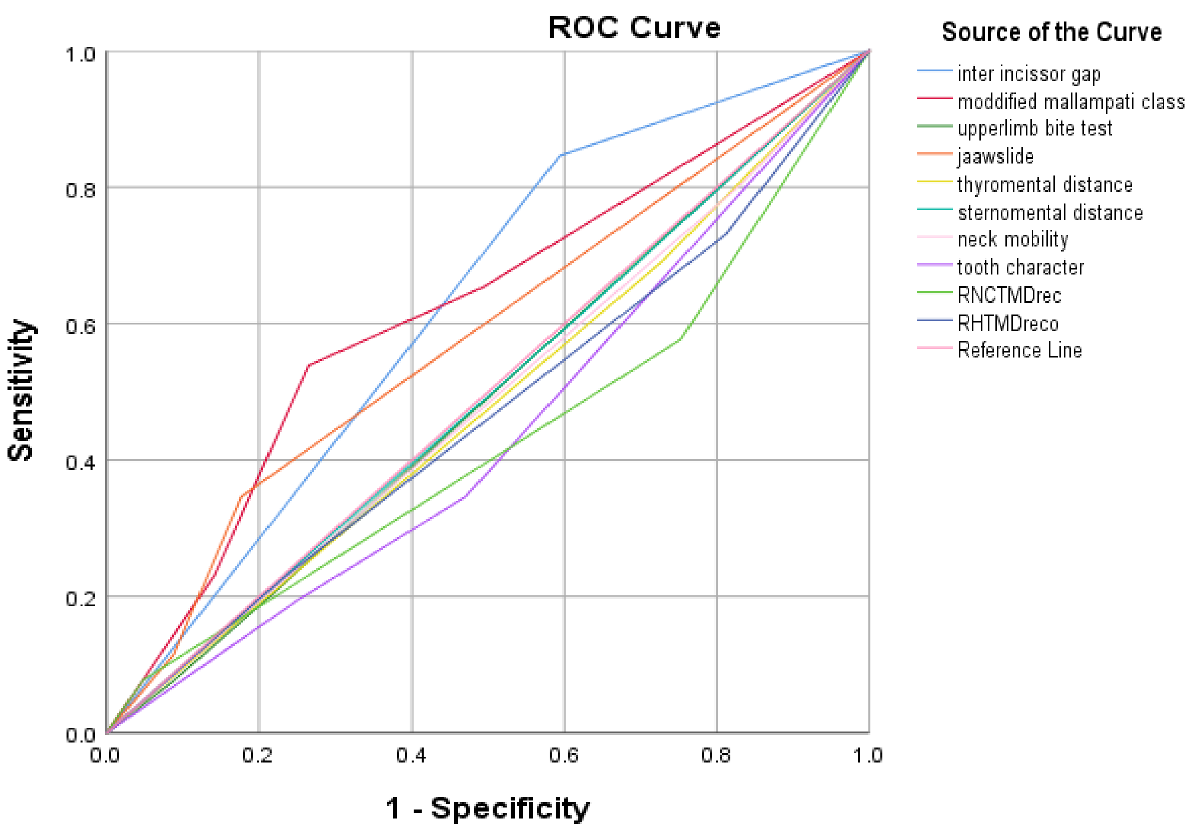

Figure 6: ROC curve for difficult tracheal intubation against airway predictive risk factors from Dec, 2022 to Mar, 2023.

Table 4: Distribution of study population per Variables related to goiter with tracheal intubation explained by frequency and percentage from Dec, 2022 to Mar, 2023.

Variable		Tracheal Intubation		P value
		Difficult	Easy	
NC	30-34	1	40	
	35-39	13	85	.086
	40-44	12	45	.026
MD	1-80	8	125	
	81-160	8	25	.003
	161-240	10	20	.000
Dx	Benign	23	139	
	Malignant	3	31	.406
TDCXR	No	9	149	
	Yes	17	21	≤.001
*p-value<0.05				
Key: *NC=Neck circumference in cm, MD= duration of mass in month, Dx= Diagnosis, TDCXR= tracheal deviation on chest x-ray*				

The p-value for diagnosis is greater than 0.2 in univariate analysis which is not fit to be included for multivariable logistic regression.

Association of predictor variable with DTI

Table 5: Association of variables with difficult intubation in multivariate analysis from Dec, 2022 to Mar, 2023

In the univariate analysis variables with a p-value of <0.2 such as BMI, IIG, MMC, JS, MD, NC, and TDCXR were included in the multivariate logistic regression model for forward stepwise regression analysis.

Variable	Categories	Tracheal intubation		**COR(95%CI)**	**AOR(95%CI)**	**P value**
		Difficult	Easy			
MD	1 – 80	8	125	1	1	
	81 – 160	8	25	5(1.7–14.6)	7.1(1.9 - 26.2)	.003
	161 – 240	10	20	7.8(2.7–22.2)	16.4(4.1 – 65.4)	.000
TDCXR	No	9	149	1	1	
	Yes	17	21	13.4(5.3– 33.9)	14.4(4.7 -44.0)	.000
Key: *MD= duration of mass in month, TDCXR= tracheal deviation on chest x-ray, COR-Crude odds ratio, AOR-Adjusted odds ratio, CI-confidence interval.*						

CHAPTER SIX

6.1 DISCUSSION

According to our study the all over magnitude of difficult tracheal intubation was found to be 13.3% (95 CI: 8% – 18%) this finding is comparable with the previous studies done in Ethiopia, Gonder (14.3%) and Nigeria (13.6%). On the contrary, the magnitude of difficult tracheal intubation for thyroid patients was higher than in studies done in Italy (7.21%) and Serbia (5%, 7%).

The discrepancy in the magnitude of difficult tracheal intubation might be due to difference technology for intubation, different population, experience of operator, sample size, exclusion that didn't exclude patients with airway related congenital anomalies.

On our finding the presence of tracheal deviation on chest X-ray was 14.4 times more likely to experience difficult intubation than patients without tracheal deviation. This is similar with the study conducted in Gondar by **Hailekiros et al,, 2015, Kalezić et al., 2016** (24,45) concluded that tracheal deviation >1cm was a strong association with difficult tracheal intubation. These is because of when the mass on the trachea increases trachea may shift to one side these may lead difficult to visualize the vocal cords and DTI would be caused

Another study by **Olusomi et al., 2018**(18) stated that the presence of tracheal deviation was not significantly different between difficult and easy intubation.

In our study; as the mass duration increase from 161 to 240 month the chance to develop difficult tracheal intubation will increase by 16.4 times than patients with the mass duration of 1 to 80 month with p <0.001 and 95%CI (4.1 – 65.4). The wide CI would be due to small sample size of the study.

Similar to these **Mallat et al., 2010** (49) stated that increase in the duration of mass was associated with difficult tracheal intubation as well they were concluded that this may be associated with an increase in mass would cause significant compression to the laryngeal structure which cause poor glottic visualization during direct laryngoscope that results in difficult tracheal intubation.

Different from these another study by **GÜLTEKİN et al., 2020** (50) stated that in large thyroidal masses with excessive tracheal shift, the laryngeal opening is usually in the normal position and intubation may not be difficult.

In our study; IIG and NM was the highest sensitive test for DTI with 84.6% and 80.8% for which both tests had lower FNR of 15.4% and 19.2% respectively suggesting that these tests are good predictors of difficult tracheal intubation for patients with thyroid disease. These is due to decrease in neck range of movement will limit the operator to position patients as well decrease in mouth opening of patients will not allow anesthetist to easily insert laryngoscope and endotracheal tube that will results in inability to visualize the airway structure during manipulation of airways with a direct laryngoscope later difficulty in tracheal intubation will occurred.

Dis-agreed to these another study by **Hailekiros et al., 2015** stated that thyromental distance followed by jaw slide and deviation were found to have highest sensitivity with values 58.3%, 53.8% & 53.8% respectively. Combination of airway parameters was found to increase specificity (93.6%) and positive predictive value (37.5%), but still sensitivity is low (23.1%).

In this study, the highest percentage of difficult tracheal intubation was seen in male (28.6%) when compared with female patients similar to these **Schiavolin et al., 2019**(34)**, Kalezić et al., 2016**(45) **and Kalezić et al., 2009**(41) stated that being male is high risk for difficult tracheal intubation.

Disagreed to these another study by **Narang et al., 2016** (48) discussed that female patients were high risk for DTI these is due to fat deposition in the back of neck among women could be one reason for difficult tracheal intubation on female patients.

In our study; the mean age of patients with difficult tracheal intubation was 41.2 ± 13.8 years compared to 39.1 ± 12.3 years in those who did not experience difficulty intubation, while another study done by **Loftus et al., 2014** (36) found that the mean age of patients with airway difficulty was 60.7 ± 3.7 years compared to 52.1 ± 1.5 years in those who did not experience airway difficulty (P = .04) these are because of there is a physiologic and anatomic explanation for difficult intubation as age increases they would more likely to develop decreases in cervical joint mobility, head, and neck movement limitation, edentulous and they become beard which makes our findings consistent with other previous literature.

In our study the preoperative tests for difficult tracheal intubation was compared using the receiver operating characteristic (ROC) curve IIG, MMC, and JS were all found to be above the reference line (0.5) with areas under the curve (AUC) of 0.626, 0.619 and 0.580 respectively, on the receiver operating characteristic curve all these tests indicating the poor ability to predict difficult tracheal intubation with this area under the curve (AUC).

CHAPTER SEVEN: STRENGTH AND LIMITATION OF THE STUDY

7.1 STRENGTH OF THE STUDY

Its multicenter study, it is the first study in the area and it adds multi-modal variables like; ratio of neck circumference to thyromental distance, and the ratio of Height to thyromental distance in predicting difficulty in tracheal intubation to these study populations.

7.2 LIMITATIONS OF THE STUDY

Limitation of this study was preoperative evaluation and intubation was not performed by similar anesthesia professionals.

X- Ray interpretation was performed by different radiology professional.

CHAPTER EIGHT: CONCLUSION AND RECOMMENDATION

8.1 CONCLUSION

We conclude that thyroid mass duration and the presence of tracheal deviation on chest x-Ray show a strong association with difficult tracheal intubation in thyroid patients. These show that single pre-operative airway assessment parameters can't be satisfactory to rule out the difficulty of tracheal intubation in this population.

8.2 RECOMMENDATION

1. for clinician

We recommend anesthesia professionals to give due attention for thyroid patient with long duration of mass and tracheal deviation to do x-ray as a preoperative test modality for such patients. The clinician shall consider x-ray for thyroid patients suspected with tracheal deviation

2. for hospital management

We recommend hospital management to provide x-Ray equipment to hospitals where thyroid surgery is done.

3. for future researcher's

We recommend including the impact on hemodynamic change and clinical outcome of DI on thyroid patients.

REFERENCES

1. *Arrangoiz R, Cordera F, Caba D, Muñoz M, Moreno E, de León EL. Comprehensive Review of Thyroid Embryology, Anatomy, Histology, and Physiology for Surgeons. Int J Otolaryngol Head & Neck Surg. 2018;07(04):160–88.*
2. *Macarow K. You have cancer. Fallible Body Narrat Heal Illn Dis. 2020;29–39.*
3. *Martinez JG, González M, Hernández Q, Rodríguez MA, Torregrosa N, Gil E, et al. Goiter surgery recommendations in sub-Saharan Africa in humanitarian cooperation. Laryngoscope Investig Otolaryngol. 2022;7(2):417–24.*
4. *Eastman CJ, Jooste P. Current challenges in meeting global iodine requirements. Nestle Nutr Inst Workshop Ser. 2012;70:147–60.*
5. *Khatawkar A V. Multi-nodular goiter: Epidemiology, Etiology, Pathogenesis and Pathology. Int Arch Integr Med. 2015;2(9):152–6.*
6. *Gebremichael G, Demena M, Egata G, Gebremichael B. Prevalence of Goiter and Associated Factors Among Adolescents in Gazgibla District, Northeast Ethiopia. Glob Adv Heal Med. 2020;9.*
7. *Alvarado AC, Panakos P. Endotracheal Tube Intubation Techniques. In Treasure Island (FL); 2022.*
8. *Marymont JH, Vender J. Current Difficult Airway Management: Not Good Enough!: Comment. Anesthesiology. 2020;1280.*
9. *Apfelbaum JL, Hagberg CA, Connis RT, Abdelmalak BB, Agarkar M, Dutton RP, et al. 2022 American Society of Anesthesiologists Practice Guidelines for Management of the Difficult Airway. Vol. 136, Anesthesiology. 2022. 31–81 p.*
10. *Thomas M, Saldanha NM. Comparison of Upper Lip Bite Test with Modified Mallampati Score in Predicting Difficult Intubation. Int J Sci Healthc Res. 2022;7(1):1–8.*
11. *De Cassai A, Boscolo A, Rose K, Carron M, Navalesi P. Predictive parameters of difficult intubation in thyroid surgery: A meta-analysis. Minerva Anestesiol. 2020;86(3):317–26.*
12. *Bartolek D, Frick A. Huge multinodular goiter with mid trachea obstruction: Indication for fiberoptic intubation. Acta Clin Croat. 2012;51(3):493–8.*
13. *Wong P, Chieh Liew GH, Kothandan H. Anaesthesia for goitre surgery: A review. Proc Singapore Healthc. 2015;24(3):165–70.*
14. *Rastogi M, Srivastava S, Kudalkar AG, Resident S, Srivastava S, Resident S. AIRWAY*

MANAGEMENT IN PATIENTS WITH THYROID SWELLING UNDERGOING THYROID SURGERY : A. 2022;9(6):56–66.

15. *Jaffar Khan M, Tageldin T, Waqas Farooqi M, Qasim Khamash O, Shahid U, El-Fatih Abdul-Rahman M, et al. Principles of Anesthesia and Airway Management in Head and Neck Surgery. In: Sun H-H (Brian), editor. Surgical Management of Head and Neck Pathologies [Internet]. Rijeka: IntechOpen; 2021. Available from: https://doi.org/10.5772/intechopen.95029*
16. *Zhou CM, Wang Y, Xue Q, Yang JJ, Zhu Y. Predicting difficult airway intubation in thyroid surgery using multiple machine learning and deep learning algorithms. Front Public Heal. 2022;10.*
17. *Khatiwada S, Bhattarai B, Pokharel K, Acharya R. Prediction of difficult airway among patients requiring endotracheal intubation in a tertiary care hospital in Eastern Nepal. J Nepal Med Assoc. 2017;56(207):314–8.*
18. *Olusomi BB, Aliyu SZ, Babajide AM, Sulaiman AO, Adegboyega OS, Gbenga HO, et al. Goitre-Related Factors for Predicting Difficult Intubation in Patients Scheduled for Thyroidectomy in a Resource-Challenged Health Institution in North Central Nigeria. Ethiop J Health Sci. 2018;28(2):169–76.*
19. *Prakash S, Mullick P, Singh R. Evaluation of thyromental height as a predictor of difficult laryngoscopy and difficult intubation : a cross-sectional observational study. Brazilian J Anesthesiol (English Ed [Internet]. 2021;(xx). Available from: https://doi.org/10.1016/j.bjane.2021.07.001*
20. *Tamire T, Demelash H, Admasu W. Predictive values of preoperative tests for difficult laryngoscopy and intubation in adult patients at tikur anbessa specialized hospital. Anesthesiol Res Pract. 2019;2019.*
21. *Tafesse D, Ataro G. Predictors of Difficult Tracheal Intubation on Adult Elective Patients in a Teaching Hospital. Open Anesthesiol J. 2016;10(1):34–9.*
22. *Amathieu R, Smail N, Catineau J, Poloujadoff MP, Samii K, Adnet F. Difficult intubation in thyroid surgery: Myth or reality? Anesth Analg. 2006;103(4):965–8.*
23. *Chang PY, Hu PY, Lin YC, Chen HY, Chiang FY, Wu CW, et al. Trachway video intubating stylet allows for optimization of electromyographic endotracheal tube placement for monitored thyroidectomy. Gland Surg. 2017;6(5):464–8.*

24. *Hailekiros AG, Workneh Abiy S. Magnitude and Predictive Factors of Difficult Airway in Patients Undergoing Thyroid Surgery, From a Goiter Endemic Area. J Anesth Clin Res. 2015;6(11).*
25. *Seo SH, Lee JG, Yu SB, Kim DS, Ryu SJ, Kim KH. Predictors of difficult intubation defined by the intubation difficulty scale (IDS): Predictive value of 7 airway assessment factors. Korean J Anesthesiol. 2012;63(6):491–7.*
26. *Hagberg C, Georgi R, Krier C. Complications of managing the airway. Best Pract Res Clin Anaesthesiol. 2005;19(4):641–59.*
27. *Cook TM, Macdougall-Davis SR. Complications and failure of airway management. Br J Anaesth. 2012;109(SUPPL1):68–85.*
28. *Moucharite MA, Zhang J, Giffin R. Factors and economic outcomes associated with documented difficult intubation in the United States. Clin Outcomes Res. 2021;13:227–39.*
29. *Frca WK. PULMONARY ASPIRATION OF GASTRIC CONTENTS ANAESTHESIA TUTORIAL OF THE WEEK 192 SpR in Anaesthesia. 2010;(August):1–6.*
30. *Dowdy RAE, Mansour ST, Cottle JH, Hannah R, Weprin HB, Yarborough LE, et al. Cardiac Arrest Upon Induction of General Anesthesia. :38–44.*
31. *Joshi R, Hypes CD, Greenberg J, Snyder L, Malo J, Bloom JW, et al. Difficult airway characteristics associated with first-attempt failure at intubation using video laryngoscopy in the intensive care unit. Ann Am Thorac Soc. 2017;14(3):368–75.*
32. *Alhomary M, Ramadan E, Curran E, Walsh SR. Videolaryngoscopy vs. fibreoptic bronchoscopy for awake tracheal intubation: a systematic review and meta-analysis. Anaesthesia. 2018;73(9):1151–61.*
33. *Russotto V, Myatra SN, Laffey JG. What's new in airway management of the critically ill. Intensive Care Med [Internet]. 2019;45(11):1615–8. Available from: https://doi.org/10.1007/s00134-019-05757-0*
34. *Schiavolin C, Iacobone M, Carron M, De Cassai A, Papaccio F, Betteto G. Prediction of difficult tracheal intubations in thyroid surgery. Predictive value of neck circumference to thyromental distance ratio. PLoS One. 2019;14(2):1–12.*
35. *Matteo RS. Clinical Anesthesia. 8th editio. H. JJS• SA• S, ROSENBAUM, editors. Vol. 59, Anesthesia & Analgesia. Wolters Kluwer Health; 2018. 638 p.*
36. *Loftus PA, Ow TJ, Siegel B, Tassler AB, Smith R V., Cohen HW, et al. Risk factors for*

perioperative airway difficulty and evaluation of intubation approaches among patients with benign goiter. Ann Otol Rhinol Laryngol. 2014;123(4):279–85.

37. *Eiamcharoenwit J, Itthisompaiboon N, Limpawattana P, Suwanpratheep A, Siriussawakul A. The performance of neck circumference and other airway assessment tests for the prediction of difficult intubation in obese parturients undergoing cesarean delivery. Int J Obstet Anesth [Internet]. 2017;31:45–50. Available from: http://dx.doi.org/10.1016/j.ijoa.2017.01.011*
38. *Cm A, Rao SS, Rooparani K, Vinay R, Kn V, Deepak TS. The Ratio of Height to Thyromental Distance (RHTMD) and Height to Sternomental Distance (RHSMD) as the Predictive Tests for Difficult Tracheal Intubation. 2022;2022(9).*
39. *El-Radaideh K, Dheeb E, Shbool H, Garaibeh S, Bataineh A, Khraise W, et al. Evaluation of different airway tests to determine difficult intubation in apparently normal adult patients: undergoing surgical procedures. Patient Saf Surg. 2020;14(1):1–8.*
40. *Durbin CG, Bell CT, Shilling AM. Elective intubation. Respir Care. 2014;59(6):825–49.*
41. *Kalezić N, Milosavljević R, Paunović I, Živaljević V, Diklić A, Matić D, et al. The incidence of difficult intubation in 2 000 patients undergoing thyroid surgery - A single center expirience. Vojnosanit Pregl. 2009;66(5):377–82.*
42. *Bouaggad A, Nejmi SE, Bouderka MA, Abbassi O. Prediction of difficult tracheal intubation in thyroid surgery. Anesth Analg. 2004;99(2):603–6.*
43. *Chaves A, Carvalho S, Botelho M. Difficult Endotracheal Intubation In Thyroid Surgery: A Retrospective Study. Internet J Anesthesiol. 2012;22(1):22–5.*
44. *Khan MNA, Rabbani MZ, Qureshi R, Zubair M, Zafar MJ. The predictors of difficult tracheal intubations in patients undergoing thyroid surgery for euthyroid goitre. J Pak Med Assoc. 2010;60(9):736–8.*
45. *Kalezić N, Sabljak V, Stevanović K, Miličic B, Marković D, Tošković A, et al. Predictors of difficult airway management in thyroid surgery: A five-year observational single-center prospective study. Acta Clin Croat. 2016;55:9–18.*
46. *Shiferraw M. City Profile: Addis Ababa. World Lit Today. 2022;96(3):5.*
47. *Adnet F, Borron SW, Racine SX, Clemessy JL, Fournier JL, Plaisance P, et al. The intubation difficulty scale (IDS): proposal and evaluation of a new score characterizing the complexity of endotracheal intubation. Anesthesiology. 1997 Dec;87(6):1290–7.*

48. *Narang N, Ashahiya ID, Panwar S, Mahendra R. Clinical Assessment of Airway and Its Correlation with Laryngoscopy Grading. Int J Sci Study. 2016;3(11):13–7.*
49. *Mallat J, Robin E, Pironkov A, Lebuffe G, Tavernier B. Goitre and difficulty of tracheal intubation Goitre et difficulte. Ann Fr Anesth Reanim [Internet]. 2010;29(6):436–9. Available from: http://dx.doi.org/10.1016/j.annfar.2010.03.023*
50. *GÜLTEKİN A, YILDIRIM İ, SAHİN A, ARAR C. Airway management of a huge thyroid mass: A case report. J Surg Med. 2020;4(10):898–900.*

ANNEXES

ANNEX I: [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]! [illegible] ____________[illegible] [illegible]5-10 [illegible]? 1. [illegible] 2. [illegible]

[illegible]

[illegible]__________________________

[illegible]___________________________

CONSENT FORM

Addis Ababa University

College of Health Sciences

School of Medicine Department of Anesthesia

Verbal consent form before conducting an interview

Greeting

Hello, my name is __________ and I'm a data collector for the study entitled "Magnitude and predictors of difficult tracheal intubation in patients who underwent elective thyroid surgery at Addis Ababa government hospitals". It is a study aimed to assess the magnitude and predictors of difficult tracheal intubation in patients who underwent elective thyroid surgery in this hospital so that enough attention and concern would be given to airway management because the complications of the difficult airway are life-threatening. I would ask you a few questions and measure some airway parameters that would take only 5-10 minutes of your time regarding this airway assessment. We planned to collect data from all thyroid patients to participate in the study because you underwent surgery in this hospital and there are no other special criteria. Participating in this study had no bearing on the quality of care you receive from this institution. You have the freedom to leave the research at any moment and to stop answering any questions that are asked. Your name, address or any other information that identifies you would not be used in the study.

Do you agree to participate in the study? YES NO

Date of data collection________________________

Name of data collector ________________________Signature______

ANNEX II: QUESTIONARIES

Instruction: for each of the questions, please circle the letter of alternatives(s) that fit the response or fill in the blank space provided.

Part I: Socio-Demographic Data

		Possible Response	Remark
101	Age	______________________	
102	Gender	1: Male 2: Female	
103	Height(cm)	______________________	
104	Weight(Kg)	______________________	
105	BMI(kg/m^2)	______________________	
106	ASA	1: I 2: II	

Part II: Preoperative Airway Assessment

201	Inter-Incisor Gap (IIG)	1: <3 patients' finger 2: ≥3 patient's finger	
202	Mallampati Class (MMC)	1: Class I 2: Class II 3: Class III 4: Class IV	
203	Upper Limp Bit Test (ULBT)	1: Class I 2: Class II 3: Class III	
204	Jaw Slide (JS)	1: Class A 2: Class B 3: Class C	
205	Thyro-Mental Distance (TMD)	_______________cm	
206	Sterno-Mental Distance (SMD)	_______________cm	
207	NC/TMD	_______________cm	

208	Height /TMD	________________cm	
209	Neck mobility	1: <90^{O} 2: ≥90^{0}	
210	Tooth character	1. Normal tooth 2. Mobile tooth 3. Lost upper incisors tooth	

Part III: Goiter-related variables

301	Diagnosis		
302	Tracheal deviation on CXR	1. No 2.Yes	
303	Neck circumference (NC)	______________cm	
304	Mass duration (month/years)	_____ month or years	

Part V: Endotracheal intubation

401	Were alternatives techniques used to facilitate intubation?	1. No 2.Yes	
402		If yes, you can encircle more than one alternative given below whenever applied.	◆ Reposition the patient ◆ Different tube sizes used ◆ Stylet ◆ Budgie ◆ Glide scope ◆ Fiberscope ◆ None
403	Number of operators required to directly perform intubation	1. I 2. II 3. III 4. >III (Specify………)	
404	Number of attempts	1. I 2. II 3. III 4. > III (Specify………)	
405	Position of vocal cords while intubation	1. Opened 2. Closed	
406	Cormack and Lehane laryngoscopy grade	1. I 2. II 3. III 4. IV	

407	Lifting force required during laryngoscopy	1. Normal 2. Increased	
408	Is external laryngeal pressure applied?	1. No 2. Yes	
409	Total intubation difficult score /IDS	0. 0 1. 1-5 2. > 5 3. ∞	
		Parameters for IDS: N1: Number of attempts required : if more than one, give 1 point for each N2: Number of operators required : if more than one, give 1 point for each N3: Number of alternative techniques used : if more than one, give 1 point for each. N4: Cormack laryngoscopy grades: if greater than one, give 1 point each. N5: Lifting force required: if increased, give 1 point. N6: Laryngeal pressure applied: if applied give 1 point N7: Position of vocal cord: if adducted or closed, give 1 point, if not possible to visualize vocal cords.	
410	Tracheal intubation	0. Easy 1. Difficult	

ANNEX III: DECLARATION

I, the undersigned, declare that this research thesis is my original work in partial fulfillment of the requirements for the MSc degree in Advanced Clinical Anesthesia. I understand that plagiarism will not be tolerated and all directly quoted material has been appropriately referenced.

Name: ………………………………………….

Signature…………………

Submission to: Department of Anesthesia, Addis Ababa University.

Date of submission………………

ANNEX IV: ASSURANCE OF INVESTIGATOR

The undersigned agrees to accept responsibility for the scientific, ethical, and technical conduct of the research project and for the provision of required progress reports as per terms and conditions of the research and publications office of Addis Ababa University.

Name of the investigator: …………………………………

Date: ………………. Signature: ………………….

Approval of the advisor's

Name	Signature	Date
1. ________________	________________	________________
2. ________________	________________	________________