Addis Ababa University

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# Assessment of predictors for difficult intubation and laryngoscopy in adult elective Surgical Patients at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia, 2019

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# Assessment of predictors for difficult intubation and laryngoscopy in adult elective Surgical Patients at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia, 2019

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## Abstract

**Background:** General anesthesia is not without Morbidity. One of the well-known life threatening events associated with general anesthesia is difficult airway which can happen during induction of anesthesia while attempting to insert the endotracheal tube with the aid of laryngoscope. Difficult intubation, inadequate ventilation and esophageal intubation are the principal causes of death or brain damage related to airway manipulation

**Objective:** The main objective of this study was to assess predicators for difficult laryngoscopy and intubation, among surgical patients who underwent elective surgery under general anesthesia with endotracheal intubation in Tikur Anbessa Hospital from February 4 to March 29, 2019

**Materials &methods:** After the Ethical Committee approval, Institutional based cross sectional study was be conduct from February 1 to March 30, 2019 on patients submitted to TASH major operation room undergoing surgery under general anesthesia with endotracheal intubation (ETT). Patients were evaluated during preanesthetic bed side tests on the Mallampati classification, and the American Society of Anesthesiologists (ASA) difficult airway algorithm .Data on socio demographic characteristics, preanesthetic airway assessment & laryngoscopic view was collected. Data were analyzed by SPSS Version 20.0 window. In the study population. Descriptive as well as analytic statistics was used for variables and data presented by tables, graphs, charts, and texts. Independent variables with the dependent variable; was analyzed by using chi- square test, , binary logistic regression, and ROC curve were performed and p value less than 0.05 was taken as strong association

**Results;** The magnitude of difficult laryngoscopy, difficult intubation, and failed intubation are 15.2%, 6.1%, and 0.07%, respectively. IID < 30mm and Mallampati classes III and IV are the most sensitive tests and to predict difficult intubation and laryngoscopy (*P*value < 0.001).Unrestricted multiple attempt increases further difficulty of airway management (*P* value < 0.001)

**Conclusion and recommendation:** In spite of various airway assessment tests, no single test was 100% accurate. We would like to recommend anesthesia professionals to use the combination of as their routine preoperative tests to predict difficult laryngoscopy and intubation.

## Declaration

The under signed certify that the research entitled “magnitude and predictive values of difficult intubation and laryngoscopy in adult elective surgical patients at Tikur Anbessa specialized hospital,

Addis Ababa, Ethiopia”, is my original work and any literature and/or data cited in this article were listed in the reference section and any assist done during this period has been given an acknowledgement.

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Investigator

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Approval of the Board of Examiners

1. Advisor

Name _____ Signature _____ Date _____ 2. Internal Examiner

Name _____ Signature _____ Date _____ 3. External Examiner

Name _____ Signature _____ Date _____

## Acronyms

ASA……..……..American society of Anesthesiologists

BMI……...Body Mass Index

C-L ……..Cormack –Lehanes

DTI……..Difficult Tracheal Intubation

ED……..Emergency Department

ETT……..Endotracheal tube

HRTMD…….Ratio of height to thyromental distance

IID……..Inter incisor distance

MMC…….modified Mallampati classification

MO…….Mouth opening

NPV…….negative predictive value

OR……operation Room

PPV……..positive predictive value

ROM…….Range of motion

SMD……Sternomental distance

SPSS……..Statistical package for Social Science

TMD……Thyromental distance

TASH……Tikur Anbessa Specialized Hospital

ULBT……Upper lip bite trial

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## Acknowledgement

First, I would like to acknowledge my advisor Mr. Mulualem Sitot and Mrs. Siryet Tesfaye for his valuable assistance and comments and I would also like to thank my colleagues who helped me during data collection time. Last but not least, I would like to thank Addis Ababa University for financial support

# Chapter One: Introduction

## 1.1 Background

Expertise in airway management is essential in every medical specialty. Maintaining a patent airway is essential for adequate oxygenation and ventilation and failure to do so, even for a brief period of time, can be life threatening(1). Difficult airway management can result in patient harm from relatively minor problems such as oral trauma up to an increased risk of aspiration and eventually hypoxia, cerebral damage and death from inability to oxygenate (2)

Appropriate management of the difficult airway constitutes an important place in the prevention of mortality and morbidity associated with anesthesia. Failure to assess for and identify potential difficulty, or the application of poor judgment in management planning, may contribute to a poor outcome. Airway assessment must go beyond carrying out a series of bedside tests; it must attempt to identify problems in each facet of airway management and incorporate these logically into a strategy. This should take into account anatomical variations, airway pathology, and previous strategies. Of great importance is the consideration of how these factors may impact on the likely success of any given technique or equipment used. The skills of the professional and the equipment available must also be accounted for (3).

The prevalence of difficult laryngoscopy has been reported to range between 1.5% and 20%, and a variety of physical examination tests have been used to estimate its presence(4)**.**

The term ‘difficult airway’ has been defined by the American Society of Anesthesiologists (ASA) taskforce as the clinical situation in which a conventionally trained anesthesiologists or anesthetist experiences problems with mask ventilation or tracheal intubation or both (5,) & defines difficult endotracheal intubation as 3 attempts at endotracheal intubation when an average laryngoscope is used or when endotracheal intubation takes 10 min or more (6). The incidence of failed intubation is approximately 1 in 1000 and the incidence of cannot intubate, cannot ventilate is approximately 1 in 2800–20,000 (7, 8).

Among the strategies proposed to decrease morbidity and mortality related to DTI the role of its prediction remains a matter of debate. Although many algorithms include preoperative assessment, some authors have suggested that attempting to predict difficult tracheal intubation (DTI) is unlikely to be useful (9). Several clinical signs have been identified as predictors of difficult laryngoscopy or difficult tracheal intubation (DTI), including the Mallampati score, mouth opening (MO), and the

thyromental distance (TMD), and body mass index (BMI) (10). However, the sensitivity and predictive positive values of these signs are low, precluding an accurate prediction of DTI and this has been confirmed by a recent meta-analysis (11). Several studies have been proposed to derive a score from multivariate analysis. Although the predictive properties of these scores were higher than those of individual signs, they remain not very high (12-14).

### 1.2. Statement of the Problem

In anesthesiology, airway assessment at the preanesthetic evaluation has been found to constitute a moment of extreme importance, and investigators in this field are constantly searching for better predictors of a difficult airway. The most commonly used tests for predicting difficult intubation include the Mallampati score, measurement of the Sternomental and thyromental distances, the mouth opening, and the mobility of the neck and the jaw ( 2)

Difficult airway is potentially catastrophic incident as it may result in airway or esophageal injury, aspiration & severe hypoxemia with consequent brain damage / or death (21). The complications related to poor/inappropriate management of difficult airway are death, brain damage, ICU admission, prolonged recovery, emergency surgical airway, and trauma to airway and teeth which require high level care and extra cost (2).

Therefore, conducting a study on the magnitude of difficult airway, laryngoscopy and its associated risk factors in TASH will help to recognize the magnitude of the problem and can also help the Hospital to decrease the incidence of difficult intubation (DI) in all patients undergoing surgery. The study will also be helpful for hospital administrators to plan preventive measures and strategies or reduce risk factors and incidence of difficult intubation. This research can also help as a baseline for future researches on related topics by indicating the magnitude and associated risk factors of difficult airway.

### 1.3. Rationale of the Study

The diagnostic accuracy of preoperative tests varies between different studies which are attributed to the difference in the incidence of difficult laryngoscopy and intubation among different populations, differences in the patient characteristics, clinical setup, and skill of the anesthetists can also influence the magnitude of difficult laryngoscopy and intubation

The study will provide information to the anesthetists who are conducting anesthesia in focusing pointes in evaluating the airway because the patents in TASH comes from all over the country and the study is not conducted in specific socio demographic area . the purpose of the study is preanesthetic evaluations

conducted by other anesthesia professional's does not have full information's about the airway and I have faced difficult intubation candidates who have been said fit for anesthesia without full filing all evaluation criteria . Other researchers conducted there study in one specific geographical locations and didn't include parameters like body mass index (BMI), physical statues of a patents. The advantage of the research is to provide a standard for evaluating the air way by their sensitivity, specificity and predictive capacity in our society

The purpose of this study is therefore to provide evidence-based information to the anesthetists and other concerned professionals on the 0magnitude of difficult laryngoscopy and intubation and to describe the validity of clinically useful preoperative tests for predicting difficult laryngoscopy and difficult intubation in patients with seemingly normal airway in Tikur Anbessa Specialized Hospital

# Chapter Two: Literature Review

## 2.1 Literature Review

There are many researches done on predictors of difficult endotracheal intubation**.** There was research done in UK by ED to relate LEMON assessment with laryngoscopic view and showed that Patients with large incisors (p,0.001), a reduced inter-incisor distance (p,0.05), or a reduced thyroid to floor of mouth distance (p,0.05) were all more likely to have a poor laryngoscopic view (grade 2, 3, or 4).Patients with a high airway assessment score were more likely to have a poor laryngoscopic view compared with those patients with a low airway assessment score (p,0.05)(15).

Another research done on difficult airway on patients presented for GA showed difficult tracheal intubation (DTI) was observed in 0.4%. True view laryngoscope has been used in 59 of 90 patients and succeeded in achieving intubation in 75% of cases. Among risk factors for difficult intubation, neither Mallampati class nor Body Mass Index (BMI) was shown to have high predictive value. An El-Ganzouri Risk Index (EGRI) score of 3 has been estimated to represent the cut-off value between easy and difficult intubation. (17)

Cross-sectional study was done in Brazil on correlation with laryngoscopy view & ETT intubation condition showed eighty-one patients submitted to general anesthesia were evaluated at a preanesthetic consultation according to the modified Mallampati classification, the Wilson score and the American Society of Anesthesiologists (ASA) difficult airway algorithm. Findings were then correlated with the Cormack-Lehanes classification and with the number of attempts at endotracheal intubation. No statistically significant correlations were found between the patients' Mallampati classification and their Cormack-Lehane grade or between the Mallampati classification and the number of attempts required to achieve endotracheal intubation (18)..

Laryngoscopy proved difficult in four patients and in all of these cases the Wilson score had been indicative of a possibly difficult airway, highlighting its good predicting sensitivity. However, the specificity of this test was low, since another 24 patients had the same Wilson score but were classified as Cormack-Lehane I/II. Moreover, two patients who had a Wilson score ≥ 4 were also classified as Cormack-Lehane grade I/II. The study concluded that the Wilson score, although seldom used in clinical practice, is a highly sensitive predictor of a difficult airway; its specificity, however, is low (18).

The research done in India on identification of ideal preoperative predictors for difficult intubation showed the overall incidence of Difficult Intubation being 24.6 %. A slight difficulty in 24% (IDS = 1-5) and moderate to major difficulty (IDS >5) in 0.6% cases was noted. Intubation was possible in all

the patients. Mallampati class III & Mouth opening was less than 4 cm in about 6% cases and Thyromental distance less than 6 cm in 5.4%. 12.5% were unable to prognath and Neck mobility was restricted in 4.6% patients. Sensitivity and specificity of MC- 16.3 % and 97%, Mo 16.3% and 96.6%, TMD - 12.8% and 97%, AP - 33.3% and 93.9% , NM - 10.5% and 97.3%. Positive and Negative Predictive Values for MC, MO, TMD, AP and NM were 63.6% and 78%, 60.9% and 78%, 57.9 and 77.3 %, 62.8% and 81.9%, 56.3% and 76.9% respectively (19).

One study done in North Ethiopia on magnitude and predisposing factors on difficult airway during induction of GA showed that the incidence of difficult laryngoscopy, difficult Intubation and failed intubation are 12.3%, 9%, and 0.005%, respectively. Mouth opening < 30mm and Mallampati classes III and IV are the most sensitive tests and second high specific test next to combination of tests to predict difficult intubation and laryngoscopy (*P*value < 0.001).Unrestricted multiple attempt without alternative airway techniques resulted in exponential increase in desaturation episodes and further difficulty of airway management (*P* value < 0.001) (20).

### 2.2 Magnitude of difficult laryngoscopy, difficult intubation and failed intubation

Study done in Gondar show the incidence of difficult laryngoscopy, difficult intubation, and failed intubation is 12.3%, 9%, and 0.47%, respectively, with no patient having difficult mask ventilation.(2)

Research done in Taiwan on comparison of ULBT &TMD for predicting difficult airway showed that only 5.7% of the patients were considered to have difficult intubations. Sensitivity, specificity, positive and negative predictive values, and accuracy were 70%, 93.3%, 39%, 98.1%, and 92.6%, respectively, for the ULBT, and 55%, 88%, 22%,97%, and 86.3%, respectively, for TMD. Specificity and positive predictive value were found to be significantly higher for the ULBT than for TMD ($p < 0.05$). The sensitivity, negative predictive value, and accuracy were not significantly different between the two methods (16).

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# Chapter Three: Objective

## 3.1 General objective

- To assess the magnitude and predictive values of preoperative tests for difficult laryngoscopy and intubation in surgical patients who underwent elective surgery under general anesthesia with

endotracheal intubation in Tikur Anbessa Specialized hospital, Addis, Ababa, Ethiopia from February 4 to March 29, 2019

### 3.2 Specific objectives

- To assess the magnitude of difficult intubation and laryngoscopy in surgical patients who underwent elective surgery under general anesthesia with endotracheal intubation
- To determine the predictors of difficult intubation in surgical patients who underwent elective surgery under general anesthesia with endotracheal

## Chapter Four: Methodology

### 4.1 study setting and period

The study was conducted in Addis Ababa, Ethiopia at TASH, which is the largest teaching and referral hospital in the country. It was established in 1972.It has around 700 beds serving around 24,000 patients as inpatient and around 250,000 as outpatient per year. It has 5 surgical wards(general surgery),and other wards for different specialties' and per year about 4000- 5000 operations are done in different departments(General surgery, obstetrics and gynecology ,neurosurgery, urology, cardiothoracic ,pediatric and orthopedics from February 4 to March 29, 2019..

## 4.2 Study design

Hospital based cross-sectional study was conducted .

## 4.3. Source population

The source population for the study was all adult patients who underwent elective surgical procedure at TASH.

## 4.4 study population

The study population included all adult patients who underwent elective surgery under general anesthesia with endotracheal intubation and full filed the inclusion criteria from February 4 to March 29, 2019.

## 4.5 Inclusion and Exclusion Criteria

### 4.5.1 Inclusion criteria

Adult patients scheduled for elective surgery under general anesthesia with endotracheal intubation.

### 4.5.2 Exclusion criteria:

- Patients with facial abnormalities, both congenital and traumatic
- Patients in whom airway assessment was not possible, such as comatose patients or patients requiring cervical spine immobility
- Patients unable to understand the request for airway assessment

## 4.6 Sample size determination

Taking magnitude of difficult intubation among GA patients to be 9% from the research done in North Ethiopia, Gondar University (20) to obtain a confidence level of 95% and a using the following formula:

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

Where n= required sample size, P=Magnitude of difficult intubation=0.09 W=margin of error=0.05 Z= 1.96

Taking an additional 15% non-response (contingency), 148 patients were included in this study.

## 4.7 sampling techniques

Systematic random sampling technique was employed to select study participants on daily operation schedule list as long as the study focused on patients with no medical and anatomical abnormalities that affects laryngoscopy view. In situational analysis done for one month, fourteen patients per day or 336 patients per month were undergone surgery in TASH on average and the sample was taken every two patients .the first sample will be taken by using lottery method.

Depending upon average values of the previous surgery per 1 months on the log book, 308 patients were operated on elective schedule. The sampling interval; K was determined using the formula:

K=N/n; 308/148 = 2 Where, n = total sample size, N = population per 1 month.

Therefore, the sampling interval was two and the first study participant (random start) was selected using lottery method from the daily operation schedule list. The first study participant selected by lottery method was the first case from the daily list of operation schedule. Then, every second cases from the operation schedule were included in the study during the study period, (i.e., 3, 5, 7…148).

## 4.8. Study variables

**Dependent variables** ○ Difficult tracheal intubation (yes, no) ○ Difficult laryngoscopy (yes, no) **Independent variables**

- ✓ Socio-demographic data
  - sex, Age, Body mass Index
- ✓ Airway-related variables (tests):Interincisor distance
  - Mallampati class, Tyromental distance
  - Upper lip bite test, Height to tyromental distance ratio
  - Sternomental distance
- ✓ type of surgery

## 4.9. Data collection

Data was collected by the data collector in the day of the operation from the anesthetists and residents that are assigned in both to preanesthetic evaluation and OR in the form of questionnaires. Half-day training was given for qualified anesthetists, who were involved in the data collection process.

Structured questionnaire was prepared and tested on 5% of the sample size at the actual study area. Informed consent was taken from each patient orally before data collection, and then patients scheduled for elective surgery under GA requiring endotracheal intubation.

Predictors of difficult intubation were assessed at the waiting room by the trained data collectors immediately before their entry to the operation room and recorded on the structured questionnaire. Each patient were observed for difficult laryngoscopy and intubation in the operation room. Cormack and Lehane's laryngoscopic grade of the patient was determined by the anesthetist who performed the laryngoscopy. Observational data collection technique was used in this study.

## 4.10. Data Quality Assurance

Training has given for the data collectors, and the questioner was tested on 5% of the calculated sample size. During the data collection process, there was close supervision of data collectors, and collected data were checked every day for its completeness, clarity, and consistency by the principal investigator

## 4.11. Data analysis and Interpretation

Before analysis the data was cross-checked for completeness and consistency. Then data was entered on SPSS version 20 for analysis. Descriptive statistics, binary logistic regression, and ROC curve were performed using SPSS. Association between independent factors and the outcome variables were determined by chi-square, p value, and odds ratio. P value of less than 0.05 was considered as statistically significant. A binary logistic regression and multivariate logistic regression analysis were computed to assess the independent predictive factors and strength of association between the outcome and explanatory variables. Validity of parameters (screening tests) such as sensitivity, specificity, odds ratio, and 95% confidence intervals was performed using crosstabs on SPSS, whereas positive predictive values and negative predictive values were calculated manually from the descriptive statistics.

## 4.12 Operational definition

**Mallampati grading-**

- Grade I: Visualization of the soft palate, fauces; uvula, anterior and the posterior pillars.
- Grade II: Visualization of the soft palate, fauces and uvula.
- Grade III: Visualization of soft palate and base of uvula.
- Grade IV: Only hard palate is visible. Soft palate is not visible at all.

**TMD**-It is defined as the distance from the mentum to the thyroid notch while the patient's neck is fully extended. This measurement helps in determining how readily the laryngeal axis will fall in line with the pharyngeal axis when the atlanto-occipital joint is extended. Alignment of these two axes is difficult if the T-M distance is < 3 finger breadths or < 6 cm in adults; 6-6.5 cm is less difficult, while > 6.5 cm is normal.

**C-L grading**

- Grade I – Visualization of entire laryngeal aperture.
- Grade II – Visualization of only posterior commissure of laryngeal aperture.
- Grade III – Visualization of only epiglottis.
- Grade IV – Visualization of just the soft palate**.**

The patients were classified while they were seated upright, with mouths maximally opened, tongues protruded, and without phonation. A modified Mallampati score class of 3 and 4 are considered predictive of difficult laryngoscopy.

**IID** It is the distance between the upper and lower incisors. Normal is 4.6 cm or more; while less than 3.8 cm predicts difficult airway.

**ULBT**:

- Class 1-lower incisors can bite the upper lip above the vermilion line.
- Class 2-lower incisors can bite the upper lip below the vermilion line.
- Class 3-lower incisors cannot bite the upper

**SMD**; it is the distance from the suprasternal notch to the mentum and measured with the head fully extended on the neck with the mouth closed. A value of less than 12 cm is found to predict a difficult intubation.

**HRTMD**; Height in centimeter/TMD

**Difficult laryngoscopy**: Cormack and Lehane grade III (epiglottis only) or grade IV view (soft palate only) Difficult intubation: if a trained anesthetist using direct laryngoscopy takes more than 3 attempts or more than 10 minutes to complete tracheal intubation

### 4.13. Ethical considerations

Ethical clearance will be obtained from the department research and publications committee and the Institutional Review Board (IRB) of the College of Health Science. Respondents will be clearly informed about the purpose of the study and the information required from them. There will not be any risk or harm on the participants associated with the study. They will also be told that they have the full right of non-involvement and the right to stop the interview at any point in time. Verbal assent will be obtained from all the study participants. Participant confidentiality will be assured. Patients who refuse to take part in the study will receive the same quality of health care service as the participants. All participants included in the study will be kept anonymous during subsequent analysis and dissemination.

### 4.14. Dissemination of findings

This study on completion could serve as a reference material to researchers, experts and policy makers for intervention. To reach these bodies the completed paper will be submitted to College of Health

Sciences, Department of anesthesia. In addition, a copy of this material will be given to TASH, Addis Ababa University student research office, Ethiopian Association of Anesthetists, Ethiopian ministry of health and result will also be disseminated through publication in peer reviewed local and international journals and through presenting it in related workshops and seminars.

# Chapter Five: Result

### 5.1 socio demographic data

From a sample of patients, 148 were included in this study. Majority of the participants 133 (89.9%) were within the age of 18 – 65 years. The mean age of participants was 40 years with standard deviation

of 15. The minimum and maximum ages were 18 and 81 which has normal distribution. The body mass index of data shows 121(81.8%) is above twenty five and 27(18.2%) shows less than twenty five.

The mean BMI of participants was 22.5 with standard deviation of 3.4 and median of 22.

**Table1** : socio demographic characteristics of participants who underwent elective surgery under general anesthesia with endotracheal intubation in Tikur Anbessa Specialized hospital, Addis, Ababa, Ethiopia from February to March , 2019

| Variables | Category | Frequency (%) | Percentage |
|---|---|---|---|
| Age | 18- 65 | 135 | 91.2% |
| | ≥65 | 13 | 8.8% |
| Sex | Male | 82 | 55.4% |
| | Female | 66 | 44.6% |
| BMI | ≤ 25 | 121 | 81.8% |
| | > 25 | 27 | 18.2% |
| Types of surgery | General surgery | 50 | 33.8% |
| | ENT | 12 | 8.1% |
| | Thoracic surgery | 18 | 12.2% |
| | Orthopaedic surgery | 10 | 6.8% |
| | Neurologic surgery | 18 | 12.2% |
| | Urologic surgery | 22 | 14.9% |
| | Gynaecologic surgery | 18 | 12.2% |

Result shows Out of 148 patients undergoing general anesthesia 50(33.8%) are general surgery procedures, 18(12.2%) thoracic surgeries, 10(6.8%) orthopedic procedures, ENT 12(8.1%), 22 (14.9%) urologic and 18 (12.2%) gynecologic surgeries. Out of 120 patients; 20 underwent orthopedic surgeries, 18 gynecologic surgeries and 82 general surgeries.

### 5.2 Magnitude of Difficult Laryngoscopy and Intubation.

In this study, we found the magnitude of difficult laryngoscopy and intubation as 18/148 (12.1%) and 9/148 (6.1%), respectively. In this study, difficult intubation was defined as number of attempts ≥4 times based on ASA definition. There were one cases with failed intubation which is 1 (0.75%).

**Table 2:** shows Preoperative airway parameters and their distribution with difficult laryngoscopy and intubation among surgical patients in Tikur Anbessa hospital from February to March, 2019

| Predicators | Frequency, n (%) | DL, n (%) | DI, n (%) |
|---|---|---|---|
| Mallampati I and II | 130(87.7%) | 3(2.3%) | 13(10%) |
| III and IV | 18(12.16%) | 15(83.3%) | 11(61.1%) |
| TMD <6cm | 16(10.8%) | 9(56.3%) | 10(62.5) |
| ≥6 cm | 132(89.2%) | 18(13.6%) | 14(10.6%) |
| SMD : <12 cm | 21(14.2%) | 10(7.87%) | 10(47.6%) |
| ≥12 cm | 127(85.8%) | 8(61.5%) | 14(11%) |
| IID ≥3cm | 132(89.2) | 15(11.36%) | 16(12.1%) |
| <3cm | 16(10.8) | 8(50%) | 8(50%) |
| ULBT | 120(81.1%) | 19(15.8%) | 20(16.6%) |
| | 28(18.9%) | 4(14.28%) | 4(14.1%) |
| HRTMD;≤23 | 117(79.1%) | 12(10.25%) | 7(5.6%) |
| >23 | 31(20.9%) | 11(35.5%) | 17(70.8%) |
| NRM class I | 125(84.5%) | 13(10.4%) | 10(8.6%) |
| Class II and III | 23(15.6%) | 10(43.5%) | 15(65.2%) |

16(10.8%) patients had TMD < 6.5cm of whom 6 had easy and 10 had difficult intubation ($p<0.05$), whereas the rest 132(89.2%) had TMD > 6.5cm and only 14 of them were difficult to intubate. 127(85.8%) and 21(14.2%) patients had SMD >12cm and SMD <12cm, respectively but the 14 difficult to intubate patients were from SMD >12cm group. 132(89.2%) and 16(10.8%) patients had IIG >3cm and <3cm, respectively and 16(12.1) and 8(50%) difficult to intubated. Out of 130(87.7%)

Mallampati class-I&II patients only 13(10%) case of difficult intubation was observed but out of 18(12.16%) patients who exhibited Mallampati class-III&IV, difficult intubation was encountered in 11 patients who also were CL laryngoscope grade-III&IV which is highly significant within the group($p<0.05$).

## 5.3 Preoperative Predictive values of difficult Laryngoscopy and Difficult intubation

### 5.3.1 **Predictive values for difficult Laryngoscopy**

The sensitivity, specificity, predictive value of positive test {PVPT}, and predictive value of the negative test {PVNT} of each airway parameter and difficult laryngoscopy shows that 130(87.7%) are Mallampati class I and II were as 18(12.16%) are Mallampati class III and IV .132 (89.2%) has TMD greeter or equal to six centimeter and 37(25%) less than six centimeter. 125(84.5%) patients has no motion limitations on their neck, 23(15.6%) has limitation of motion .127 (85.8%) has SMD greeter or equal to twelve centimeter and 21(14%) has SMD less than twelve centimeter. In our study we have found that upper lip bite test (ULBT) had a higher sensitivity 99.2% and negative predictive value 85.3%.and also Mallampati had a sensitivity of 45.8% and negative predictive value of 86%( Table 3).

**Table 3:** Sensitivity, specificity, positive predictive values, and negative predictive values for preoperative parameters against difficult laryngoscopy among surgical patients

| Test | Sn % | Sp % | PPV % | NPV% | P VALUE | Area | Accuracy | 95% CL | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | lower | upper |
| MMC | 45.8 | 65.9 | 20.4 | 86.2 | 0.004 | 0.96 | 96 | 0.577 | 0.756 |
| TMD | 58.3 | 22% | 12.6 | 73 | 0.016 | 0.416 | 41.6 | 0.284 | 0.549 |
| SMD | 41.7 | 91.1 | 47.6 | 88.2 | 0.001 | 0.622 | 62.2 | 0.485 | 0.758 |
| IID | 93.5 | 50 | 50 | 87.5 | 0.001 | 0.642 | 64.2 | 0.504 | 0.780 |
| HRTD | 88.6 | 70.8 | 54.8 | 93.2 | 0.01 | 0.659 | 65.9 | 0.527 | 0.722 |
| ULBT | 99.2 | 16.7 | 80 | 85.3 | 0.001 | 0.583 | 58.3 | 0.440 | 0.722 |

Sn=sensitivity, Sp=specificity, PPV=positive predictive value, NPV=negative predictive value

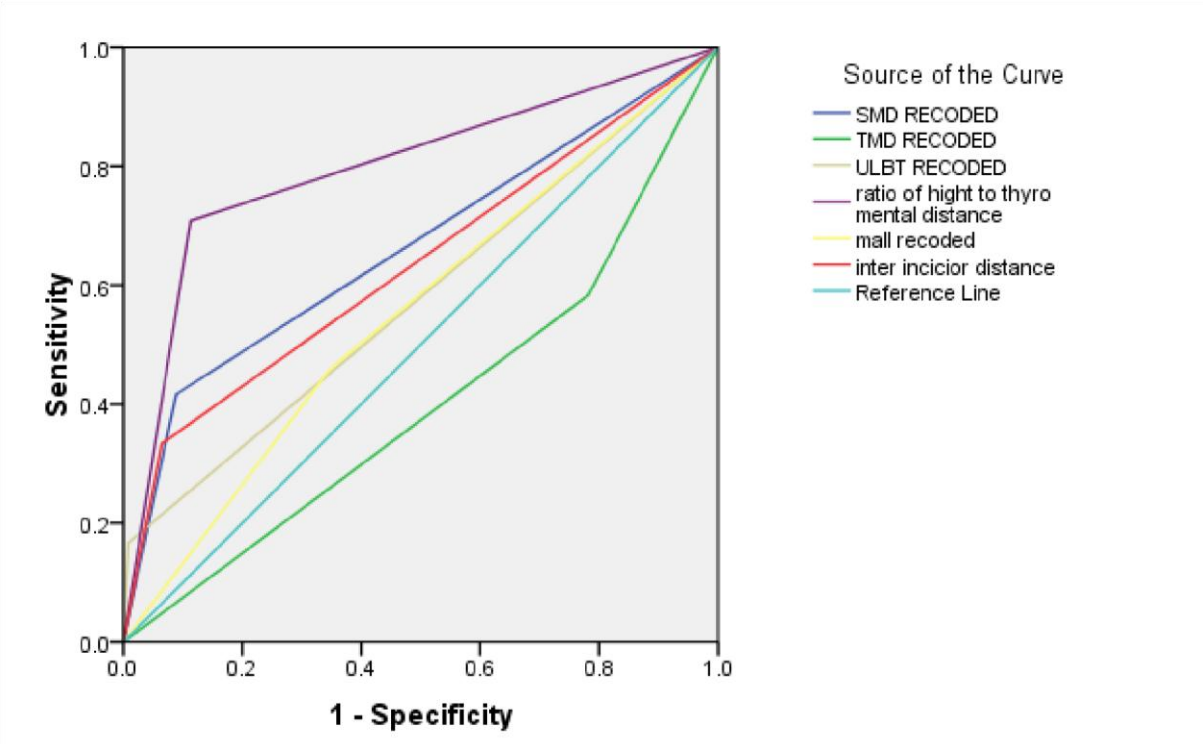


Figure 1; Receiver operating curve for preoperative tests against difficult laryngoscopy in the study population

### 5.3.2 Predictive values for difficult intubation

We can see that higher accuracy to predict difficult intubation in laryngoscopic grade III and IV, Mallampati class III and IV, and SMD (77.2%, 65.9.6%, and 69.6%, respectively). Similar to that of difficult laryngoscopy, preoperative tests for difficult intubation also showed higher specificity and negative predictive values than sensitivity and positive predictive values

.

Mallampati grade III and IV and HRTMD have showed greater sensitivity (69.6% and 47.8%, respectively) when compared to other tests. Receiver operating characteristics curve above revealed HRTMD, Mallampati class, and SMD above the reference line (0.5) with the area under the curve of 0.659, 0.652, and 0.696, respectively TMD is almost along the reference line with the area under the curve of 0.456. (See table 4)

Table 4 Sensitivity, specificity, positive predictive values, and negative predictive values for preoperative parameters against difficult intubation

| Test | Sn % | Sp % | PPV | NPV | P – VALUE | Area | Accuracy % | 95% CI | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | lower | Upper |
| MMC | 69.6 | 65.6 | 30.6 | 92.6 | 0.002 | 0.779 | 77.9 | 0.644 | 0.914 |
| TMD | 58.3 | 22 | 12.6 | 73 | 0.014 | 0.456 | 45.6 | 0.255 | 0.650 |
| SMD | 34.8 | 89.6 | 38.1 | 88.2 | 0.017 | 0.661 | 66.1 | 0.453 | 0.87 |
| IID | 34 | 50 | 93.6 | 88.6 | 0.024 | 0.679 | 67.9 | 0.468 | 0.89 |
| HRTMD | 47.8 | 84 | 35 | 89.7 | 0.044 | 0.803 | 80.3 | 0.641 | 0.964 |
| ULBT | 17.4% | 99.2% | 80.4 | 86.7 | 0.001 | 0.60 | 60 | 0.386 | 0.816 |

Sn=sensitivity, SP=specificity, PPV=positive predictive value, NPV=negative predictive value

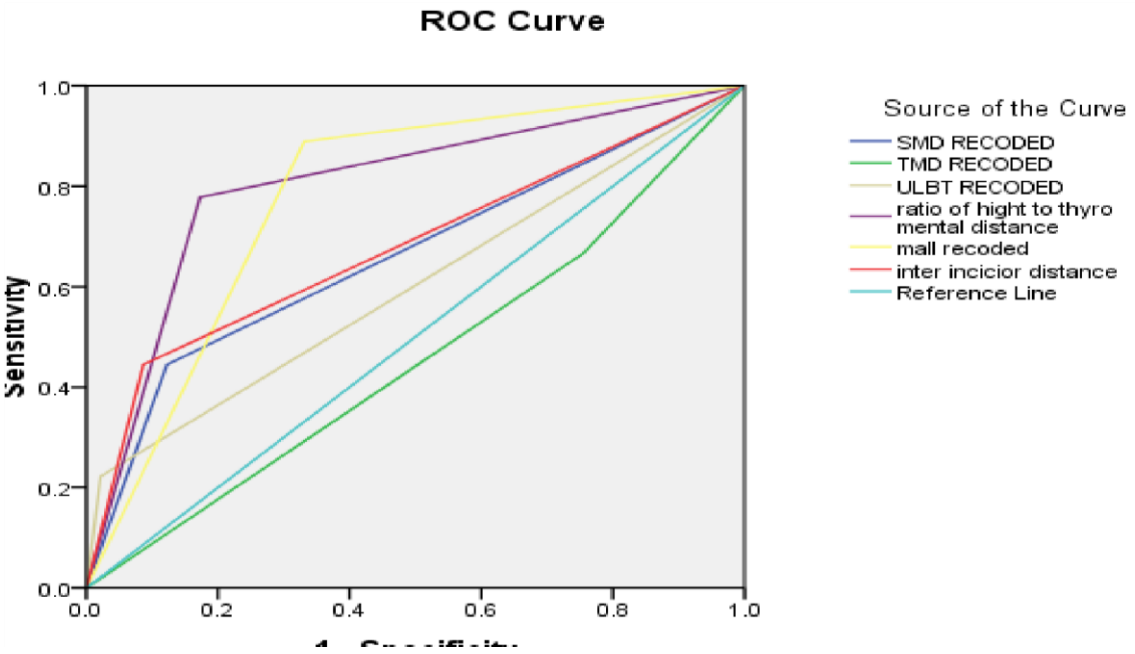


Figure 2; receiver operating curve for preoperative test and difficult intubation

# Chapter Six: Discussion

In this study we have found the magnitude difficult laryngoscopy and intubation as 23/148 (15.1%) and 9/148 (6.1%) respectively. Difficult intubation and laryngoscopy occurs with similar incidence from a literate review done is about 1.5-5.8% (28). Smita et al. (31) found 9.7% and 4.5% difficult Laryngoscopy and intubation, respectively. Iohom et al. (32) and Merah et al (19) reported difficult laryngoscopy as 9% and 3.4%, respectively.

Laryngoscopy in our study appeared to be higher compared to the available literatures (31, 33) Probable explanation for this result may be because our study was conducted in teaching hospital, and most of the intubations were performed by undergraduate students (55%). this may lead to incorrect grading of laryngoscopic view due to lack of adequate experience .

There is also another study done in Dublin, Ireland, were the magnitude of difficult intubation was 9% (23). Savva et al. (28) conducted a prospective study to predict difficult tracheal intubation on 350 patients, and they found difficult tracheal intubation in 17/350 (4.9%) patients, which was comparable to our finding.

According to Srinivasa et al. (29), the *p* value was found to be significant with Mallampati class III & IV, IID, TMD, & SMD for difficult laryngoscopy and intubation which was in line to our findings. In our study of all difficult intubations encountered, one of them had failed mask ventilation which is 1/148(0.7%) and also only one surgical airway were performed 1/148 (0.7%). In our study, Pearson's correlation showed a positive correlation between age of patients and difficult laryngoscopy (p value 0.024) but not for difficult intubation.

In our study sensitivity, specificity, PPV and NPV Mallampati classification for difficult laryngoscopy to be (45.8, 65.9%, 20.4% and 86.2%) respectively. a research done by AK Gupta et al (24), a study on Kashmir population regarding difficult intubation and predictors of difficult intubation reported that sensitivity, specificity, PPV and NPV of Mallampati class as 77.3%, 98.2%, 48.7% and 99.5%, respectively. George and Jacob reported 54.5% sensitivity of Mallampati class as a predictor of difficult tracheal intubation (25). Which is a more similar finding with our study.

ULBT was found to have sensitivity of 99.2% and specificity of 16.7% that similar with Eberhart et al, (20) which were 92.5% and 28% respectively. There are also other researches that state a higher value of specificity than sensitivity a study done by Khan et al (27) show that sensitivity of 76% and specificity of 88%.that might be due to lower incidence of difficult intubation 5.8% larger sample size (500) patients.

This study also found that SMD to have sensitivity and specificity, PPV and NPV as follow respectively 30% , 87.6%, 26% and 91.5% which is similar result with a study done by Dawit T et al (22) 0%, 97.5%, 0% and 100% respectively . A low PPV indicates test failure to answer the anesthetist's question regarding how likely would be the difficult intubation given that the test result was positive.

.

In our study BMI is found to be poor predictor of difficult intubation with a P value greater than 0.065 and have got low specificity and negative predictive value 23% and 35% which is similar finding with finding Dawit et al 0% respectively (22).

There is still no single test with 100% sensitivity and specificity to predict difficult laryngoscopy and intubation. Among airway parameters, in our study Mallampati classifications III & IV {sensitivity 69.6%, specificity 65%}, IID $\leq$ 30mm {sensitivity 93%, specificity 50%},a study done by selshi et al ( 2) also shows {sensitivity 65, specificity 90%}and IID {sensitivity 73%, specificity 81%}

This study is comparable with the study conducted by Iohom et al. (32), where they found poor sensitivity and positive predictive values for MC, TMD, IID, and SMD. Similarly, Merah et al.( 32) found the sensitivity, specificity, and the positive predictive values for the airway predictors as follows: MMT (61.5%, 98.4%, 57.1%), TMD (15.4%, 98.1%, 22.2%), SMD (0%, 100%, 0%), and IIG (30.8%, 97.3%, 28.6%), which shows poor sensitivity and positive predictive values but better specificity.

According to Shiga et al. (11), screening tests included were Mallampati classification, thyromental distance, Sternomental distance, mouth opening, and Wilson risk score. Each test yielded poor to moderate sensitivity (20–62%) and moderate to fair specificity (82–97%).In contrast to the above findings, Srinivasa et al. (29), and Savva (28) showed greater sensitivity, specificity, and positive predictive values for most of the above tests. this may be due to differences in patients' physical appearance, sample size, and cutoff values for the screening tests.

A binary logistic regression identified that MMC and TMD as independent predictors of difficult laryngoscopy with a p value of 0.004 and 0.016, respectively, at the 93% Hosmer and Lemeshow test. Patients with Mallampati class III and IV have 16 times risk to be difficult laryngoscopy (AOR 16 at 95% CI).

Similarly, we also identified that Cormack and Lehane laryngoscopic grade III and IV, Mallampati class III and IV, and ULBT grad three as independent predictors for difficult intubation (*p* value 0.000, 0.002, and 0.001, respectively) at the 75% Hosmer and Lemeshow test. Adjusted odds ratio for ULBT, CL III and IV, and MC III and IV include 36.9, 31.6, and 14.2, respectively, at the 95% confidence interval. A multivariate analysis showed that ULBT and Mallampati class as an independent predictors for both DL and DI with a *p* value of (0.004, 0.001) and (0.002 and 0.001), respectively.

In our study, HRTMD showed better accuracy (65.9%) and MMC (96%) for difficult laryngoscopy, whereas Mallampati class III and IV and Cormack and Lehane laryngoscopic grade III and IV showed the following accuracy for difficult intubation (65.9% and 77.6%), respectively.

Available literatures did not show the predictive value of difficult laryngoscopy for difficult intubation. A good predictive test should have high sensitivity, specificity, positive and negative predictive values. Also it should be simple enough to allow routine clinical use during preoperative evaluation and versatile so as to be applicable to different ethnic groups, gender and age. However high sensitivity is desirable as it will identify most patients in whom intubation will truly be difficult.

# Chapter Seven: Conclusion and Recommendation

## 7.1. Conclusion

We found magnitude of 15.1% and 6.1%% for difficult laryngoscopy and intubation, respectively, among elective surgical patients with apparently normal airways in Tikur Anbessa Specialized Teaching Hospital.

Binary logistic regression identified that Mallampati class and thyromental distance as an independent predictors for difficult laryngoscopy, laryngoscopic grade III and IV, Mallampati class III and IV, and Sternomental distance less than 12 cm were identified as an independent predictors for difficult intubation .A multivariate analysis identified Mallampati class and thyromental distance as an independent predictors for both difficult laryngoscopy and intubation.

Sensitivity and positive predictive values of individual preoperative tests appeared to be poor but showed good specificity and negative predictive values. ROC curve revealed better accuracy with MMC III and IV and height ratio to tyromental distance to predict difficult laryngoscopy with the area under the curve of 0.78 and 0.798, respectively, at 95% confidence interval. Similarly, SMD and ULBT showed low accuracy to predict difficult intubation with the area under curve of 0.401 and 0.578, respectively.

- Based on the result, we conclude that the magnitude of difficult intubation is not quite small that the anesthetists should expect difficult airway management in apparently normal patients.

- Moreover, not all preoperative screening tests reliably indicate difficult intubation when used alone. Combination of some tests may have favorable effect in predicting true difficulty. However, Mallampati class III&IV alone can predict the probability of difficult endotracheal intubation in adult patients.

## 7.2 Recommendation

- In spite of various airway assessment tests, no single test was 100% accurate.
- So it is advisable to use combination of different tests.
- We would like to recommend anesthesia professionals to use the combination of as their routine preoperative tests to predict difficult laryngoscopic intubation.

- Anesthesia professionals should develop guideline for preoperative airway assessment to decrease incidence of difficult laryngoscopy and intubation.

- Further multicenter study should be conducted in this particular topic to develop national guideline for preoperative airway assessment

## 7.3 Limitation of study

- Most of the laryngoscopies and intubations were performed by undergraduate students, and this might have contributed for higher magnitude of difficult

  .
- Airway management may not follow standard guideline, or there may be interpersonal variations in the anesthetic management in terms of their experience, preparation, and availability of equipment for intubation which may also have an impact on the magnitude of difficult laryngoscopy and intubation.

- Adequate time is not being given during evaluation of the airway that might have effect on measurements of predictors

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# 9. Annexes

## 9.1. Individual consent form

Greeting!

Hello, my name is _____ and I’m a data collector for the study entitled “predictors of difficult airway & laryngoscopic view at Tikur Anbessa Hospital”. It is a study aimed to assess the relationship between gross airway assessments with laryngoscopic view during endotracheal intubation. I will ask you few questions and do some physical examinations that will only take 5 -10 minutes of your time regarding this matter.

Being a part of this study will not affect in any way the service you are getting in this hospital. You are selected randomly to participate in the study just because you undergo a surgery in this hospital no other special criteria. You are free to withdraw from the study and you can stop answering to any questions that are forwarded to you at any time you want. In the study any answer you gave will be confidential and in addition your name, address or any information that identifies you will not be used. Do you agree to participate in the study? A. yes B. No

## 9.2. Questionnaire

**Socio demography**

1. Age
2. Sex

   A. male B. female

3. Body mass index ……

**Airway assessment**

1. A. Mallampati

   A .I B.II C.III D.IV

2. TMD

a <6cm b->6cm

3. IID

A. Admits three fingers B. admits less than three fingers

4. Neck range of motion

A. no limitation B .slight limitation C. strong limitation

5. Laryngoscopic view (C-L) grading-grade

A. I B. II C. III D.IV

6. Number of attempts

A. One B. two C. three D. more than three

7. Types of surgery

A .general B .neurosurgery C. Thoracic D. gynecology E. urology F. ENT

8. Complications during intubation

A. dental trauma B. desaturation C. esophageal intubation

9. Aides used to facilitate intubation

A. cricoid applied B. boogi C. stiylet D. Glideslope E. Fiber optics

10. Intubation attempts

A. One B. two C. three D. more than three

11. Surgical airway due to failed intubation

A. yes B. No

12. Time required for intubation

A. < than 10 minutes B. > than 10 minutes

13. Awaking the patent due to difficult intubation

A. yes B. no

14. Mask ventilation

A. possible B. impossible

15. Final result to intubate

A. possible B. impossible

16. Intubated by

A, anesthesia student B. stuff anesthesia professionals