ADDIS ABABA UNIVERSITY

COLLAGE OF HEALTH SCIENCE

DEPARTMENT OF ANESTHESIA

COMPARISON OF MODIFIED MALLAMPATI CLASSIFICATION WITH CORMACK AND LEHANE GRADING IN PREDICTING DIFFICULT LARYNGOSCOPY AMONG ELECTIVE SURGICAL PATIENTS WHO TOOK GENERAL ANESTHESIA IN WERABE COMPREHENSIVE SPECIALIZED HOSPITAL 2020/2021.

A Thesis Submitted to Department of Anesthesia, College of Health Sciences, and Addis Ababa University for requirement of partial fulfillment of Degree of Masters of Science in Advanced Clinical Anesthesia.

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Title	Comparison Of Modified Mallampati Classification With Cormack And Lehane Grading In Predicting Difficult Laryngoscopy Among elective surgical Patients Who Took General Anesthesia in W/C/S/H- cross Sectional study
Study Area	Werabe Comprehensive Specialized Hospital
Study period	From February 2021- April 2021
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Declaration

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

Name: _____Signature: _____

Submission to Msc Tutor, Department of Anesthesia, and Addis Ababa University.

Date of Submission: _____

this thesis work has been submitted for examination with my/our approval as Advisors and Tutors on the Master of Science degree in Anaesthesia

Name and Signature

1. _____

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4._____

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Table of Contents

Acronym

MMC	Modified Mallampati Classification
MMT	Modified Mallampati Test
CLG	Coramack and Lehane Grading
C-Lg	Cormack and Lehane Gradig
MP	Mallampati
MM	Modified Mallampati
CL	Cormack and Lehane
ASA	American Society Of Anesthesiologist
ETT	Endotracheal Tube
BMI	Body Mass Index
EGD	Extraglotic Device
DI	Dificult Intubation
BMV	Bag And Mask Ventilation
AUC	Area Under The Curve
ROC	Recivier Operating Curve
AAU	Addis Ababa University
DL	Difficult Laryngoscopy
WCSH	Werabe Comprehensive Specialized Hospital

Tables and figures

Abstract

Background: Difficult laryngoscopy/intubation cause various complications likes hypoxia, brain damage or even death if it is not managed early. Appropriate airway assessment in the preoperative period is an important task and in patients with no apparent difficult airway indicator, Modified Mallampati test (MMT) alone is used frequently to predict difficult airway even if its predictive value is low. Cormack and Lehane grading (CLG) is the gold standard but not applied before anesthesia.

Objective: It was to compare modified mallampati classification (MMC) with Cormack and Lehane grading in predicting difficult laryngoscopy among patients who took general anesthesia.

Method: Institutional based cross sectional survey study was conducted among 141 elective surgical patients with no apparent difficult airway indicator from February 2021 to April 2021. The correlation between MMC and CLG was calculated using spearman's correlation coefficient, and the area under curve (AUC) was analyzed using receiver operating characteristics (ROC) curve analysis for MMT.

Result: The incidence of difficult laryngoscopy and intubation were 14.9% and 9.2% respectively. Spearman correlation coefficient (ρ) was 0.330 with $p<0.001$. AUC against difficult laryngoscopy and intubation was 0.705 & 0.726 respectively. Sensitivity and specificity of MMT were 47.6% & 93.3% for difficult laryngoscopy and 53.8% and 91.4% for difficult intubation respectively.

Conclusion and Recommendation: Correlation between MMC and CLG was low. Sensitivity of MMT was also low. Therefore, additional clinical tests are necessary as part of screening test for difficult airway.

Keywords: difficult laryngoscopy, modified mallampati classification, cormak and lehane grading

CHAPTER ONE

1. INTRODUCTION

1.1 Background

Airway management is one of the daily activities in anesthesia practice. During airway management, difficult airway is a challenging and catastrophic phenomenon facing anesthetists in their practice. In clinical practice, the difficult airway has four components. These components are: Difficult laryngoscopy, Difficult BMV (bag mask ventilation, Difficult extra glottic device(EGD) and Difficult cricothyrotomy(1).

Difficult laryngoscopy is defined as inability of visualizing of any parts of the vocal cords during multiple attempts at the time of direct laryngoscopy(2,3). DI(difficult intubation) frequently results from inability to obtain adequate glottic visualization with laryngoscopy(2). The concept of difficult laryngoscopy and intubation is highly linked to inadequate glottic visualization; if the glottic visualization is poor, intubation will be more challenging(1).

Cormack and Lehane determined the most widely used methods of classifying the degree of visualization of the vocal cord during direct laryngoscopy, in which laryngoscopic view is graded as grade I to grade IV (1,3,4). This grading system is performed after induction of anesthesia and during direct laryngoscopy. Standard description of the laryngeal view is the best view of larynx with optimal head and neck positioning, optimum blade length and position, optimal external laryngeal manipulation and muscle relaxation (or abolition of glottic reflexes)(5). Based on laryngeal structure view by direct laryngoscopy, Cormack and Lehane put Grade I : when the entire glottis is visible, Grade II : when posterior commissure of the glottis

is visible, Grade III : when epiglottis only is visible, and Grade IV : when any portion laryngeal structure is invisible(1,4–9).

Cormack and lehane grade 3 and 4 are considered as difficult laryngoscopy(1,5,10). In the C–L grading system, the degree of laryngeal aperture visualization during direct laryngoscopy had not clearly described. In grade 2 laryngeal view, portions of the vocal cord structure may be visible or only the arytenoid cartilages may be visible. Therefore grade 2 can be divided as grade 2a and 2b. when portion of the vocal cord is visible, we call it as grade 2a and when the arytenoid cartilage only is visible, it is considered as grade 2b. From grade 2 views, around 20% are Grade 2b.(1)

Difficult laryngoscopy is said to be when unable to visualize the vocal cords, which includes Grades 2B, 3 and 4(6). From patients with grade 2b view, intubation is difficult in two-thirds of them, whereas from patients with grade 2a views, the prevalence of difficult intubation is around 4%.(1)

There are multiple methods available to assess the airway difficulty used by anesthetists. However, the ideal and universally acceptable classification system is still ongoing.(8) Difficult laryngoscopy and intubation can be predicted in the preoperative period by using clinical assessments. Modified mallampati classification is one of the tests used commonly(10).

Mallampati classification was first developed by Mallampati and later modified by Samsoon in 1987.(4) Modified mallampati classification has four classes. MMC is assigned after viewing oropharyngeal structure. This is done by putting the patient sitting up straight position with the head in neutral position. Then the patient open the mouth maximally and protrude tongue out(4,11). Modified Mallampati classes are assigned as Class I if hard palate, Soft palate, uvula, tonsilar fauces and pillars are visible; Class II if hard palate, Soft palate, fauces and uvula- tip may be masked- are visible; Class III if hard palate, Soft palate and base of uvula are visible; Class IV if

hard palate only is visible and Soft palate is not visible at all. MM Class III and IV are considered as difficult laryngoscopy(1–4,10–14). There is also additional MMC which is called Class zero. if any part of the epiglottis is visible when the patient open his/her mouth and protrude the tongue during airway assessment, we call it class zero.(14).

Appropriate airway assessment in the preoperative period to identify those who have risk of difficult airway is an important task to prepare for the facing difficulties. Most commonly, MMT is used as preoperative airway assessment tool. But its predictive value is low when used alone especially in those who have no apparent difficult airway indicator as described by different authors. Even though in werabie comprehensive specialized hospital, anesthetists used modified mallampati test to predict difficult laryngoscopy and intubation in patients with no apparent difficult airway indicator and if class I and II are found, nobody was prepared for difficult airway due to considering as easy.

1.2 Statement of the problem

Airway management using direct laryngoscopy is one of the daily tasks of anesthetist. Difficult laryngoscopy/intubation may cause various complications likes hypoxia, brain damage or even death if it is not managed early(15–17). From all anesthesia related deaths, 30% to 40% deaths are due to the inability to manage a difficult airway.(15)

From more than half to one-third of cardiac arrests while performing general anesthesia, it is due to difficult airway which results in inadequate oxygenation and/or ventilation(8). Difficult laryngoscopy causes sore throat and serious airway trauma as well as aspiration of gastric contents or mendelson syndrome(7). In 17% of difficult airway there are no documented preoperative airway assessment(15) and this is why difficult airway harms the patient due to inadequate preparation for such difficulties.

In my observation in werabe comprehensive specialized hospital, difficult laryngoscopy was encountered in surgical patients, and after surgery and anesthesia some patients complain sore throat, hoarseness of sound, pain in the oropharynx and sometimes difficulty of breathing.

Globaly,the prevalence of difficult laryngoscopy was reported to be between 1.5% and 20%, (16). The variation in patients characteristics that arises from their race or ethnicity causes the difference in the incidence of difficult laryngoscopy and difficult intubation from population to population(18). To predict its presence, different physical examination tests have been used by anesthetists. Among these tests, Mallampati scoring is the most frequently used clinical bed side tests in the assessment of airway(6,8,16,18).

Cormack and lehane grading is a gold standard to predict difficult laryngoscopy and tracheal intubation. But this is done after induction and muscle relaxation, and not good to predict difficult laryngoscopy before induction. Anticipating difficult airway

in the preoperative period and preparedness to manage it is an important task of anesthetist. Among bed side clinical tests, most widely used and applicable one is modified mallampati test. Its sensitivity, specificity, positive and negative predictive value in predicting difficult airway is studied by different researchers.

But the diagnostic accuracy of MMT in predicting difficult laryngoscopy is variable(19). Khatiwada S. et al (2017) expressed its sensitivity is as higher(19), and other researchers as low(3,4,15,16).

In clinical practice in werabe comprehensive specialized hospital, anesthetists used MMT only to predict difficult laryngoscopy and intubation. If the patient's airway is classified as MMC class I or class II in patients who have no apparent difficult airway risks, it was always considered as ease of laryngoscopy and intubation, and no preparation for difficulties to manage the upcoming difficult airway. Is that modified mallampati classes match with Cormack and Lehane grades, which is the gold standard, in those patients, who have no apparent difficult airway risk factor, came to werabe comprehensive specialized hospital who need surgical and anesthesia service? Or difficulties during airway management and related complications without preparation for the faced challenges are going on?

Therefore, this study would show how much preoperative determined MMC was matched with Cormack and lehane grade during laryngoscopy and how much was the incidence of difficult laryngoscopy and intubation in those patients who have no apparent difficult airway indicator.

1.3 Justification of the study

From the causes of patient morbidity and mortality related to anesthesia, the presence of difficult airway is the major cause. To reduce or avoid these morbidity and mortality, preoperative airway assessment and preparation for the difficulties is an important task.

Even if there are many clinical bedside airway assessment tests, mostly anesthetists use MMT as a beside clinical airway assessment tool to predict difficult laryngoscopy and intubation. However, the accuracy, sensitivity and specificity, positive and negative predictive value of MMT are different. Some authors expressed as high accuracy, sensitivity and specificity. On the other hand, others expressed as low accuracy and sensitivity.

The incidence of difficult laryngoscopy is different as expressed by different authors in different papers. This is due to the difference in patient characteristics like ethnicity and variation in the prevalence of retrognatia(18). Therefore, there might be another incidence of difficult airway, accuracy, sensitivity and specificity where I planned to conduct this research.

In werabe comprehensive specialized hospital, Mostly anesthetists use MMT as clinical bedside test to predict difficult laryngoscopy and intubation. In my knowledge and ability of searching literatures, comparison or correlation of modified mallampati classes with Cormack and Lehane grades are not investigated in our population.

Conducting this research in this institution is important to determine how much MMC match with CLG and how much sensitive the test done in these population in predicting difficult laryngoscopy and intubation, and can avoid avoidable complications-morbidity and mortality-by alarming the professionals in preparing for the upcoming difficulties in those who have no apparent difficult airway risks.

Therefore, I conducted this research in werabe comprehensive specialized hospital to compare and see the relationship between MMCs and CLGs, and to determine the incidence of difficult laryngoscopy and intubation; accuracy, sensitivity and specificity, positive and negative predictive value of MMT in predicting difficult laryngoscopy and intubation.

CHAPTER TWO

2. LITERATURE REVIEW

Among major causes of patient morbidity and mortality during daily anesthetic practice, inability to manage difficult airway takes greater place(18). Modified Mallampati classification (MMPC) is widely used as preoperative clinical bed side assessment of airway in predicting difficult laryngoscopy and intubation(10,20).

In the study conducted in Istanbul, Turkey by Selvi O. et al (2016) on 451 patients, sensitivity and specificity of MMT for difficult laryngoscopy were 43.24%, 95.65%, 47% and 94.96% respectively. The area under the curve (AUC) for MMT against difficult laryngoscopy was 0.694.(16)

In the study conducted in Singapore by Koh LKD. Et al (2002) on 605 patients, the incidence of difficult laryngoscopy and intubation were 5.1% and 6.9% respectively. Sensitivity, specificity and positive predictive value were 45%, 92% and 24% respectively(6).

Khatiwada S. et al (2017) conducted prospective, observational study in Eastern Nepal involving 314 ASA I & II adult patients who required endotracheal intubation. In this study, they found that 3.8% of the patients had difficult laryngoscopy and Modified Mallampatti Test had highest sensitivity in predicting difficult laryngoscopy which was 83% (19).

In the research conducted in Singapore by P. J. BUTLER and S. S. DHARA (1992), the incidence of difficult laryngoscopy was 8.2%. In this study, the sensitivity, specificity and positive predictive value of MMC in predicting difficult laryngoscopy was 56%, 81% and 21% respectively.(21)

In the prospective cross sectional study of 122 patients conducted in Pakistan by Nassir KK. et al (2011), Mallampati classification classes successfully predicted Cormack & Lehane grade 1 and 2 in 83.60% of cases. From 122 patients, 79 were MMC I of which 72.15% were CLG I; 30 were MMC II of which 33.33% were CLG II; 11 were MMC III of which 9.09% were CLG III; 2 were MMC IV of which 50.0% were CLG IV. Spearman's Rank correlation between Mallampati classification and Cormack & Lehane grades was 0.335 (7)

Cross sectional study conducted in India by Murugesan K. et al (2018) with 236 subjects had found that 74 people had Mallampatti grade I. From these, 43(58.10%) had Cormack Lehane grade I, 30(40.54%) Cormack Lehane grade II and 1(1.351%) had Cormack Lehane grade III; 140 people had Mallampatti grade II. From these, 98 (70%) had Cormack Lehane grade I, 36 (25.71%) had Cormack Lehane grade II and 6 (4.285%) had Cormack Lehane grade III; 21 people had mallampatti grade III. Out of these, 2 (9.52%) had Cormack Lehane grade I, 17 (80.95%) had Cormack Lehane grade II and 2 (9.52%) had Cormack Lehane grade III. Out of 1 people with Mallampatti grade IV, 1 (100%) had Cormack Lehane grade II. The measure of agreement was very poor between Mallampatti grading with Cormack Lehane grading (kappa statistics value 0.103, P value 0.032).(8)

Ezri T. et al (2001) conducted prospective research in Houston, Texas which involve 764 patients and found that patients with MP class zero had a grade I laryngoscopy. MM Class 1 was associated with 10.9% grade II and 3.2% grade III laryngoscopy. There was a stepwise increase in the incidence of CL grade III as the airway class changes from 2 to 3 and from 3 to 4. They found that the sensitivity of MM Classes 3 and 4 in predicting difficult laryngoscopy was 84%; specificity was 71%, and positive and negative predictive values were 97% and 26% respectively(14). In their study, the

incidence of grade IV laryngoscopy view was zero and didn't show the relationship of MMC with CL grade IV.

The study conducted in Imphal, India by Jack A. et al (2018) had found that 42.9% of patients had grade I, 36% had grade II, 33.3% had grade III in both CL grading and MMT classification and none of them had grade IV in both the grading systems. The sensitivity and specificity of MMT in predicting difficult laryngoscopy were 57.69% and 51.28% respectively(11).

Sanyal R. et al (2019) conducted prospective crossectional study in India on 110 patients. The value of corrected chi square test was 76.8 with a P value of < 0.001, and the Spearman correlation Coefficient between modified Mallampati test and Cormack Lehane classification was 0.8 and one tailed value was significant at 5% level. The sensitivity and specificity of MMC were 42.86% with a wide confidence interval (95% CI 17.66% to 71.14%) and 82.56% respectively.(4)

The cross sectional study conducted in Tikur Anbesa Specialized Hospital by Tamrie T. et al (2019) on 242 patients, the incidence of difficult laryngoscopy and intubation were 13.6% and 5% respectively. Sensitivity, specificity, positive predictive value and negative predictive value of MMT for difficult intubation was 58.3%, 90.9%, 25% and 97.6% respectively. AUC for MMT against difficult intubation was also 0.746. Sensitivity, specificity, positive predictive value and negative predictive value of MMT for difficult laryngoscopy was 51.5%, 94.7%, 60.7% and 92.5% respectively. AUC for MMT against difficult intubation was 0.731 (13).

Lebowitz PW. et al (2017) conducted research in USA on 492 patients to see the relationship between MMC and CLG. In this study MMT was done with and without phonation and saw the relation between these two types of MMC with CLG. In their study MMC with phonation had improved correlation CLG than MMC without phonation. From these patients MMT performed without phonation, 15% of them

are MMC I. Among these, 11% were CLG I, 3% CLG II, 1% CLG III and 1% CLG. 35% of the patients were MMC IV. From these, only 2% were CLG IV and 5% were CLG III. 23% of the patients were MMC III. From these none of them were CLG III. In their study the sensitivity of modified mallampati test was 50%(22).

From the above literatures, we found that the sensitivity and specificity of MMT was different. In some studies, sensitivity was higher-83%(19), 84%(14), and on the other hand, it was lower- 42.86%(4), 43%(7). The relationship between MMC and CLG was also varied from study to study. And different authors recommended adding additional bedside tests for predicting difficult laryngoscopy and intubation. In werabe specialized hospital, still MMT only was used as clinical bedside test to predict difficult airway in those who have no clear difficult airway indicator. How much sensitive, and how much MMCs matched with CLGs was unknown. Therefore, this study determined how much MMT is sensitive in predicting difficult laryngoscopy and intubation and how much MMCs matched/correlated with CLGs.

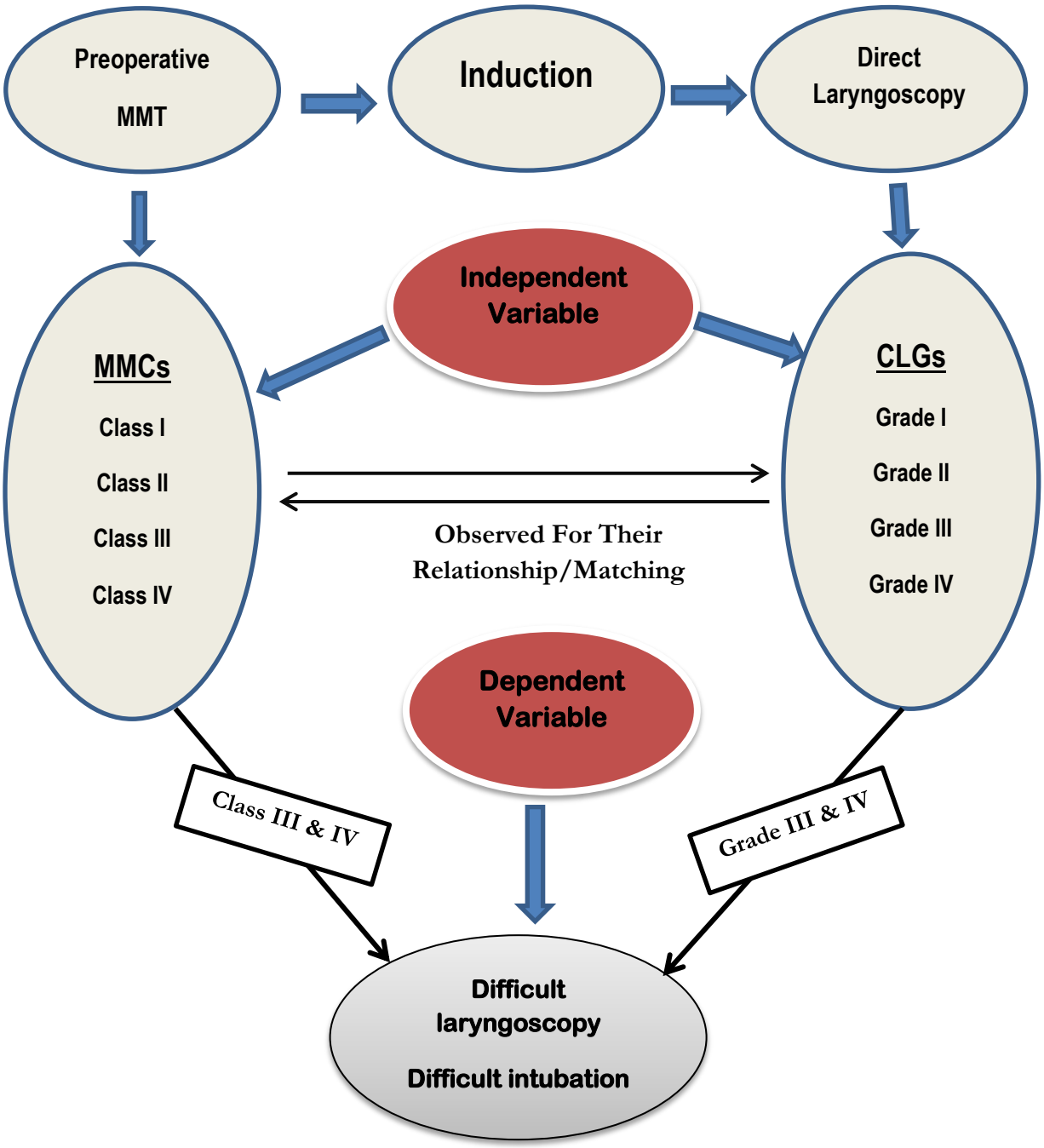


Figure 1: conceptual framework

CHAPTER THREE

3. OBJECTIVE OF THE STUDY

3.1 General objective

It was to compare modified Mallampati classification (MMC) with Cormack and Lehane (C-L) grading in predicting difficult laryngoscopy among patients who took general anesthesia.

3.2 Specific objective

- To compare MMC classes with C-L grades in predicting difficult laryngoscopy
- To determine sensitivity, specificity, negative and positive predictive value of MMC in predicting difficult laryngoscopy.
- To determine the incidence of difficult laryngoscopy and intubation

CHAPTER FOUR

4. METHOD AND MATERIAL OF THE STUDY

4.1 Study setting

This study was conducted in Worabe Comprehensive Specialized Hospital which is one of public hospital in SNNPRs. It started giving service in 2007 and is 178 km far from Addis Ababa. It provides diversity of both outpatient and inpatient services for about 5 million populations from neighboring region. It offers services at general and specialty levels including neonatal intensive care unit(NICU), pediatric intensive care unit (PICU), adult intensive care unit (AICU), Surgery, Gynecology& Obstetrics, Ear, Nose and Throat (ENT), Neurology, maxillofacial, plastic and orthopedics procedures.

4.2 Study design and period

An institutional based cross sectional survey study was employed from February/2021 to April 2021.

4.3 Population

4.3.1 Source population

All patients who were undergone elective surgery with general anesthesia at werabe comprehensive specialized hospital were selected.

4.3.2 Study population

All patients who were undergone elective surgery with general anesthesia with ETT at werabe comprehensive specialized hospital were included.

4.4 Study variable

4.4.1 Dependent variable

Difficult laryngoscopy
Difficult intubation

4.4.2 Independent variable

- MMC
- CLG
- Sociodemographic data
- Types of surgery
- BMI

4.5 Inclusion and exclusion criteria

4.5.1 Inclusion criteria

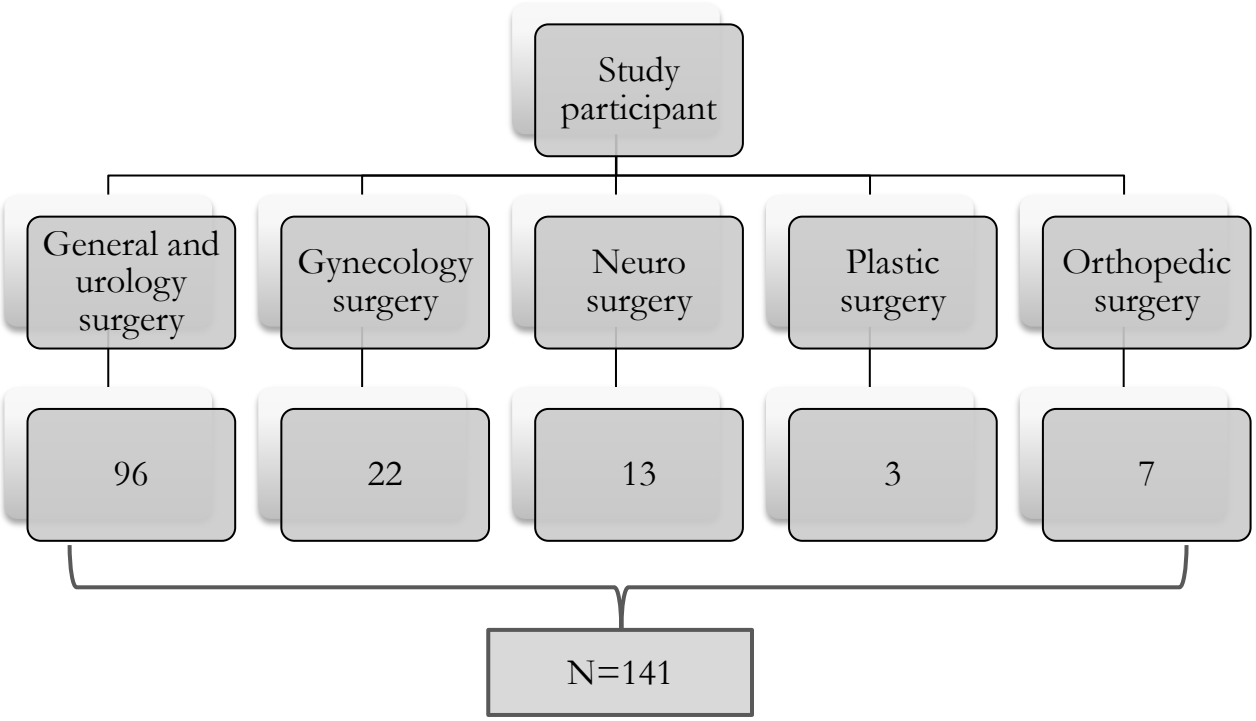
- ASA class I & II
- age of 18 to 65 years
- BMI<30
- Patients taking general anesthesia with ETT

4.5.2 Exclusion criteria

- DM patients with prayers sign
- Patients with immobile atlantooccipital joint and cervical vertebrae
- Patient with oral mass
- Patient with maxillofacial trauma
- Large anterior neck mass like huge goiter
- Protruded teeth
- TMJ ankylosis
- Burn contracture on the neck.
- Those intubated with anesthetist whose experience was less than one year

4.6 Sample size

During situational analysis, 144 patients were found in three months in werabe comprehensive specialized hospital. Therefore, all eligible study participants in the study period were included. During the study period 141 eligible study participants were found.



4.7 Study participant selection procedure

All patients who fit the inclusion criteria in the study period were included.

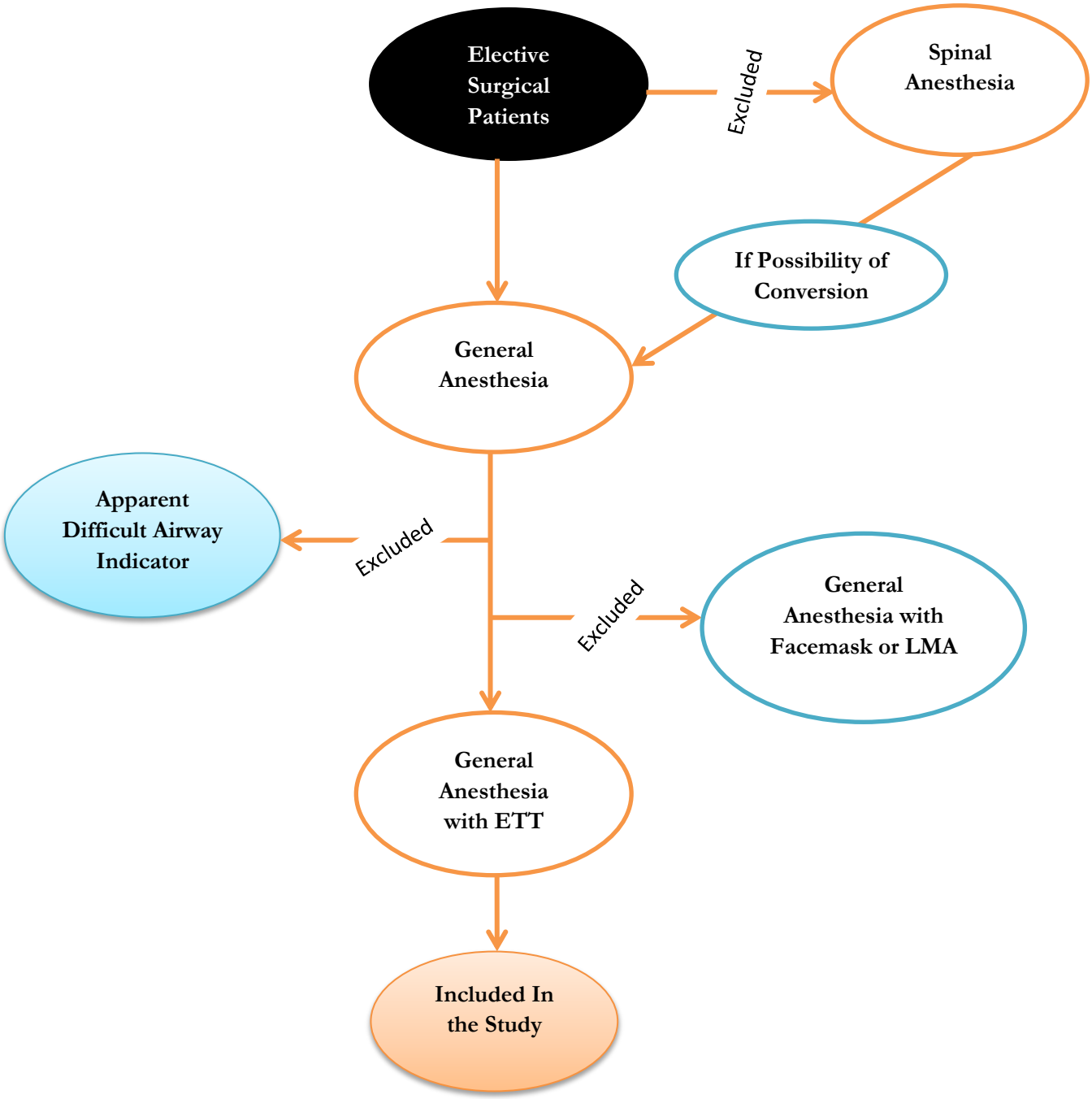


Figure 2: study participant selection procedure

4.8 Data collection and Data quality control

Trained data collectors and supervisor was assigned for data collection. Before the start of data collection, data collector informed the study participants about the aim of the study, their right to participate and not to participate on the study, and about no harm on them but any gift couldn't be given for their participation. Then after obtained signed informed consent, MMT was done by trained anesthetist at the corridor while patients changed their cloth. Direct laryngoscopy was done by charge in anesthetist on the table and data collector asked him/her as which structure of the larynx was viewed by showing diagrammatic representation of the larynx.

Supervisor monitored the process of data collection and completeness of individual patient data. To ensure quality of data, pre-test of the data collection tool (the questionnaire) was done on 14 patients who were not included in the main study and no need of amendment on the questionnaire. Incomplete data was not entered into the database for analysis. Data clean up and crosschecking was done before analysis.

4.9 Data processing and analysis

Data was checked, coded, entered and analyzed by using SPSS version 24. Demographic data was analyzed and expressed using frequency, mean and standard deviation. The correlation between MMC & CLG was expressed using cross tabulation and spearman correlation coefficient. Analysis using ROC curve for MMC and CLG was done. Two by two table was constructed for Predicted essay laryngoscopy and intubation (MMC I and II),and predicted difficult laryngoscopy and intubation (MMC III and IV) and sensitivity and specificity, positive and negative predictive, positive and negative likelihood ration and accuracy value of MMC were calculated using cross tabulation. For the area under the curve, p-value<0.05 was considered as statistically significant.

4.10 Ethical clearance

Ethical clearance was obtained from the ethical clearance committee of Addis Ababa University, department of anesthesia and permission was obtained from werabe comprehensive specialized hospital before the start of the study.

4.11 Dissemination plan

The final results of the study will be presented to Addis Ababa university department of anesthesia as part of MSc thesis, copies of final results will be disseminate,

presented at national conferences and will be sent to national and international journals for publication.

4.12 Operational definition

Endotracheal tube: a tube use to insert into the trachea to provide artificial ventilation.

ASA classification: this is patient's physical status evaluation and based on the physical status of the patient it has six classes: class I, II, III, IV, V, and VI.

Body mass index: weight of the patient divided by height squre. This is important to classify the patient as obese, overweight or normal

Fixed Atlantooccipital joint: inability of atlantooccipital joint (the joint between the occipital bone and the first cervical vertebra) to slide.

Direct laryngoscopy: the procedure performed to visualize vocal cord using laryngoscope.

Prayer's sign: also known as diabetic stiff hand syndrome. It is inability of approximating one or more of the digits when the patient attempt to approximate palmar surface of the proximal and distal interphaleangeal joints with palms pressed together and digits abducted.

Difficult laryngoscopy: inability to visualize the vocal cord during direct laryngoscopy after induction and muscle relaxation. CLG III and IV are considered as difficult laryngoscopy. The pictorial representation/illustration is shown on the appendix (annex IV).

Apparent difficult airway indicator: any mass in the mouth, large anterior neck mass, short neck, fixed atlantooccipital joint and cervical vertebrae, maxillofacial trauma, Protruded teeth, temporomandibular joint ankylosis, burn contracture on the neck.

Difficult intubation: >3 attempts **or ≥ 10** minutes is required to intubate the patient using direct laryngoscopy by experienced anesthetist (minimum of one year experience)

Huge goiter: class III goitre which means large goiter mass visible without palpation on normal position of head with pressure causes pressure marks and retrosternal extension occurred.

Modified Mallampati test: test used to predict difficult airway by viewing oropharyangeal structure. Based on this test, there are five classes viz: 0, I, II, III and IV (annex IV).

Sensitivity: the conditional probability of correctly identifying difficult airway (difficult intubation and laryngoscopy) by modified mallampati test or how correctly MMT correctly diagnose the presence of difficult airway. $\frac{true\ positive}{true\ positive + false\ negative}$

Specificity: the probability of correctly diagnose or identify not being difficult airway by modified mallampati test. $\frac{true\ negative}{true\ negative + false\ positive}$

Positive predictive value: the probability of being difficult airway for MMT predicted difficult airway. $\frac{true\ positive}{true\ positive + false\ positive}$

Negative predictive value; it is the probability of not being difficult airway for MMT predicted not being difficult airway. $\frac{true\ negative}{true\ negative + false\ negative}$

CHAPTER FIVE

5. Result

In this study, a total of one hundred forty one (141) study participants who fulfilled inclusion criteria and had been being volunteer by giving consent were included. Their sociodemographic data were expressed using frequency, percentage, mean and standard deviation.

Majority of study participants were females (51.8%). The mean age of the study participants was 39.50(±12.03) years with Minimum of 18 years and Maximum of 63 years. The mean BMI was 22.68(±3.00) with Minimum of 16.50 and Maximum of 29.38 (Table 1).

Table 1: sociodemografic data of the study participants

	Male	Female	Total
N (f (%))	68 (48.2%)	73 (51.8%)	141(100%)
Age (mean±SD)	40.46 ±12.59	38.62 ±11.50	39.50 ±12.03
Weight (mean±SD)	61.00 ±8.78	58.55±8.45	59.73 ±8.67
Height (mean±SD)	1.65 ±0.096	1.59 ±0.10	1.62 ±.11
BMI (mean ±SD)	22.26 ±2.34	23.06 ±3.48	22.68 ±3.00

SD= standard deviation, f= frequency, Age=age of the patient in years, weight= weight of the patient in kg, Height= height of the patient in meter, BMI= body mass index of the patient

In our study participants, majority of them were in general surgery and urology specialty which accounted 96(68.1%) and the least one was in plastic surgery which accounted 3(2.1%).

Before induction, MMT was performed for each study participants to predict difficult laryngoscopy and intubation. From 141 study participants, majority of them had modified mallampati class I which accounted 65 (46.1%) (Table 2).

After induction during direct laryngoscopy Cormacke and Lehane laryngoscopic grade was evaluated. Cormack and Lehane Grade I took the highest number from all other grades (table 2).

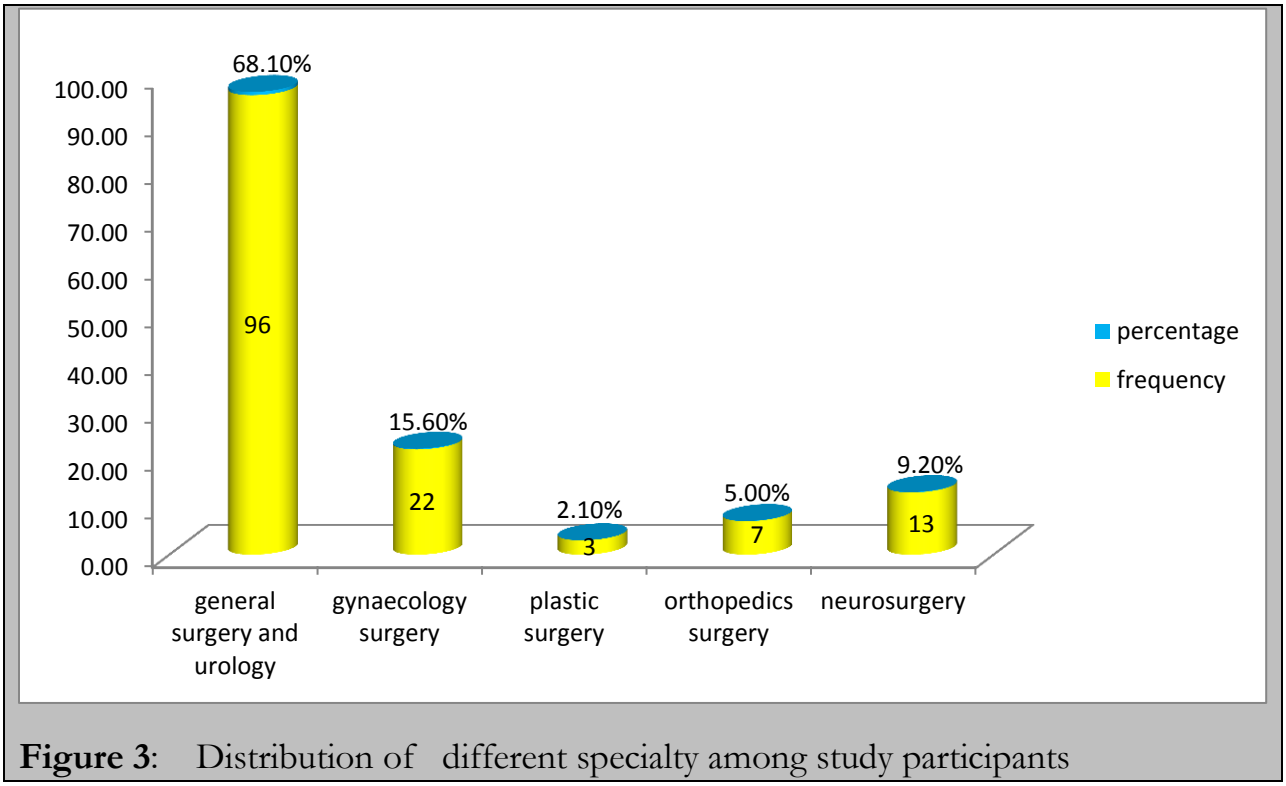


Figure 3: Distribution of different specialty among study participants

Table 2: Frequency and percentage of Modified Mallampati classes and Cormack and Lehane Grades

Grade or class	MMC	CLG
0	1(0.7%)	Not applied
I	65(46.1%)	62(44.0%)
II	47(33.3%)	57(40.4%)
III	23(16.3%)	17(12.1%)
IV	5(3.5%)	5(3.5%)
Total	141(100.0%)	141(100.0%)

MMC= modified mallampati class, CLG= Cormack and Lehane Grade

Matching between Modified Mallampati classes and Cormack and Lehane grades was evaluated for 141 study participants. Modified Mallampati class 0 was matched with Cormack and Lehane grade I. From 46.10% MMC I, approximately half i.e 23.4% were classified as CLG I and the remaining 22.7% were classified under CLG II and III. More than half of MMC IV (2.1% out of 3.5%) was classified as CLG IV (Table 3 and Figure 4).

Table 3: comparison of Class to Grade relation

		Cormack And Lehane Grades				
		grade I	grade II	grade III	grade IV	Total
Modified Mallampati Classes	class 0	1(0.7%)	0(0.0%)	0(0.0%)	0(0.0%)	1(0.7%)
	class I	33(23.4%)	29(20.6%)	3(2.1%)	0(0.0%)	65(46.1%)
	class II	20(14.2%)	25(17.7%)	2(1.4%)	0(0.0%)	47(33.3%)
	class III	8(5.7%)	3(2.1%)	10(7.1%)	2(1.4%)	23(16.3%)
	class IV	0(0.0%)	0(0.0%)	2(1.4%)	3(2.1%)	5(3.5%)
Total		62(44.0%)	57(40.4%)	17(12.1%)	5(3.5%)	141(100.0%)

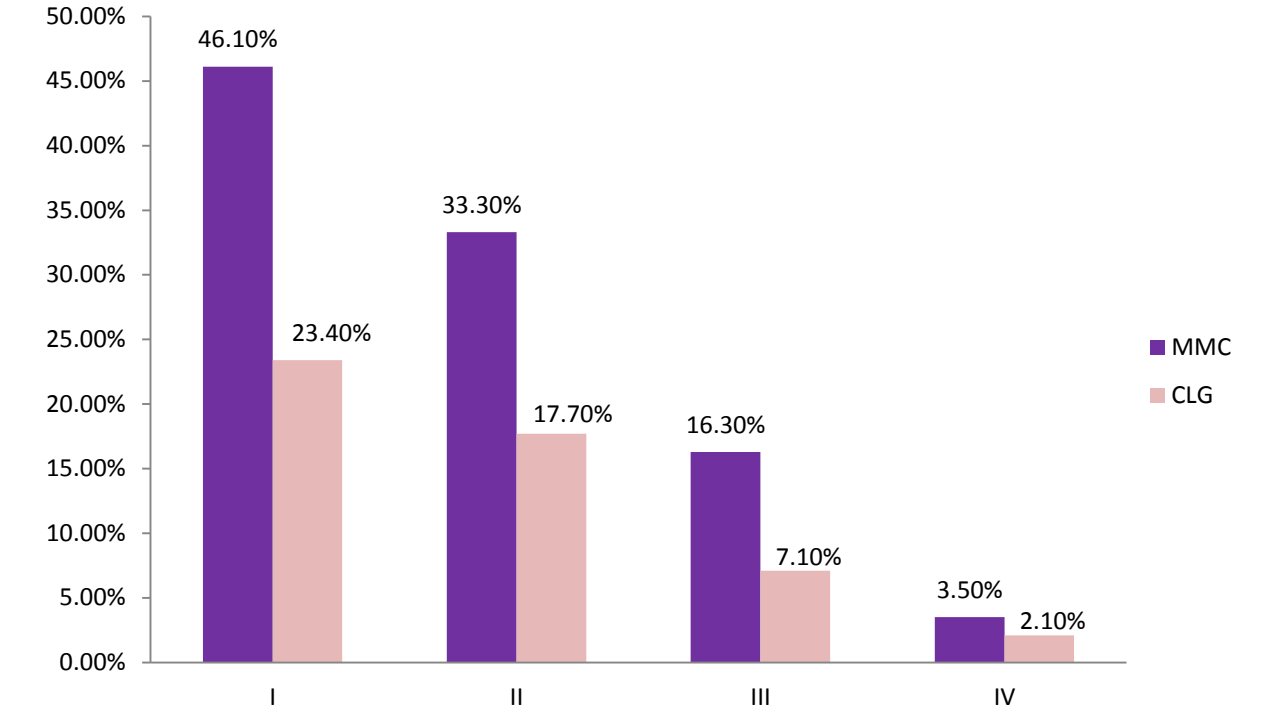


Figure 4: Modified Mallampati Class to Cormack and Lehane Grade comparison

The correlation between modified Mallampati classes and Cormack and Lehane grades were evaluated using spearman correlation coefficient. Spearman correlation coefficient (ρ) was 0.330 with p-value of 0.00 for (2-tailed) and 0.00 for (1-tailed) (Table 4).

Table 4: the correlation between MMC and CLG

			CLG
Spearman's rho (ρ)	**MMC**	Correlation Coefficient	0.330**
		p-value (2-tailed)	0.00
		p-value (1-tailed)	0.00

***. Correlation is significant at the 0.01 level (2-tailed/1-tailed). MMC= modified mallampati class, CLG= cormack and lehane grade*

In our study population who had no apparent difficult airway indicator, the prevalence of difficult laryngoscopy and difficult intubation was 14.9% and 9.2% respectively. The prevalence of difficult intubation was higher in males compared to females. Majority of difficult intubation and laryngoscopy was found in General surgery and urology specialty. Difficult intubation was 7.8% and difficult laryngoscopy was 12.10% (Figure 6).

Sensitivity and specificity of modified mallampati test (MMT) in predicting difficult laryngoscopy were 47.6% and 93.3% respectively, and in predicting and difficult intubation were 53.8% and 91.4% respectively. Positive predictive value, Negative predictive value, Positive likelihood ratio, Negative likelihood ratio and Accuracy were also expressed (Table **6).** The area under the curve was also determined using ROC curve for MMT against difficult laryngoscopy and intubation (Figure 7 and 8).

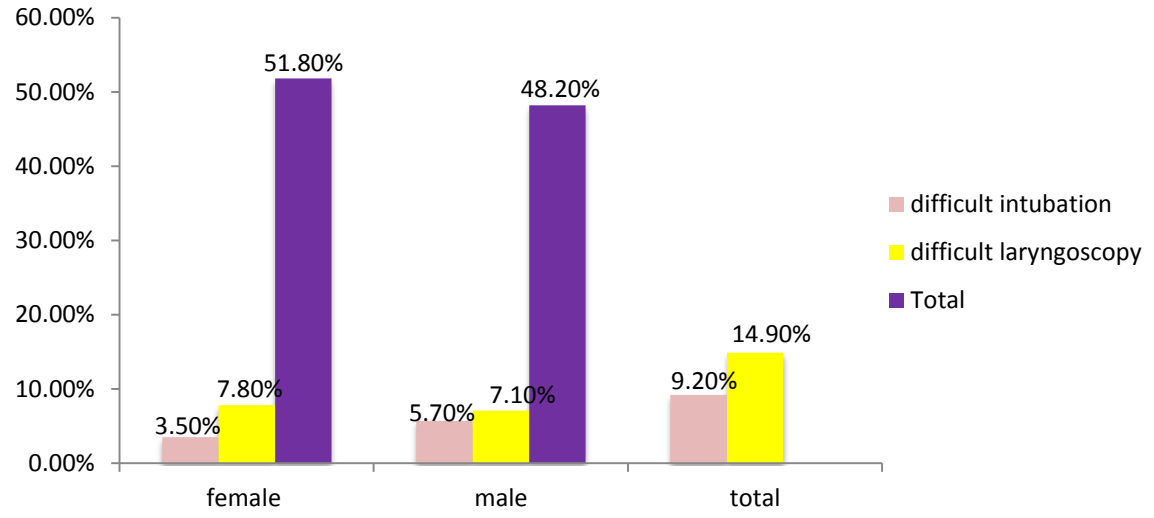


Figure 5: Distribution of difficult laryngoscopy and intubation among male and female study participants.

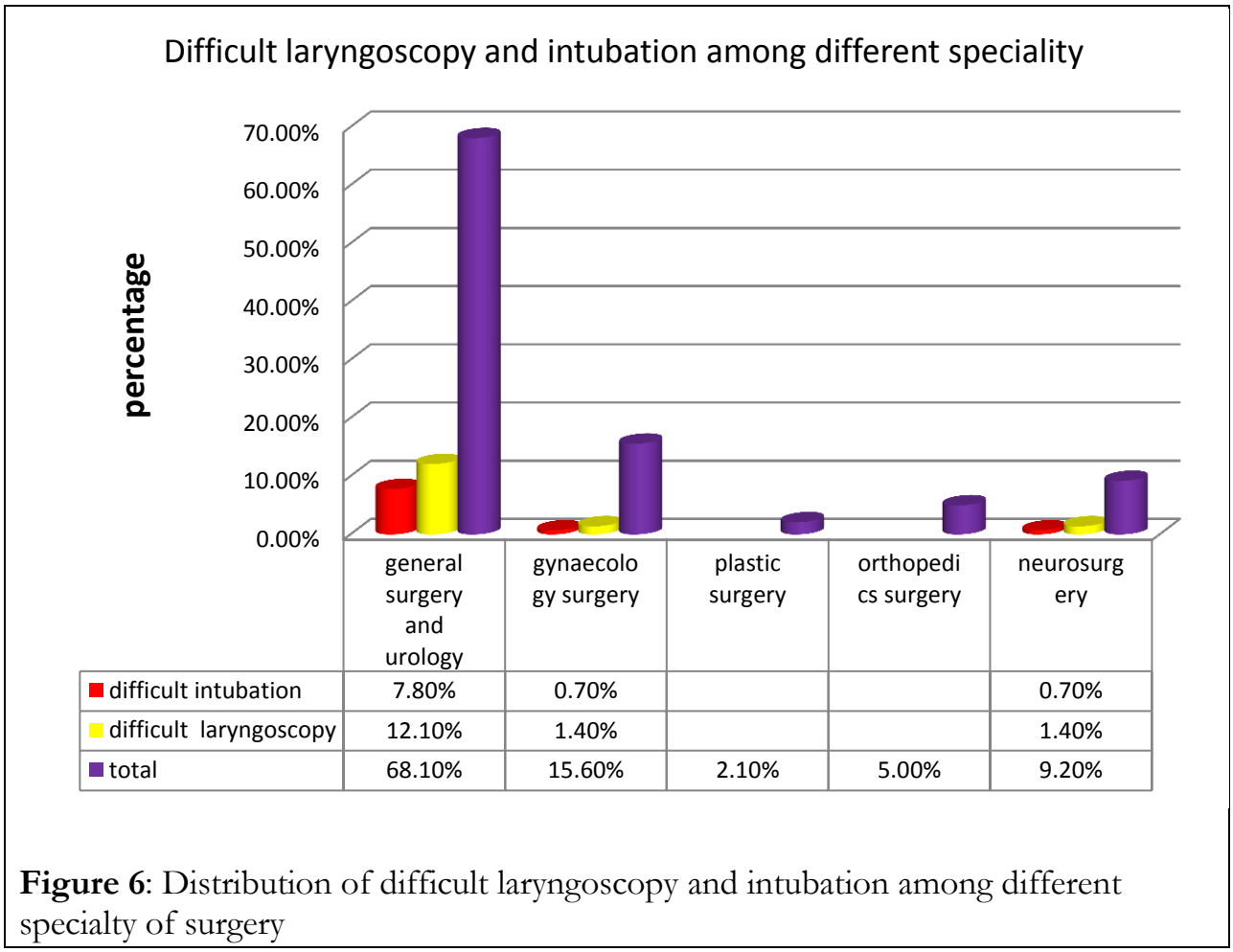


Figure 6: Distribution of difficult laryngoscopy and intubation among different specialty of surgery

From 141 study participants, 18 participants were diagnosed as having difficult laryngoscopy with our MMT and 11 are misdiagnosed as easy laryngoscopy. But among these diagnosed difficult laryngoscopy, 10 participants were identified correctly. 18 study participants were diagnosed as having difficult intubation and 6 study participants were misdiagnosed as easy intubation with modified mallampati test. From 18 predicted difficult intubation, only 7 difficult intubations were identified/predicted correctly (Table 5).

Table 5: Distribution of true positive, true negative, false negative and false positive in both difficult intubation and difficult laryngoscopy.

	DL (n=141)	DI (n=141)
TP	10	7
TN	112	117
FP	8	11
FN	11	6

TP= true positive, TN= true negative, FN= false negative, FP= false positive, DL= difficult laryngoscopy, DI= difficult intubation

Table 6: sensitivity, specificity, Positive predictive value, Negative predictive value, Positive likelihood ratio, Negative likelihood ratio, accuracy and area under the curve of modified mallampati test in predicting difficult laryngoscopy and difficult intubation.

		Sn	Sp	PPV	NPV	PLR	NLR	Accuracy	AUC	P-value	95% CI
MMT*	**DL**	47.6%	93.3%	55.6%	91.1%	7.10	0.56	87.94%	0.705	0.003	0.564-0.845
	DI	53.8%	91.4%	38.9%	95.1%	6.26	0.51	86.52%	0.726	0.007	0.555-0.897

**modified mallampati test,DL=difficult laryngoscopy, DI= difficult intubation , Sn=sensitivity, Sp=specificity, PPV= positive predictive value, NPV= negative predictive value, PLR=positive likelihood ratio, NLR= negative likelihood ratio, AUC= area under the curve, CI= confidence interval*

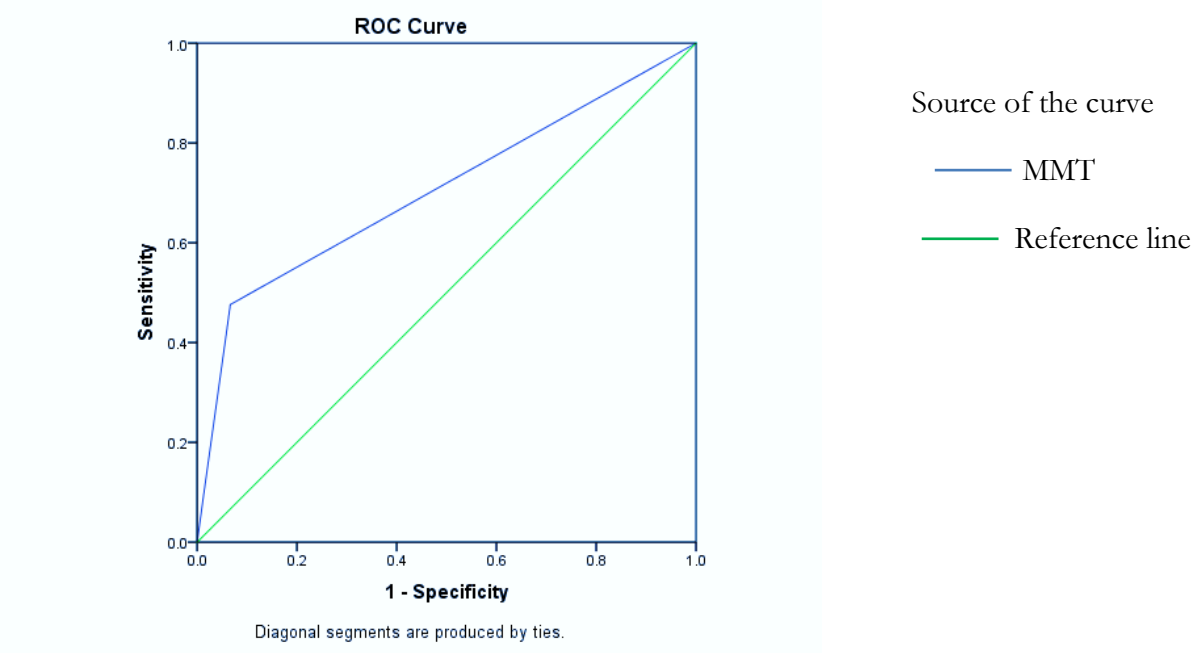


Figure 7: Receiver operating curve for modified mallampati test against difficult laryngoscopy in the study population

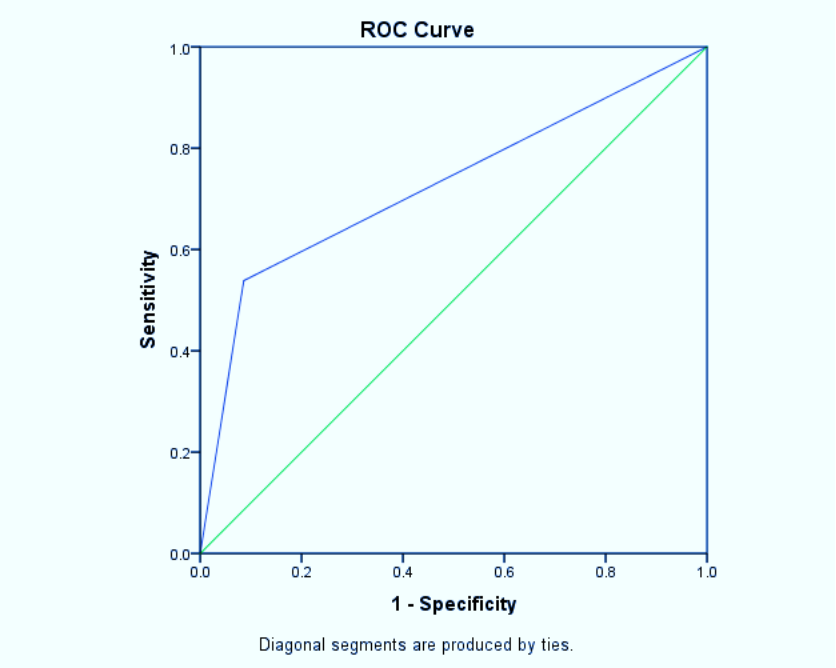


Figure 8: Receiver operating curve for modified mallampati test against difficult intubation in the study population

CHAPTER SIX

6. Discussion

In our study participant the correlation between modified mallampti class and Cormack and Lehane grade was low. Sensitivity and positive predictive value was also low.

The incidence of MMC class 0, part of epiglottis is visible while performing MMT, in our study participants was 0.7% whereas Prakash S. et al determined it as 1.7% (18). Our result of MMC 0 fitted with Cormack and Lehane Grade I, and according to Ezri T, et al (2001) , MMC class zero , the incidence was 1.18%, had a grade I laryngoscopy(14). Variation in the incidence might be related to variation in sample size and variation in our population.

In our study participants who had no apparent difficult airway indicator, 46.1 % (65) had MMC I. From which only around half i.e 23.4% (33) had CLG I and 2.1 %(CLG III) had difficult laryngoscopy. 33.3% of the study participants had MMC II. Among these, 17.7% had CLG II and 1.4 % of them had difficult laryngoscopy. 16.3% of the study participants had MMC III from which 7.1 % had CLG III. 8.5% of MMC III had difficult laryngoscopy. The remaining 7.8% had no difficult laryngoscopy. 3.5% of the study participants had MMC IV. From these, 2.1% had CLG IV. In our study participants, all MMC IV patients had difficult laryngoscopy and intubation. In the cross section study conducted by Ezri T. et al (2001), MMC I was associated with 3.2% difficult laryngoscopy (CLG III)(14). Cross sectional study conducted by Murugesan K. et al (2018) showed that 1.351% difficult laryngoscopy was found from MMC I. From MMC II, only 25.71% had Cormack Lehane grade II and 4.285% had difficult laryngoscopy (8). From this we can say that class to grade relationship varies from population to population and predicted easy laryngoscopy and intubation may become difficult.

The correlation between MMC and CLG in our study participants was observed using spearman's rank correlation coefficient. The spearman's correlation coefficient (ρ) was found to be 0.330 with p-value of 0.00 for (2-tailed) and 0.00 for (1-tailed) which was statistically significant. But the strength of relation is still low. And this is in line with the result expressed by Nassir KK. et al (2011) with spearman's correlation coefficient (r) of 0.335(7). But in prospective cross sectional study conducted in

Indian population by Sanyal R. et al (2018) (4), the Spearman correlation coefficient between Mallampati and Cormack & Lehane classification was higher with the magnitude of 0.8. This difference might be due difference in the characteristics of our study participants.

In our study population who had no apparent difficult airway indicator, the prevalence of difficult laryngoscope and difficult intubation were 14.9% and 9.2% respectively. This difficult laryngoscopy result is in line with the result determined by Tamrie T. et al (13), Sanyal R. et al (4) which were 13.6% and 14% respectively. But the prevalence of difficult intubation was higher compared with the result determined through cross sectional study conducted by Tamrie T. et al , and KOH L.D.K. et al (14) (9.2% Vs 5% and 6.9% respectively). This discrepancy might be aroused from difference in patient characteristics, individual skill and availability of different airway equipment. The prevalence of difficult laryngoscopy in our study was higher compared with the result determined by Butler P. J. and Dhara S. S. (1992) (14% Vs 8.2%) (21) and this is may be due to variation in patient characteristics.

In the study area, the only practiced preoperative test in predicting difficult airway was MMT and its sensitivity in predicting difficult laryngoscopy and intubation in the study participants who had no apparent difficult airway indicator was low with the magnitude of 47.6% and 53.8% respectively. The Sensitivity determined by sanyal R. et al (4), KOH L. K. D. et al(6) and Selvi O. et al(16) were similar with our result with the magnitudes of 42.86 %, 45% and 43.24% respectively. Nasir KK. et al (7) also found low sensitivity which was 25.52 %. On the other hand, in the cross sectional study conducted by Khatiwada S. et al (2017), highest sensitivity in predicting difficult laryngoscopy was reported with the magnitude of 83%(19). This discrepancy may be related to variation in patient characteristics and assessment technique.

Specificity of MMT for difficult laryngoscopy and intubation in our study participants was higher, which was 93.3% and 91.4% respectively. Similarly, KOH L.D.K. et al (14), and Selvi O. et al (16) pointed out that specificity of MMT for difficult laryngoscopy was 92% and 95.65 % respectively.

Positive predictive value was 55.6% for difficult laryngoscopy and 38.9% for difficult intubation. Positive predictive value for difficult laryngoscopy determine by Butler P. J. and Dhara S. S.(1992) (21) was 21%.

Negative predictive value, Positive likelihood ratio, Negative likelihood ratio andAccuracy of modified mallampati test (MMT) in our study participants was found to be 91.1%, 7.10, 0.56 and 87.94% respectively for difficult laryngoscopy and 95.1%, 6.26, 0.51 and 86.52% respectively for difficult intubation.

The area under the curve (AUC) was determined using ROC curve analysis for MMT against difficult laryngoscopy and difficult intubation. The AUC against difficult laryngoscopy was found to be 0.705 which is acceptable discrimination and statistically significant (p-value=0.003; 95% CI= 0.564 & 0.845) and against difficult intubation was found to be 0.726. It is acceptable discrimination and statistically significant (p-value=0.007; 95% CI =0.555 & 0.897). This is similar with AUC determined by Tamrie T. et al (13) which was 0.746 for difficult intubation and 0.731 for difficult laryngoscopy.

On the other hand, the AUC determined by Selvi O. et al was 0.694 (95% CI=0.650 & 0.737) (16) which was indicator of poor discrimination compared to our result.

7. Conclusion

In Werabe comprehensive specialized hospital, the incidence of difficult laryngoscopy and difficult intubation in those who had no apparent difficult airway indicator was 14.9% and 9.2% respectively. The sensitivity and positive predictive value of MMT was low. And relying only on MMC for those who have no apparent difficult airway indicator will lead to unanticipated difficulties and inadequate preparation.

Grade to grade matching or correlation between MMC and CLG was low in our study population, spearman's correlation coefficient (ρ)=0.330 with p-value of 0.00 for (2-tailed) and 0.00 for (1-tailed).

Therefore, to increase predictive value of MMT, other tests should be added as routine preoperative assessment tool.

8. Recommendation

Difficult airway causes morbidity and mortality in our surgical patients if we do not identify and manage it timely. Therefore, every anesthetist should add other assessment tool in addition to MMT during their preanesthetic evaluation. Always anesthetists should make themselves ready for any difficulties at any time with skill and equipment even if MMC class I & II. Different difficult airway management equipment should be available in the OR in difficult airway cart. Training should be given for anesthetists about additional airway assessment tool and their application.

9. Strength and limitation of the study

The strength of this study is that all patients who fulfilled inclusion criteria in the study period were included in the study. Anesthetists who handle airway in our study participants had a minimum of one year experience and this reduce experience related difficulties.

Limitation of the study is that in this study we don't address CLG 2a and 2b about their contribution for difficult intubation. The presence of covid-19 pandemic affects the available number of our study participants.

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11. ANNEX

11.1 Annex I: Information sheet

THESIS TITLE:

COMPARISON OF MODIFIED MALLAMPATI CLASSIFICATION AND CORMACK AND LEHANE GRADING IN PREDICTING DIFFICULT LARYNGOSCOPY AMONG PATIENTS WHO WILL TAKE GENERAL ANESTHESIA IN WERABE COMPREHENSIVE SPECIALIZED HOSPITAL 2020/2021.

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Phone NO; 0925729441/0922586080

Advisor; Eyayalem Melese (Lecturer of anesthesia)

Zewetir Ashebir (Lecturer of anesthesia)

Organization: Addis Ababa University, collage of health science, department of anesthesia.

Introduction

This information sheet is prepared with the aim comparing modified mallampati classification and cormack and lehane grading in predicting difficult laryngoscopy among patients who will take general anesthesia in werabe comprehensive specialized hospital 2020/2021.

Purpose of the Research Project

Comparing modified mallampati classification and cormack and lehane grading in predicting difficult laryngoscopy among patients who will take general anesthesia in werabe comprehensive specialized hospital 2020/2021.

The results of this study will be used to design appropriate intervention programs to reduce the incidence of airway related morbidity and mortality in W/C/S/H.

Procedure

This study will involve all elective surgical patients without apparent difficult airway indicator who will take general anesthesia with endotracheal tube in the study period. Each Study participants will be selected to be one of the study participants if they have willingness to participate in this study and ready to give consent.

Risk

There is no any harm on those who participating in this research. Any personal information registered in the book will not be copied and transferred to other bodies. No need of writing patients name but by code. Every piece of information will be kept confidentially.

Benefits

There is no incentive or payment to be gained by taking part in this project. The information collected from this research project will be kept confidential and only accessed the researcher and research assistant only.

Confidentiality

The information collected from study subjects will be kept confidential and stored in a file, without patients name by assigning a code number to it. And hence no report of the study ever identifies the participants.

Right to Refusal or Withdraw

They will have the full right to refuse participating in this research. They have also the full right to withdraw from this study at any time they wish.

Person to contact

For any questions or concerns patients can contact the principal investigator using the following addresses:

Name: Dessalegn yemam

E-mail: desuyemam@gmail.com /desuyemam@yahoo.com

Telephone: +251 925729441/+251 922586080

11.2 **Annex II:** Informed consent

This informed consent form is for those who take general anesthesia with endotracheal tube. I am inviting you to participate in research to get information on comparison of mallampati classes with Cormack and lehane grades.

I am _____, the members of the research team. I am doing research on comparing modified mallampati classification (MMC) with Cormack and Lehane (C-L) grading in predicting difficult laryngoscopy among patients who will take general anesthesia. I am going to give information and invite you to be part of this research. Before you decide, you can talk to anyone you feel comfortable with about the research.

Your role in the success of the research is important and I appreciate your contribution to the research. Would this be okay with you?

I consent voluntarily to participate as a participant in this research.

Patient name_____ signature_____

Date of data collection _____

Questioner identification number_____

11.3 Annex III: Amharic version of informed consent

የመጠይቅ ፈቃድ ቅጽ

የተከበራችሁ የጥናቱተሳታፊዎች የዚህ ጥናት ዋና አላማ በ2013 ዓ.ም በወራቤ ኮምፕረሄንሲቭ ስፔሻዩዝድ ሆስፒታል ኦንራሲዮን ክፍል ሙሉ የስንስቴዚያ ህክምና ወስደው ያለምንም ችግር በማሸን እንዲተነፍሱ ለማስቻል ነዉ። በሰጋጣሚ እርስዎም በዚህ ጥናት እንዲሳተፉ ተመርጠዋል።የዚህ ጥናት ጥቅም በእርስዎ ፈቃድ መሰረት መረጃዎችን በመሰብሰብ በሚገኘዉ ዉጤት መሰረት መረጃዎችን በማጠናቀር ውጤቱን ቀድሞ ከነበረው ጋር ለማገናዘብ እንዲቻልና አስፈላጊ ሆኖ ሲገኝ መስተካከል ያለባቸዉን ለማስተካከል ነዉ። ጥናቱ በትክክል አላማውን እንዲመታ የእርሶዎን መልካም ፍቃድ እንጠይቃለን። በጥናቱ የመሳተፍ ወይም ያለመሳተፍ መብትዎ የተጠበቀ ነዉ። በጥናቱ ላይ እንዲሳተፉ በአክብሮት እንጠይቃለን።

ለመሳተፍ ፈቃደኛ ነዎት? ሀ/ አዎ ፈርማ _____

ለ/ አይደለሁም.....

የጥያቄው መለያ ቁጥር .....መረጃዉ የተሰበሰበበት ቀን----------

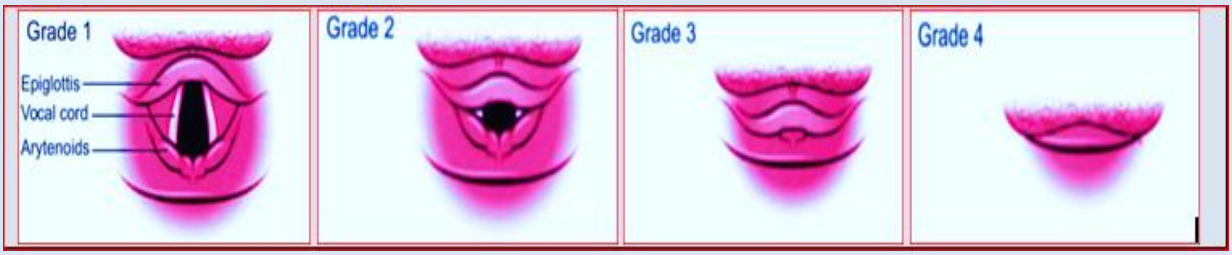
መረጃዉ ሰብሳቢ ስምና ፈርማ---------- ----------

የሱፐርቫይዘር ስምና ፈርማ---------- ----------

ለመሳተፍ ፈቃደኛ ስለሆኑ እናመሰግናለን።

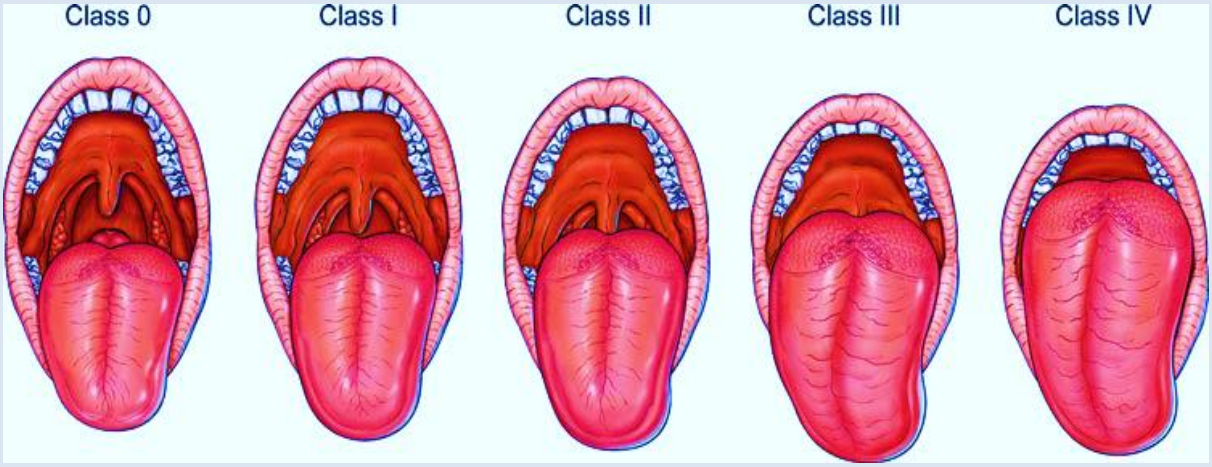
11.4 **Annex IV:** Mallampati classification and Cormack and Lehane Grading

Figure 9: Cormack and lehane grading



Cormack and lehane grading based on laryngeal structure visualization

Figure 10: mallampati classes



Mallampati classification by viewing oropharyngeal structire

11.5 Annex V: Questionnaire

QUESTIONS	
Part I: sciodemografic data	**Answers**
101. What is the age of the patient?	
102. What is the gender of the patient?	a) male b) female
103. How much is the weight of the patient?	
104. How much is the height of the patient?	
105. How much is the BMI of the patient?	
Part II: clinical preoperative patient data	**Answer**
106. What is the MMC of the patient?	a) I c) III b) II d) IV e) 0
107. what is ASA physical status of the patient	a) class I b) class II c) class III d) class IV e) class V f) class VI
108. What is a type of surgery?	

109. Is there any comorbidity other than surgical diagnosis?	a) Yes b) No
201. If yes what is it?	
202. Does it have contribution for difficult airway?	a)yes b)no
Part III: post induction patient information	**Answer**
204. Do you apply external laryngeal pressure during laryngoscopy?	a) Yes b) No
205. What is the CLG of the patient?	a) I c) III b) II d) IV
206. Is the laryngoscopy of the pt difficult?	a) Yes b) No
207. Is the intubation of the pt difficult?	a) Yes b) No
208. Is direct laryngoscopy on awake patient?	a) Yes b) No
209. Is laryngoscopic attempt without muscle relaxant?	a) Yes b) No
301. Is the patient coughing during laryngoscopy?	a) Yes b) No