ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCE

SCHOOL OF MEDICINE DEPARTMENT OF ANESTHESIA

INCIDENCE OF DIFFICULT AIRWAY AMONG ADULT PATIENTS OF UNDIAGNOSED OBSTRUCTIVE SLEEP APNEA WHO UNDERGOING ELECTIVE SURGERY IN PUBLIC HOSPITALS OF ADDIS ABABA, ETHIOPIA, FROM FEBRUARY 2021 TO APRIL 2021.

INVESTIGATOR:

KUCHULO GEREMU

ADVISORS:

1. Mr. SULAIMAN JEMAL (MSc. Lecturer)
2. Mrs. MISRAK WELDEYOHANS (MSc. Lecturer)

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

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Investigator	Kuchulo Geremu (MSc student)
Advisors	1/ Mr. Sulaiman Jemal (MSc.) Tel: +251911623363 E-mail:sulaiman_jemal@yahoo.com 2/ Mrs. Misrak Weldeyohans (MSc.) Tel: +251928114926 E-mail:dzewege@yahoo.com
Title	Incidence of difficult airway among adult patients of undiagnosed obstructive sleep apnea who undergoing elective surgery.
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Study area	Addis Ababa public hospitals, Ethiopia.
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Investigator Address	Tel +251977758314, E-mail: kefesgroup@gmail.com

DECLARATION

This research thesis entitled “Incidence of difficult airway among adult patients of undiagnosed obstructive sleep apnea who undergo elective surgery in Public hospitals of Addis Ababa, Ethiopia, from February to April 2021” was prepared by Kuchulo Geremu. A thesis submitted to the department of Anesthesia School of Medicine College of health science Addis Ababa University as partial fulfillment of requirement for the degree of masters of Science in advanced clinical Anesthesia.

Submitted by:

Kuchulo Geremu ___________ ______________

Investigator Signature Date

This thesis work has been submitted for examination with my approval as an advisor.

Approved by advisors:

1. Mr. Sulaiman Jemal (MSc. Lecturer) ________ __________

Signature Date

2. Mrs. Misrak Weldeyohans (MSc. Lecturer) __________ __________

Signature Date

Approved by board of examiners:

_________________________________ __________ ___________

External Examiner Signature Date

_________________________________ __________ ____________

Internal Examiner Signature Date

ABBREVIATIONS AND ACRONYMS

ASA- American society of Anesthesiologist

AOR- Adjusted odds ratio

BMI- Body mass index

BSc- Bachelor of Science

CI- Confidence Interval

DI- Difficult Intubation

DMV-Difficult Mask Ventilation

EAA-Ethiopian Anesthetist Association

ECG- Electrocardiography

ENT- Ear Nose and Throat

ETB- Ethiopian Birr

H_A- Alternative Hypothesis

H_o- Null Hypothesis

HR-OSA- High Risk Obstructive Sleep Apnea

IDS- Intubation Difficult Scale

JS- Jaw slide

LR-OSA- Low Risk Obstructive Sleep Apnea

STOP-BANG- Snoring, Tiredness, Observed apnea, blood Pressure, Body mass index, Age, Neck circumference and Gender

MSc- Master of Science

MO-mouth opening

NC- Neck Circumference

Non-OSA- none Obstructive Sleep Apnea

OR-Odds Ratio

OSA- Obstructive Sleep Apnea

RR- Relative Risk

SD- Standard Deviations

SMD- Sternomental distance

SPO_2- Oxygen saturation

SPSS- Statistical Package for Social Sciences

TMD-Thyromental distance

USA- United States of America

ABSTRACT

Introduction: Obstructive sleep apnea (OSA) is a serious clinical condition characterized by repeated episodes of partial/complete obstruction of the upper airway during sleep and is more undiagnosed in patients undergoing surgery. The occurrence of difficult airway leads to significant morbidity and mortality in the perioperative period and there is a higher occurrence of difficult airway among OSA patients. Thus, identification of suspected OSA patients during preoperative evaluation would necessitate adequate preparation and prevents this unwanted outcome.

Objective: To compare the incidence of difficult airway among adult patients of undiagnosed OSA undergoing elective surgery in public hospitals of Addis Ababa, Ethiopia, from February 1/2021 to April 30/2021.

Method: A multi-center prospective cohort study was conducted at Addis Ababa public hospitals, Ethiopia, in adult patients of American Society of Anesthesiologist physical status class I and II. The study population was divided into high and low-risk OSA groups based on STOP-BANG score ≥3 and <3 respectively. The incidence of the difficult airway was compared between study groups. Statistical analysis was done by using SPSS version 23. Median was used for Continuous data and frequencies, number, or percentage was used for categorical variables. Chi-square/Fischer exact test was used to compare categorical data. Mann–Whitney U test was used to compare continuous data. Logistic regression was done to determine factors predicting difficult airway. P-value less than 0.05 was taken as significant.

Result: A total of 113 patients were enrolled in this study. Based on the STOP-BANG score, patients were grouped into high-risk OSA (36 patients) and low-risk OSA (77 patients). Among this difficult intubation was 22.2% in high-risk OSA versus 5.2% in low-risk OSA, (p=0.017). Difficult mask ventilation was significantly higher in the high-risk OSA group than the low-risk OSA group (25% versus 6.5%), (p=0.011). Male gender, neck circumference>40cm, Mallampati class 3, and sternomental distance<12.5cm were predictors of difficult intubation. Whereas, Age>50 years, history of snoring, and neck circumference>40cm were predictors of difficult mask ventilation.

Conclusion: The occurrence of difficult intubation and difficult mask ventilation was significantly higher in patients with STOP-BANG score of 3/more. Therefore, every adult patient who undergoes elective surgery is advised to be screened for OSA by STOP-BANG questionnaire.

Keywords: obstructive sleep apnea, difficult airway, general anesthesia, STOP-BANG, surgery

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CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

Obstructive sleep apnea (OSA) is a serious clinical condition characterized by repeated episodes of partial/complete obstruction of upper airway during sleep (1). Its prevalence is 9-24% in general population and more presents in surgical population. It affects 11-24% of men and 7-10% of women in the age group of 40-50 year old and overweight/obese individuals (2).

The most common clinical features of OSA are: snoring, daytime sleepiness/drowsiness, and breathing pauses during sleep. Snoring is loud enough heard through closed door and intermittent and often accompanied by apnea and/or hypopnea, which may progress to feeling of suffocation, choking, and awakening from sleep. Hence, OSA is related to restless sleep, tiredness/fatigability, irritability and cognitive disorder (1).

Myocardial ischemia, heart failure, hypertension(both systemic and pulmonary), arrhythmias, cerebrovascular disease, metabolic syndrome, insulin resistance, gastroesophageal reflux disease, obesity and depression are some of medical conditions associated with OSA (1,3). Quality of life is adversely affected by the symptoms of OSA and productivity is also impaired (4).

Even though OSA affects people in all parts of world, there is insufficient data on the state of disorder in developing nations, especially those in Africa. In Africa, the administration of sleep medicine services is at its younger stage. The state of OSA in African countries, including its prevalence, clinical presentations and consequences is largely not known (5).

OSA patients have been gaining a number of attention from health care providers particularly in the last decades, as current evidence associate it to a number of chronic illness that are physically serious and economically draining consequences (6).

Even though polysomnography is the gold standard for the diagnosis of OSA, it is often impractical to be used as a routine preoperative screening tool because of its expensiveness, time consuming, low availability and requirement of sleep medicine specialist, who is not readily available in many centers (6,7).

Therefore, many screening tools have developed to identify OSA patients; among these the STOP-BANG questionnaire is highlighted due to its good sensitivity, easy memorization and is validated for surgical patients (7–9). It has 8 components, yes/no response questionnaire with a positive point assigned for each affirmative answer. There are four questions about snoring, day time drowsiness, observed apnea and diagnosis of hypertension, and four questions are concerning about measurements neck circumference, BMI, sex and age. It has score from 0 to 8 and a cut-off value 3 is used to discriminate between at high risk (i.e. STOP-BANG≥3) and low risk (i.e. STOP-BANG<3) for OSA (10). The respective sensitivity of STOP-BANG≥3 to identify any OSA (Apnea-hypopnea index>5), moderate to severe OSA (Apnea-hypopnea index>15) and severe OSA(Apnea-hypopnea index>30) is 83.9%, 93% and 100% (7,9).

Difficult airway and OSA shares the same anatomical structures; an airway that is difficult to maintain during anesthesia indicates a predisposition to OSA and the reverse is certainly true (11,12). Upper airway anatomical changes which results in reduction of upper airway lumen such as upper airway connective tissue disorders, oropharyngeal crowding, large tongue, thick neck, diminished mandibular length, inferiorly placed hyoid bone and retro position of maxilla leads to OSA as well as difficult airway (3,11,13).

1.2 STATEMENT OF PROBLEM

Preoperatively, 60% of patients with moderate to severe OSA (12) and 82% of males and 93% of females with OSA remains undiagnosed (14). These indicates a number of patients with undiagnosed OSA undergo surgical procedures with either general/regional anesthesia. Recently, Society of Anesthesia and Sleep Medicine guidelines strongly recommend preoperative screening to identify patients with suspected OSA scheduled for elective surgery to reduce perioperative complications and enhance patient safety (1). Likewise, the American Society of Anesthesiologists made similar recommendations (15).

Difficult airway can present either difficulty with facemask ventilation or difficulty with tracheal intubation, or combination of both (16). The entire incidence of difficult endotracheal intubation in surgical population is 5.8% (17). Those patients at high risk for OSA demands similar concerns in perioperative period as patients already diagnosed for OSA (18). From these, they pose difficult airway irrespective of their severity compared to general population (19). When inappropriately managed, difficult airway leads to serious sequela like aspiration, airway trauma, hypoxia, pneumothorax, cardiopulmonary arrest, brain injury (20) and it accounts for 35% of all anesthesia-related deaths (21).

A study in India by Mathangi et al (22) in 2018, reported 22.2% of difficult intubation among OSA patients and similarly a study by Corso et al. (23) in Italy (2014) showed difficult intubation was 20% in high risk OSA patients. Conversely, study in Brazil (2018) showed no association between HR-OSA and difficult intubation in patient undergo ENT surgery (24).

Another study (2014) done by Toshniwal et al. (25) in USA reported the proportion of difficult intubation among obese patients was significantly higher in patients with high STOP-BANG scores than in patients with low STOP-BANG scores. This is opposite to study (2009) done by Steven Porter et al. (26) showed there was no relationship between diagnosis of OSA and difficult intubation among obese patients.

Another study done in France by Blumen et al (2001) showed that DMV was not associated with OSA (27). This contradicts to study done in India by Mathangi et al. (22) in 2018 and in Italy by Corso et al (23) in 2014 that reported DMV was 77.7% and 23% in OSA respectively.

Many studies were done in different countries which comparing the difficult airway among HR-OSA and LR-OSA patients; nevertheless, their results are conflicting.

1.3 SIGNIFICANCE OF STUDY

OSA patients' presents with a significant challenge for anesthetist in the perioperative period as there are concerns of difficult endotracheal intubation, difficult mask ventilation or both and postoperative upper airway obstruction. Evidences from different literature indicate occurrence of severe airway complications in perioperative period in patients with undiagnosed OSA as the result of failure to secure airway during induction, post-extubation airway obstruction and pulmonary arrest due to postoperative use of opioids and sedatives. For that reason, identification of OSA patients, by using STOP-BANG questionnaire, during preoperative evaluation would necessitate adequate preparation and prevents these unwanted outcomes.

In addition to conflicting reports from previous studies, there was no published data from Ethiopia regarding this study. This invited us to perform this study in Ethiopia. Hence, the purpose of this study was to compare the incidence of difficult airway among adult patients of undiagnosed OSA undergoing elective surgery.

The result of this study would provide important information for perioperative care providers (anesthetists in particular), patients, administrators, and program managers as well as for policy makers and serve as a source for further researchers.

CHAPTER TWO: LITERATURE REVIEW

2.1 DIFFICULT AIRWAY

One of the crucial actions of anesthetic management in patients with OSA is controlling of the airway. Encountering difficult airway is one among feared adverse effects of general anesthesia and OSA patients are at risk for difficult airway irrespective of their severity (19). The entire incidence of difficult endotracheal intubation in surgical population is 5.8% (17) and it causes significant anesthesia related morbidity and mortality (20,21).

A prospective observational study (2009) done by Patrick J Neligan et al (26) on 180 consecutive morbidly obese adult patients with OSA underwent bariatric surgery under general anesthesia showed there was no relationship between diagnosis of OSA and difficult intubation at ramped position (P=0.09). However, Mallampati class ≥ 3 (P = 0.02) and male gender (P = 0.02) were predictors difficult intubation.

Kim et al (28) in 2006 conducted a case-control study in South Korea. The data was obtained from 90 patients with a polysomnography confirmed diagnosis of OSAS underwent uvulopalatopharyngoplasty surgery under general anesthesia and 90 controls who undergone endoscopic sinus surgery. They reported the prevalence of difficult intubation was higher in OSAS group than in the control group (16.7% vs 3.3%, p=0.003).

According to the prospective cohort study (2018) conducted in India by Mathangi et al. (22) with a total of 100 adult patients underwent surgery under general anesthesia were divided in to two groups by using STOP BANG screening tool; OSA group (54 patients) and non-OSA group (46 patients) showed that DMV was 77.7% in OSA vs 15.2% in non-OSA at relative risk of 5.11[95% CI: 2.55-10.260] and DI was 22.2% in OSA vs 4.3% in non-OSA at relative risk of 1.75[95% CI: 1.295-2.379]. SMD was a predictor of difficult intubation with AOR of 0.514(95% CI: 0.3-0.9).

Corso RM et al. (23) conducted a prospective observational study in Italy (2014) with a total of 3452 consecutive adult surgical patients were included; patients were grouped in to low risk for OSA(2997 patients) and high risk for OSA(455) based on STOP BANG questionnaire. They reported the incidence of DI was 20% (95% CI: 17-24%) in high risk OSA group compared to 9% in low risk OSA group and high risk OSA patients showed a higher incidence of DMV

%(95% CI: 19-27%) vs 7% in low risk group. They reported BMI≥30 kg/m^2 was a predictor for both DI with an AOR of 2.25(95% CI: 1.75-2.89) and DMV with an AOR of 2.29(95% CI: 1.74-3.02).

In Turkey Acar et al(29) and his colleague conducted a prospective cohort study (2014) in 200 adult surgical patients underwent surgery under general anesthesia and out of them 83 patients were high risk for OSA based on STOP BANG questionnaire. They reported the incidence of difficult DI was higher in the patients at high risk for OSA (i,e. a STOP BANG score of ≥ 3) than in patients at a low risk (13.3% vs 2.6%, p=0.004). They reported male gender, higher neck circumference and higher Mallampati class predicts DI with AOR and 95% CI of 4.049(95% CI: 1.224-13.399), 1.130(95% CI: 1.023-1.248) and 5.211(2.259-12.024) respectively.

Pera et al (24) conducted a prospective observational study in Brazil (2018) among 48 patients who underwent ENT surgery under general anesthesia. Among 48 patients, 39 were at high risk OSA (i.e. a STOP BANG score of ≥ 3) and 9 where at low risk OSA (i.e. a STOP BANG score of <3). They reported there was no association between difficult intubation and high risk OSA (i.e. a STOP BANG score of ≥ 3), p=0.18.

In France Blumen et al (2001) conducted prospective observational study in 24 patients who operated under general anesthesia to relieve their OSA. They reported DI was occurred in all patients; however, DMV was not associated with OSA and it is not a matter of concern in OSA patients (27).

These aforementioned literatures compared difficult airway that occurred in patients with OSA and non-OSA and also between patients at high risk OSA and low risk OSA. Besides, they reported factors predicting difficult airway. And others also showed patients at high risk for OSA demands similar concern in the perioperative period as those who confirmed as having OSA. These literatures seem confusing for practitioners as their reports are contradictory to each other. From their reports we can easily understand that further researches are needed to arrive upon clear conclusions for practitioners and others.

2.2 HYPOTHESIS TESTING

Ho_1: There is no difference in incidence of difficult intubation between adult patients with HR-OSA and LR-OSA undergoing elective surgery

HA_1: There is difference in incidence of difficult intubation between adult patients with HR-OSA and LR-OSA undergoing elective surgery

Ho_2: There is no difference in incidence of difficult mask ventilation between adult patients with HR-OSA and LR-OSA undergoing elective surgery

HA_2: There is difference in incidence of difficult mask ventilation between adult patients with HR-OSA and LR-OSA undergoing elective surgery

2.3 CONCEPTUAL FRAME WORK

Airway evaluation parameters, individual components of STOP-BANG and preoperative SPO_2 on DI and DMV

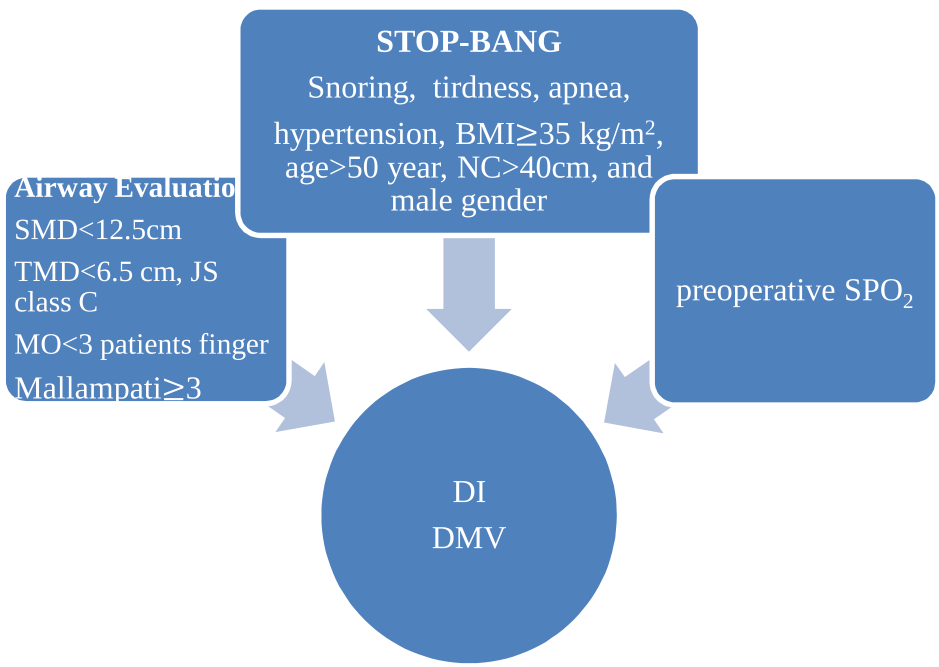

Figure 1Conceptual frame work (22,23,26,29)

CHAPTER THREE: OBJECTIVES

3.1GENERALOBJECTIVES

To compare the incidence of difficult airway among adult patients of undiagnosed OSA undergoing elective surgery in public hospitals of Addis Ababa, Ethiopia, from February 1/2021 to April 30/2021.

3.2 SPECIFIC OBJECTIVE:

The specific objectives of this study were:

1. To compare the incidence of difficult intubation between adult patients with HR-OSA and LR-OSA who undergone elective surgery from February 1/2021 to April 30/2021.
2. To compare the incidence of difficult mask ventilation between adult patients with HR-OSA and LR-OSA who undergone elective surgery from February 1/2021 to April 30/2021.

CHAPTER FOUR: METHODS AND MATERIALS

4.1 STUDY AREA

This study was carried out in Addis Ababa, the capital city of Ethiopia. The city has a subtropical highland climate with average elevation of 2500 meters above sea level. The city consists of 11 sub-cities with a total area of 520 km^2. Most ethnic groups of the country are represented. It has 14 public /governmental hospitals and 86 health centers. From these, Black lion Specialized, Yekatit 12 and Menelik II referral Hospitals were selected as study areas by using lottery method.

Black lion specialized hospital is a very large tertiary hospital of the country, found in Addis Ababa. It was founded in 1972 and became a university teaching hospital in 1998. It has 800 beds, 17 operating rooms, and around 6000-8000 operations done per year.

Yekatit 12 hospital was formed in 1923 as one of the modern medical delivery centers Ethiopia. It was decided to become a medical college by city government of Addis Ababa in 2011. It has 8 operating rooms in which 4000-5000 operations done annually.

Menelik II referral hospital is a first public hospital of Ethiopia found in Addis Ababa which was established in 1910 by Menelik II emperor. It is a referral and teaching hospital that gives a service for more than 15 million people in its catchment area. It has 8 operating rooms.

4.2 STUDY DESIGN AND PERIOD:

A multi-center prospective cohort study was conducted in public hospitals of Addis Ababa, Ethiopia, from February 1/2021 to April 30/2021.

4.3 POPULATION

4.3.1 SOURCE POPULATION

Include all patients who underwent surgical procedures under general anesthesia at public hospitals of Addis Ababa.

4.3.2 STUDY POPULATION

Include all patients who underwent elective surgical procedures under general anesthesia at selected public hospitals of Addis Ababa.

4.4 ELIGIBILITY CRITERIA

4.4.1 INCLUSION CRITERIA

All patients of both sex, age≥18 year, and those belongs to ASA physical status class I and II scheduled for elective surgery under general anesthesia was included.

4.4.2 EXCLUSION CRITERIA

Patients having the following condition and/or undergoing procedures were excluded.

- ✓ Cardiothoracic surgery
- ✓ Neurosurgery
- ✓ Cesarean section and/or obstetric patients
- ✓ Patients with neuromuscular disease
- ✓ Patients having craniofacial abnormality and/or underwent maxillofacial surgery
- ✓ Psychiatric patients and those not willing to provide consent
- ✓ Patients with previous history of difficult airway
- ✓ Patients with pulmonary disease
- ✓ Pre-induction SPO_2<92%
- ✓ Patients suspected to be difficulty such as those with temporomandibular stiffness from joint disease/long standing diabetes and huge thyroid mass

4.5 STUDY VARIABLE

4.5.1 DEPENDENT VARIABLES

Difficult airway:

- ✓ Difficult intubation
- ✓ Difficult mask ventilation

4.5.2 INDEPENDENT VARIABLES

- ✓ Socio demographic characteristics: Age, sex, weight, height, BMI, neck circumference
- ✓ ASA physical status
- ✓ History of snoring
- ✓ history of tiredness/ day time sleepiness
- ✓ history of cessation of breathing during sleep
- ✓ hypertension
- ✓ Pre-induction SPO_2
- ✓ Preoperative airway assessment: modified Mallampati grade, mouth opening, SMD, TMD and jaw slide/mandibular protrusion

4.6 SAMPLE SIZE DETERMINATION

Based on previous study (India), the incidence of difficulty endotracheal intubation in adult surgical patients was 22.2% in OSA comparison with 4.3% in non-OSA (22). The OpenEpi version 3 software was used to calculate sample sizes. It was calculated by assuming HR-OSA to LR-OSA ratio of (2:1), significance level of 5% and study power of 80%. The calculated sample size for HR-OSA and LR-OSA was 38 and 76 patients respectively.

4.7 SAMPLING AND DATA COLLECTION TECHNIQUE

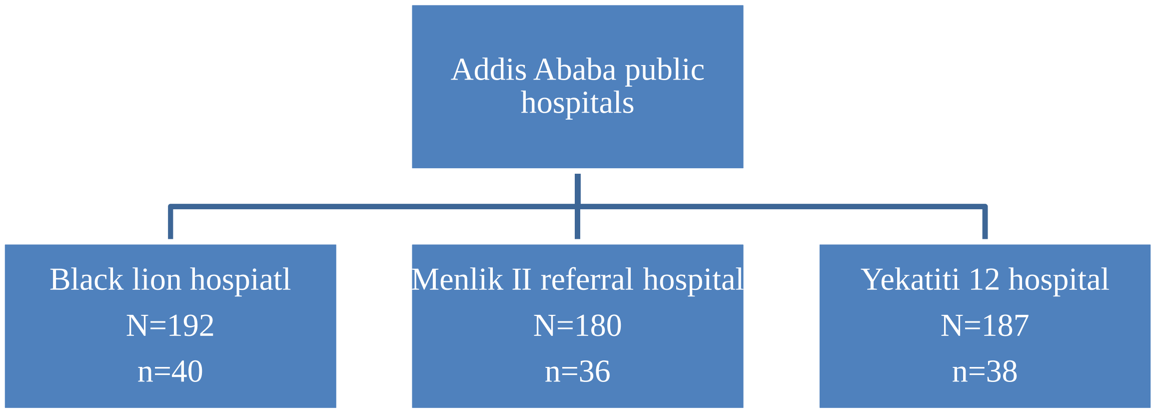

Figure 2 Proportional allocations for sample size

Stratified, systematic random sampling technique was employed to select study participants from each surgical specialty (i.e. General, Urology, Gynecology, Orthopedics, vascular and ENT surgeries) in the above hospitals. Patients who fulfilled the inclusion criteria were chosen from daily operating room schedule list of respective hospitals. After brief explanation about study, verbal informed consent was obtained and only those who agreed were included in this study.

The one trained operating room nurse regarding data collection in each hospital selected and interviewed the patients and recorded STOP-BANG questionnaire in the preoperative period. The data regarding airway assessment and management was recorded by anesthetist who provided anesthesia for the patient. The STOP-BANG questionnaire was used to group the risk of OSA for all patients. The acronym STOP-BANG stands for S-(history of snoring), T-(history of tiredness/daytime sleepiness), O-(history of observed apnea during sleep), P-(history of hypertension), B-(body mass index>35kg/m^2), A-(age>50 year), N-(neck circumference>40cm) and G-(male gender). Each positive answer was given one point and the summation of each was taken as total score out of 8. The data such as weight, height, and BMI and neck circumference were measured.

Patients scoring ≥3 and <3 in STOP BANG was taken as patients at HR-OSA and LR-OSA respectively. The airway was managed by anesthesia provider (BSc of at least two year of experience, MSc and MSc student, year two anesthesia resident and above).

In the operation room, Standard ASA monitors (non-invasive blood pressure, pulse-oximetry, and electrocardiogram) were applied. Premedication was not given and patients were induced with induction agents as indicated after 3 to 5 minutes of pre-oxygenation. The adequacy of mask ventilation was approved and ease of mask ventilation was graded. Neuromuscular blocker was injected and after adequacy of relaxation is confirmed laryngoscopy was inserted using curved/straight blade 3 or 4 at standard sniffing position. Use of additional technique and/or equipment's including bougie, stylet, external laryngeal pressure, change of operator, and ease of endotracheal intubation was also recorded.

Occurrence of DMV and DI was compared between study groups by using DMV score (30) and intubation difficulty scale (IDS) score (31) respectively.

4.8 DATA QUALITY CONTROL ISSUE

To assure the quality of data, training on the objective and relevance of study and brief orientation on the assessment tool was provided for data collectors. During data collection, each questionnaire was revised by investigator for being complete and appropriate. Incomplete data was not entered, and cross checking was done before analysis on SPSS.

4.9 DATA ANALYSIS AND INTERPRETATION

Statistical analysis was done by using SPSS version 23. Mean ± SD or median was used for continuous data and categorical variables were expressed by frequencies, number/percentage. Chi-square/Fischer exact test was used to compare categorical data between the HR-OSA and LR-OSA group. Student t-test/ Mann–Whitney U test was used to compare continuous variables between study groups. Univariate analysis was done to identify each risk factor for difficult intubation and mask ventilation. Multivariate logistic regression was done for those factors having p-value <0.02 on univariate analysis. The odds ratio and 95% confidence interval was obtained for each risk factor. P value less than 0.05 was taken as statistically significant.

4.10 ETHICAL CONSIDERATION

Ethical clearance was obtained from Addis Ababa University Collage of Health Science Faculty of Medicine department of Anesthesia before the start of the study. Consent for data collection was also obtained from hospitals manager. The importance of the study was explained & verbal informed consent was obtained from each participant by the data collector. Confidentiality was kept during study by avoiding identifiers and using codes to identify patients. Participant's involvement in the study was on voluntary bases.

4.11 RESULT DISSEMINATION PLAN

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

4.12. OPERATIONAL DEFINITION

Difficult mask ventilation (DMV) is defined as mask ventilation inadequate to maintain oxygenation, unstable MV or MV requires two providers or SPO_2<92% by pulse oximetry (30). It has five grades as shown below.

Grade 0	Ventilation by mask not attempted
Grade 1	Ventilated by mask
Grade 2	Able to mask ventilate with oropharyngeal airway or other adjuvant
Grade 3	Difficult mask ventilation (inadequate, unstable, or requiring two practitioners, SPO_2<92%)
Grade 4	Unable to mask ventilation

SPO_2 (oxygen saturation**)** is a fraction of oxygen saturated hemoglobin relative to total hemoglobin in blood. Normal ranges from 95-100%.

Difficult Intubation (DI): is defined as an intubation difficult scale (IDS) score > 5.

Intubation difficult scale (IDS) score is derived from an objective assessment of seven parameters which are known to be associated with DI. The sum of points given for each parameter can be calculated soon after intubation, allowing it to be categorized as being easy, slightly difficult, or moderate to major difficult and impossible intubation. The total IDS range from zero to infinity (31). It has four grades as shown below.

Total intubation difficult score	**Grade of intubation**
0	I. Easy intubation
1-5	II. Slightly difficult intubation
>5	III. Moderate to major difficult intubation
IDS=∞	IV. Impossible intubation

BMI (body mass index) is defined as the body mass (in kilogram) divided by the square of patients` height (in meter).

Neck circumference (NC) is circumference of the neck (in centimeter) measured at the level of cricoid cartilage. NC>40cm is a thick neck.

Mouth opening: inter-incisor distance measured by patients own fingerbreadths after mouth is fully opened. Normal is 3/more patient's own fingers

TMD: is a distance between the mentum (chin) and the superior thyroid notch measured in cm after neck is fully extended. Normal is >6.5cm and value <6.5cm predicts DI.

SMD: is a distance between the sternal notch and the mentum (chin) measured in cm after neck is fully extended. Normal is >12.5cm and value <12.5cm predicts DI.

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

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

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

Class III: only soft palate and hard palate are visible

Class IV: only hard palate is visible

Higher Mallampati class is when patient has **Class III**/ **IV** which shows difficult intubation is most likely.

Jaw slide/mandibular protrusion (JS): the ability patient to protrude the lower incisors forward beyond upper incisors. It has three classes

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

Class B: protrusion of lower incisors up to upper incisors

Class C: inability to protrude the lower incisors. The lower incisors are behind of upper incisors. **JS class C** shows poor mandibular protrusion and shows DI.

ASA physical status class: is a surgical risk stratifications validated by American Society of Anesthesiologist; described as follows:

ASA I: a healthy patient with no organic/physiological/psychiatric problems.

ASA II: controlled medical conditions with mild systemic effect and no limitation of functional ability.

CHAPTER 5: RESULT

A total of 114 patients who underwent surgical procedure under general anesthesia were proposed to be studied. Among these 113 patients were included in our study due to incomplete data in one patient. The population consisted of 70(61.95%) females and 43(38.05%) males. The median age was 59 year for high risk OSA and 39 year for low risk OSA. From those included in this study, 77 patients and 36 patients were grouped in to LR-OSA and HR-OSA respectively based on STOP BANG ≥3 as a cut off value.

Comparison of each parameters of STOP BANG was done between HR-OSA and LR-OSA; and there was statistically significance of individual parameter of STOP BANG between study groups as shown in the following table 1.

Table 1 Individual parameters of STOP BANG between HR-OSA and LR-OSA

STOP-BANG		HR-OSA	LR-OSA	p-value
Age>50 year	**yes**	20(54.1%)	17(45.9%)	<0.001*[1]
	no	16(21.1%)	60(78.9%)	
Age (year)	**median**	54.00 year	39.00 year	0.001*[1]
Sex	**male**	19(44.2%)	24(55.8%)	0.027*[1]
	female	17(24.3%)	53(75.7%)	
BMI>35kg/m^2	**yes**	9(64.3%)	5(35.7%)	0.011*[2]
	no	27(27.3%)	72(72.7%)	
NC>40cm	**yes**	14(82.4%)	3(17.6%)	<0.001*[1]
	no	22(22.9%)	74(77.1%)	
Snoring	**yes**	15(60%)	10(40%)	0.001*[1]
	No	21(23.9%)	67(76.1%)	
Tiredness	**yes**	16(59.3%)	11(40.7%)	<0.001*[1]
	No	20(23.3%)	66(76.7%)	
apnea	**yes**	12(80%)	3(20%)	<0.001*[2]
	no	25(24.5%)	74(75.5%)	
Hypertension	**yes**	15(75%)	5(25%)	<0.001*[1]
	No	21(22.6%)	72(77.4%)	

*Statistically significant BMI-body mass index, [1]Chi-square test, [2]Fisher`s exact test, NC-neck circumference

Preoperative airway assessment parameters were compared between patients with HR-OSA and LR-OSA. HR-OSA group has higher modified Mallampati class, lower TMD and SMD than their counter parts which were statistically significant. However, there were no statistically significance differences of jaw slide and mouth opening between study groups. HR-OSA group has significantly higher ASA physical status class than LR-OSA. There was no median difference of preoperative SPO_2 between study groups as shown in the table 2.

Table 2preoperative airway assessment parameters between study groups

Airway and others		HR-OSA	LR-OSA	p[#]-value
Mallampati ≥3	**yes**	18(48.6%)	19(51.4%)	0.008[*]
	no	18(23.7%)	58(76.3%)	
SMD <12.5cm	**yes**	16(53.3%)	14(46.7%)	0.003[*]
	No	20(24.1)	63(75.9%)	
TMD <6.5cm	**yes**	14(48.3%)	15(51.7%)	0.028[*]
	No	22(26.2%)	62(73.8%)	
JS class C	**yes**	8(38.1%)	13(61.9%)	0.497
	No	28(30.4%)	64(69.6%)	
MO<3 finger	**yes**	11(40.7%)	16(59.3%)	0.256
	No	25(29.1%)	61(70.9%)	
ASA class	**I**	18(21.6%)	66(78.6%)	<0.001[*]
	II	18(62.1%)	11(37.9%)	
Pre-induction SPO_2(median)		99.00%	99.00%	0.209

[*]Statistically significant, [#]Chi-square test, SMD-sternomental distance, TMD-thyromental distance, JC-jaw slide, MO-mouth opening, ASA-American society of Anesthesiologist, SPO_2- oxygen saturation

The incidence of difficult intubation was significant higher in HR-OSA 8(22.2%) group than LR-OSA 4(5.2%) group, RR of 4.278(95% CI:1.378-13.284). That means, HR-OSA patients are 4.278 times more at risk of developing DI as compared to their counter parts as shown in table 3 and figure 3. The same was true for incidence of difficult mask ventilation in respective group which was 9(25%) versus 5(6.5%) in HR-OSA and LR-OSA, RR of 3.850(95% CI: 1.390-10.667). Meaning, HR-OSA patients are 3.850 times more at risk developing DMV than LR-OSA patients as shown in table 3 and figure 4.

Table 3 The incidence of difficult airway between HR-OSA and LR-OSA (STOP BANG≥ 3 and <3)

Risk stratification	DI	P[#]-value	RR(95% CI)
HR-OSA	8(22.2%)	0.017*	4.278(1.378-13.284)
LR-OSA	4(5.2%)		
	DMV		
HR-OSA	9(25%)	0.011*	3.850(1.390-10.667)
LR-OSA	5(6.5%)		

*Statistically significant [#]Fisher`s Exact test, CI-confidence interval, HR-OSA-high risk OSA, LR-OSA- low risk OSA, RR-relative risk

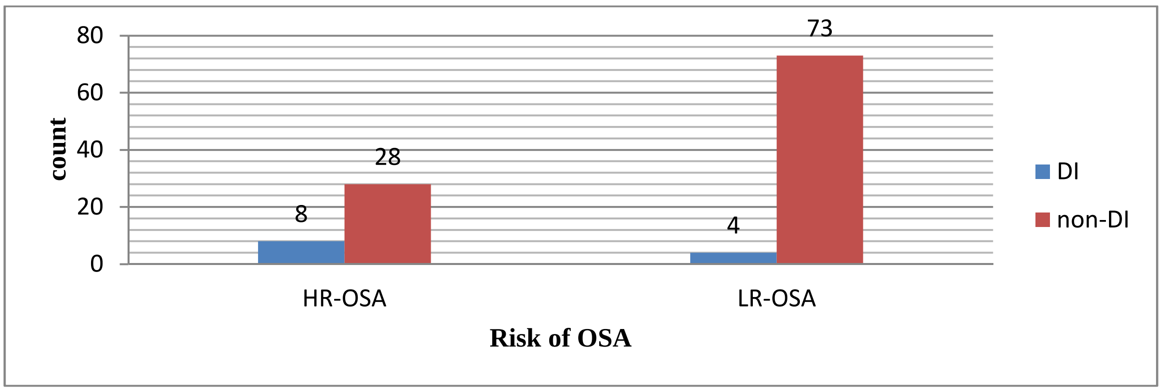

Figure 3 Comparison of DI between study populations

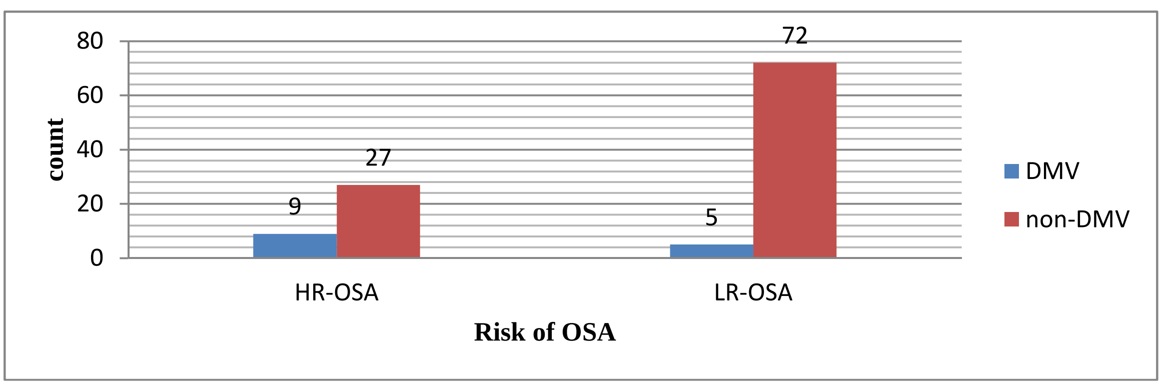

Figure 4 Comparison of DMV between study populations

Multivariate logistic regression was done for components of STOP BANG which were significant on univariate analysis to predict difficult airway. Among these: SMD<12.5cm, Mallampati class ≥3, male gender and neck circumference >40 cm were predictors of difficult intubation as shown on the table 4. Whereas, age>50 year, neck circumference >40 cm and having history of snoring were among predictors of difficult mask ventilation as shown in the table 5.

Table 4Predictors of difficult intubation in multivariate logistic regression analysis

Predictors	Univariate (p-value)	COR(95% CI)	AOR(95% CI)	Multivariate (p-value)
Age> 50 year	0.963	1.030(0.289-3.670)	-	-
BMI>35kg/m^2	0.03	4.550(1.16-17.841)	-	-
NC>40 cm	0.012	5.298(1.449,19.366)	9.861(1.575,61.738)	0.014
Hypertension	0.384	0.392(0.048,3.227)	-	-
Snoring	0.80	1.197(0.298,4.803)	-	-
Tiredness	0.211	0.262(0.032,2.131)	-	-
Apnea	0.71	1.354(0.266,6.883)	-	-
Male gender	0.011	5.912(1.502,23.271)	6.934(1.304,36.887)	0.023
Pre-induction SPO_2	0.67	1.135(0.628,2.053)	-	-
MO<3 fingers	0.033	3.81(1.114-13.025)	-	-
Mallampati>3	0.003	7.821(1.973,31.008)	9.084(1.506,54.787)	0.016
SMD<12.5cm	0.001	11.429(2.84,45.986)	7.498(1.261,44.597)	0.027
TMD<6.5cm	0.011	5.027(1.453,17.392)	2.381(0.478,11.865)	0.290
JS class C	0.039	3.795(1.07-13.456)	-	-

AOR-adjusted odds ratio, ASA-American society of Anesthesiologist, CI-confidence interval, COR-crude odds ratio, JC-jaw slide, MO-mouth opening, SMD-sternomental distance, SPO2-oxygen saturation, TMD-thyromental distance

Table 5 Predictors of difficult mask ventilation in multivariate logistic regression analysis

Predictors	Univariate (p-value)	COR(95% CI)	AOR(95% CI)	Multivariate (p-value)
Age> 50 year	0.001	10.295(2.661,39.823)	8.560(1.906,38.447)	0.005
BMI>35kg/m^2	0.062	3.560(0.941,13.457)	-	-
NC>40 cm	<0.001	13.333(3.779,47.049)	9.288(2.025,42.591)	0.004
Hypertension	0.721	0.750(0.154,3.647)	-	-
Snoring	0.002	6.431(1.976,20.938)	4.862(1.106,21.369)	0.036
Tiredness	0.274	1.944(0.591,6.401)	-	-
Apnea	0.90	1.103(0.221,5.497)	-	-
Male gender	0.033	0.104(0.013,0.829)	-	-
Pre-induction SPO_2	0.394	0.800(0.480,1.1335)	-	-
MO<3 fingers	0.662	1.322(0.379-4.613)	-	-
Mallampati>3	0.149	2.300(0.472,7.134)	-	-
SMD<12.5cm	0.279	0.423(0.089,2.01)	-	-
TMD<6.5cm	0.699	0.766(0.198,2.962)	-	-
JS class C	0.264	0.304(0.37-2.462)	-	-

AOR-adjusted odds ratio, ASA-American society of Anesthesiologist, CI-confidence interval, COR-crude odds ratio, JC-jaw slide, MO-mouth opening, SMD-sternomental distance, SPO_2-oxygen saturation, TMD-thyromental distance

CHAPTER 6: DISCUSSION

The incidence of DI and DMV and individual components STOP BANG in predicting DI and DMV were the major findings of this study. Besides, the association of individual components of STOP-BANG with HR-OSA is also the outcome of this study.

In this study individual parameters of STOP BANG were significantly associated with HR-OSA. Median age was significantly greater in HR-OSA group than their counterparts. Similarly, Mathangi et al (22) and Acar et al (29) reported the mean age was significantly higher in HR-OSA than LR-OSA group. This is probably because prevalence of OSA increases as age increases (7).

Male gender was significantly associated with HR-OSA in this study that supported by previous studies by Corso et al (23) and Acar et al (29) who demonstrated being male is associated with OSA.

Kim et al (28) reported hypertension and OSA were significantly associated. Their report alike with this study that shows hypertension was significantly higher in HR-OSA than LR-OSA group. This association might be due to frequent stimulation of sympathetic nervous system because of lower Pao_2 (13) and chronic daytime hypercarbia in OSA patients (7).

This study demonstrated BMI and neck circumference was significantly higher in HR-OSA group. Likewise, Mathangi et al(22) and Acar et al(29) reported measurements such as BMI and neck circumference were significantly greater in HR-OSA group as compared to LR-OSA group. These might be due to obesity is considered as predictors of OSA (13). History of snoring, tiredness/ daytime sleepiness and history of observed apnea was also significantly associated with HR-OSA in ours.

Preoperative airway parameters assessment such as Mallampati class 3/more, lower TMD and SMD were significantly associated with HR-OSA than their counterparts in this study. Similarly, Mathangi et al(22) reported Mallampati class 3/more, lower TMD and SMD was significantly associated with OSA patients. Additionally, Acar et al (29) reported Mallampati class 3/more was significantly associated high risk OSA patients. Higher Mallampati class in HR-OSA patients might be due to excess soft tissue deposit in the lateral pharyngeal wall and large tongue which obscures visualization of surrounding structures. On the other hand, lower TMD and SMD might be due to increase in circumference of neck and posterior neck fat accumulation in majority of OSA patients.

Nevertheless, mouth opening and jaw slide/mandibular protrusion showed no difference among study population. Similarly, Mathangi et al(22) reported no difference in mouth opening between OSA and non-OSA. These might be due to temporomandibular joint is intact in OSA patients unless these patients have known joint stiffness from comorbidities such as joint disease/ long standing diabetes mellitus which were excluded from our study.

In this study HR-OSA group had significantly higher ASA physical status class than LR-OSA group. Previously, Mathangi et al(22) also showed OSA group had significantly higher ASA physical status class than non-OSA group. This might be due to increase comorbidities in OSA patients.

There was no significant median difference in preoperative arterial oxygen saturation among study populations. Similarly, Acar et al(29) demonstrated there was no significant mean difference in preoperative SPO_2 between high and low risk OSA.

We found the incidence of difficult intubation was significantly higher (22.2%) in HR-OSA group versus 5.2% in LR-OSA group, RR of 4.278(95% CI: 1.378-13.284). That means, HR-OSA patients are 4.278 times more at risk of developing DI as compared to their counter parts. This in line with Mathangi et al(22) finding who reported the incidence of difficult intubation was 22.2% in OSA and 4.3% in non-OSA group, RR of 1.75[95% CI: 1.295-2.379].

Conversely, a prospective observational study conducted among 48 patients underwent ENT surgery under general anesthesia in Brazil (2018) by Pera et al (24) reported HR-OSA (i.e. STOP BANG$\geq$ 3) were not associated with difficult intubation, p=0.18. This might be due to difference in definition of difficult intubation i.e. they defined DI as more than 3 intubation attempts or when more than 10 minute is required for insertion of endotracheal tube under direct laryngoscopy. Besides, their study focused only on ENT procedures.

Corso et al(23) reported incidence of difficult intubation was 20% in HR-OSA and 9% in LR-OSA group. This slight variation in LR-OSA group might be due to difference in definition of difficult intubation (i.e. they used Cormack and Lehane grade ≥3). Furthermore; they used a STOP BANG≥ 5 to discriminate between high risk-OSA and low risk-OSA.

Another study in Turkey by AV Acar et al(29) reported the incidence of difficult intubation was significantly higher in high risk than low risk for OSA (13.3% versus 2.6%), p=0.004. As compared to our finding, this slightly lower figure might be due to different in definition for assessment of difficult intubation (they used laryngoscopy grade≥ 3).

A retrospective case-control study conducted by Kim et al(28) reported the prevalence of difficult intubation was 16.6% in OSA group and 3.3% in non-OSA group (p=0.003). Comparing their study with this study might be difficult because of different in study design and in their study OSA was confirmed by polysomnography. Moreover, there was difference in definition of intubation (i.e. they used Cormack and Lehane grade 3/ more).

Neligan et al (26) conducted a prospective observational study among 180 consecutive morbidly obese patients who underwent bariatric surgery and among them 68% of patients were polysomnography confirmed OSA; surprisingly, they reported no relationship between diagnosis of OSA and difficult intubation (p=0.09). This is most likely due to intubation was performed at ramped (head elevated laryngoscopy) position in their study population that is known to facilitates laryngeal view and difference in definition of difficult intubation. Comparison with our finding might be difficult because of their study focused only on obese patients.

In this study the incidence of difficult mask ventilation was 25% in HR-OSA group versus 6.5% in LR-OSA group, RR of 3.850(1.390-10.667). Meaning, HR-OSA patients are 3.850 times more at risk developing DMV than LR-OSA patients. Our finding was consistent with study in Italy by Corso et al (23) who reported the incidence was 23% in HR-OSA group versus 7% in LR-OSA group.

The incidence of DMV reported from India by Mathangi et al(22) was 77.7% in OSA versus 15.2% non-OSA group, RR of 5.11[95% CI: 2.55-10.260]. This greater discrepancy might be due to lower number of HR-OSA group (36 patients) in this study as compared to their study (54 patients in OSA versus 46 patients in non-OSA).

Contrary to our finding, a study in France by Bluman et al (2001) reported DMV is not associated with OSA and it is not a matter of concern in OSA patients (27). This is probably because they carried out study in small sample (only 24 patients were enrolled).

In this study male gender (AOR of 6.93), neck circumference>40cm (AOR of 9.86), modified Mallampati class 3/more (AOR of 9.08) and SMD<12.5cm (AOR of 7.49) were predictors for difficult intubation in multivariate logistic regression model. Similarly, Acar et al (29) reported modified Mallampati class 3/more(AOR of 5.21), male gender(AOR of 4.05), and neck circumference>40 cm (AOR of 1.13), but not higher age predicts difficult intubation. Corso et al (23) reported BMI≥30 kg/m^2 (AOR of 2.25) was good predictors of DI but not higher age and male gender. Mathangi et al (22) reported SMD less than normal and Neligan et al(26) demonstrated modified Mallampati class 3/more (p=0.02) and male gender (p=0.02) but not BMI>35 kg/m2 and neck circumference>40 cm were predictors of difficult intubation.

Age>50 year (AOR of 8.56), history of snoring (AOR of 4.86) and neck circumference>40cm (AOR of 9.28) were predictors of difficult mask ventilation in our finding in multivariate logistic analysis. BMI≥ 30 kg/m^2 (AOR of 2.29) was good predictors of difficult mask ventilation as reported by Corso et al (23).

According to this study four and five patients from LR-OSA group developed DI and DMV respectively. Thus, health care provider who responsible for airway management should take in to account that difficult airway can also occur in LR-OSA patients even though in less extent.

CHAPTER 7: STRENGTH AND LIMITATION OF THE STUDY

7.1 STERENGH OF STUDY

All the study populations were passed under the STOP BANG screen.

7.2 LIMITATION OF THE STUDY

In this study OSA was not polysomnography confirmed. Furthermore, airway was managed by different anesthesia providers and the small sample size enrolled were limitations of study.

CHAPTER 8: CONCLUSION AND RECOMMENDATION

8.1 CONCLUSION

The occurrence of difficult mask ventilation and difficult intubation was significantly higher in patients with STOP BANG score of three or more. Male gender, neck circumference>40cm, Mallampati class ≥3 and sternomental distance<12.5cm were predictors of difficult intubation. Whereas, Age>50 year, history of snoring and neck circumference>40cm were predictors of difficult mask ventilation.

8.2 RECOMMENDATION

We recommend every adult patient who scheduled to undergo elective surgery would be screened for OSA by STOP BANG questionnaire for triage to prevent these adverse events. All the necessary instruments used to screen STOP BANG and to manage difficult airway would be available. A new policy would be made to increase man powers that specialize in sleep study. Further study with large sample size and/or polysomnography confirmed OSA will be necessary.

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ANNEX I: CONSENT FORM

Identification

Name of the Institute ______________________

Address of the Institute ______________________

Hello! How are you? I am______________________ here to collect information about the research study aimed at incidence of difficult airway among adult patients of undiagnosed OSA who undergoing elective surgery. A study will be conducted by Kuchulo Geremu, a Master of Science student in department of Anesthesia School of Medicine College of health science Addis Ababa University, Ethiopia, 2021.Your response to the study items will highly contribute to the success of the study. Therefore, you are kindly requested to give candid response to each of the items. I have been briefed that your identity would be kept confidential and the information will be used for the intended purpose only.

Are you willing to participate in the study?

1/ Yes 2/No

Thank you for your participation!

For more information and question contact the investigator. Kuchulo Geremu

Tel: +251977758314

Email: kefesgroup@gmail.com

Advisers: 1/ Mr. Sulaiman Jemal (MSc. lecturer)

Tel: +251911623363

E-mail:sulaiman_jemal@yahoo.com

2/ Mrs. Misrak Weldeyohans (MSc. lecturer)

Tel: +251928114926

E-mail:dzewege@yahoo.com

Amharic version verbal consent form before conducting interview:

ከቃለ መጠይቅ በፊት ፈቃደኝነት መጠየቂያ ቅጽ:

ጤና ይስጥልኝ! ______________እባላለሁ:: እዚህ የተገኘሁት በአዲስ አበባ ዩንቨርስቲ አንስትዚያ ት/ቤት የጥናት ቡድን አባል ለሆነው ለኩቹሎ ገረሙ መረጃ ለመሰብሰብ ነው:: የጥናቱ ዋና አላማ የማንኮራፋትና የእንቅልፍ መቆራርጥ (Obstructive sleep apnea) ህመምና ከሰው ሰራሽ የመተንፈሻ መርጃ መሳሪያዎችን በኦፐራሲዮን ጊዜ የማስገባት ችግር ምን ያህል እንደሆነ ለማጥናት ነው:: ትክክለኛ የሰው ሰራሽ የመተንፈሻ መርጃ መሳሪያ አጠቃቀም ኦፐራሲኦን ለሚደረጉ ህሙማን ህይወትን ሊነጥቁ ከሚችሉ ችግር ይታደጋል:: በዚህ ጥናት መሳተፎም ሆነ አለመሳተፎ በሆስፒታሉ ውስጥ በሚያገኙት አገልግሎት ላይ ምንም አይነት ለውጥ አያመጣም:: የተመረጡትም በዚህ ሆስፒታል ቀዶ ጥገና ስለተደረገልወት ብቻ ነው:: ቃለመጠይቁን በማንኛውም ሰአት ማቋረጥ ወይም ጥያቄዎችን አለመመለስ ይችላሉ:: ለጥያቄዎች የሚሰጧቸዉ መልሶች በሚስጥር የሚጠበቁ ሲሆን የእርሶ ስም ወይንም እርሶን የሚለይ ማንኛውም መረጃ አይገለጽም:: እንዲሁም የሚሰጡት ምላሽ ከርሶ ማንነት ጋር በማንኛውም መልኩ አይያያዝም:: ስለዚህ በጥናቱ ላይ በፍቃዶ እንዲሳተፉ በአክብሮት እጠይቃለሁ::

በጥናቱ ለመሳተፍ ፈቃደኛነዎት? 1. አዎ 2. ፍቃደኛ አደለሁም

ስለ ትብብሮም አመሰግናለሁ!

ለበለጠ መረጃ፣ ኩቹሎ ገረሙ

ስልክ: +251977758314

ኢሜል:kefesgroup@gmail.com

ANNEX II: PRE-OPERATIVE AND INTRA-OPERATIVE PARAMETERS

Instruction: For each question, please encircle the possible response/s/

Data code: ______________

1/ STOP-BANG AND OTHERS

101	Age	____year
102	Sex	1/ male 2/ female
103	ASA physical status	1/ I 2/ II
104	Neck Circumference (at the level of cricoid cartilage)	_____cm
105	Weight	______kg
s106	Height	______m
107	BMI	______kg/m^2
108	Has anyone observed you snore loudly during your sleep (loud enough to be heard through closed doors)?	1/ yes 2/ no
109	Do you often feel tired, fatigued, or sleepy during daytime?	1/ yes 2/ no
110	Has anyone observed you stop breathing during your sleep?	1/ yes 2/ no
111	Do you have or are you being treated for high blood pressure?	1/ yes 2/ no
112	History previous surgery under general anesthesia	1/ yes 2/ no
113	If yes to question 13, have you told history of difficult intubation/ any documented	1/ yes 2/ no

2/ AIRWAY EVALUATION PARAMETERS

201/ Modified Mallampati class:

Class	Visible structures
Class I	Fauces, anterior and posterior tonsillar pillars, uvula and soft palate
Class II	Fauces, base of uvula and soft palate
Class III	Only soft palate and hard palate
Class IV	Only hard palate

1/ II 2/II 3/ III 4/ IV

202/ Jaw slide/mandibular protrusion

Class	Ability to protrude the mandible
Class A	protrusion of lower incisors forward beyond upper incisors
Class B	protrusion of lower incisors up to upper incisors
Class C	The lower incisors are behind of upper incisors.

1/ A 2/ B 3/ C

203/ Mouth opening________ patient's own fingers

204/ TMD ________cm

205/ SMD_________ cm

3/ INTERAOPERATIVE: AIRWAY MANAGEMENT

301/ Experience of Anesthesia provider

A/ <2 years

B/ two year/more

C/ Anesthesia R2 and above

302/ preinduction SPO_2...............

303/ MASK VENTILATION

Grade 0	Ventilation by mask not attempted
Grade 1	Ventilated by mask
Grade 2	able to mask ventilate with oropharyngeal airway or other adjuvant
Grade 3	Difficult mask ventilation (inadequate, unstable, or requiring two practitioners, SPO_2<92%)
Grade 4	unable to mask ventilation
Grade	A/ 0 B/ 1 C/ 2 D/ 3 E/ 4

304/ ENDOTRACHEAL INTUBATION PARAMETERS/ IDS SCORE

No	PARAMETRES	Response	Remark
1	Number of intubation attempt	A/ 1x C/ 3x B/ 2x D/….x (specify)	
2	Number of operator/ person perform intubation	A/ one C/ three B/ two D/….(specify)	
3	Alternative technique used	A/ repositioning of patient B/ change of blade C/ change of ETT D/ bougie E/ stylette F/ fiber optic intubation G/ intubation through LMA H/ change in approach (nasotracheal/orotracheal)	
4	Cormack-Lehane grade	A/ one C/ three B/ two D/ four	
5	Lifting force required during laryngoscope	A/ normal B/ increased	
6	External laryngeal pressure	A/ applied B/ not applied	
7	Position of vocal cord	A/ abducted (away from midline) B/ adducted (towards midline)	
Total score			

Total intubation difficult score	Grade of intubation
0	I. Easy intubation
1-5	II. Slightly difficult intubation
>5	III. Moderate to major difficult intubation
IDS=∞	IV. Impossible intubation

Data collector

Name________________ Signature ______________ Date______________

Investigator

Name_______________ Signature ____________ Date______________