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Comparison of Mallampati test in sitting position and in supine position for prediction of difficult tracheal intubation among adult patients who undergoing surgery under general anesthesia at Addis Ababa governmental hospitals from February –April 2021 Comparative cross-sectional study

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Comparison of MALLAMPATI test in sitting position and in supine position for prediction of difficult tracheal intubation among adult patients who undergoing surgery under general anesthesia at Addis Ababa governmental hospitals. 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 Anesthesia. I understand that plagiarism will not be tolerated and all directly quoted material has been appropriately referenced

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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 Anesthesia

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Abbreviations/Acronyms

C-L GRADING: Cormack and Lehans grading

DTI: difficult tracheal intubation

IDS: intubation difficulty score

MMT: Mallampati test

OR: operation room

ROC curve: receiver operating curve

ABSTRACT

Background: Mallampati test is a method of assessing the airway for the prediction of difficult laryngoscopy and intubation. The sitting position is the routine position for this test and shows limited clinical value because of its low sensitivity and moderate specificity in predicting difficult intubation and laryngoscopy in other side supine position may improve its efficacy. Mallampatii in supine positions for prediction of difficult tracheal intubation and/ or laryngoscopy was compared with sitting position.

Objective: To assess the Mallampati test in sitting and supine positions on predicting difficult laryngoscopy and intubation among Adult surgical patients undergoing general anesthesia among selected Addis Ababa governmental hospitals.

Method: a cross-sectional study was conducted at Addis Ababa governmental hospitals among 403 adult patients who underwent surgery that requires intubation. Samples were selected by using systemic random sampling technique. Mallampati test was performed in sitting and supine position during the preoperative period. Cormac and Lehans grade and Intubation Difficulty Scale were recorded at the time of intubation. Mallampati in both positions compared with Cormac and Lehans grade and Intubation Difficulty Scale by using chi-square test. Statistical package for social sciences (SPSS) software version 26.0 used for data analyses. A p-value of < 0.05 was considered statistically significant. Statistical measures including sensitivity, specificity, positive predictive values, and negative predictive values were calculated.

Result: the incidence of difficult laryngoscopy and intubation is 13.7% and 9.7% respectively. Supine shows sensitivity of 78.8%; specificity of 93%; positive predictive value of 64.1 and negative predictive value of 96.5 whereas sitting shows sensitivity of 75%; specificity of 96.3%; positive predictive of 76.5 and negative predictive value of 96 concerning difficult laryngoscopy. In relation to difficult intubation supine shows sensitivity of 78.4%; 89.8% specificity; 45.3 positive predictive value and 97.5 negative predictive value whereas sitting shows 73% sensitivity, 93% specificity, 52.9% PPV and 97% negative predictive value.

Conclusion and recommendation sitting have high specificity and positive predictive whereas supine has high sensitivity and negative predictive for prediction of difficult tracheal intubation and laryngoscopy. Despite its low positive predictive value supine have comparable prediction for difficult intubation and we can use it as alternative approach.

Keywords: MALLAMPATII, difficult intubation; difficult laryngoscopy; supine; sitting

1. Introduction

1.1 Background

Maintaining a patent airway is essential to prevent hypoxic brain insult and death among patients undergoing surgery. Although the widespread use of gum elastic bougies, LMA fiber-optic intubation and development of difficult airway algorithm declines the incidence; DTI is still the major cause of anesthesia-related hypoxic brain insult accounts for 17% of the respiratory-related injuries and results in about 28% of all anesthesia-related deaths(1,2).

Difficult airway comprises the inability to visualize any portion of vocal cords and insert tracheal tube without multiple attempts by experienced anesthesiologist. Sometimes it may go to failed mask ventilation and tracheal intubation. The incidence of difficult laryngoscopy and difficult intubation is 12.3%, and 9%, respectively. Generally, this situation highly determined by patient condition, setting available in the operation room, and the skill of the practitioner(3,4)

There are different bedside parameters used to assess the ease and difficulty of intubation during preoperative. This may include MMT score, mouth opening, Thyromental distance, and Sternomental distance. By 1985 Sehagiri MMT an Indian American anesthesiologist develops a hypothesis based on the visualization of the cover-up of the uvula and facial pillars by the base of the tongue and divides patients into three classes and after that, the 4th class added by Dr. Samsoon and Dr. Youngs(5,6). MMT predicts ease and difficulty of intubation by estimating the tongue size relative to the oral cavity and possibly indicate whether displacement of the tongue by the laryngoscope blade is likely to be easy or difficult. In addition, it assesses whether the mouth can be opened adequately to allow intubation(7).

The sitting position is the position where MMT test is routinely performed. In this position, patient opens his mouth and protrudes his tongue maximally and the class will be determined to predict inadequate exposure of the glottis consequently difficult tracheal intubation. But MMT in sitting position have limited value as it shows a low predictive value of DTI and laryngoscopy(8). Approaching Mallampati test through supine position may improve its efficacy and clinical use(9).

By this study, the predictive value of MMT in the sitting position and supine position was compared for the prediction of DTI.

1.2 Statement of the problem

The sitting position is the position in which Mallampati test is routinely performed to predict difficult airway so as to reduce the chance of those unanticipated difficult airway consequences but in our day to day clinical practice its effectiveness is on question mark and shows limited anticipation of difficult airway as it shows many false predictions of easy as well as difficulties(10).

On the study done in Gondar University a prevalence of difficult intubation and Laryngoscopy were about 9.2% and 12.3%. even though the Mallampati test which is performed in sitting position shows balanced measure of validity in respect to Mouth Opening and Sliding Jaw scale; its sensitivity and PPV shows limited value for prediction of difficult laryngoscopy and intubation(4).

By considering sitting as a standard and routine position for Mallampati test; different articles were written on perspective of clinical efficacy of Mallampati test. A systemic review and meta-analysis on accuracy of Mallampati in prediction of difficult airway was done by Lee and shows poor to good accuracy and finally concludes Mallampati tests are insufficient to confidently predict the presence or absence of a difficult airway. In another systemic review and meta-analysis Lundstorm concludes the modified Mallampati score is inadequate as a stand-alone test of a difficult laryngoscopy or tracheal intubation. on another meta-analysis of Bedside Screening test performance of Mallampati shows poor pooled sensitivity values and relatively moderate specificity values were obtained whereas Positive and negative likelihood ratios were moderate but unsatisfactory for clinical use (8,11,12).

The major task of anesthetist is to maintain patent airway and the goal of airway parameters is to avoid or to reduce the undiagnosed or unpredicted difficult airway. As literatures and our clinical practice shows Mallampati performed in sitting position shows ineffective in prediction of difficult intubation and laryngoscopy so to improve its effectiveness changing to supine position may be important. But due to its applicability is low and studies are not much on this area Anesthesiology professionals are not confident and hesitate to use this position for Mallampati test.

There were different researches conducted on Mallampati test in sitting and supine for better prediction of difficult intubation and laryngoscopy. Bindra et al states Mallampati in supine position has better prediction of difficult laryngoscopy and intubation. In most literatures supine shows better sensitivity than sitting position it means that Mallampati profited from supine position as it predicts difficult airway correctly than when it predicts in sitting. In contrast some literatures shows supine has poor prediction of difficult intubation(2,9,13)

1.3 significance of the study

The aim of study conducted is to minimize the incidence of unanticipated difficult intubation.

There is inconsistency among literature done on predictive value among MMT in sitting and supine positions. By this study in which position MMT could have the highest prediction for difficult intubation laryngoscopy will be determined

There is clinical situations evaluation on the patient's airway in sitting became impossible such as traumatic injury to the cervical, the thoracic, lumbar or the sacral vertebrae In cases that require emergency intubation, MMT in sitting position is not feasible(10). The critical illness that the patient possesses and the issue of cooperation is the main factors that make this position is challenging(14). In such time to use supine as the alternative approach research based description on the performance of supine is needed.so by this study if the comparable or better usefulness of supine position is concluded it will help anesthetists to use it confidently

At the end of this study, the researchers can use it as a reference for their studies.

2: Literature review

According to a prospective observational study done in India (2020), MMT in the supine position without phonation shows the highest sensitivity and lowest specificity when compared to MMT in the sitting position. Of 130 patients 19 had actual difficulty intubation, MMT in the sitting position was able to predict as difficult airway in cases of 16 patients and the sensitivity was about 84.2% but MMT in the supine position without phonation was better effective and able to identify 18 of the patients and the sensitivity was about 94.7%. Even though MMT in supine position had shown the lowest false-negative there was a significant number of false positives which are over predicted in this position so because of its low predictive power MMT in supine position should be with a cautious approach and combined with other parameters (15).

In the prospective study done in India in 2018 Awashti et al. describes MMT in supine position had high sensitivity and low specificity than sitting position for prediction of difficult laryngoscopy (Se 85.1% vs 71.43% Sp % 78.4vs 94.6%) on the other hand for difficult intubation prediction; the sensitivity in both postures was equal and was 80% but the sensitivity much better in MMT sitting than the supine position. (94.62% vs 76.84%) The positive predictive value in both positions was low, on the other hand, the negative predictive value was above 95% it had a good correlation with the test, but still, the highest correlation was seen in the sitting position(16).

After a prospective observational Cohort Study (May 2017), on the performance of the MMT Classification Evaluated in Supine Position for the Prediction of Difficult Tracheal Intubation The MMT performed in the supine position is possibly superior to that performed in the sitting position for predicting difficult intubation. Receiver operating characteristic (ROC) curve were used for discriminative power of the MMT classification in sitting and supine positions to predict difficult tracheal intubation and shows that the area under the ROC curve for the MLPT in a supine position (82%) was greater than that for the MMT in the sitting position (70%.) in general the positive predictive value and the negative predictive value in both positions was comparable whereas when the sitting position takes the superiority on specificity[89% vs 83%), the supine looks better on sensitivity [72%vs 83%](14).

A Bindra et al (march 2010) on the study of the reliability of MMT in the supine position for prediction of difficult intubation concludes MMT in the supine position is a better predictor of difficult intubation for the reason of it explains high positive predictive value of 69% than for sitting MMT 31%.otherwise in this study shows sensitivity, specificity and negative predictive value is higher in MMT in sitting position than supine (Se 23% vs 21%, Sp 98% vs 93%, NPV 84% vs 79%)(2)

According to a prospective observational study conducted (April 2012), Khatiwada S et al stated that sensitivity in both positions was 77% and the percentage of correctly predicted easy intubations as a proportion of all predicted easy intubations was comparable and it is about 97% and 96% in supine and sitting position respectively. Otherwise sitting position shows superiority

in specificity and positive predictive value and the accuracy is about 67%. MMT in supine accuracy is 55%(17).

In the prospective cross-sectional study done in Iran in June 2015, Khan, et al concludes the MMT test in supine had poor results in predicting difficultly in laryngoscopy and intubation and had high false-positive and false-negative outcome. In this study the sensitivity for laryngoscopy and intubation noted in sitting and supine position without phonation is equal and it is about 67.86%.it also works in negative prediction value. But regarding specificity and positive predictive value sitting position puts better impact than supine.(Sp 81.67% vs 72.67%, PPV 14.07% vs 9.90%)(13).

3. Objective of the study

General objective

To assess the performance of Mallampati test in supine and sitting position in prediction of difficult intubation and laryngoscopy among adult who underwent surgery

3.2 Specific objectives

- ✓ To compare the sensitivity, and specificity between MMT test in supine and sitting position
- ✓ To compare the positive and negative predictive value between MMT test in supine and sitting position

4: Methodology

4.1Study area

This study was conducted at TASH, PAULOS HOSPITAL, MINILIK HOSPITAL and ZEWDITU HOSPITAL. These hospitals are among tertiary governmental hospitals found in Addis Ababa, capital city of Ethiopia. These hospitals operation room are composed of multi specialties and able them to perform different and a lot of procedures at a time.

4.2. Study design and period

Hospital based cross-sectional study was conducted from February to April 2021

4.3. Population

4.3.1 Source population

Adult patients who underwent surgery at Addis Ababa governmental hospital from February to April 2021

4.3.2 Study population

Adult patients who underwent surgery under general anesthesia and requires intubation at Addis Ababa governmental hospitals from February to April 2021

4.4 Inclusion and Exclusion criteria

4.4.1 Inclusion

Adult patients who underwent surgery under general anesthesia and requires endotracheal intubation at Addis Ababa governmental hospital from February to April 2021

Exclusion criteria

- Upper airway pathology like mass in the oral cavity, edentulous patients or gap in frontal teeth,
- restricted neck movement and patients unable to sit(cervical spine fracture, prolapsed disc)
- Intubation experience less than 1 year

4.5 Sample size determination

$$n = \frac{(z_{\alpha/2})^2 \cdot pq}{d^2}$$

As this study is new for Ethiopia, I take p value as 0.5.

Where: n= number of sample size.

Z= desired 95% confidence,

Z=1.96.

d = is the margin of sampling error tolerated (5%) So sample size equal to 384 and with 5% contingency equals to 403

4.6 Sampling technique

In respect to surgery case flow the three month situational analysis was done on each hospital. According to the analysis the surgical cases done the consecutive 3 months are 504 in TASH, 380 in St. PAULOS HOSPITAL, 180 in ZEWDITU MEMORIAL HOSPITAL, and 160 in MINILIK HOSPITAL. Finally the sample size was allocated proportionally to all hospitals based on their average three months report.

So during the study period a total of 1224 patients undergo elective surgery. Since the calculated sample size is 403, 1224 divided by 403 is 3.03

Systematic random technique was used during data collection on each Hospital after the first case selected on lottery method and every kth (3rd) patient was chosen for the study during the study period

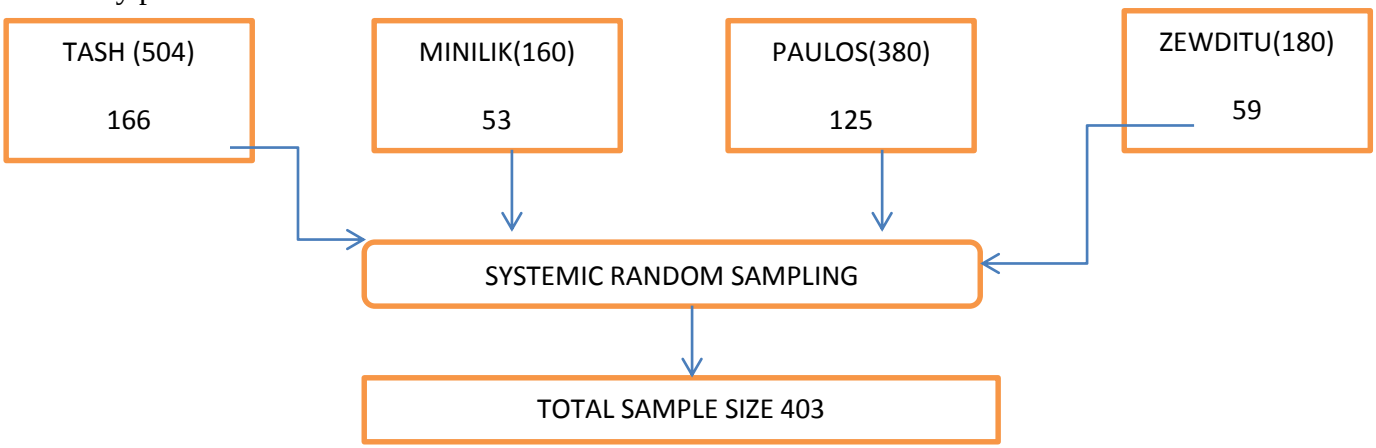

Figure 4.1 sample determination and situational analysis

4.6 Study variables:

4.6.1. Dependent variable:

Cormack and lehans grading and IDS score.

4.6.2. Independent variables

Demographic variable

- ✓ Age
- ✓ Height
- ✓ BMI
- ✓ Weight

MALLAMPATI

- ✓ MMT in sitting position
- ✓ MMT in supine position

4.7 Data collection

4.7.1Data source, Data collection tools, procedure and personnel

Data were collected from selected study participants by using pretested questionnaire with in the period of February to April 2021. During preoperative period, at the day of surgery the demographic data of the patient and the MMT test in sitting position was recorded by the observer. Before induction time the same observer demonstrates MMT test in supine position while the patient turned to supine in OR table.

Mallampati classes I and II was considered as easy or low risk and classes III and IV was considered as difficult or high risk.

At the time of induction and intubation laryngoscopy view (Cormack and Lehans grade) was assessed by using Macintosh blade 3 or 4 by anesthetist**.** Grade III or IV defined as the difficult laryngoscopy whereas Grade I or II defined as easy. Intubation difficulty was also assessed by difficult tracheal intubation score. The score IDS ≥ 5 was considered as difficult whereas IDS < 5 was considered as easy intubation.

4.7.2 Data processing and analysis

Data were coded, edited and then entered and cleaned by using Epi Info version 7 and exported to Statistical package for Social Sciences (SPSS) software version 26.0.The continuous variables (age, weight, height and body mass index) presented as mean ±SD.. Chi square test was used to compare the Mallampati grades in sitting and supine position with C-L laryngoscopy grade and DTI. Kappa agreement analysis was done to sort out better agreement between the two positions A P value of < 0.05 considered statistically significant. Statistical measures including sensitivity, specificity, positive predictive values, negative predictive values and accuracy were calculated for comparing the two positions for predicting difficult or ease of laryngoscopy and intubation. The values presented as number or percentage.

4.7.3 Data quality assurance

To assure the quality of data, training on the objectives and relevance of the study and brief Orientations on the assessment tool was provided for data collector. The questioner was pretested in order to measure its adherence to the stated objective. During data collection, each questioner was revised by the investigator for being complete and proper.

4.8 Operational Definition

MALAMPATII

It relates size of tongue with oral cavity.

Class I Visualization of the soft palate, fauces, uvula, and both anterior and posterior pillars
Class II Visualization of the soft palate, fauces, and uvula
Class III Visualization of the soft palate and the base of the uvula
Class IV The soft palate is not visible at all

Sitting position: the patient sit upright with the head in the neutral position, the mouth opened maximally and the tongue protruded maximally. The observer was opposite to the patient at eye level.

Supine position: The patients turn to supine in OR table. Patient's head was placed on a 10-cm-high pillow, and the observer assesses the airway by looking vertically downward.

CORMACK AND LEHANS GRADING

Grade 1: full exposure of glottis (anterior and posterior commissure)

Grade 2: Anterior commissure not visualized

Grade 3: epiglottis only

Grade 4: no glottis structure visible

IDS(intubation difficult score): has seven variables

N1= the number of supplementary attempts each score 1

N2= the number of supplementary operators each score 1

N3= the number of alternative technique

- Repositioning of the patient score 1
- Change of material (blade, tube, using stylet) score 2
- Change in approach (orotracheal/nasotracheal) score 3
- Use of LMA score 4

N4= glottis exposure defined as cormack grade minus one

N5= lifting force applied during laryngoscopy. 0 for normal and 1 for increased.

N6= necessity of applied external laryngeal pressure. If applied score 1.

N7 = the position of vocal cord during laryngoscopy. Abduction score 0 while adduction score 1

Statistical terminologies

Sensitivity = percentage of correctly predicted difficult intubations as a proportion of all intubations that were truly difficult [= TP/ (TP + FN)].

Specificity = percentage of correctly predicted easy intubations as a proportion of all intubations that were truly easy [= TN/ (TN + FP)].

Positive predictive value (PPV) = percentage of correctly predicted difficult intubations as a proportion of all predicted difficult intubations [= TP/ (TP + FP)].

Negative predictive value (NPV) = percentage of correctly predicted easy intubations as a proportion of all predicted easy intubations [= TN/ (TN + FN)].

4.9 Ethical Considerations

The research held after approval and obtaining of clearance ethical Review Board of Addis Ababa University (AAU), permission and letter of cooperation obtained from department of anesthesia and legal letter submitted selected Hospitals,. Verbal form of consent from the patient

taken and the assessment done accordingly, the confidentiality of participant records and privacy of the health facility were maintained.

4.10. Dissemination and Utilization of Results

The finding of the study was submitted in a form of a thesis to AAU College of Health Science, Department of anesthesia. The result will be publicly defended following submission. Copies will be provided to relevant stakeholders. Efforts will be made to present the results in scientific conferences and to publish in reputable journals.

5. Results

5.1 Socio-demographic characteristics

Among 403 samples 23 of them are not recruited to final analysis as they did not met the inclusion criteria. From the total 380 sample size about 240 (63.2) are females whereas 140 (36.8) are males. Their age, weight, height and BMI distribution are 40± 16yr, 60.3±9.66kg, 1.66±0.66cm and 21.88±3.77kg/cm2 respectively.

Table 5.1. Frequency and percentage of sex, age and BMI

Variable		Frequency	Percent %
Sex	Male	140	63.2
	Female	240	36.8
BMI	Underweight	32	8.4
	Normal	278	73.2
	Overweight	60	15.8
	Obese	10	2.6
Total		380	100%

5.2 Frequency of MMT in supine and sitting position

From all 380 sample, difficult MMT prediction revealed higher in supine position 60(15.8%) when compared relative to sitting position 51(13.4). The improvement of MMT grade seen in supine position in around 55 cases where as worsening to high class observed in 20 cases. The following table shows the percentage of MMT classes on sitting and supine position.

Table 5.2 percentage and frequency of MMT grade sitting and supine position

Variable		Frequency	Percentage
Sitting	Grade I,	225	59.2
	Grade II	104	27.4
	Grade III,	49	12.9
	Grade IV	2	0.5
Supine	Grade I,	170	44.7
	Grade II	146	38.4
	Grade III,	60	15.6
	Grade IV	4	1.1
Total		380	100%

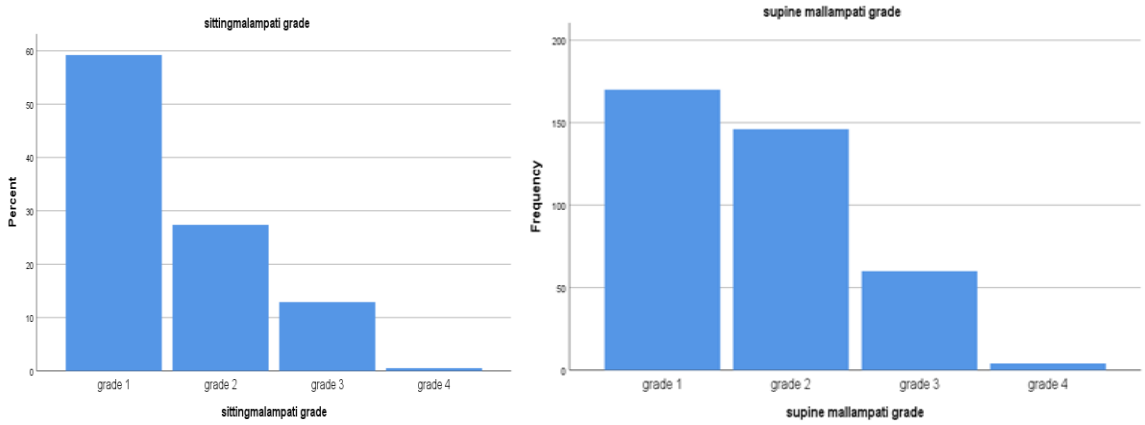

Figure 5.1 frequency presentations for MMT grade in sitting and supine position

The agreement between sitting and supine position for MMT score was done by using kappa analysis and shows substantial agreement. The following table is for the agreement analysis of MMT score between the two positions by considering sitting as a gold standard position for MMT test.

Table 5.3 kappa agreement between MMT in sitting and supine position

Variable		Sitting MMT		K	P value
		Difficult	Easy		
Supine MMT	Difficult	44	20	0.724	< 0.001
	Easy	7	309		

5.3 MMT in supine and sitting position in relation to difficult laryngoscopy and intubation

The diagnostic power of the MMT test in supine and sitting positions in predicting difficult intubation in relation to DTI and C-L grading by comparing statistical parameters presented in this study illustrates the falsely predicted difficult intubation value is higher in a supine position whereas sitting position shows better in detecting easy intubation correctly. The sensitivity and specificity in the supine are comparable to the sitting position and the area in ROC curve analysis shows both positions have a good consistency to sensitivity and 1-specificity which makes them a very good diagnostic tool for the prediction of difficult laryngoscopy and intubation. The following table compares the analysis done for statistical parameters sensitivity, specificity, PPV, NPV, and also ROC curve analysis to the area of the curve between the two positions.

Table 5.4 comparison of sensitivity, specificity, PPV, NPV and also ROC curve analysis to area of curve between MMT the sitting and supine position in relation to C-L grading.

Variables	TP	FP	TN	FN	Sensitivity	Specificity	PPV	NPV	Accuracy	AUC	CI 95%	P Value
MMT in sitting	39	12	316	13	75	96.3	76.5	96	0.93	0.857	0.785-0.928	<0.001
MMT in supine	41	23	305	11	78.8	93.0	64.1	96.5	0.91	0.859	0.792-0.926	<0.001

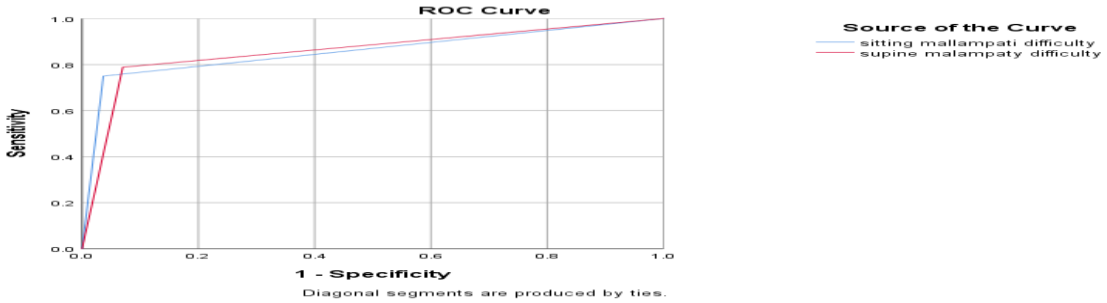

Figure 5.2 ROC curve of Mallampati in sitting and supine position and difficult laryngoscopy

Table 5.5 comparison of sensitivity, specificity, PPV, NPV and also ROC curve analysis to area of curve between MMT the sitting and supine position in relation to IDS.

Variables	TP	FP	TN	FN	Sensitivity	Specificity	PPV	NPV	Accuracy	AUC	CI 95%	P Value
MMT in sitting	27	24	319	10	73	93.0	52.9	97.0	0.91	0.830	0.743-0.916	<0.001
MMT in supine	29	35	308	8	78.4	89.8	45.3	97.5	0.89	0.841	0.761-0.921	<0.001

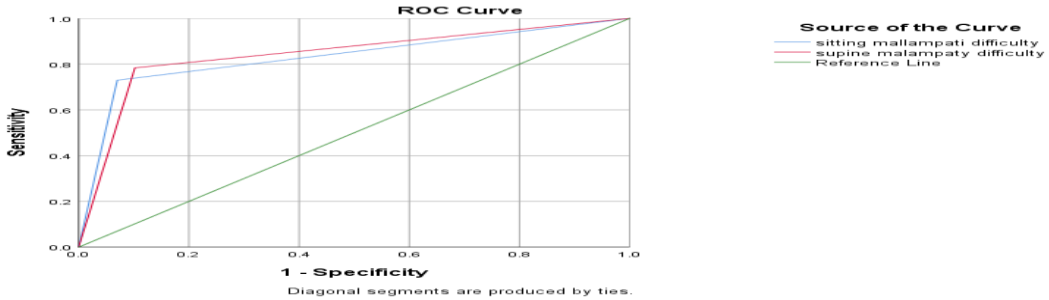

Figure 5.3 ROC curve of Mallampati in sitting and supine position in relation to DTI

6. Discussion

As all airway parameters the major aim of Mallampati assessment is to predict difficult airway accurately because failure to predict both difficult face mask ventilation and difficult tracheal intubation could lead to disastrous clinical situations which may include hypoxic induced brain insult and death. By this study the prediction for difficult intubation and laryngoscopy of Mallampati in sitting and supine were studied

By this study 380 subjects were recruited for analysis; from them, 52(13.7%) difficult laryngoscopy and 37(9.7%) difficult intubation was noticed. On the study done in Gondar University Sleshi et al(4), describes the incidence of difficult laryngoscopy and difficult intubation is about 12.3% and 9% which is consistent with our result. Although the actual finding of difficult intubation and laryngoscopy shows such value; the prediction made by MMT in sitting and supine position shows high and was about 51(13.3%) and 62(16.7%) respectively.

Agreement analysis was done between MMT in sitting and supine positions. They had a kappa value of 0.724 and can be considered as substantial agreement. In the study done in India; Sankal et al (15) describe the kappa agreement between MMT in the supine and sitting position as 0.72 which means they do have a substantial agreement which is highly consistent with our result.

During the MMT test, changing the position from sitting to supine does not only improves but also worsens MMT grade from lower class (grade I and II) to higher class (grade III and VI) in about 55(14%) and 20(6%) cases respectively. A considerable shift of MMT towards the worst class in the supine position compared with the sitting position was also described by Sankal et al (15).

From 52 actual difficult laryngoscopy sitting position detects 39 of them and the sensitivity is about 75% while supine position detects 41 of them and the sensitivity is about 78.8% in contrast supine position have high false-positive it makes this position less specific than sitting position. The specificity between the two positions was 96.3% for sitting and 93% for supine so the sitting position found to be highly specific.

This result is consistent with many works of literature as they describe supine have either comparable or better sensitivity rather sitting have better specificity. Better sensitivity of MMT in a supine position for prediction of difficult laryngoscopy was described by Sankal et al and Awesthi et al(15,16) whereas khan et al and khatiwada et al (13,17) describes both positions have equivalent sensitivity. In contrast, Bindra et al(2) describe sitting have better sensitivity than the supine position. In all literature MMT in the sitting position shows better specificity than the supine position.

This is also true in predicting difficult intubation. Among 37(9.7%) of the total difficult intubation; the sitting position correctly detects 27 of them and the sensitivity was about 73% while the supine position correctly predicts 29 of them and the sensitivity was78.4%. In contrast, the percentage of correctly predicting easy intubation seen in sitting position was about 93%

which can be considered as better when compared with a specificity of 89.8% in the supine position. This shows supine is highly sensitive but less specific than sitting position for prediction of difficult intubation.

This result is highly consistent with the result noted by Sankal et al and Hanouz et al (14,15). The high sensitivity in the sitting position compared to supine was noted by Khan et al while sitting is still better in specificity. This contradiction might be arisen by the method they used to determine whether there is difficult intubation or not. In our study, DTI is determined by IDS to score while khan et al uses >10minute intubation time or > 3 Attempt as difficult intubation.

The positive predictive value seems sided to the sitting position. In sitting position the percentage of correctly predicted difficult intubations as a proportion of all predicted difficult intubations was about 76.5 and 52.9 for difficult laryngoscopy and difficult intubation respectively. This value is decreased in the supine position and was about 64.1 and 45.3 for difficult laryngoscopy and intubation respectively.

Although the negative predictive value of supine shows a slight increment; we can say both had comparable value in the prediction of difficult laryngoscopy and intubation. The NPV of supine was about 96.5 and 97.5 whereas sitting was 96 and 97 for difficult laryngoscopy and intubation respectively.

This shows MMT in the sitting position has high PPV and comparable NPV when compared to MMT in the supine position. This result is highly consistent with the result described by Sankal et al and Khatiwada et al(15,17). The high PPV and NPV in sitting position was noted by khan et al and Bindra et al(2,13)

The accuracy of MMT on prediction of difficult laryngoscopy and intubation was calculated in both positions. In both cases, MMT in sitting position shows superiority supine position. Concerning the prediction of difficult laryngoscopy, sitting has an accuracy of 0.93 whereas supine has an accuracy of 0.91. In relation to difficult intubation, sitting possesses an accuracy of 0.91 while supine has an accuracy of 0.89. This result is highly consistent with the result shown by Sankal et al and Khatiwada S et al(15,17).

The area under ROC curve for predicting difficult laryngoscopy calculated with supine (0.859) was noted greater than sitting MMT (0.857). The superiority also seen in case of prediction of difficult intubation and area under ROC curve calculated in sitting is 0. 830 and in supine is 0. 841. As the result shows; the diagnostic performance of both positions is comparable and makes them very good diagnostic test positions. Hanouz J et al (14) describe the area under ROC curve for predicting DTI calculated with the supine MMT (0.82) was greater than that for the MMT in the sitting position (0.70). These results have consistency with our result as it gives superiority for supine position. In contrast, Awesthi et al(16) show area under ROC 0.830 for sitting and 0.821 for supine in relation to difficult laryngoscopy whereas 0.86 for sitting and 0.74 for supine in relation to difficult laryngoscopy. That means the study gives superiority to sitting MMT so it

contradicts our result conclusion. The result difference may be the result of the age group difference as Awasthi et al did their research on children age from 3- 10 years while ours is adult age above 18 years.

7 strength and Limitation of the study

Strength of the study

As the study is new in our country and done in multicenter; it could give a baseline for further investigation especially for those who are interested to study the effect of positioning and phonation on MMT and its predictive value.

Limitation of the study

- The areas in which the study was conducted were not only medical centers but also they were learning centers. This predisposes the students who were not well experienced to be engaged in the intubation process
- Mallampati test is highly liable to subjectivity

8 Conclusion and recommendation

MMT in supine has high sensitivity and negative predictive value in contrast it has low specificity and PPV compared with sitting position. Even though it have high false positive the overall diagnostic performance of MMT in supine is very good and comparable prediction for difficult with sitting position so we can use it as alternative approach and also we can use safely for those who require emergency intubation and unable to sit.

Reference

1. Articles S. Practice Guidelines for Management of the Difficult Airway. 2013;(2).

2. Bindra A, Prabhakar H. Is the modified Mallampati test performed in supine position a reliable predictor of difficult tracheal intubation ? 2010;482–5.

3. Lenfant F, Ph D, Riou B, Ph D, Manach Y Le, Ph D. Time for a Paradigm Change. 2012;(6):1223–33.

4. Workeneh SA, Gebregzi AH, Denu ZA. Magnitude and Predisposing Factors of Difficult Airway during Induction of General Anaesthesia. 2017;2017.

5. Mallampati SR, Stephen P, Gugino LD, Ph D, Desai SP, Crna BW. A clinical sign to predict difficult tracheal intubation : a prospective study. 1985;429–34.

6. Martin DW, Graham SC, Bohrer E, Leigh JM. 1990;Volume 45, pages 486-502. 1990;45:486–7.

7. Selection S, Assessment Q. Predicting Difficult Intubation in Apparently Normal. 2005;(2):429–37.

8. Adamus M, Fritscherova S, Hrabalek L, Gabrhelik T, Zapletalova J, Janout V. MALLAMPATI TEST AS A PREDICTOR OF LARYNGOSCOPIC VIEW. 2010;154(4):339–44.

9. Tham EJ, Gildersleve CD, Sanders LD, Mapleson WW, Vaughan RS. EFFECTS OF POSTURE , PHONATION AND OBSERVER ON MALLAMPATI CLASSIFICATION. 1992;32–8.

10. Caravelli R, Tyler K. Reports FEASIBILITY OF THE PREOPERATIVE MALLAMPATI AIRWAY ASSESSMENT IN EMERGENCY DEPARTMENT PATIENTS. JEM [Internet]. 2010;38(5):677–80. Available from: http://dx.doi.org/10.1016/j.jemermed.2008.12.019

11. Lee A, Fan LTY, Gin T. A Systematic Review (Meta-Analysis) of the Accuracy of the Mallampati Tests to Predict the Difficult Airway. 2006;1867–78.

12. Lundstrøm LH, Møller AM, Charuluxananan S, Hermite JL. Poor prognostic value of the modified Mallampati score : a. 2011;107(September):659–67.

13. Khan ZH, Eskandari S, Yekaninejad MS. Original Article A comparison of the Mallampati test in supine and upright positions with and without phonation in predicting difficult laryngoscopy and intubation : A prospective study. 2015;31(2):207–12.

14. Hanouz J, Hospitalier C, Caen U De, Bonnet V, Parc P, Hospitalier C, et al. Comparison of the Mallampati Classification in Sitting and Supine Position to Predict Difficult Tracheal Intubation: A Prospective Observational Cohort Study. 2017;(August).

15. Sankal A, Halemani KR, Bhadrinath N. Assessment of the Effect of Supine Posture and Phonation on Modified Mallampati Grading and its Applicability in Prediction of Difficult Airway. 2018;19–24.

16. Awasthi P, Gautam S, Malik A, Singh V, Kohali M, Jafa S, et al. Comparison of Mallampati test in supine and upright positions with and without phonation in predicting difficult laryngoscopy and intubation in age groups 3-10 years. 2018;6(2):61–7.

17. Khatiwada S, Bhattarai B, Pokharel K, Acharya R, Ghimire A, Baral DD. Comparison of modified mallampati test between sitting and supine positions for prediction of difficult intubation. 2012;10(1):12–5.

Annexes

Annex I: Information and Consent Form

Information sheet:

I am going to conduct research on comparison of mallampati in sitting and supine for prediction of difficult intubation. There is no risk to take part in the study, all information is confidential. Their names will not keep in the form. Their participation in the study will be voluntary: They are not obliged to participate and may discontinue at any time. Moreover, this research thesis is approved by Ethical review board of AAU and college of health science, department of Anesthesia.

Consent Form

Hello! Good morning/afternoon? My name is ……. I am here today to ask some few questions and to perform airway examination in different position. The objective is to compare airway assessment in different position for its effectiveness for prediction of DTI. Addis Ababa, Ethiopia, 2020/2021.

Your willingness and genuine response for the questions and examination can make the study achieve its goal. Therefore, you are kindly requested to respond very voluntary with patience. The assessment may take 10 to 15 minutes. We assure you that this study is surely confidential, thus writing your name is not needed. Are you willing to participate in answering the questionnaire?

Yes!

Go to the next page.

Annex II. Questionnaires checklists

Part I: Socio demographic characteristics

S.NO	Question	Possible responses	Remark
101	Patients Age		
102	Sex	A. Male B. Female	
103	Weight		
104	Height		
104	BMI		

Part II: anatomical variables

	Question	Possible response	Remark
201	Mouth opening	A. > /= 3 finger	
		B. < 3 finger	
202	Tyromental distance	A. > 6.0 cm	
		B. < 6.0 cm	
203	Sternomental distance	A. > 12.5 cm	
		B. < 12.5 cm	
204	Jaw sliding scale	A. JSD A	
		B. JSD B	
		C. JSD C	

Part: III MMT class in both positions

	Question	Possible Response	Remark
301	**Sitting position**	**A. Grade 1**	
		B. Grade 2	
		C. Grade 3	
		D. Grade 4	
302	**Supine position**	**A. Grade 1**	
		B. Grade 2	
		C. Grade 3	
		D. Grade 4	

Part V Airway management technique

	Question	Response	Remark
501	**Attempt**	**A. 1 attempt**	
		B. 2 attempts	
		C. ≥3 attempts	

502	**Alternative technique**	**A. Applied** **B. Not applied**
503	**Alternative technique**	➢ **Repositioning of the patient** ➢ **Change of material (blade, tube, using stylet)** ➢ **Change in approach (orotracheal/nasotracheal)** ➢ **Use of LMA**
504	**Experience of 1st operator**	**A. ≤One year** **B. Two year** **C. ≥ three year**
505	**External Laryngeal pressure**	**A. Applied** **B. Not applied**
506	**Cormack and lehans grading**	**A. Grade 1** **B. Grade 2** **C. Grade 3** **D. Grade 4**

507	**Vocal cord mobility**	**A. Abduction** **B. Adduction**
508	**Lifting force applied during laryngoscopy**	**A. Normal** **B. Increased**