Cross-sectional Study

Comparison of Mallampati test in sitting position and in supine position for prediction of difficult tracheal intubation among adult patients who underwent surgery under general anesthesia at Addis Ababa governmental hospitals 2021, comparative cross-sectional study

Zekarias Markos a, Eyayalem Melese b, a, Lemlem Getachew b, Lidya Haddis b

a Department of Anesthesia, College of Medicine and Health Sciences, Wachemo University, Hossana, Ethiopia
b Department of Anesthesia, College of Medicine and Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia

ARTICLE INFO

Keywords:
Mallampati
Sitting
Supine
Difficult intubation
Difficult laryngoscopy

ABSTRACT

Background: The Mallampati test is used to evaluate the airway to predict difficult laryngoscopy and intubation. The sitting position is the standard for this test, but it has limited practical utility due to its low sensitivity and moderate specificity in predicting difficult intubation and laryngoscopy. The supine position, on the other hand, may improve its efficacy.

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

Method: A cross-sectional study was conducted on 403 adult patients who underwent surgery that required endotracheal intubation. The preoperative Mallampati test in sitting and supine positions was compared to the Cormac and Lehan grade and Intubation Difficulty Scale using the chi-square test. The Statistical Package for Social Sciences (SPSS) software version 26.0 was used to analyze the data. A p-value of less than 0.05 was used to determine statistical significance. As statistical measurements, 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 positions show a sensitivity of 78.8%; specificity of 93%; a positive predictive value of 64.1 and a negative predictive value of 96. Whereas sitting shows sensitivity of 75%; specificity of 96.3%; positive predictive value of 76.5 and negative predictive value of 96 concerning difficult laryngoscopy. Related to difficult intubation supine shows a sensitivity of 78.4%; 89.8% specificity; 45.3 positive predictive value and 97.5 negative predictive values, whereas sitting shows 73% sensitivity, 93% specificity, 52.9% positive predictive value and 97% negative predictive value.

Conclusion: and recommendation: For predicting difficult tracheal intubation and laryngoscopy, sitting has a high specificity and positive predictive value, but supine has high sensitivity and negative predictive value. Despite its poor positive predictive value, supine has a comparable prediction for difficult intubation therefore it can be used as an alternative approach.

1. Introduction

Maintaining a patent airway is critical for preventing hypoxic brain injury and death in surgical patients [1–4]. During the preoperative period, various bedside parameters are utilized to determine the ease or difficulty of intubation. MMT score, mouth opening, Thyromental distance, and Sternomental distance are some of the factors that can be considered. By 1985, Sehagiri MMT, an Indian American anesthesiologist, has developed a hypothesis based on the visualization of the uvula and facial pillars cover-up by the base of the tongue and has divided
patients into three classes, with a fourth class being added by Dr. Sam-
soon and Dr. Youngs [5–7].

In our day-to-day clinical practice, the Mallampati test is routinely
performed in the sitting position to predict difficult airways and reduce
the risk of those unanticipated difficult airway consequences. However,
its effectiveness is under dubious and shows limited anticipation of the
difficult airway as it demonstrates many false predictions of an easy and
difficult airway. As per a study conducted at Gondar University, the
Mallampati test, which is performed in a sitting position, does indeed
have a balanced measure of validity in comparison to the Mouth
Opening and Sliding Jaw scale, but its sensitivity and predictive power
for difficult laryngoscopy and intubation are limited [4].

Different articles were written from the perspective of the clinical
efficacy of the Mallampati test by considering sitting as a standard and
routine position for the Mallampati test. Lee conducted a systematic
review and meta-analysis on the accuracy of Mallampati tests in the
prediction of difficult airways, results revealed that the tests are insuf-
ficient to reliably predict the presence or absence of a difficult airway.
Lundstrom concludes that the modified Mallampati score is insufficient
as a stand-alone test of difficult laryngoscopy or tracheal intubation in
another systematic review and meta-analysis.

According to the literature and our clinical experience, Mallampati
conducted in the sitting position is inefficient in predicting difficult
intubation and laryngoscopy, thus switching to the supine position may
be necessary to improve its efficiency. However, a study in this field is
minimal due to its limited applicability. Anesthesiologists are hesitant to
utilize this position for the Mallampati test because they are uncertain.

Several research have been conducted on the Mallampati test in
sitting and supine for better prediction of difficult intubation and
laryngoscopy. The literature on the predictive efficacy of MMT in sitting
and supine positions is inconsistent. Mallampati in the supine position,
according to Bindra et al., has a better prediction of difficult laryngos-
copy and intubation. In most studies, the supine position is found to be
more sensitive than the sitting position. This suggests Mallampati
profited from the supine position since it accurately predicts difficult
airways compared to sitting. In contrast, some research suggests that
supine intubation predicts difficult intubation poorly [2,8–11].

The Mallampati test is routinely performed in the sitting position in
our daily clinical practice to predict difficult airways and reduce the risk
of unanticipated difficult airway consequences. However, its efficacy is
disputed, and it indicates a lack of prudence in anticipating a difficult
airway, as seen by numerous incorrect predictions of an easy and diffi-
cult airway. The Mallampati test, which is performed in a sitting posi-
tion, has a balanced measure of validity when compared to the Mouth
Opening and Sliding Jaw scale, according to a study conducted at
Gondar University, but its sensitivity and predictive power for difficult
laryngoscopy and intubation are limited [4].

2. Methods

It is an institutional-based Case control study conducted at three
public hospitals From October 2020 to June 2021. This study has been
registered with the Research Registration Unique Identifying Number
(UIN):researchregistry8110; https://www.researchregistry.com/registe-
r-

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

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.
3. Sampling technique

A three-month situational analysis was conducted on the surgical case flow of each hospital. According to the data, 504 surgical cases were performed in TASH, 380 in St. Paul’s Hospital, 180 in ZEWIDTU MEMORIAL HOSPITAL, and 160 in MINILIK II HOSPITAL during the course of three months. Finally, a proportional sample size was assigned to each institution based on their average three-month reports.

So, during the study period, a total of 1224 patients underwent elective surgery. Since the calculated sample size is 403, 1224 divided by 403 is 3.03 (see Fig. 1).

After the first case was chosen by the lottery method, a systematic random technique was used to collect data on each hospital, and every third patient was chosen for the study during the study period.

3.1. Data collection technique

Data were collected from selected study participants using a pre-tested questionnaire from February to April 2021. During the preoperative period, on 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 the MMT test in the 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 were considered as difficult or high risk.

The anesthetist classified the laryngoscopy view (Cormack and Lehane’s grade) at the time of induction and intubation using a Macintosh blade 3 or 4. Difficult laryngoscopy is defined as Grade III or IV, whereas an easy laryngoscopy is defined as Grade I or II. The difficult tracheal intubation score has been used to assess intubation difficulty. Intubation with an IDS of 5 was regarded as challenging, but intubation with an IDS of 5 was considered easy.

4. Data quality control

To ensure the quality of the data, the data collectors were given training on the study objectives and relevance, as well as brief instructions on the evaluation technique. The interviewer was pre-tested to see how well it adhered to the stated goal. During data collection, the investigator double-checked each questioner for accuracy and completeness.

4.1. Data analysis and interpretation

Using Epi Info version 7, data were coded, edited, entered, and cleaned before being exported to the Statistical Package for Social Sciences (SPSS) software version 26.0. The continuous variables (age, weight, height, and BMI distribution) are presented as mean ± SD. Mallampati grades in sitting and supine positions were compared with the C-L laryngoscopy grade and DTI. Kappa agreement analysis was done to sort out a better agreement between the two positions. A P value of <0.05 was 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 the difficulty or ease of laryngoscopy and intubation. The values were presented as numbers or percentages.

5. Results

5.1. Socio-demographic characteristics

Among the 403 samples, 23 of them were not recruited for final analysis as they did not meet 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 ± 9.66 kg, 1.66 ± 0.66 cm, and 21.88 ± 3.77kg/cm² respectively (see Table 1).

From all 380 samples, the difficult MMT prediction was revealed to be higher in supine position 60 (15.8%) when compared to sitting position 51 (13.4%) (see Table 2). The improvement of MMT grade was seen in the supine position in around 55 cases, whereas worsening to high class was observed in 20 cases. Table 2 shows the percentage of MMT classes in sitting and supine positions.

Utilizing kappa analysis, the agreement between the sitting and supine postures for the MMT score was determined and found to be substantial. Table 3 displays the MMT score agreement analysis between the two positions, utilizing sitting as the gold standard position for the MMT test.

5.2. MMT in supine and sitting position in relation to difficult laryngoscopy and intubation

By comparing statistical parameters presented in this study, the diagnostic power of the MMT test in predicting difficult intubation in the supine and sitting positions concerning DTI and C-L grading shows that perhaps the falsely predicted difficult intubation value is higher in the supine position, whereas the sitting position shows better incorrectly

Table 1

| 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% |

Fig. 1. sample determination and situational analysis.
detecting easy intubation. The sensitivity and specificity in the supine position are comparable to those in the sitting position, and the area in the ROC curve analysis shows that both positions have good consistency in sensitivity and 1-specificity, making them excellent diagnostic tools for predicting difficult laryngoscopy and intubation. Table 4 compares the sensitivity, specificity, PPV, NPV, and ROC curve analysis (see Table 5).

6. Discussion

As with all airway parameters, the major aim of Mallampati assessment is to predict difficult airways 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. In this study, the Mallampati test prediction for difficult intubation and laryngoscopy in sitting and supine was investigated.

In this study 380 subjects were recruited for analysis; from them, 52 (13.7%) difficult laryngoscopy and 37 (9.7%) difficult intubation were noticed. The study was done at Gondar University Sleshi et al. [4], describes the incidence of difficult laryngoscopy and difficult intubation as 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.

Kappa agreement was tested in both sitting and supine postures for MMT. They had a kappa score of 0.724, which is considered significant agreement. Sankal et al. [13] describe the kappa agreement between MMT in the supine and sitting positions as 0.72, indicating that they have a strong agreement, which is highly compatible with our findings.

All through 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%) of subjects, whereas supine position shows high and was about 51(13.3%) and 62(16.7%) respectively.

Kappa agreement was tested in both sitting and supine postures for MMT. They had a kappa score of 0.724, which is considered significant agreement. Sankal et al. [13] describe the kappa agreement between MMT in the supine and sitting positions as 0.72, indicating that they have a strong agreement, which is highly compatible with our findings.

All through 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%) of subjects, whereas supine position shows high and was about 51(13.3%) and 62(16.7%) respectively. A considerable shift of MMT towards the worst class in the supine position compared with the sitting position was noticed. The study was done at Gondar University Sleshi et al. [4], de Sankal et al. [13] describe the kappa agreement between MMT in sitting and supine position.

Table 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%       |

This study is consistent with a large number of studies, which states that supine has equivalent or better sensitivity than sitting, but sitting has better specificity. Sankal et al. and Avesthi et al. [13,14] found that MMT had better sensitivity in the supine position for predicting difficult laryngoscopy, but Khan et al. and Khatiwada et al. [8,9] found that both positions have comparable sensitivity. Bindra et al. [2], on the other hand, indicate that sitting has better sensitivity than supine. MMT in the sitting position has been shown to have higher specificity than MMT in the supine position in all studies.

The sitting position properly detects 27 of the total difficult intubations with a sensitivity of roughly 73%, whereas the supine position correctly predicts 29 of them with a sensitivity of 78.4%. 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. It shows that supine is highly sensitive but less specific than sitting position for prediction of difficult intubation.

This result is very similar to the findings of Sankal et al. and Hanouz et al. [11,13]. Khan et al. noted that sitting had a higher sensitivity than supine, whereas sitting still has a higher specificity. This discrepancy could be due to the approach they used to identify whether or not there was difficult intubation. In our study, DTI was assessed by IDS, whereas Khan et al. defined difficult intubation as >10 min intubation time or ≥3 attempts.

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 values 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.

When compared to MMT in the supine position, MMT in the sitting position exhibits a higher PPV and a comparable NPV. This finding is very similar to the findings of Sankal et al. and Khatiwada et al. [9,13]. Khan et al. and Bindra et al. both noted the high PPV and NPV in the sitting position [2,8].

The accuracy of MMT in the prediction of difficult laryngoscopy and intubation was calculated in both positions. In both cases, MMT in the sitting position shows superiority to the 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 results shown by Sankal et al. and Khatiwada et al. [5,13].

The area under the ROC curve for predicting difficult laryngoscopy calculated with supine (0.859) was noted greater than sitting MMT (0.857). The superiority is also evident in the prediction of difficult intubation, with an area under the ROC curve of 0.830 in sitting and 0.857 in supine (0.857). The superiority is also evident in the prediction of difficult intubation respectively.

In this study 380 subjects were recruited for analysis; from them, 52 (13.7%) difficult laryngoscopy and 37 (9.7%) difficult intubation were noticed. The study was done at Gondar University Sleshi et al. [4], describes the incidence of difficult laryngoscopy and difficult intubation as 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.

Kappa agreement was tested in both sitting and supine postures for MMT. They had a kappa score of 0.724, which is considered significant agreement. Sankal et al. [13] describe the kappa agreement between MMT in the supine and sitting positions as 0.72, indicating that they have a strong agreement, which is highly compatible with our findings.

All through 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. [13].

Sitting position detects 39 of 52 true difficult laryngoscopies with a sensitivity of around 75%, whereas supine position detects 41 of them with a sensitivity of about 78.8%. However, the supine position has a large false-positive rate, making it less specific than the sitting. The specificity of the two positions was 96.3% for sitting and 93% for supine, indicating that the sitting position was quite particular.

Table 3 Kappa agreement between MMT in sitting and supine position.

| Variable | Sitting MMT | K | P value |
|----------|-------------|---|---------|
| Difficult| 44          | 0.724 | <0.001 |
| Easy     | 7           | 0.309 |         |

Z. Markos et al.

Annals of Medicine and Surgery 82 (2022) 104711

Table 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  |
diagnostic performance, making them excellent diagnostic test positions. Hanouz J et al. [11] describe the area under the ROC curve for predicting DTI calculated with the supine MMT (0.82) as 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, Awasthi et al. [14] 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 is to say, the study recommends sitting MMT, which is in direct opposition to our findings. The age group difference could explain the discrepancy in results, as Awasthi et al. studied children aged 3–10 years, whereas we studied adults aged 18 and older.

7. Limitation of the study

The investigation took place in both medical and educational settings. This makes it more likely for students who haven’t had much experience with intubation to be involved. Mallampati test is highly liable to subjectivity so inter-observer variability is common.

8. Strength of the study

It is multicenter study.

9. Conclusion

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 has high false-positive, the overall diagnostic performance of MMT in supine is a very good and comparable prediction with sitting positions.

10. Recommendation

Supine position can be utilized as an alternative approach, and it’s also safe for those who need emergency intubation but can’t sit.

10.1. Operational definitions

10.1.1. Mallampati test

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 eye level.

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

10.1.2. 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

10.1.3. 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

Ethical approval

Ethical clearance was obtained from the ethical clearance committee of Addis Ababa University, department of anesthesia and permission was obtained from Tikur Anbessa specialized hospital, St. paulos Hospital millennium medical college, Minilik II hospital and Zewditu memorial referral hospitals before the start of the study.

Funding

Addis Ababa University.

Author contribution

1. Zekarias Markos as a team member He developed the proposal, trained the data collectors, analysed the data & wrote the result and interpreted the result.
2. Eyayalem Melese: as a team member He developed the proposal, trained the data collectors, analysed the data & wrote the result and interpreted the result, over all he leads the research team.
3. Lemlem Getachew: as a team member He developed the proposal, trained the data collectors, analysed the data & wrote the result and interpreted the result and corresponding Author.
4. Lidya Haddis as a team developed the proposal, trained the data collectors, analysed the data, wrote the result, and Interpreted the result.

Declaration of competing interest

Nothing to declare.

Trail registry number

Name of the registry: Research Registration.
Unique Identifying number or registration ID: researchregistry8110; https://www.researchregistry.com/register-now#user-researchregistry;/:~:text= researchregistry7534.

Guarantor

I will take the responsibility for the work. I’m the member in conduct of the study and I have access to the data, and I controlled the decision to publish.

Table 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  |
Mr EYAYALEM MELESE GOSHU. 
Senior Anaesthetist, Assistant Professor, Department of Anesthesia, 
School of Medicine. 
College Of Health Sciences, Addis Ababa University Email: eyayalem.melese@aau.edu.et/eyayalem@yahoo.com: Tele. +251913002201.

Consent for publications

Not applicable.

Availability of data and materials

Data and materials will be shared upon reasonable request.

Acknowledgement

The authors would like to express our heartfelt gratitude to Tikur Anbessa Specialized Hospital, St Paulos hospital, Menelik II hospital and Zewditu hospitals staffs and Addis Ababa University for providing us the fund, ethical clearance, internet and Library service.

Abbreviation

AAU Addis Ababa University 
AUC Area under curve 
C-L GRADING Cormack and Lehans grading 
DTI Difficult tracheal intubation 
IDS Intubation difficulty score 
MMT Mallampati test 
OR operation room 
PPV positive predictive value 
NPV negative predictive value 
ROC curve receiver operating curve

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2022.104711.

References

[1] S. Articles, Practice Guidelines for Management of the Difficult Airway, 2013, 2.
[2] A. Bisdra, H. Prabhakar, Is the Modified Mallampati Test Performed in Supine Position a Reliable Predictor of Difficult Tracheal Intubation ?, 7, 2010, pp. 482-485.
[3] F. Lenfant, B. Riou, Y Le Manach, Time for a Paradigm Change (6) (2012) 1223–1233.
[4] S.A. Workneh, A.H. Gebregzi, Z.A. Dena, Magnitude and Predisposing Factors of Difficult Airway during Induction of General Anaesthesia, vol. 2017, 2017.
[5] S.R. Mallampati, P. Stephen, L.D. Gugino, S.P. Desai, B.W. Crna, A Clinical Sign to Predict Difficult Tracheal Intubation : a Prospective Study, 1985, pp. 429–434.
[6] S. Selection, Q. Assessment, Predicting Difficult Intubation in Apparently Normal (2) (2005) 429–437.
[7] Martin DW, Graham SC, Bohrer E, Leigh JM. 1990;Volume 45, pages 486-502. 1990;45:486–7.
[8] Z.H. Khan, S. Eskandari, M.S. Yekaninejad, 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 31 (2) (2015) 207–212.
[9] S. Khatiwada, B. Bhattarai, K. Pokharel, R. Acharya, A. Ghimire, D.D. Baral, in: Comparison of Modified Mallampati Test between Sitting and Supine Positions for Prediction of Difficult Intubation, vol. 10, 2012, pp. 12–15, 1.
[10] E.J. Tham, C.D. Gildersleve, L.D. Sanders, W.W. Mapleson, R.S. Vaughan, EFFECTS OF POSTURE : PHONATION AND OBSERVER ON MALLAMPATI CLASSIFICATION, vol. 32–8, 1992.
[11] J. Hanouz, C. Hospitalier, U De Caen, V. Bonnet, P. Parc, C. Hospitalier, et al., Comparison of the Mallampati Classification in Sitting and Supine Position to Predict Difficult Tracheal Intubation: A Prospective Observational Cohort Study, 2017;August.
[12] G. Mathew, R. Agha, for the STROCSS Group, STROCSS 2021: strengthening the Reporting of cohort, cross-sectional and case-control studies in Surgery, International Journal of Surgery 96 (2021), 106165.
[13] A. Sankal, K.R. Halemani, N. Bhadrinath, Assessment of the Effect of Supine Posture and Phonation on Modified Mallampati Grading and its Applicability in Prediction of Difficult Airway, 2018, pp. 19–24.
[14] P. Awasthi, S. Gautam, A. Malik, V. Singh, M. Kohali, S. Jafa, et al., in: 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, vol. 6, 2018, pp. 61-67, 2.