

Accuracy of Modified Mallampati Test over Other Parameters for Preoperative Prediction of Difficult Endotracheal Intubation

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To cite this article:

Venkateshamurthy Banavara Champa, Venkappa Yashoda, Nagarajaroo Karnalli Gurudutta. Accuracy of Modified Mallampati Test over Other Parameters for Preoperative Prediction of Difficult Endotracheal Intubation. *International Journal of Anesthesia and Clinical Medicine*. Special Issue: *Anesthesia for Laparoscopic Surgery*. Vol. 8, No. 1, 2019, pp. 1-5. doi: 10.11648/j.ijacm.20200801.11

Received: August 19, 2019; **Accepted:** November 12, 2019; **Published:** February 19, 2020

Abstract: Difficult airway remains a potential problem for practicing anaesthesiologists. Modified mallampati test alone has low sensitivity and specificity. Preoperative assessment of the airway using a combination of simple tests will increase the sensitivity and specificity of prediction of difficult airway than using a single parameter alone. This study was done to compare the sensitivity, specificity and accuracy for preoperative prediction of difficult endotracheal intubation in adults undergoing elective surgeries using combination of Modified Mallampati test [MMT], Sternomental distance [SMD], Thyromental distance [TMD] and Neck mobility [NM] over MMT alone and to assess whether MMT alone or in combination with TMD, SMD and NM is a better predictor of difficult laryngoscopy. This is a prospective observational study. 100 patients undergoing elective surgeries under general anaesthesia were enrolled into two groups. Group 1 was the MMT group and Group 2 was the MMT, TMD, SMD & NM Group. Results were analysed using SPSS software Version 12 and STATA used for analysing the sensitivity, specificity, PPV, NPV and accuracy in each group. P value calculated using Chi Square test. Group 1 had lower sensitivity, specificity, PPV, NPV as well as Accuracy when compared with that of Group 2. The combination of the parameters yielded a greater accuracy in predicting the difficult intubation stressing the importance of assessing the evaluation of other parameters like TMD, SMD & NM along with MMD for successful prediction of a difficult endotracheal intubation. In conclusion the MMT alone in preoperative assessment of difficult laryngoscopy is less sensitive. The combination of MMT, TMD, SMD & NM is more sensitive as well as specific to predict a difficult intubation than using MMT alone in the pre-operative period.

Keywords: Cormack Lehane (C-L) Grading, Difficult Intubation, Modified Mallampatitest (MMT), Neck Mobility (NM), Sternomental Distance (SMD), Thyromental Distance (TMD)

1. Introduction

An important responsibility of an anaesthesiologist is to maintain a patent airway in anaesthetized patients. Failure to secure the airway and interruption of gas exchange, for even a few minutes, can result in catastrophic outcome such as brain damage or even death. [1]

Unanticipated difficult intubation is not only a threat to patient's life, but often evaluates the skill of an experienced anaesthesiologist. Even though the reported incidence of unanticipated difficult intubation in anaesthesia is rare, it

often leads to disastrous respiratory complications. [2] Thus, to predict a possible difficult airway on time is of utmost importance.

Difficult airway remains a potential problem for practising anaesthesiologists. Various tests are performed to evaluate airway. But none of the available indices are able to predict all difficult intubation. [3] Modified Mallampati test is widely used for preoperative prediction of difficult intubation. When used as a single examination, the Modified Mallampati test is of limited value in predicting difficult intubation because of the low sensitivity and specificity. [4]

Other frequently used parameters include Thyromental distance, Sternomental distance and Neck mobility. Literature has shown uses of different preoperative measurement parameters in predicting difficult intubation. However, limited information is available on effect of combining these parameters in enhancing the validity of parameters. Hence, this study was designed in an attempt to determine the accuracy of combination of parameters like TMD, SMD, NM along with MMT than MMT alone in the preoperative period for predicting difficult intubation in patients undergoing elective surgeries under GA.

2. Objectives

To compare the sensitivity, specificity and accuracy for preoperative prediction of difficult endotracheal intubation in adults undergoing elective surgeries using combination of Modified Mallampati test, Sternomental distance, Thyromental distance and Neck mobility over Modified Mallampati test alone.

To assess whether MMT alone or in combination with TMD, SMD and NM is a better predictor of difficult laryngoscopy.

3. Material and Methods

After obtaining the Institutional Ethics Committee approval, this prospective observational study was designed on 100 patients undergoing elective surgeries under GA at Shivamogga Institute of Medical Sciences, Shivamogga in the period between June 2017 and June 2018. Informed written consent was obtained from all the patients. Patients in the age group 18-70 years of ASA status 1 & 2 were enrolled in the study. Apparent malformations of the airway, Swellings, scars and contractures in front of the neck, patients with intra oral growth, patients unable to communicate, Cervical spine pathologies and BMI >40 were excluded from the study. All the patients were assessed preoperatively using MMT, TMD, SMD and Neck mobility by one investigator. Alternate patients were enrolled into two groups. Group 1 was the MMT group. Group 2 was the group with combined parameters of MMT, TMD, SMD, and NM. These findings were correlated with the laryngoscopic view of the glottis under GA, using Cormack and Lehane classification, performed by another experienced (more than 5 years) anaesthesiologist not involved in the preoperative assessment.

The parameters assessed were as follows

Modified Mallampati Classification (MMT) [5]

Class I: Faucial pillars, uvula, and soft palate are visualized.

Class II: Base of the uvula and soft palate are visualized.

Class III: Soft palate only is visualized.

Class IV: Hard palate only is visualized.

MMT class 1 & 2 was considered as easy airway and MMT class 3 & 4 was considered as difficult airway.

Thyromental distance was measured from the tip of the mentum to the thyroid notch with the head extended and

mouth closed. Distance < 6.5 cm was considered as difficult airway. [6]

Sternomental distance was measured from the sternal notch to the tip of mentum with the head extended. Distance < 12.5 cm was considered as difficult airway. [7]

The Neck mobility was assessed visually with the patient in facing directly to the examiner with his head erect, then he was asked to extend the head maximally and the examiner estimates the angle traversed by the occlusal surface of upper teeth. [8]

Cormack and Lehane Grading: [9]

Grade 1- Visualization of the entire laryngeal aperture;

Grade 2 - Visualization of only the posterior portion of the laryngeal aperture

Grade 3 - Visualization of only the epiglottis

Grade 4 - No visualization of the epiglottis or larynx

Grade 1 & 2 was considered as easy intubation and Grade 3 & 4 was considered as difficult intubation

Preoperatively an investigator visited the patients on the day prior to the surgery and performed a standard preoperative airway and clinical assessment and documented the findings using pretested data collection form and obtained the informed and written consent. Detailed airway assessment was done using the following parameters for prediction of difficult airway. All the parameters were assessed with the patient in sitting position.

On the day of surgery, Standard general anaesthesia [GA] was administered to the patients under standard monitoring consisting of ECG, non-invasive blood pressure, SpO₂ and ETCO₂. Intravenous access was secured with 20 G cannula and crystalloid infusion started slowly. After premedication with In j. Glycopyrrolate 0.2mg, In j. Midazolam 1mg and In j. Pentazocine 0.4-0.5 mg/kg IV was administered. Anaesthesia induced with In j. Propofol 2mg/kg IV and after confirming bag mask ventilation, In j. Vecuronium 0.1mg/kg IV administered. Later ventilated with oxygen for 4 minutes allowing for complete skeletal muscle relaxation. The Intubation was attempted by another investigator with at least 5 years of experience in anaesthesiology not involved in preoperative assessment of airway of the patient, using either No. 3 or No. 4 Magill blade and intubation was done with appropriate size endotracheal tube. [10] Difficult airway cart was kept ready and consisted of McCoy blades, stylet, bougie, LMA and cricothyrotomy sets. External laryngeal pressure was used when required. Details of the manoeuvres used were documented. He/She then documented the level of difficulty by grading the patient using Cormack and Lehane grading.

All the patients were monitored throughout the surgery and successfully reversed and extubated.

3.1. Method of Data Collection

The study population were evaluated in two groups. Alternate patients were enrolled in two groups.

Group 1: Modified Mallampati scale

Group 2: Combination of Modified Mallampati scale, Sternomental distance, Thyromental distance and Neck mobility

The preoperative assessment data and the intubation findings were used to determine the accuracy of the above mentioned tests in predicting difficult intubation. Data was analysed using SPSS software version 12. Sensitivity, specificity, positive and negative predictive values and accuracy were calculated for both groups using STATA. P value determined using Chi Square test. P value <0.05 was considered statistically significant.

3.2. Statistical Terms

True positive was a difficult intubation that had been predicted to be difficult.

False positive was an easy intubation that had been predicted to be difficult.

True negative was an easy intubation that had been predicted to be easy.

False negative was a difficult intubation that had been predicted to be easy.

Sensitivity is the percentage of correctly predicted difficult intubation, as a proportion of all intubation. That were truly difficult, i.e., true positives/ (true positives + false negatives).

Specificity is the percentage of correctly predicted easy intubation, as a proportion of all intubation. That were truly

easy, i.e., true negatives/ (true negatives + false Positives).

Positive predictive value is the percentage of correctly predicted difficult intubation, as a proportion of all predicted difficult intubation., i.e., true positives/ (true positives + false positives).

Negative predictive value is the percentage of correctly predicted easy intubation, as a proportion of all predicted easy intubation., i.e., true negatives/ (true negatives +false negatives).

Accuracy is the percentage of correctly predicted easy or difficult intubation, as a proportion of all intubation., i.e., (true positives + true negatives)/ (true positives+ true negatives+ false positives+ false negatives).

Sample size calculated for sensitivity and specificity of two models by considering 5% Alpha level and 80% power. Sample size calculated using software "R".

$$Z = 1.28, p = 0.5, c = 0.05, P = 250$$

$$S = Z^2 * p * (1-p) / c^2 = 163$$

New sample size for P = 250 is N = S / 1+ (1-S)/P

$$N = 163 / 163 + 162/250 = 98.90 = 99 \text{ rounded off to } 100$$

Therefore n1 = 50 and n2 = 50

4. Results

Table 1. Statistical data of Group 1.

MMT			C-L grade		Total
			1&2	3&4	
Group 1	1&2	Frequency	30	8	38
	Easy	%	85.7%	53.3%	76.0%
	3&4	Frequency	5	7	12
	Difficult	%	14.3%	46.7%	24.0%
Total		Frequency	35	15	50
		%	100.0%	100.0%	100.0%

Table 2. Statistical data of Group 2.

MMT, TMD, SMD & NM			C-L Grade		Total
			1&2	3&4	
Group 2	Easy	Frequency	31	4	35
		%	91.2%	25.0%	70.0%
	Difficult	Frequency	3	12	15
		%	8.8%	75.0%	30.0%
Total		Frequency	34	16	50
		%	100.0%	100.0%	100.0%

Table 3. Comparison of the p-value of the results between two groups.

Satistics	Group	Value	95% CI	p-value
Sensitivity	Group 1	46.67%	21.27% to 73.41%	0.11
	Group 2	75.00%	47.62% to 92.73%	
Specificity	Group 1	85.71%	69.74% to 95.19%	0.71
	Group 2	91.18%	76.32% to 98.14%	
Positive Predictive Value (PPV)	Group 1	58.33%	34.55% to 78.78%	0.398
	Group 2	80.00%	56.69% to 92.44%	
Negative Predictive Value (NPV)	Group 1	78.95%	69.62% to 85.99%	0.27
	Group 2	88.57%	76.72% to 94.80%	
Accuracy	Group 1	74.00%	59.66% to 85.37%	0.13
	Group 2	86.00%	73.26% to 94.18%	

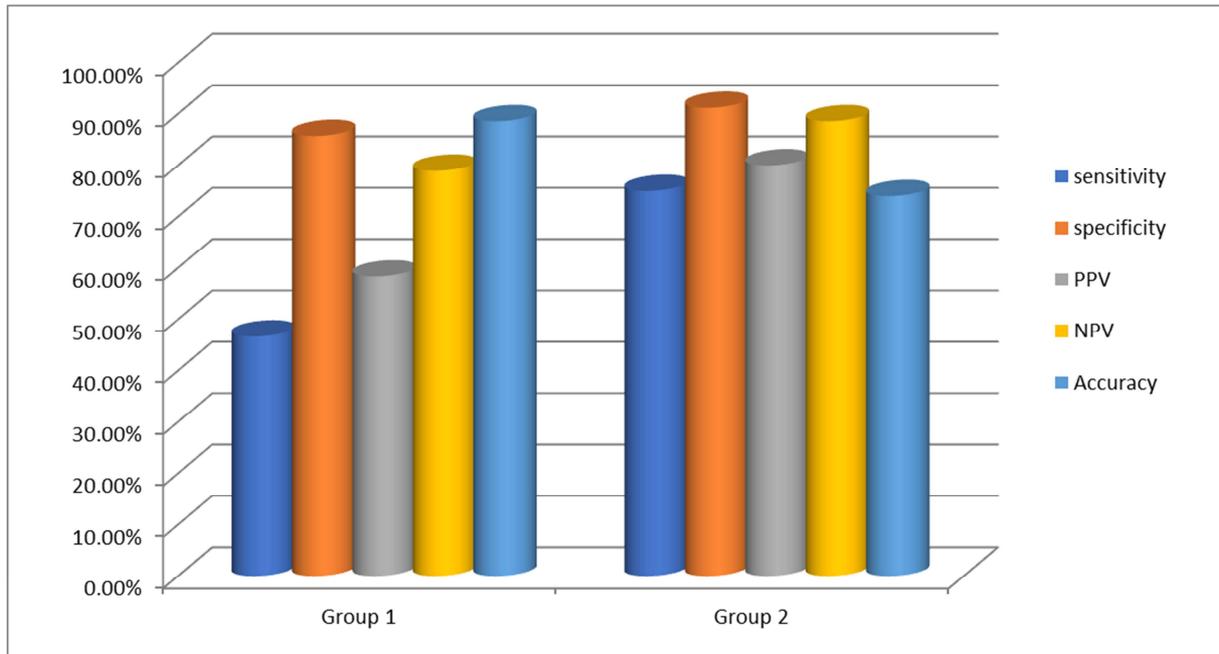


Figure 1. Comparison of the results between the two groups.

Group 1 had sensitivity of 46.67% but increased to 75% in group 2. The specificity increased from 81.71% in group 1 to 91.18% in group 2 in predicting the difficult airway with the combination of MMT with TMD, SMD & NM. The PPV increased to 80.00% in group 2 compared to 58.33% in group 1 and the NPV had remarkable variation from 78.95% in group 1 to 88.57% in group 2. The accuracy increased by 12% i.e 74% in group 1 to 86% in group 2, thus stressing the importance of assessing the evaluation of other parameters like TMD, SMD & NM along with MMD for successful prediction of a difficult endotracheal intubation, thereby avoiding the dreaded unanticipated airway challenge to any anaesthesiologist.

5. Discussion

Unanticipated difficult endotracheal intubation is a dreaded challenge any anaesthesiologist can face with. The American Society of Anaesthesiologists define difficult airway as the clinical situation in which a conventionally trained anaesthesiologist experiences difficulty facemask ventilation of the upper airway, difficulty with tracheal intubation, or both. [11]

Many bedside simple evaluation of the airway for preoperative assessment are available with the Modified Mallampati score [12, 13] being the most commonly and widely used. The other available yet less commonly used bedside and simple tests are Thyromental distance, Sternomental distance, Neck mobility, ULBT, BMI, neck circumference and many more but none have been proved as the gold standard in predicting the accuracy of a difficult airway. Preoperative assessment of the airway using a combination of simple tests will increase the sensitivity and specificity of prediction of difficult airway than using a

single parameter alone. [14]

Wajekar et al. [15] conducted a study on prediction of ease of laryngoscopy and intubation using Upper Lip Bite Test, Modified Mallampati Classification, and Thyromental Distance in Various Combination. They concluded that all three screening tests for difficult intubation have only poor to moderate discriminative power when used alone. Combinations of individual tests add some incremental diagnostic value.

Honarmand et al. [16] conducted a study on comparison of five methods in predicting difficult laryngoscopy using neck circumference (NC), neck circumference to thyromental distance ratio (NC/TMD), the ratio of height to thyromental distance (RHTMD), upper lip bite test (ULBT) and Mallampati test (MMT). They concluded that RHTMD and ULBT as simple preoperative bedside tests have a higher level of accuracy compared to NC/TMD, TMD, NC, MMT in predicting a difficult airway. [5] In an another study conducted by same author in 2014 comparing between hyomental distance ratios (HMDR), ratio of height to thyromental (RHTMD), modified Mallampati classification test (MMT) and upper lip bite test (ULBT) in predicting difficult laryngoscopy of patients undergoing general anesthesia, they concluded that the HMDR is comparable with RHTMD and ULBT for prediction of difficult laryngoscopy in the general population, but was significantly more than for MMT. [16]

Ambesh et al. [17] conducted a study on combination of the Modified Mallampati score, Thyromental distance, Anatomical abnormality, and Cervical mobility (M-TAC) predicts difficult laryngoscopy better than Mallampati classification. They concluded that the M-TAC scoring system has provided a higher sensitivity and specificity in predicting difficult laryngoscopy in comparison with

Mallampati classification.

Milan Adamus et al. [18] conducted a study on Mallampati test as a predictor of laryngoscopic view. They concluded that when used as a single examination, the Modified Mallampati test is of limited value in predicting difficult intubation.

In our study, MMT alone as a predictor of difficult airway has low sensitivity. There is remarkable increase in the sensitivity from 46.7% to 75%. The combination of parameters in airway assessment also has yielded a better specificity from 85.71% in group 1 to 91.18% in group 2. Hence the probability of anticipating a difficult intubation is more with the use of multi parameters like MMT, TMD, SMD and NM.

The increase in the PPV and NPV in group 2 suggests that the combination of the various parameters used in the study is a better predictor to rule out a difficult intubation.

The accuracy of the combination of above mentioned parameters for predicting a difficult airway has increased by 12% as compared with that of MMT alone (74% in group 1 vs 86% in group 2).

Studies that assess the sensitivity, specificity, predictive values for a diagnostic prediction show a variable result usually because of the different criteria used by different investigators.

The present study has limitations like exclusion of difficult airways, obese patients and also presence of inter subject variability. The study population may be less and a larger sample size could result in more accurate prediction of accuracy of the prediction of difficult intubation.

6. Conclusion

The MMT alone in pre operative assessment of difficult laryngoscopy is less sensitive. The combination of MMT, TMD, SMD and NM is more sensitive as well as specific to predict a difficult intubation than using MMT alone in the pre operative period. The accuracy too is increased with the combination of the above mentioned parameters. Though not statistically significant, we conclude to practice a routine assessment of airway using the combination of the above parameters for the proper assessment of airway thereby avoiding unanticipated difficult airway.

In summary, we conclude that using simple bedside evaluation tests like TMD, SMD & NM along with the routinely used MMT could more accurately predict the difficult endotracheal intubation.

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