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Original research article

Comparison of Validity of Mallampati Test and Lower Jaw Protrusion Maneuver in Predicting Difficult Laryngoscopy and Intubation

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Abstract

Background: Unanticipated difficult laryngoscopy and tracheal intubation is a main concern for the anesthesiologist. Failure to maintain a patent airway after the induction of general anesthesia is the most common cause of anesthesia-related morbidity and mortality. The morbidity associated with difficult intubation can be reduced if a difficult airway is anticipated preoperatively. There are many bedside tests to predict difficult airway.

Aim and Objective: The main aim and objective of this study was to compare the sensitivity and specificity of the Mallampati technique with the lower jaw protrusion maneuver in predicting difficult laryngoscopy and tracheal intubation using the Cormack-Lehane grading of intubation as the gold standard.

Methods: A total of 275 patients undergoing thyroidectomy at MCH, Thiruvananthapuram, were selected as the study population. The airway was assessed by the Modified Mallampati Classification (MMC); classes III and IV were considered as predictors of difficult intubation. Lower Jaw Protrusion Maneuver Grades B and C were considered predictors of difficult intubation. A senior anesthesiologist with 5 years of experience assessed the laryngeal view by direct laryngoscopy using Cormack and Lehane grading. Grades 3 and 4 were considered difficult for laryngoscopy and intubation. The validity parameters, such as sensitivity, specificity, false positive and negative values, positive predictive value (PPV), and negative predictive value (NPV), were calculated.

Results and Discussion: MMC: Sensitivity 63.6%, Specificity 98.4%, PPV 77.8%, NPV 96.9%, Accuracy 95.6% LJP: Sensitivity 72.7%, Specificity 98.4%, PPV 80%, NPV 97.6%, Accuracy 96.4%

Conclusion: The lower jaw protrusion test has a higher level of accuracy, sensitivity, positive predictive value, and negative predictive value compared to the Mallampati test. Lower jaw protrusion appears to be a better choice for preoperative airway evaluation. So the LJP test can be added to routine preoperative evaluation of the airway, but it has the limitation that it cannot be performed in some patients, like the edentulous patients and patients with a low intellectual coefficient.

Key Words: Cormack Lehane grading, Lower Jaw Protrusion Test, Modified Mallampati Classification.

Introduction

Unanticipated difficult laryngoscopy and tracheal intubation remains a main concern for the anesthesiologist, as the failure to maintain a patent airway after the induction of general anesthesia is the most common cause of anesthesia-related morbidity and mortality [(1)]. Difficult laryngoscopy and tracheal intubation can lead to many complications like soft tissue damage [(2, 3)],bronchial intubation, ,laryngospasm, bronchospasm, the inability to ventilate or intubate, hypoxic brain injury, and even death [(1, 4,5)].Difficult intubation is reported in 1.5-13% of elective surgery patients [(6)].

Majority of airway disasters occurred when airway difficulty was not recognised. The risks and complications associated with difficult intubation can be reduced if a difficult airway is anticipated before surgery. Therefore, airway assessment is important during preanesthetic evaluation, as it helps in recognising a potentially difficult airway. So combinations of different tests and scores are developed to predict patients in whom laryngoscopy and intubation might be difficult, but none of them have proven to be totally reliable [(5, 7, 8)].

As difficult intubation is defined in a number of ways, visualization obtained during laryngoscopy remains the mainstay of definition (9). Cormack and Lehane classified the laryngoscopic view into different grades, and they are widely used to label the difficulty of tracheal intubation [(10, 11)].

Modified Mallampati testing is the most widely used bedside screening test for the assessment and prediction of difficult airway. Other bedside screening tests include the lower jaw protrusion test, neck movements, interincisor gap, etc..

Lower Jaw Protrusion Maneuver is a well-known simple bedside maneuvre that has been used in a number of studies to predict difficult airway. It has a simple grading system in which patients were divided depending on the extent to which they can translate their thyromental joint to approximate their superior and inferior incisors [(12,13,14).] Since the importance of jaw thrust during laryngoscopy was described 100 years ago, there have been a lot of studies published in the last decade recommending the addition of the lower jaw protrusion maneuver in the routine assessment of the airway.

Materials and method

The aim of the study was to compare the sensitivity and specificity of the Mallampati technique with the lower jaw protrusion maneuver in predicting difficult laryngoscopy and tracheal intubation using the Cormack-Lehane criteria for intubation as the gold standard in patients undergoing elective surgery under general anesthesia. After receiving Institutional Ethics committee approval, 275 patients scheduled for surgery under general anesthesia in the Department of Anesthesia, Government Medical College, Thiruvananthapuram, who provided informed and written consent, were the source of data. Results were recorded using a preset proforma. It was a diagnostic test evaluation—a cross-sectional study.

This study was done on ASA PS I, II, and III patients of either gender who were willing to take part and were having elective surgery under GA. The patients had to be at least 18 years old and meet the criteria for inclusion and exclusion. The study lasted two years.

Inclusion criteria

- ASA PS I, II, and III patients
- Patients over the age of 18.

- Patients who gave their informed written consent.

Exclusion criteria

- Bed bound
- Edentulous
- Having oral pathology
- Obesity [body mass index (BMI) > 28 kg/m2]
- Glasgow Coma Scale (GCS) 14 or below
- Those undergoing obstetric or emergency procedures
- Patient who refused consent

Sample size calculation

N = Z α/2 [Sp] 2 /[{sensitivity+specificity}-1]d 2
Standard deviation in the parent study:
Z = 5% significance level
d = 20% mean
N=3.84[7.57] 2 /[{27.06+95.76}-1][21.08x.2] 2 =55
20% intubation difficulty
Sample size: 55x100/20 = 275
The sample size was calculated using the information obtained from the previous study. [8]

Study procedure

After obtaining informed written consent, 275 patients satisfying inclusion criteria were included in the study. This study was conducted in the preoperative waiting area and operating rooms of a tertiary care hospital. Patients' airway was assessed by the principal investigator at the pre-operative waiting area. Cormack and Lehane's criteria of laryngoscopy is taken as gold standard and Mallampati technique and Lower jaw protrusion maneuvers as study methods.

The MT was performed with the patient sitting in a neutral position, mouth wide open, tongue protruding to its maximum, and the patient not phonating. Classification is assigned to one of the four grades. Out of the four grades of modified MT, grades I and II were considered predictors of "easy" laryngoscopy and intubation, while grades III and IV were considered predictors of "difficult" laryngoscopy and tracheal intubation.

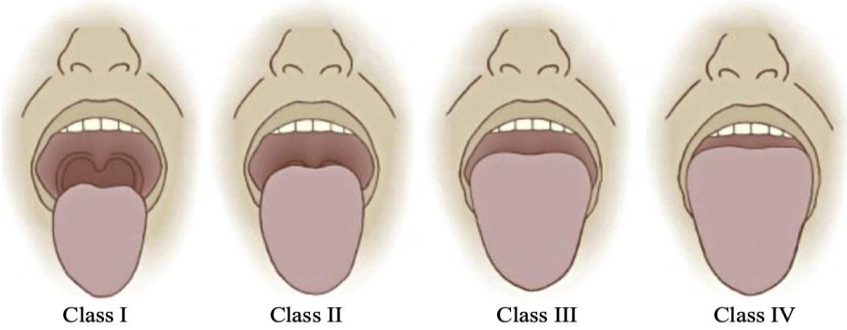

Figure 1: Modified Mallampati classification.

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
The LJP maneuvre was performed by asking the patient to protrude his or her lower jaw as much as possible beyond the upper jaw. Patient was then assigned to one of the three grades of mandibular protrusion. LJP grade A was considered a predictor of "easy" laryngoscopy and tracheal intubation, while grades B and C were considered predictors of "difficult" laryngoscopy and tracheal intubation. Figure 2.

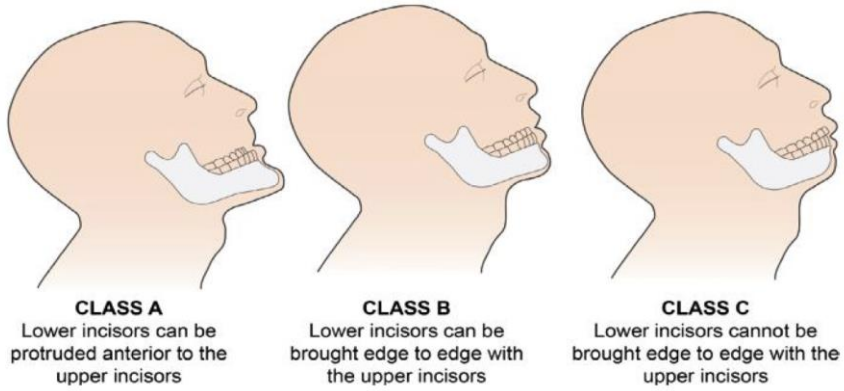

Fig 2: Lower jaw protrusion maneuver

Cormack and Lehane's classification of difficult intubation was also classified as "easy" (grades I and II) or "difficult" (grades III and IV). Figure 3

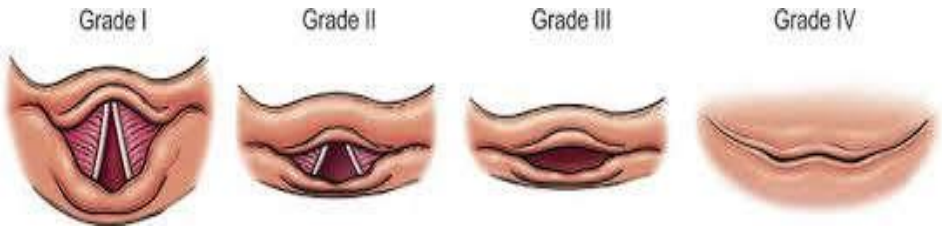

Fig 3: Cormack Lehane scoring system

GRADE1 - Most of the glottis is visible
GRADE2 - Only posterior part of the glottis is visible
GRADE3a - Only epiglottis is visible, can lift up the epiglottis
GRADE3b - Epiglottis is seen, cannot lift up the epiglottis
GRADE4 - Not even epiglottis is seen

All this information was recorded in a prescribed proforma. Other patient data, including age, sex, weight, height, BMI, ASA status, and surgical speciality, were recorded.

Patient was then shifted to operating room and routine monitors [Electrocardiography (ECG), Non Invasive Blood Pressure (NIBP), Pulse Oximetry (SpO2)] applied. After obtaining baseline readings, an intravenous access was maintained. Premedication with midazolam 1 mg, metoclopramide 10 mg, ,glycopyrrolate 0.2 mg, ,fentanyl 1-2 micrograms per kg is followed by preoxygenation for 3 minutes. After thiopentone sodium (5-6 mg/kg), lignocaine 1.5 mg/kg, and xylo 1.5 mg/kg were administered, and adequate ventilation and sedation were confirmed, vecuronium (0.1 mg/kg) was administered. For 3 minutes, ventilation was aided. Anaesthesia was maintained with 50% nitrous oxide, oxygen, and isoflurane(0.5-1%). Mcintosh blade size 3 or 4 is used for intubation by a senior anaesthesiologist with atleast 5 years of experience, and the laryngeal view was assessed using Cormack and Lehane grading. The patient was intubated with an appropriately sized

cuffed oral endotracheal tube, which was secured after confirming bilateral equal air entry and anaesthesia was maintained.

Statistical analysis

Data analyzed using computer software, Statistical Package for Social Sciences (SPSS) version 16. Sensitivity, specificity, PPV, NPV and accuracy of each tests are calculated and compared. Data presented as Mean±SD or number (%). Chi square test used for qualitative observation and independent t test used for quantitative observation, BMI Body mass index

Results

A total of 275 participants were enrolled and completed the study. Participants were mostly women (90.5% vs. 9.5%). The average weight, height, and BMI of the study participants were all within the normal range and had no significant influence on the airway examination. Table 1 shows more anthropometric and laryngoscopic information of the study participants.

Table 1: Demographic and anaesthetic observations of the patients (N=275)

Variables	**Overall statistics Mean±SD**	**Cormack and Lehane**		**P value**
		Easy I and II 253(93%)	**Difficult III 22(8%)**	
Age in years	41.02±12.2	41.02±12.2	45.09±11.07	0.1
Weight in kg	58.26±4.96	58.18±4.854	59.14±6.167	0.1
Height in cm	158.99±4.37	158.94±4.329	159.55±4.983	0.5
BMI	23.03±1.62	23.027±1.6326	23.182±1.5945	0.3
Duration of Laryngoscopy in seconds	13.7±1.6	13.232 ±.9563	20.077±3.7500	**0.00****
Gender **Female** **Male**	 249(90.5%) 26(9.5%)	 230(90.9%) 23(9.1%)	 19(86.4%) 3(13.6%)	 0.5
Number of attempts at laryngoscopy **1** **2**	 264(96%) 11(4%)	 253(92%) 0 253(92%)	 11(4%) 11(4%) 22(8%)	**0.00****

Data presented as Mean±SD or number (%) Chi square test used for qualitative observation and independent t test used for quantitative observation, BMI Body mass index

More than 93.5% of participants received an "Easy" Mallampati grade, while nearly 6.5% received a "Difficult" Mallampati grade. Similarly, 92.7% of the patients enrolled in the study had an "easy" grade on the LJP test, and 7.3% had a "difficult" grade as shown in Table 2

Table 2: Laryngoscopic view of all patients with respect to Mallampati, LJP and Cormack (N=275)

Predictors	Cormack and Lehane		Total	P value
	Easy I 164(59.5%) and II 89(32.4%)	Difficult III 22(8%)		
Mallampatti				**0.00****
I -Easy	97(59.1) 36(40,.4%)	3(13.6%)	136(49.5%)	Easy 93.5%
II-Easy	65(39.6%) 51(57.3%)	5(22.7%)	121(44%)	
III-Difficult	2(1.2%) 2(2.2%)	14(63.6%)	18(6.55%).	Difficult 6.5%
Lower jaw protrusion grade				**0.00****
A-Easy	164(100%) 85(95.5%)	6(27.3%)	255(92.7%).	Easy 92.7%
B-Difficult	4(4.5%)	15(68.2)	19(6.9%)	
C-Difficult	0 0	1(4.5%)	1(0.4%)	Difficult 7.3%
Total	**253(93%)**	22(8%)	275(100%)	

There was no grade IV intubation. The mean intubation time in our study was 13.7±1.6 s. When the "Easy" grades of Mallampati were compared with Cormack and Lehane's grades, there were 8% participants who have actually difficult laryngoscopic grades, i.e., grades III of Cormack and Lehane. (Table 2)

Statistical measures used to describe the predictive values for LJP maneuver and MT in predicting difficult intubations are shown in Table 3.

Mallampati test predicted 18 patients to have difficult intubation out of which only 14 were difficult as per the gold standard test, the Cormack and Lehane grading. 257 patients were predicted to have easy intubation out of which only 253 patients had an easy intubation as per Cormack Lehane grading.

20 patients were predicted to have difficult intubation by LJP test out of which only 16 were difficult as per the gold standard test, the Cormack and Lehane grading. 255 patients were predicted to have easy intubation out of which only 249 patients had an easy intubation as per Cormack Lehane grading.

With these values the sensitivity, specificity, positive predictive value, negative predictive value, accuracy were calculated. Kappa value of 0.31 and P value is 0. 00 showed fair agreement

Table 3: Predictive values for MMT and LJP and their combinations to predict the difficult laryngoscopy and tracheal intubation (N=275)

	MPC	LJP
Sensitivity	63.6	72.7
Specificity	98.4	98.4
False Negative	36.4	27.3
False Positive	1.6	1.6
Positive Predictive value	77.8	80
Negative Predictive value	96.9	97.6
Positive Likelihood ratio	40.3	46
Negative Likelihood ratio	0.4	0.3
Accuracy	95.6	96.4

Using McNemar's test and with a 95% CI, statistically significant differences were observed between these two predictive tests ($P < 0.05$) showing a higher level of sensitivity (72.7%) and accuracy (96.4%) for the LJP maneuver than the MT, which has a sensitivity and accuracy of 63.6% and 95.6%, respectively.

Discussion

In this present study, authors examined the airway of 275 patients who came for thyroidectomy to MCH, Thiruvananthapuram, requiring general anesthesia and elective intubation .The objective of the study was to compare the sensitivity and specificity of the Modified Mallampati test with the Lower Jaw Protrusion maneuver in predicting difficult laryngoscopy and tracheal intubation using the Cormack-Lehane criteria for intubation as the gold standard. Simple random sampling was used in this study. Females were more prevalent in this study, so the results are more applicable to females. 90.5% of the study population were females.

In patients undergoing surgery, the reported incidence of difficult laryngoscopy and endotracheal intubation ranges from 1.5-13% [15, 16, 17, 8, 18] .This variation in incidence may be due to different reference standards among studies for difficult intubation, which were based on Cormack Lehane grading,number of laryngoscopic attempts, and use of the BURP maneuver. The incidence of difficult airways in this study is 8%, which is consistent with a meta-analysis of nine studies that included 14438 patients and a DVL incidence of 6% to 27% [19]. Failed intubation was not encountered in any of these patients.

In this current study, 19.3% of participants were under the age group of 18–30 years. There are 30.2% of patients under the age group of 31–40 years and 28% of patients under the age group of 41–50 years. There are 15.3% of patients under the age group of 51–60 years and 7.3% of patients older than 60 years. Maximum strength is under the age group of 31–60 years, which is 73.5%, and hence this study is more applicable to the age group of 31–60 years. The mean height of the participants was 159cm. The mean weight of participants was 58.3 kg, and the mean BMI was 23.

Patients who were posted for total thyroidectomy were enrolled in this study. Chances of a difficult airway in thyroid patients are higher, so total thyroidectomy cases were included . Voyagis et al [20] described that goiter, when accompanied by airway deformity, constitutes an aggravating factor for difficult intubation. Many articles state that goiter, when

accompanied by tracheal compression, constitutes an aggravating factor for difficult airway [21,22,23]

Modified Mallampati Classes 1 and 2 are considered easy intubation, and Classes 3 and 4 are considered difficult intubation. 6.5% of participants were predicted to have difficult intubation according to this test, and 93.5% of the participants were predicted to have easy intubation.
Lower jaw protrusion A was considered easy intubation, and lower jaw protrusions B and C were considered predictors of difficult laryngoscopy and tracheal intubation. 7.3% of the patients were predicted to have difficult laryngoscopy and intubation, and 92.7% were considered as easy intubation.

The sensitivity of Modified Mallampati test in our study was 63.6% which is higher compared to that demonstrated by Vani et al[24] which was 25%.Specificity 98.4% in our study is nearly consistent to a study conducted by Oates et al in 1991 which was a prospective study including 751 patients to compare the Mallampati classification with Wilson's risk sum in the prediction of difficult laryngoscopy and assessed the inter observer variation in performing these tests.

The sensitivity (63.6%) and positive predictive value (70.8%) are higher compared to the study conducted by Oates et al. The sensitivity, specificity, and positive predictive value of the Mallampati classification were assessed to be 0.42, 0.84, and 4.4, respectively [25]. There is wide interobserver variability for the Mallampati test. Hilditch et al. [26] ,Eberhart et al. [8] and Karkouti et al. [27] have shown poor interobserver reliability for the Mallampati test.

The sensitivity of the lower jaw protrusion test in our study was high (72.7%), in contradiction to the works by James et al. [12] and Sava et al. [13]. In their studies, sensitivities were 14.9% and 29.4%, respectively. The specificity and positive predictive value of the lower jaw protrusion test in our study are 98.4% and 80%, which are higher compared to studies done by Ul Haq and Ullah et al, which are 88.47% and 70.56%, respectively.

The accuracy of the Modified Mallampati Test and the Lower Jaw Protrusion Test in the present study are 95.6% and 96.4%, respectively, which are higher compared to the studies done by Ul Haq and Ullah et al. (80.39 % and 90.13%, respectively). In our study, the Lower Jaw Protrusion Maneuver and Mallampati Test were performed for the assessment of the airway by the primary investigator, which reduced the risk of inter-observer variation and increased the reliability of the tests.

A test to predict difficult intubation should have high sensitivity so that it will identify patients in whom intubation will be truly difficult [3, 4]. It should also have a high positive predictive value, so that only a few patients who are actually easy to intubate are subjected to the protocol for management of difficult airways [28,29]

Conclusion

The lower jaw protrusion test has a higher level of accuracy, sensitivity, positive predictive value, and negative predictive value compared to the Mallampati test. Lower jaw protrusion appears to be a better choice for preoperative airway assessment due to its higher sensitivity and positive predictive value. The Mallampati test is the most commonly used test for predicting difficult intubation. The LJP test can be added to routine preoperative airway evaluation, but it has the limitation of not being able to be performed in some patients, such as the edentulous patients or those with a low intellectual coefficient.

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Conflict of interest: Nil

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