Comparing Efficacy of Modified Mallampati Test and Upper Lip Bite Test to Predict Difficult Intubation

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ABSTRACT

Introduction: The failure to maintain a patent airway following induction of general anaesthesia can lead to disastrous complications. Hence, it is important to identify patients with difficult airway preoperatively. The present study was conducted to evaluate and compare efficacy of Modified Mallampati Test (MMT) and Upper Lip Bite Test (ULBT) to predict difficult intubation.

Material and Methods: 200 patients undergoing elective surgeries under general anaesthesia with endotracheal intubation were enrolled in the study. Modified Mallampati Test (MMT) and Upper Lip Bite Test (ULBT) were performed on all patients preoperatively. MMT class III and class IV and ULBT class III were considered potentially difficult intubation. An experienced anesthesiologist, unaware of preoperative airway evaluation, performed the laryngoscopy and graded the glottic view as per Cormack and Lehane's classification. Grade III and IV were considered as difficult intubation. Sensitivity, specificity, accuracy, positive and negative predictive values of ULBT and MMT were calculated.

Results: MMT was more sensitive (75.00%) than ULBT (25.00%); both tests had high specificity (MMT 91.30%; ULBT 95.11%). Positive predictive value was 42.86% for MMT while it was 30.77% for ULBT. Negative predictive value was 97.67% and 93.58% for MMT and ULBT respectively. Accuracy of MMT was 90.00% while it was 89.5% for ULBT.

Conclusions: Both tests are good predictors of easy intubation but poor predictors of difficult intubation. MMT is better than ULBT at predicting difficult intubation.

Keywords: Modified Mallampati Test, Upper Lip Bite Test

INTRODUCTION

Airway management remains one of the most important responsibilities of an anaesthesiologist. The inability to maintain a patent airway following induction of general anaesthesia is a major concern for anaesthesiologists. Although maintaining optimal oxygenation/ventilation, via various devices, is always the primary goal in the management of a difficult airway, tracheal intubation remains the gold standard in securing the airway.

The incidence of difficult intubation - defined as Cormack–Lehane's grade ≥3 – is 5.8% for the overall patient population[1] and it is higher in obstetric patients.[2-4]

The unanticipated difficult intubation places patients at increased risk of complications ranging from sore throat to serious airway trauma, oesophageal injury and aspiration.[5,6] In some cases the anaesthesiologist may not be able to maintain a patent airway, leading to severe complications such as brain damage or death and up to 30% of anaesthetic deaths are attributed to management of difficult airway.[7,8] It would be useful to identify these patients preoperatively in order to avoid such catastrophic incidents. MMT has been used widely to predict difficult intubation in the pre-operative period, but several studies have cast doubts on its reliability, mainly due to higher inter-observer variability.

The ULBT, which involves the assessment of jaw subluxation and presence of buck teeth in a single test has been claimed to have more reliability in predicting difficult airway with low inter-observer variability.

The present study was conducted to compare Modified Mallampati Test (MMT) and Upper Lip Bite Test (ULBT) to predict difficult intubation.

MATERIAL AND METHODS

After obtaining institutional ethical committee clearance, this prospective study was conducted in 200 ASA 1, 2 and 3 patients of either sex aged between 18 to 55 years undergoing elective surgical procedures under general anaesthesia with endotracheal intubation at a tertiary care hospital. Edentulous patients, patients with BMI>30, inability to open the mouth, patients requiring Rapid Sequence Induction of anaesthesia, and any factor predicting difficult intubation were excluded from the study. A power analysis was conducted assuming a moderate effect: a power of 80% and type I error of 5% and using two sided alternative hypothesis, a sample size of 200 was determined to be appropriate for the study.

A thorough pre anaesthetic evaluation was carried out in all patients. All routine and relevant investigations were asked for, and ASA grading of the patient was determined. Two hundred consecutive patients requiring oral endotracheal intubation for general anaesthesia for an elective surgery that fulfilled the inclusion and exclusion criteria and satisfied the requirement of preoperative evaluation were enrolled in the study. The procedure was explained in detail to all patients. Written informed consent was obtained from all patients.

Preoperatively, each patient's airway was evaluated using MMT and ULBT. Classification of oropharyngeal view was assessed according to MMT as follows. Patients were made to sit at eye level to the observer with mouth fully open and tongue maximally protruded, and patients were asked not to phonate.

Class I: Soft palate, fauces, uvula, and pillars are seen

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Class II: Soft palate, fauces, and uvula are seen
Class III: Soft palate and base of uvula seen.
Class IV: Soft palate not visible
MMT classes III and IV were considered potentially difficult intubation.
The class of ULBT was determined as follows:
Class I: Lower incisors can bite upper lip above the vermillion line
Class II: Lower incisors can bite upper lip below the vermillion line
Class III: Lower incisors cannot bite the upper lip
ULBT class III was considered potentially difficult intubation.
On the day of surgery after confirming starvation, IV access was secured by routine operation theatre anaesthetist in the pre-operative room. Ringer lactate was started at 2ml/kg/hr. In the operating room, patient's heart rate, arterial blood pressure, oxygen saturation and ECG were monitored. The equipments required for management of difficult intubation were kept ready. Patient was premedicated with IV glycopyrrolate 0.004 mg Kg-1, IV midazolam 0.05 mg kg-1 and IV fentanyl 1.5 µgmKg-1. After pre-oxygenation with 100% oxygen for 5 minutes using circle absorbing system with capnograph attached, patient was induced with IV thiopentone 3-5 mg Kg-1 till loss of eye lash reflex. Endotracheal intubation was accomplished with vecuronium 0.1mg kg-1 after ventilating the patient with oxygen, air (33:66 %) and sevoflurane for 3 minutes by senior anaesthesiologist having minimum three years experience in clinical anaesthesia. The optimal intubating position was obtained (sniffing morning air position) by placing a pillow under the occiput, laryngoscopy was done using Macintosh laryngoscope with blade no. 3 or 4 depending upon personal preferences and glottic view was graded without any external pressure or other manoeuvres applied, according to the Cormack and Lehane's grading.
Grade I: Full view of the glottis
Grade II: Only posterior commissure visible
Grade III: Only epiglottis visible
Grade IV: No glottic structure visible
Grades III and IV were considered as difficult intubation. Patients were intubated with appropriate sized endotracheal tube. Confirmation of successful intubation was done by bilateral auscultation over lung fields and capnography. Number of attempts for successful intubation, number of failed intubation, equipments and manoeuvres required for successful intubation were noted. Oxygen saturation was continuously monitored and the patient was oxygenated with bag mask ventilation if at any point of time oxygen saturation was below 95%. Patients requiring more than two attempts for intubation were considered as failure to intubate and noted. The chief anaesthesiologist then decided upon the intubating aid to be used for successful intubation.

STATISTICAL ANALYSIS

The completed data sheets were analysed by SPSS version 16 software (SPSS Inc.). The preoperative assessment data and the laryngoscope findings were used to evaluate the predictive value of each test for difficult laryngoscopy. As MMT and ULBT class are categorical variable, we used a 2 × 2 table to assess the validity parameters i.e. sensitivity, specificity, positive and negative predictive values, and accuracy. Calculations were performed using Excel 2013 for Windows (Microsoft Inc., Redmond).
McNemar test was used to compare nonparametric variables between two groups. Considering that both ULBT and MMT were used to predict difficult airways and ultimately were contrasted with Cormack Lehane's classification and the two tests were not independent of each other, McNemar test was considered to be most appropriate. P value <0.05 was taken as level of significance.

RESULTS

We studied 200 patients, 110 were males and 90 were females. The mean age of patients was 32.87±9.6 years. The mean BMI was 22.17kg/m^2±3.59. 122(61%) patients belonged to ASA grade I; 64 (32%) patients to ASA grade II and 14 (7%) patients to ASA grade III.
Incidence of difficult intubation was 8% i.e. 16 out of 200 assessed patients had difficult intubation. All 16 patients had Cormack Lehane's grade III and none had Cormack Lehane's grade IV. Cormack Lehane's grade III patients were intubated using either External Laryngeal pressure or using Gum elastic Bougie at second attempt. Remaining patients were intubated at the first attempt. There was no failure to intubate the trachea in our study.
The validity of MMT and ULBT in predicting a difficult intubation was reviewed (Tables 1 and 2 respectively). We found that MMT is more sensitive (75.00%) than ULBT (25.00%). both tests had high specificity (MMT 91.30%; ULBT 95.11%). Positive predictive value was 42.86% for MMT while it was 30.77% for ULBT. Negative predictive value was 97.67% and 93.58% for MMT and ULBT respectively. Accuracy of MMT was 90.00% for MMT while it was 89.5% for ULBT.

DISCUSSION

Management of difficult airway is the most important challenge for an anaesthesiologist. Unanticipated difficult airway is a major factor contributing to anesthetic-related morbidity and mortality.9 Preoperative airway assessment helps an anaesthesiologist to make appropriate preparation to manage difficult airway prior to anaesthetic induction. Accordingly, the search for a predictive test that has ease of applicability and accuracy of prediction (discriminating power) persists. Preferably, any test done preoperatively to predict difficult laryngoscopy and intubation should be highly sensitive, specific,

MMT		Cormack Lehane Grading		Total
		Difficult	Easy	
Predicted Difficult (MMT III and VI)	Frequency	12(TP)	16(FP)	28
	%	6.0%	8.0%	14.0%
Predicted Easy (MMT I and II)	Frequency	4(FN)	168(TN)	172
	%	2.0%	84.0%	86.0%
Total	Frequency	16	184	200
	%	8.0%	92.0%	100.0%
*TP-True Positive; FP-False Positive; FN-False Negative; TN-True Negative.				

Table–1: Validity of mmt

ULBT		Cormack Lehane Grading		Total
		Difficult	Easy	
Predicted Difficult (ULBT III)	Frequency	4(TP)	9(FP)	13
	%	2.0%	4.50%	6.50%
Predicted Easy (ULBT I and II)	Frequency	12(FN)	175(TN)	187
	%	6.0%	87.50%	93.50%
Total	Frequency	16	184	200
	%	8.0%	92.0%	100.0%
*TP-True Positive; FP-False Positive; FN-False Negative; TN-True Negative				

Table–2: Validity of ULBT

Parameter	MMT	ULBT
True Positives	12(6%)	4(2%)
False Positives	16(8%)	9(≈5%)
False Negatives	4(2%)	12(6%)
True Negatives	168(84%)	175(≈88%)
Sensitivity (95% CI)	75.00% (47.65, 92.73)	25.00% (7.286, 52.35)
Specificity (95% CI)	91.30% (86.26,94.94)	95.11% (90.93, 97.74)
Positive Predictive Value (95% CI)	42.86% (24.43,62.85)	30.77% (9.09, 61.40)
Negative Predictive Value (95% CI)	97.67% (94.14,99.36)	93.58% (89.07, 96.65)
Diagnostic Accuracy (95% CI)	90.00% (81.37, 93.75)	89.5% (80.78, 94.40)

Table-3: Comparison of predictive values for the ULBT And MMT

and should have a high PPV with few negative predictions.

Modified Mallampati Test (MMT) has been in use for more than two decades to assess presence of difficult airway preoperatively. It determines size of the tongue in relation to the oropharynx and also ability to open the mouth. Although Mallampati[10] found significant correlation between the ability to visualize pharyngeal structures and ease of laryngoscopy and endotracheal intubations, over the years many limitations have been pointed out by various authors. The absence of definite demarcation between classes II, III and IV and the effect of phonation on oropharyngeal classification lead to high inter observer variability and decreased reliability.[11] Other limitations of MMT include the fact that the test does not assess neck mobility and patient's dentition which are important factors in predicting difficult intubation.

In 2003, Khan and his colleagues introduced Upper Lip Bite test[12] which checks both jaw subluxation and buck teeth. They proposed the use of ULBT as an alternative to the most widely used Modified Mallampati Test. They found that ULBT was easy to demonstrate to patients and very convenient to perform as a bedside test. The classes were clearly demarcated and delineated making inter observer variability highly unlikely. Thus, its use was independent of skill or experience level of the observer

However, ULBT on its own fails to take into account relative tongue and pharyngeal size, mandibular space and a narrow high arched palate. Also, ULBT requires patient's cooperation, ability to move the teeth and the presence of teeth.

In our study we found that sensitivity of MMT was 75.00% which was comparable to the study conducted by Erzi et al[13] (76%); Schmitt H et al[14] (76%) and Eberhart et al[15] (70.2 %.) The sensitivity of MMT ranges from 34%-66% as per Lee et al[16] and 0% to 100% as per Lundstrøm et al.[17]

The specificity of MMT in our study was 91.30% which is more as compared to that found in the study of Khan et al[12] (66.8%) and Eberhart et al[15] (61%). A higher specificity similar to our study has also been reported by Cattano et al[18](91%).

The wide variations in reported specificity and sensitivity for MMT in various studies may be because of the technicalities involved in the demonstration, incorrect evaluation of the test and inter observer variability as was found by Eberhart et al.[15]

Bilgin et al[19] showed that a low prediction value of MMT was due to involuntary phonation during test, which probably alters the Mallampati classification. Oates and colleagues[20] showed that one critical factor in doing a reliable Mallampati score was maximal extrusion of tongue and opening of the mouth.

We conducted MMT in a sitting position. Singhal et al proposed that the MMT shows higher grades if the patient is assessed in the supine instead of sitting position.[21] The validity of MMT measured in sitting position may not be accurate in predicting a difficult intubation as intubation is usually performed in supine position.

The positive predictive value of MMT in our study was 42.86% which is quite high when compared to other studies. This could be due to the fact that, all the patients' airways were evaluated by a single resident, unlike in other studies wherein two or more than two anaesthesiologists were involved in assessing the airway preoperatively. This might have contributed to inter observer variability in their study leading to high false positivity.

The negative predictive value of MMT was 97.67%, which is comparable to the study done by Khan et al[12] (98.4%); and Eberhart et al[15] (93.8%). The percentage of false negative for MMT in our study was 2% which was comparable to the original study by Khan et al[12] where incidence of false negative was 1%. The percentage of false positive for MMT in our study was 8% whereas it was 33.4 % in the study conducted by Khan et al[12] and 20% in the study conducted by Hester et al.[22] This could be due to inter-observer differences in laryngoscopy techniques, MMT classification and/or differences in sample characteristics. Accuracy of MMT in the present study was found to be 90% which is comparable to the parent study conducted by Mallampati et al[10] (92.9%), however it was higher than the study by Khan et al[12] (67.7%).

In our study the sensitivity of ULBT was 25.00% which is well below what Khan et al[12] got in their study (76.5%), but it was nearer to the value obtained by Eberhart et al[15] (28%). This means that several patients with difficult intubation will not be identified by ULBT (larger number of patients with false negative test). Lower sensitivity of ULBT can be explained due to higher incidence of difficult intubation in our study (8%) with large proportion of false negative results (6%). Likewise, incidence of difficult intubation in Eberhart[15] study was 12% with 8.5% incidence of false negatives. In the study conducted by Khan et al[12] incidence of difficult intubation was 5.7% with 1.33% incidence of false negatives.

In our study the specificity of ULBT was 95.11%, well above

the original trial by Khan et al[12] (88.7%). This is because of lesser number of false positive (4.5%) results obtained in our study with ULBT as compared to Khan's study (10.6%).The high specificity of ULBT means it is a good test to predict easy intubations.

The PPV of ULBT in our study was 30.77% which was comparable to study done by Eberhart et al[15] (33.6%) and Khan et al[12] (28.9%). Hester[22] however found PPV of ULBT much higher (83%) than our study. This can be explained by the fact that predictive values depend on sensitivity, specificity, and incidence of difficult intubation which was higher in the study by Hester et al[22] (18%) compared to present study (8%).

On comparing both tests, we found that MMT is more sensitive (75.00%) than ULBT (25.00%), difference in the sensitivity between the two tests was found to be statistically significant. Khan et al[12] in their study also had found sensitivity of MMT to be more than ULBT (MMT 82%; ULBT 76%), however, this was not statistically significant.

Both tests had high specificity (MMT 91.30%; ULBT 95.11%) and difference in the specificity between the two tests was not found to be statistically significant. Similarly, Khan et al[12] found specificity of ULBT higher than MMT in their study (MMT 89%; ULBT 92%) and this difference was statistically significant.

There was statistically significant difference between two tests for PPV (MMT- 42.86%; ULBT- 30.77%), and NPV (MMT- 97.67; ULBT- 93.58%) (p value s<0.05).

In our study, incidence of difficult intubation was found to be 8% i.e 16 out of 200 assessed patients had difficult intubation. The incidence of difficult laryngoscopy and tracheal intubation as reported in extant literature is 1.5% to 13%.[1,10,23,24] This depends on criteria used to characterize it and racial differences, resulting in different anatomical features of oropharynx and larynx among different studies.

An ideal test to predict difficult intubation should have high sensitivity, so that it will identify most patients in whom intubation will truly be difficult, thus minimizing the risk of unanticipated difficult/failed intubation. From this point of view, the sensitivity of a test may be a more valuable parameter for predicting difficult intubation than its specificity. It should also have a high PPV, so that only few patients with airways actually easy to intubate are subjected to the protocol for management of a difficult airway. This would reduce cost, time and burden on the anaesthesiologist. Similarly, a test should have a high NPV to correctly predict the ease of laryngoscopy and intubation.

In our study, we found that both tests had inadequate sensitivity and positive predictive values in predicting difficult intubation, Low PPV could be either because the test is not predicting all cases of true difficult intubation (ULBT) or due to more false positive cases (MMT).In clinical practice, anaesthesiologists are mostly concerned with unanticipated difficult airway (false negative predictions) which may find them unprepared. In our study, the incidence of false negative for ULBT was 6% and that for MMT was 2%.

Both tests have a negative predictive value of more than 90%, thus stressing the fact that both these tests can be good predictors of easy intubation.

The most important advantage of ULBT, as we found in our study, was less or no chance for inter observer variability because of clear demarcation of different classes. Also, the presence of buck teeth which is an important factor predicting difficult intubation was easily noticed.

CONCLUSION

In conclusion, both tests are poor predictors of difficult intubation (low positive predictive values) when used as single preoperative bedside screening tests. MMT is a better test at predicting difficult endotracheal intubation when compared to ULBT. Both tests are better predictors of easy intubations (high negative predictive value).

Limitations and Future scope

1. The present trial was designed for only elective cases. Unanticipated difficult intubation especially in emergency hours is devastating, when skilled faculty in managing difficult airway is usually not available. Furthermore, our conclusion is not applicable to all subgroups of the general population, such as elderly or obstetric patients.
2. Laryngoscopy was undertaken by different anaesthesiologists. Nevertheless, only experienced anaesthetists were involved
3. Current trial was limited to one tertiary care centre and in future, multicentric study may be essential.
4. Study in future with larger sample size, patients with higher ASA classification and different ethnicities is needed.

REFERENCES

1. Shiga T, Wajima Z, Inoue T, Sakamoto A. Predicting difficult intubation in apparently normal patients: A meta-analysis of bedside screening test performance. Anesthesiology. 2005;103:429–37.
2. Cormack RS, Lehanc J. Difficult tracheal intubation in obstetrics. Anaesthesia. 1984;39:1105.11.
3. Mhyre JM, Healy D. The unanticipated difficult intubation in obstetrics. Anesth Analg. 2011;112:648–52.
4. Lyons G. Failed intubation. Six years' experience in a teaching maternity unit. Anaesthesia. 1985;40:759–62.
5. Hirsch IA, Reagan JO, Sullivan N. Complications of direct laryngoscopy. A prospective analysis. Anesthesiology Review. 1990;17:34–40.
6. Johnson KG, Hood DD. Esophageal perforation associated with endotracheal intubation. Anesthesiology. 1986;64: 281–3.
7. Benumof JL, Scheller MS. The importance of transtracheal jet ventilation in the management of the difficult airway. Anesthesiology. 1989;71:769-78.
8. Bellhouse CP, Doré C. Criteria for estimating likelihood of diffi culty of endotracheal intubation with the Macintosh laryngoscope. Anaesth Intensive Care. 1988;16:329-37.
9. Savva D. Prediction of difficult tracheal intubation. Br J Anaesth. 1994;73:149-53.
10. Mallampati SR, Gatt SP, Guigino LD, Desai SP, Woraks AB, Freiberger D et al. A clinical sign to predict difficult tracheal intubation: A prospective study. Can Anesth Soc J. 1985;32:429-34.
11. Tham EJ, Gildersleve CD, Sanders LD, Mapelson WW, Vaughan RS. Effects of posture, phonation and observer on Mallampati classification. Br J Anaesth. 1992;68:32-38.
12. Khan ZH, Kashfi A, Ebrahimkhani E. A Comparision of the Upper Lip Bite Test (a simple new technique) with Modified Mallampati Classification in predicting difficulty in endotracheal intubation : A Prospective blinded study.

Anesth Analg. 2003;96:595-599.
13. Ezri T, Medalion B, Weisenberg M, Szmuk P, Warters RD, Charuzi I. Increased body mass index per se is not a predictor of difficult laryngoscopy. Can J Anaesth. 2003; 50:179–83.
14. Schmitt H, Buchfelder M, Radespiel-Troger M, Fahlbusch R. Difficult intubation in acromegalic patients: incidence and predictability. Anesthesiology. 2000;93:110–4.
15. Eberhart LHJ, Arndt C, Cierpka T, Schwanekamp J, Wulf H, Putzke C et al. The reliability and validity of Uppper Lip Bite Test with the Mallampati classification to predict difficult laryngoscopy: An external prospective evaluation. Anesth Analg. 2005;101:284-289.
16. Lee A, Fan LTY, Karmakar MK, NaganKee WD. A Systematic review (meta-analysis) of the accuracy of Mallampati tests to predict difficult airway. Anesth Analg. 2006;102:1867-78.
17. Lundstrøm LH, Vester-Andersen M, Møller AM, Charuluxananan S, L'hermite J, Wetterslev J; Danish Anaesthesia Database. Poor prognostic value of the modified Mallampati score: a meta-analysis involving 177 088 patients. Br J Anaesth. 2011;107:659-67.
18. Cattano D, Panicucci E, Paolichhi A. Risk factors assessment of the difficult airway : an Italian survey of 1956 patients. Anesth Analg. 2004;99:1774-1779.
19. Bilgin H, Ozyurt G. Screening tests for predicting difficult laryngoscopy: A clinical assessment in Turkish patients. Anaesth Intensive Care. 1998;26:382-6.
20. Oates JD, Macleod AD, Oates PD, Pearsall FJ, Howie JC, Murray GD. Comparison of two methods for predicting difficult intubation.Br J Anaesth. 1991;66:305–9.
21. Singhal V, Sharma M, Prabhakar H, Ali Z, Singh GP. Effect of posture on mouth opening and modified Mallampati classification for airway assessment. J Anesth. 2009;23:463-5.
22. Hester CE, Dietrich SA, White SW, Secrest JA, Smith T. A comparison of preoperative airway assessment techniques: The Modified Mallampati and the Upper Lip Bite test. AANA Journal. 2007;75:177-182.
23. Ramadhani SAL, Mohamed LA, Rocke DA, Gouws E. Sternomental distance as sole predictor of difficult laryngoscopy in obstetric anaesthesia. Br J Anaesth. 1996;77:313-316.
24. Tse JC, Rimm EB, Hussain A. Predicting difficult endotracheal intubation in surgical patients scheduled for general anesthesia: prospective blind study. Anesth Analg. l995;81:254-8.

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