Original Research Article

Indian Journal of Anesthesia and Analgesia
March – April 2020; 7(2): 488–492
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.7220.7

Comparison of the Upper Lip Bite Test (ULBT) with the Ratio of Height to Thyromental Distance (RHTMD) for the Prediction of Difficult Laryngoscopy in Apparently Normal Patients

Jenish Patel[1], Dipika Patel[2], Vedang Vaidya[2], Jinesha Chauhan[3], Bhumi Maru[4], Jayshree Thakkar[5]

[1]Junior Lecturer, [2]Associate Professor, [3–5]Resident, [6]Professor and Head, Department of Anaesthesia, Gujarat Cancer & Research Institute, BJ Medical College, Ahmedabad, Gujarat 380016, India.

Abstract

Background: Various anatomical measurements & noninvasive clinical tests, singly or in various combinations can be performed to predict difficult laryngoscopy & intubation in apparently normal patients. Recently introduced "Upper Lip Bite Test (ULBT)" & "Ratio of Height to Thyromental Distance (RHTMD)" are claimed to have high predictability in comparison to commonly used Mallampatti Grading (MPG). *Materials and Methods:* We conducted a prospective single blinded observational study of 150 adult patients of ASA Grade I & II, assessed them for MPG, ULBT & RHTMD according to standard methods & correlated with the Cormack & Lehane grade. The Data analysis was done using Graphpad Software. *Result:* ULBT & RHTMD had more sensitivity, specificity, positive predictive value & negative predictive value, i.e., 83%, 85%, 69%, 89%, 56%, 78%, 89%, 92% respectively as compared to MPG 28%, 85%, 48%, 73%. P - value for both the tests were < 0.01 in comparison with MPG. *Conclusion:* Amongst the three methods used, RHTMD is best predictive test for difficult laryngoscopy in apparently normal patients, but ULBT can also be used as an acceptable alternative which is less cumbersome than RHTMD.

Keywords: Upper Lip Bite Test (ULBT); Mallampatti Grading (MPG); Ratio of Height to Thyromental Distance (RHTMD).

How to cite this article:
Jenish Patel, Dipika Patel, Vedang Vaidya, et al. Comparison of the Upper Lip Bite Test (ULBT) with the Ratio of Height to Thyromental Distance (RHTMD) for the Prediction of Difficult Laryngoscopy in Apparently Normal Patients. Indian J Anesth Analg. 2020;7(2):488–492.

Introduction

Airway management can be considered to be the foremost important component, critical to the anesthetic management of a patient. Indeed, almost 85% of all mistakes concerning airway management result in irreversible cerebral damage[1] and upto 30% of all anesthetic deaths can be attributed to the management of difficult airway.[2,3]

Around 1–18% of the general population have a difficult airway which is a significant percentage.[4-9] Hence, many different tests have been developed in order to predict the incidence of a difficult airway and thus reduce the chances of an airway mishap. Several preoperative airway

Corresponding Author: **Dipika Patel,** Associate Professor, Department of Anaesthesia, Gujarat Cancer & Research Institute, B.J. Medical College, Ahmedabad, Gujarat 380016, India.

E-mail:drdipikapatel@gmail.com

Received on 26.12.2019, **Accepted on** 28.01.2020

assessment test include the Inter-Incisor Gap (IIG), Head and Neck Movement (HNM), modified Mallampati Test (MMT), Sternomastoid Distance (SMD) and Thyromental Distance (TMD). These tests are useful bedside tests but have a low sensitivity and low positive predictive value (33-71%) while false positive results are high.[10–13]

Prediction of a different intubation is important as it can help in preventing airway accidents but which anatomical landmarks and clinical features are the best predictors is still controversial. The recently introduced Upper Lip Bite Test (ULBT) and Ratio of Height to Thyromental Distance (RHTMD) are simple noninvasive bedside tests which have better predictive value of a difficult airway in apparently normal looking patients compared to the commonly used Modified Mallampatti Test (MMT).

We conducted this study to compare sensitivity, specificity, Positive Predictive Value (PPV) and Negative Predictive Value (NPV) for ULBT and RHTMD in comparison to MMT to predict difficult laryngoscopy in apparently normal looking patients.

Aims and Objectives

To compare the efficacy of ULBT and RHTMD with the commonly used MMT in terms of:

(a) Sensitivity

(b) Specificity

(c) Positive Predictive Value (PPV)

(d) Negative Predictive Value (NPV)

Materials and Methods

After obtaining the approval from our institutional ethical committee, this observational, single blinded prospective evaluation was designed on a study group of 150 adult patients, all of whom were above 18 years of age, of either sexes, who belonged to either ASA Grade 1 or 2 category and were undergoing elective procedures under general anesthesia. Patients unable to sit or stand erect, those with obvious facio-maxillary anomalies, ASA 3, 4 and edentulous patients were excluded from the study.

Following routine preanesthetic check up by the attending anesthesiologist, written informed consent was taken from each patient, The airway was assessed preoperatively in the preoperative room on the day of surgery by the same anesthetist in all studied patients to avoid inter observer error. All the patients were assessed using all the 3 tests.

The oropharyngeal view was assessed using a Modified Mallampatti Test (MMT) by asking the patient to open his or her mouth maximally and to protrude the tongue without phonation while being seated. Upper Lip Bite Test (ULBT) was done to assess the range of freedom of the mandibular movement with respect to the architecture of the teeth concurrently. Each patient was asked to bite their upper lip with their lower incisor and were categorized as follows:

Class 1: lower incisor can hide the mucosa of upper lip. (easy laryngoscopy and intubation)

Class 2: lower incisor can partially hide mucosa of upper lip. (difficult laryngoscopy and intubation)

Class 3: lower incisor unable to touch mucosa of upper lip. (difficult laryngoscopy and intubation)

Thyromental distance was measured in the midline from the upper end to thyroid cartilage to the mentum of mandible with the neck fully extended and mouth closed, using a rigid ruler.

Class 1 : > 6.5 cms

Class 2 : 6–6.5 cms

Class 3 : < 6 cms

Patients height (in cms), body weight (kgs) and Body Mass Index (BMI) were also recorded. Ratio of height to thyromental distance was calculated and graded as follows:

RHTMD = Height (in cms)/TMD (in cms)

1. Grade 1 : < 23.5 (easy laryngoscopy and intubation);
2. Grade 2 : > 23.5 (difficult laryngoscopy and intubation).

Standardized anesthetic protocol was followed in all the patients. Patients were kept NBM for 8 hrs. Standard monitoring were applied. Venous access was obtained and premedication was given which included Inj. Glycopyrrolate 0.04 mg/kg, Inj. Ranitidine 1 mg/kg, Inj. Fentanyl 2 μg/kg. All patients were preoxygenated with 100% O_2 *via* facemask. All patients were induced with Inj. Thiopentone 5 mg/kg and Inj. Succinylcholine 1 mg/kg to facilitate endotracheal intubation.

Laryngoscopy was performed after complete relaxation with patient's head in the sniffing position, laryngoscopy was performed with a Macintosh no 3 or 4 laryngoscope blade by anesthesiologist (of atleast 2 year of experience) who was blinded to the results of preoperative airway assessment.

Glottic visualization was assessed using a modified Cormack and Lehane (CL) classification.

Cormack & Lehane Grades 3 & 4 were considered as difficult laryngoscopy and these results were compared with predictions of modified mallampatti test, upper lip bite test and ratio of height to thyromental distance. True Positive (TP), False Positive (FP), True Negative (TN), False Negative (FN) were calculated for individual tests. Sensitivity, specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV), likelihood ratio were calculated and results were derived.

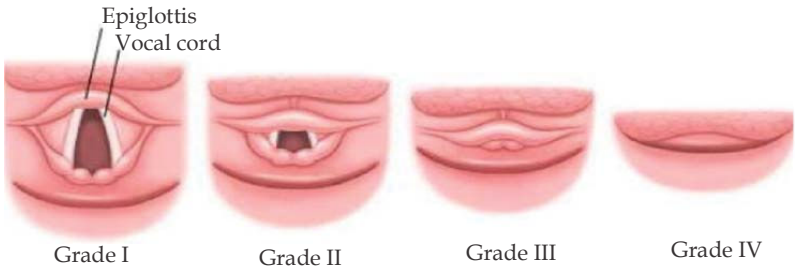

Fig. 1:

Standard formula for different tests for data analysis:

1. Sensitivity = TP/(TP + FN) No. of difficult intubations correctly predicted/No. of difficult intubations;
2. Specificity = TN/(TN + FP) No. of easy intubations correctly predicted/No. of easy intubation;
3. PPV = TP/(TP + FP) No. of difficult intubation correctly predicted/No. of intubation predicted to be difficult;
4. NPV = TN/(TN + FN) No. of easy intubation correctly predicted/No. of intubation predicted to be easy;
5. Likelihood ratio = Sensitivity/1-specificity. It is defined as how much more likely is it that a patient who tests positive has a disease compared with one who tested negative.

Observations and Results

As we can see in Table 1, there was no significant difference in context to age, sex and BMI, ($p \geq 0.001$).

Table 2 shows, the detailed results of the true and false positive and negative results of our study data. As we can see, the true positive and false negative results in our commonly done MMT is quiet different from the results in ULBT and RHTMD methods. According to the results in Table 2, sensitivity and specificity was calculated and is shown in (Table 3).

The data analysis was done using Graph pad

Table 1: Demographic data

Variable	Laryngoscopic Examination		*p* - value
	Easy	Difficult	
	(CL I & II)	(CL III & IV)	
Age (yrs)	44.35 ± 10.04	45.43 ± 9.33	0.6
BMI (kg/cm^2)	20.41 ± 4.10	20.80 ± 3.98	0.4
Sex (M/F)	71/31	31/19	

Table 2: Sensitivity and specificity of test

	MPG Classification	ULBT	RHTMD
True Positive (TP)	13	41	41
True Negative (TN)	90	70	91
False Positive (FP)	15	31	11
False Negative (FN)	32	08	07
Total	150	150	150

Software. ULBT & RHTMD were found to have more sensitivity, specificity, positive predictive value and negative predictive value i.e. 83%, 85%, 69%, 89%, 56%, 78%, 89%, 92% respectively compared to MPG of 28%, 85%, 48%, 73%. *p* - value for both tests were < 0.01 (0.0001, 0.0007) for ULBT & RHTMD respectively in comparison with MPG test.

Table 3: Sensitivity specificity PPV NPV of test

	MPG Classification	ULBT	RHTMD
Sensitivity	28%	83%	85%
Specificity	85%	69%	89%
Positive Predictive Value	48%	56%	78%
Negative Predictive Value	73%	89%	92%

Discussion

The incidence of difficult laryngoscopy and intubation varies from 1.5 to 13%. One of the causes of death and permanent brain damage related to anesthesias is failed intubation.[21] An unexpected difficult intubation is one of the most important contributory factor in cases of anesthesia related mortality and morbidity.[14] Hence, the search for a predictive test which is easy to perform and is very efficient is still continuing.

The RHTMD and ULBT are relatively newer tests with better predictability as compared to MMT. Schmitt et al. showed that the ratio of height to TMD has a better predictive outcome as compared to TMD alone.[15] They showed that RHTMD > 25 cm can be used to predicting difficult laryngoscopy as compared to our study RHMTD ≥ 23.5 cm was determined. Mohammadreza Safavi et al. compared RHTMD, ULBT and MMT in predicting difficult laryngoscopy. They also found that RHTMD has a better sensitivity and specificity as compared to MMT.[20] Our study also showed similar results.

Wilson et al. explained five risk-factors associated with difficult laryngoscopy-weight, jaw movement, head and neck movement, buck teeth and receding mandible.[16] One of our techniques of ULBT, measures the combined effect of jaw movement, protruding teeth and receding jaw - this combining three of the factors of difficult laryngoscopy. So, it gives a better predictive value.

Khan et al.[17] and Hester et al.[18] found out ULBT was superior to MMT in every aspect for predicting a difficult airway. Even in our study, we found the same result. Khan et al. showed sensitivity, specificity, PPV, NPV and accuracy of ULBT were 76.5%, 88.7%, 28.9%. 98.4%, 88.0% respectively. While Hester et al determined sensitivity of 55%, specificity of 97%, PPV of 83%, accuracy of 90% for ULBT.

Merah et al. studied that sensitivity, specificity and PPV of TMD for predicting difficult intubation were 15.4%, 98.1%, 22.2% respectively.[23] Savva reported that TMD had a sensitivity of 64.7% and a specificity of 81.4%.[14] TMD alone has been used to predict difficult airway since many years, but its value as an indicator is questionable as it varies with patients size and body proportions.

Krobbuaban B et al.[19] and Krishna et al.[22] also found the ratio of height to TMD to be a more accurate predictor of difficult laryngoscopy. They assumed RHTMD ≥ 23.5 cm to predicting difficult intubation.

In our study, The incidence of difficult intubation was 8.3% . The validity of MPG to predict a difficult intubation was low. The addition of RHTMD and ULBT to MPG for preoperative assessment improved the accuracy in predicting a difficult airway. Any test used for airway assessment should be easy to perform at the bedside, noninvasive, highly sensitive to predict the maximum number of patients of difficult airway correctly, highly specific to predict easy airway and should be free observer bias as much as possible. It is also highly desirable that the test should have a high PPV (to avoid disastrous consequences of difficult laryngoscopy and intubation) and low NPV (so, that only a few patients are subjected to the protocols for difficult intubation).

Conclusion

Among the 3 methods used in our study, RHMTD was found to be the best in predicting difficult airway in apparently normal looking patients, but ULBT can also be used as an acceptable alternative which is less cumbersome as compared to RHTMD.

References

1. Caplan RA, Posner KL, Ward RJ, et al. Adverse respiratory events in anesthesia: A closed analysis. Anesthesiology 1990;72:828–33.
2. Benumof JL, Scheller Ms. The importance of transtracheal jet ventilation in the management of the difficult airway. Anesthesiology 1989;71:769.
3. Bellhouse CP, Dore C. Criteria for estimating likelihood of difficulty of endotracheal intubation with Macintosh laryngoscope. Anesthesia Intensive Care 1988;16:329.
4. Cormack RS, Lehane J. Difficult tracheal intubation in obstetrics. Anesthesia 1984;39:1105–111.
5. Aro L, Takki S, Aromaa U. Technique for difficult intubation. BR J Anesthesia 1971;43:1081.
6. Mallampatti SR, Gatt SP, Gugino LD, et al. A clinical sign to predict difficult tracheal intubation: A prospective study. Canadian Anesthesia Soc J 1985;32:429–34.
7. Philips OC, DUerksen RL. Endotracheal intubation a new blade for direct laryngoscopy. Anesth Analg 1973;52:691.
8. Finucane BT, Santora AH. Difficult intubation. In: Principles of Airway Manangement. Philadelphia: Davis;1980.
9. Deller A, Schreiber MN, Gramer J, et al. Difficult intubation: Incidence and predictability: A prospective study of 8284 adult patients. Anesthesiology 1990;73:1053.
10. Klock PA, Benumof JL. Definition and incidence of difficult airway. In: Hagberg CA, editor. Benumof's Airway Management: Principle and practice. 2nd edition. Philadelphia: Mosby Elsevier; 2007. pp. 215–33.
11. Merah NA, Wong DT, Ffoulkes-Crabbe DJ, et al. Modified Mallampatti test, thyromental distance and inter-incisor gap are the best predictors of difficult laryngoscopy in West Africans. Can J Anesth 2005;52;291–96.
12. Tse JC, Rimm EB, Hussain A. Predicting difficult endotracheal intubation in surgical patients scheduled for general anesthesia: A prospective blind study. Anesth Anal 1995;81:254–58.
13. Domi R. The best prediction test of difficult intubation. J Anesthesil Clin Pharamacol 2010;26: 193–96.
14. Savva D. Prediction of difficult tracheal intubation. British J of Anesthesia 1994;73:149–53.
15. Schmitt HJ, Kirmse M, Radespiel-Troger M. Ratio of patient's height to thyromental distance improves prediction of difficult laryngoscopy. Anesth Intensive Care 2002;30:763–65.
16. Wilson ME, Spiegelhalter D, Robertson JA, et al. Predicting difficult intubation. Br J Anesth 1988;61:211–16.
17. Khan ZH, Kashfi A, Ebrahimkhani E. A comparison of the upper lip bite test with modified Mallampatti classification in predicting difficulty in endoreacheal intubation a prospective blinded study. Anesth Analg 2003;96:595–59.
18. Hester CE, Dietrich SA, White SW. A comparison of preoperative airway assessment techniques: The modified Mallampatti and the upper lip bite test. AANA J 2007;75:177–82.
19. Krobbuaban B, Diregpoke S, Kumkeaw S. An assessment of the ratio of height to thyromental distance compared to thyromental distance as a predictive test for prediction of difficult tracheal intubation in Thai patients. J Med Assoc Thai 2006;89:638–42.
20. Mohammadreza Safavi, Azim Honarmand, Narges Zare. A comparison of the ratio of patient's height to thyromental distance, modified Mallampatti and the upper lip bite test in predicting difficult laryngoscopy. Soudi Journal of Ansthesia 2011 Jul–Sept;5(3):258–63.
21. Gupta S, Pareek S, Dulara SC. Comparisn of two methods for predicting difficult intubation in obstretic patients. Middle East J Anesthesiol 2003;17:275–85.
22. Krishna HM, Agarwal M, Dali JS, et al. Prediction of difficult laryngoscopy in Indian population: Role of ration of patient's height to thyromental distance. J Anesthesi Clin Pharmacol 2005;21:257–60.
23. Merah NA, Wong DT, Ffoulkes-crabbe DJ, et al. Modified Mallampati test, thyromental distance and inter-incisor gap are the best predictors of difficult laryngoscopy in West Africans. Can J Anesth 2005;52:291–96.