



COMPARISON OF THE UPPER LIP BITE TEST WITH INTER INCISOR DISTANCE FOR PREDICTION OF DIFFICULT ENDOTRACHEAL INTUBATION: A PROSPECTIVE SINGLE BLIND STUDY

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ABSTRACT

BACKGROUND: We prospectively compared the Upper Lip Bite Test with Inter Incisor Distance to predict difficult endotracheal intubation.

METHOD: Two anaesthesiologist, not involved in intubation of airway of the patients, evaluated airway by using upper lip bite test (ULBT) and inter incisor distance (IID). Laryngoscopy and intubation performed by another anaesthesiologist, he assessed the laryngeal view and graded according to the Cormack-Lehane grading system. Sensitivity, specificity, accuracy, positive value, negative predictive value, internal consistency were calculated for each test.

RESULTS: Upper Lip Bite Test is proved to be more sensitive in difficult intubation prediction (54.3%) in comparison to Inter Incisor Distance (9.6%). However Upper Lip Bite Test is found to be less specific (45.6%) to rule out easy intubations than Inter Incisor Distance (95.1%)

CONCLUSION: We found that ULBT is more sensitive to anticipate difficult intubation than the IID. Nevertheless IID is more specific to predict easy intubations than the ULBT. Hence we feel that it would be better if we use IID first to rule out easy intubations as it is more specific than we can apply ULBT to the patients who's airway is predicted as difficult by the IID, to predict true cases of difficult airway.

KEYWORDS : Upper Lip Bite Test, Inter Incisor Distance, endotracheal intubation, difficult intubation

Unanticipated difficult endotracheal intubation always stays primary concern for the anesthesiologists and can cause delay or failure of multiple attempts in intubation.¹

A closed claim study conducted by American society of anaesthesiologists reported 17% adverse respiratory complications due to difficult intubations and 85% of these patients died or suffered due to hypoxic brain damage.²

In clinical settings, the assessment should be simple, convenient and of high predictive power. However whether true prediction is possible and which variables should be used for evaluation is still debatable.^{3,4}

ULBT have been described as a useful tool for the prediction of difficult intubation in various studies.⁵ Whilst it is very common practice to see the mouth opening to assess the airway whether it is possible to introduce the laryngoscope into the mouth pertinent to that most commonly used mallampatti classification is also based on the adequate mouth opening.⁶ In our study, we aim to compare ULBT with IID for the prediction of difficult endotracheal intubation with primary objective to explore the possibility of an easy, accurate and less time consuming bed side test for difficult endotracheal intubation prediction. We have also compared sensitivity, specificity, positive predictive value, negative predictive value and internal consistency between the two tests.

METHODS

It is a prospective, comparative, single blind study conducted in 300 patients, who were admitted in the hospital aged ≥ 16 years, scheduled to undergo elective surgery under general anesthesia were considered for enrollment in the study after obtaining approval from the local ethics committee and informed, written consent from the patients, participated in the study.

The inclusion criteria included ASA I and II patients, aged ≥ 16 years scheduled for surgery under general anesthesia. ASA Grade III and IV, edentulous patients, those unable to open the mouth, laryngeal masses, limitation of cervical movements, limitation of temporomandibular and atlanto-axial joints, history of difficult laryngoscopy and intubation were excluded from the study.

Preoperatively, the two anaesthesiologist, not involved in intubation of the patient's airway, evaluated the airway by using ULBT and inter IID and recorded the data.

To perform upper lip bite test, anaesthesiologists asked the patient to bite their upper lip as above as possible. if patient was able to bite

above the vermilion classified as class I, if patient was not able to bite above the vermilion but touched the vermilion classified as class II And if patient was not able to touch the vermilion then classified as class III.

To record inter incisor distance: anaesthesiologists asked the patient to open mouth maximally, measured the distance between the incisors using measuring scale.

- class I ≥ 4
- class II ≤ 4

Another Anaesthesiologist who had more than 10 years experience in intubations and not informed of the preoperative airways assessment done by upper lip bite test and inter incisor distance test, anaesthesiologist assessed the difficulty of laryngoscopy at intubation by Cormack and Lehane grading system, after patient is being adequately anesthetized and fully relaxed on the operating table. Patient's head was placed in the sniffing position and initial laryngoscopy was performed with a Macintosh No. 3 blade. However, if difficulty was encountered and the first attempt failed to provide the laryngoscopic view, a Macintosh No. 4 blade was used and recorded Cormack and Lehane grading and if laryngoscopy found to be difficult even after changing the laryngoscope blade external laryngeal pressure and adjustment of head position was done if situation demanded, to perform the intubation

No external laryngeal pressure was applied while reporting the laryngeal view. A grade of I or II was considered to represent easy intubation and a grade of III or IV to represent difficult intubation. The preoperative assessment data and the laryngoscopic findings were used to determine the accuracy of the above mentioned tests in prediction of difficult intubation.

STATISTICAL ANALYSIS

We used chi-square test to determine whether the demographic data (age, sex, weight,) and distribution of the study subjects are comparable and their differences are significant or not, to identify the role of the upper lip bite test and inter incisor distance in difficult intubation prediction and to understand the association of both the test with Cormack Lehane score. We used receiver operating characteristic (ROC) curve to define the sensitivity and specificity, positive predictive value, negative predictive value and significance of the upper lip bite test and inter incisor distance. Cronbach's alpha is used to measure internal consistency and reliability of both the study tests.

RESULT

Out of 300 study subjects 134 (44.7%) were males while 166 (55.3%)

were females (Table1) Statistically there was no significant difference. (P=0.482). However demographic distribution of the subjects according to the gender and weight was significant (P=0.001)

Table 1- Demographic distribution of study subjects according to age and gender and weight

Age groups		Male	Female	Total
	16-30 years	83(27.7%)	92(30.7%)	175(58.3%)
31-50 years	46(15.3%)	65(21.7%)	111(37.0%)	
>51 years	5(1.7%)	9(3.0%)	14(4.7%)	
Total	134(44.7%)	166(55.3%)	300	
Chi Sqaure Value		1.461		
P Value		0.482(
Weight groups				
	<50 kg	20(6.7%)	51(17.0%)	71(23.7%)
51-70 kg	94(31.3%)	106(35.3%)	200(66.7%)	
>71 kg	20(6.7%)	9(3.0%)	29(9.7%)	
Total	134(44.7%)	166(55.3%)	300	
Chi Sqaure Value		15.187		
P Value		0.001		

Among total 300 patients, ULBT predicted 137 easy intubations, out of which 94 (TN) easy intubations predicted correctly and 43 (FN) intubations predicted incorrectly and ULBT predicted total 163 difficult intubations, out of which number of difficult intubation predicted correctly and number of intubations predicted incorrectly are 51 (TP) and 112 (FP) respectively.

Among total 300 patients, IID predicted total 281 easy intubations out of that number of truly predicted easy intubations are 196 (TN) and number of easy intubations predicted falsely are 85 (FN), in addition to that IID predicted total 19 difficult intubations out of which 9(TP) intubations are correctly predicted as difficult intubations and 10 intubations are predicted wrong as difficult intubations (FP).

During laryngoscopy, Cormack & Lehane grading was evaluated, according to which 206 laryngoscopies are of grade 1 and out of 206, 168 intubations were easy and 38 intubations were difficult. In grade 2 there are total 79 laryngoscopic veiw and among them 31 intubations were found to be easy and 48 intubations were difficult. We found total 15 laryngoscopies under grade 3 and out of that number of easy and difficult intubations were 7 and 8 respectively. There was Highly significant association.(P=0.001). We did not mention Cormack Lehane grade 4 in the table because we had not find any laryngoscopic view of grade 4.

Table 2: Association between Intubation & Upper Lip Bite Test (ULBT), Inter Incisor Distance and difficult Intubation prediction and correlation of the results of both the test with Cormack and Lehane grading system.

ULBT	Total no of Intubations predicted to be easy	137	No of easy intubation predicted correctly (TN)	94
			No of easy intubation predicted incorrectly (FN)	43
	Total no of Intubations predicted to be difficult	163	No of difficult intubation predicted correctly (TP)	51
			No of difficult intubation predicted incorrectly (FP)	112
Chi Square Value		0.336		
P Value		0.985		
IID	Total no of Intubations predicted to be easy	281	No of easy intubation predicted correctly (TN)	196
			No of easy intubation predicted incorrectly (FN)	85
	Total no of Intubations predicted to be difficult	19	No of difficult intubation predicted correctly (TP)	9
			No of difficult intubation predicted incorrectly (FIP)	10

	Chi Square Value	2.424	
	P Value	0.119	
Cormack Lehane (CL) Gradings	Scores	intubations	
	Score 1	206	Easy 168
			Difficult 38
	Score 2	79	Easy 31
			Difficult 48
	Score 3	15	Easy 7
		Difficult 8	
Chi - square		51.068	
P value		0.001	

Figure 4

Table 3: Sensitivity, Specificity of ULBT in prediction of difficult Intubation by ROC Curve

Area under the curve Parameter	Upper Lip Bite Test (ULBT)	Inter Incisor Distance (IID)
ROC Curve Area	0.519	0.524
Sensitivity	54.3%	9.6%
Specificity	45.6%	95.1%
+ VE Predictive Value	31.2%	47.4%
-VE Predictive Value	68.6%	69.7%
P Value	0.597(NS)	0.512(NS)
Internal Consistency (Reliability) between ULBT & IID, Cronbach's alpha value	0.110 (Very poor internal consistency)	
P value	0.158(NS)	

Figure 3

Table 3 reveals Sensitivity, Specificity of ULBT in prediction of difficult Intubation by ROC Curve. Area under the ROC curve (AUC) is a combined measure of sensitivity and specificity. AUC is a measure of the overall performance of a diagnostic test and is interpreted as the average value of sensitivity for all possible values of specificity. It can take on any value between 0 and 1. The closer AUC is to 1, the better the overall diagnostic performance of the test, and a test with an AUC value of 1 is one that is perfectly accurate. AUC was 0.519. Sensitivity of ULBT was 54.3% in prediction of difficult Intubation i.e true positive while specificity of ULBT was 45.6% in prediction of easy intubation i.e true negative. It concludes that it is good in the detection of true positive and true negative cases both and there is statistically no significant difference(P=0.597). Sensitivity, Specificity of Inter Incisor Distance (ID) in prediction of difficult Intubation by ROC Curve. Table 4 reveals Sensitivity, Specificity of Inter Incisal Distance (ID) in prediction of difficult Intubation by ROC Curve. AUC was 0.524. Sensitivity of ID was 9.6 % in prediction of difficult Intubation i.e true positive while specificity of ID was 95.1% in prediction of easy intubation i.e true negative. It conclude that it is very poor in the detection of true positive and it is very good in detection of true negative cases and there is statistically no significant difference (P=0.512). Sensitivity of ULBT was more i.e 54.3% as compare to Inter Incisal Distance (ID) which had only 9.6% sensitivity in prediction of difficult Intubation. Specificity of ID was more i.e 95.1 as compare to ULBT which had 45.6% in prediction of easy intubation.

We measured Internal Consistency (Reliability) of ULBT & IID by Cronbach's Alpha in prediction of difficult Intubation. Intraclass correlation coefficient , Cronbach's Alpha (α) was only 0.111 which shows that ULBT & ID have very Poor internal consistency in prediction of difficult Intubation

DISCUSSION

It has always been a primary concern for the anesthesiologist to anticipate the difficult airway prior to intubation to minimize the chances of unexpected adverse events due to unpredicted difficult intubation.,^{1,7,8}

Many preoperative airway assessment methods are developed, identified and studied till now such as inter-incisor gap, mallampati classification, head and neck movement, horizontal length of mandible, sternomental distance, and thyromental distance may be used to predict difficult intubations, but sensitivity and positive predictive value (PPV) of these tests are not adequate, moreover false positive values are high.^{1,7}

Many studies are still going on to investigate simple bedside airway assessment tests, either single or used with other tests in different combinations to predict difficult endotracheal intubation, which have high sensitivity, specificity, PPV, negative predictive value (NPV), likelihood ratio (LR) with minimal false positive, and false negative values.^{9,10}

We included 300 patients in our study, and the incidence of difficult intubation was 31.3% with no failed intubation. Smita Prakash et al studied incidence specifically on Indian population (N=330) reported that, incidence of difficult laryngoscopy was 9.7% and incidence of difficult intubation was 4.5% in patients with apparently normal airways.¹¹

In a metanalysis conducted by Toshiya Shiga, They had taken total 35 studies and 50,760 patients and reported overall incidence of difficult intubation was 5.8% for apparently normal patients, 3.1% for obstetric patients and 15.8% for obese patient¹².

The incidence of difficult intubation may vary depending upon the criteria defined for difficult intubation, due to racial variation, age of patients, e.t.c⁷. For the prediction of difficult airway ideal test would have very high sensitivity, specificity and positive predictive value. Various studies are available on the literature, they compared so many tests with each other and in different combinations to investigate the sensitivity, specificity and positive predictive value of the tests. In our study we compared ULBT with IID and investigated their sensitivity, specificity and positive predictive value to predict difficult intubation by using ROC curve.

In our study, sensitivity of the upper lip bite test was 54.3%, specificity was 45.6%, positive predictive value was 31.2% and negative predictive value was 68.6% for the difficult intubation anticipation. It is good in the detection of true positive and true negative cases both and there is statistically no significant difference (P=0.597)

Study done by Jigisha Prahladrai et al reported, ULBT is the best predicting test with highest sensitivity and specificity (96.64% and 82.35%, respectively). ULBT has also good PPV, NPV, RR, and LR compared to other predictive tests.⁷

In one more study conducted by Zahid Husain⁵ et al, they studied different diagnostic tests (ULBT, thyromental distance and sternalmental distance e.t.c). They found ULBT had the highest sensitivity (81.5%), specificity (91.4%) and negative predictive value (37.5%) compared with the other tests. The positive predictive value (98.7%) for all the tests was lower than the ULBT, results were not comparable to our study may be due to their large sample size of the study subjects (N=4500).

Wilson¹³ et al described five risk factors which are important in the prediction of difficult airway, including weight (p=0.05), head and neck movement (p=0.001), jaw movement (p=0.001), receding mandible (p=0.001) and buck teeth (p=0.001). However, our technique, Upper Lip Bite Test, assess both jaw subluxation as well as the presence of buck teeth simultaneously, hence increasing its predictive value and the reliability.

The ULBT can be divided in 3 grades depending on the ability of the lower teeth to bite the upper teeth. The ULBT appeared high in grade, if the patient had buck teeth, receding mandible or difficulty in opening the mouth¹⁴.

Study done by Salimi A (N=350), investigated the Sensitivity, specificity, positive and negative predictive values, and accuracy were 70%, 93.3%, 39%, 98.1%, and 92.6%, respectively, for the ULBT, also not comparable to our study even though our sample size (N=300) is comparable.

In our study we also investigated the sensitivity (9.6%), specificity (95.1%), positive predictive value (47.4%) and negative predictive value (69.7%) for the IID to predict difficult intubation.

Merah¹⁶ et al found that sensitivity, specificity and positive predictive value of IID is 30%, 97% and 28% respectively¹⁶ specificity (95.1%) of the IID is comparable to our study however positive predictive value of IID is 47.4% which is 19.4% higher than this study. Variations may be because of inter observer variations, racial and ethnic characteristics or

some other factors.

Study conducted by Sarka Fritscherova¹⁷ at al reported in the the sensitivity, specificity and positive predictive value for inter incisor distance is 79.7%, 71.6% and 73.8 5 respectively. Which is not comparable with our study. Negative predictive value in this study was 77.5% and in our study we found negative value of 69.7 is for IID which is not very far from that study.

The three classes for the new test (ULBT) are clearly demarcated and delineated, making inter observer variations highly unlikely similarly when using IID. It has also a less chance of considerable inter observer variations. Sensitivity of IID was 9.6% in prediction of difficult intubation i.e true positive while specificity of IID was 95.1% in prediction of easy intubation i.e true negative. It is very poor in the detection of true positive and it is very good in detection of true negative cases and there is statistically no significant difference (P=0.512)

The possible limitation of this study, and any clinical or bedside study, is that patients do not completely understand the instructions. We suggest that the anaesthesiologist demonstrate the test, thereby enabling patient compliance. ULBT is difficult to understand for some patients. It's a subjective test. Patients feel little embarrassed to perform this test. Sometimes patients do not cooperate

We believe that a precise, tangible, and practically workable test would decrease differences between various examiners' observations.

CONCLUSION

The ULBT has an inherently larger level of accuracy compared with the IID. The ULBT could easily predict 54.3% of difficult intubations and could, predict 45.6% of easy intubations. IID could predict only 9.6% difficult intubations but IID is better to rule out easy intubations (95.1%). In our study we compared ULBT with the IID but suggest that it be compared with the other prevailing tests as well which are often used to assess difficult intubations.

REFERENCES

- Gupta S, Sharma KR, Jain D. Airway assessment: Predictors of difficult airway. *Indian J Anaesth*. 2005;49:257-62
- Caplan RA, Posner KL, Ward RJ, Cheney FW. Adverse respiratory events in anesthesia: A closed claims analysis. *Anesthesiology*. 1990;72:828-33
- Cook TM, Mac Dougall-Davis SR. Complications and failure of airway management. *British Journal of Anaesthesia*. 2012 Dec 1;109(1):168-85
- Khan RM. Airway assessment. In: Khan RM, editor. *Airway Management*. 4th ed. Hyderabad: Paras Medical Publisher; 2011. p.14.
- Zahid Hussain Khan, Shahriar Arabi. Diagnostic value of the upper lip bite test in predicting difficulty in intubation with head and neck landmarks obtained from lateral neck X-ray. *Indian J Anaesth*. 2013;57(4): 381-86.
- Mallampati SR, Gatt SP, Guigino LD, Desai SP, Waraksa B, Freiberger D. A clinical sign to predict difficult tracheal intubation: A prospective study. *Can Anaesth Soc J*. 1985;32:429-34
- Jigisha Prahladrai Badheka, Pratik M Doshi, Ashutosh M Vyas, Nirav Jential Kacha, Vandana S Parmar. Comparison of upper lip bite test and ratio of height to thyromental distance with other airway assessment tests for predicting difficult endotracheal intubation. *Indian journal of critical care medicine*. 2016;20(1):3
- Jeffrey L. Apfelbaum, Carin A. Hagberg, Robert A. Caplan, Casey D. Bliit, Richard T. Connis. Practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. *Anesthesiology*. 2003; 98:1269-77
- Domi R. The best prediction test of difficult intubation. *J Anaesthesiol Clin Pharmacol* 2010;26:193-96.
- Khan ZH, Maleki A, Makarem J, Mohammadi M, Khan RH, Zandieh A. A comparison of the upper lip bite test with hyomental/thyrostermental distances and mandible length in predicting difficulty in intubation: A prospective study. *Indian J Anaesth* 2011;55:43-6
- Smita Prakash, Amitabh Kumar, Shyam Bhandari, Parul Mullick, Rajvir Singh, Anoop Raj Gogia. Difficult laryngoscopy and intubation in the Indian population: An assessment of anatomical and clinical risk factors. *Indian journal of anaesthesia*. 2013;57(6):569-75
- Toshiya Shiga, MZen'ichiro Wajima, Tetsuo Inoue, Atsuhiko Sakamoto. Predicting Difficult Intubation in Apparently Normal Patients: A Meta-analysis of Bedside Screening Test Performance. *Anesthesiology*. 2005;103:429-37
- Willson ME, Spiegelhalter O, Robertson IA, Lesser P. Predicting difficult intubation. *Br J Anaesth* 1988;61:211-16.
- Khan ZH, Kashfi A, Ebrahimkhani E. A comparison 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: 595-99.
- Salimi A1, Farzanegan B, Rastegarpour A, Kolahi AA. Comparison of the upper lip bite test with measurement of thyromental distance for prediction of difficult intubations. *Acta Anaesthesiol Taiwan*. 2008 Jun;46(2):61-5
- Merah NA, Wong DT, Ffoulkes-Crabbe DJ, Kushimo OT, Bode CO. Modified Mallampati test, thyromental distance and inter-incisor gap are the best predictors of difficult laryngoscopy in West Africans. *Canadian journal of anaesthesia- Journal canadien d'anesthésie*. 2005 Mar;52(3):291-6.
- Sarka Fritscherovaa, Milan Adamusa*, Katerina Dostalova, Jirina Koutnaa, Lumir Hrabalek, Jana Zapletalovac, Radovan Uvizla, Vladimir Janouta. CAN DIFFICULT INTUBATION BE EASILY AND RAPIDLY PREDICTED? *Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub*. 2011; 155