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Original Research Article

A prospective observational study to predict difficult intubation using simple non-invasive tests

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Abstract

Introduction: Airway assessment is the first step in successful airway management. Several anatomical and functional maneuvers can be performed to estimate the difficulty of endotracheal intubation. We aimed to elucidate the role of upper lip bite test (ULBT), hyomental/thyrosternal (HMD/TSD) distances, the mandible length (ML) and their correlation in predicting difficulty intubation in relation to laryngoscopic view as per Cormack Lehane (CL) grading.
Methods: After institutional approval informed consent obtained from160 consecutive patients aged between 20 to 60 years of ASA grading I and II scheduled for elective surgical procedures requiring tracheal intubation and meeting the inclusion criteria were enrolled in this study. Each patient was evaluated regarding ULBT, HMD, TSD, ML. Larngoscopy was assessed and findings were graded according to Cormack and Lehane's grading system.
Results: The above study states the Negative Predictive Value (NPV) and Positive Predictive Value (PPV) of ULBT were found to be 86.7% and 94.5% respectively. Specificities of ULBT, HMD, TSD and ML were found to be 98.6%, 97.8%, 96.4% and 97.8% respectively. Diagnostic accuracy of ULBT, HMD, TSD, ML were found to be 93.8%, 88.1%, 84.4% and 91.3% respectively.
Conclusion: It concludes that high specificity, NPV, PPV and Accuracy of ULBT as revealed in this study could be good rationale for its application in the prediction of difficulty or easiness in the intubation.
Keywords: ULBT, HMD, TSD, ML, CL Grading, Difficult intubation.

1. Introduction

Analysis of the American society of Anaesthesiologist "closed claim project" database has shown that the development of an airway emergency increases the odds of death or brain damage by 15 folds, therefore one of the fundamental responsibility of the anaesthesiologist is to establish airway patency and to ensure adequate ventilation and oxygenation [1]. The reported incidence of difficult intubation ranges from 0.5 to 18% [2-6].

Airway assessment is the first step in successful airway management. Several anatomical and functional maneuvers can be performed to estimate the difficulty of endotracheal intubation. We aimed to elucidate the role of upper lip bite test (ULBT), hyomental/thyrosternal (HMD/TSD) distances, mandible length (ML), their possible correlation in predicting difficult intubation and its direct correlation with difficult laryngoscopic view as per Cormack Lehane (CL) grading. Aim is also to find out the best predictor of difficult intubation amongst the Upper Lip Bite test, Hyomental distance, Thyrosternal distance and Mandibular length on the basis of Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value, Accuracy.

2. Materials & methods

After obtaining the approval from our institution's ethical committee and informed consent from the patients, 160 male and female patients of ASA physical status I or II, aged 20–60 years, scheduled to undergo elective surgery under general anaesthesia between August 2015 and August 2016 were considered for enrollment. All the procedures of the current study were conducted in accordance with Helsinki declaration. Edentulous patients, those unable to open the mouth, patients with pharyngolaryngeal pathology, with a history of thyroid or neck surgery, pregnancy, or with limitation of temporo-mandibular and atlanto-axial joints were excluded from the study. All patients included in this study underwent a routine pre anesthetic checkup. Airway assessment included Mouth Opening, Modified Mallampati Class, Upper Lip Bite Test (ULBT), Hyomental distance, Thyrosternal distance and Mandibular length.

The ULBT class was determined according to the following criteria: class I, lower incisures can bite the upper lip above the vermilion line; class II, lower incisors can bite the upper lip below the vermilion line; and class III, lower incisors cannot bite the upper lip [7]. The HMD was measured in supine position with the head fully extended and with the mouth closed as the straight distance from the lower border of the mandibular mentum to the superior border of the hyoid bone in centimetres. The TSD was also measured in the supine position with the head fully extended and the mouth closed as the distance between prominentia laryngea of the thyroid cartilage and incisura jugularis of the sternal bone. ML was measured from the angle of mandible to the tip of the chin [4]. ULBT of class III, HMD < 3.5 cm,< 6.5 cm, and ML< 9 cm were considered as markers of a potentially difficult intubation based on receiver operating characteristic analysis (ROC).

After induction of anaesthesia, anaesthesiologist blinded to the pre operative measurements attempted laryngoscopy with Macintosh size 3 blade and determined the laryngoscopic view using the Cormack -Lehane grading system as follows : Grade 1 : full view of the glottis, Grade II : Glottis partly exposed, anterior commissure not seen, Grade III : Only epiglottis seen, Grade IV : Epiglottis not seen. No external laryngeal pressure was applied while reporting laryngeal view. C-L grade I and II were considered as "easy intubations" and C-L grading III and IV were considered as "difficult intubations".

3. Result

Statistical analysis was performed using SPSS software. Data was analyzed using kappa value and calculation of sensitivity, specificity, positive productive value (PPV), negative predictive value (NPV) and accuracy with their 95% confidence interval (95%CI). Kappa values measuring agreement between tests were calculated. P value less than 0.05 was considered significant. ROC was applied for determination of cut points. Out of the total 160 patients 76 were females and 84 were males; 121 were ASA I and 76 were ASA II. Difficult laryngoscopy (CL grading III and IV) was seen in 21 patients but a difficult intubation was encountered in none of the patients.

Table 1: Percentage of patients according to grades of Cormack Lehane grading

Cormack and Lehane Grading	N	%
Grade I	104	65.0%
Grade II	35	21.9%
Grade III	20	12.5%
Grade IV	1	0.6%
Total	160	37.5%

Table 2: Comparison of upper lip bite test (ULBT) and Cormack Lehane (CL) grading in prediction of easy/difficult intubation

ULBT	Cormack and Lehane Grading		Total
	Easy	Difficult	
Easy	137	8	145
Difficult	2	13	15
Total	139	21	160
Kappa statistic - 0.688 ; p-value < 0.01			

Table 3: Comparison of Hyomental distance (HMD) and Cormack Lehane (CL) grading in prediction of easy/difficult intubation

HMD	Cormack and Lehane Grading		Total
	Easy	Difficult	
Easy	136	16	152
Difficult	3	5	8
Total	139	21	160
Kappa statistic - 0.294 ; p-value < 0.01			

Table 4: Comparison of Thyrosternal distance (TSD) and Cormack Lehane (CL) grading in prediction of easy/difficult intubation

TSD	Cormack And Lehane Grading		Total
	Easy	Difficult	
Easy	134	20	154
Difficult	5	1	6
Total	139	21	160
Kappa statistic - 0.017 ; p-value - 0.576			

Table 5: Comparison of Mandible Length (ML) and Cormack Lehane (CL) grading in prediction of easy/difficult intubation

ML	Cormack And Lehane Grading		Total
	Easy	Difficult	
Easy	136	11	147
Difficult	3	10	13
Total	139	21	160
Kappa statistic - 0.542 ; p-value < 0.01			

4. Discussion

This study was designed to evaluate the efficacy of ULBT, HMD, TSD, ML in predicting difficult intubation to draw possible correlation between the tests and C-L grades. Out of the total 15 patients of who had a ULBT of class III ,13 were found to have a C-L grade of III or IV reflecting a strongly positive correlation between a higher ULBT class and difficult laryngoscopic view. Again accuracy of ULBT was found to be higher than other test which testifies that ULBT carries lower false positive and negative value in predicting a difficult laryngoscopic view. In patients who had ULBT I and II the probability of difficult laryngoscopic view was exceedingly low which is in agreement with earlier study given by Khan ZH, Cormack RS, Huh J [7-9].

All other tests also had a high NPV reflecting that they correlated well with the ease of laryngoscopy. Compared to HMD and ML which had a significant agreement with laryngoscopic view there was no agreement between TSD and laryngoscopic grading. Association of ML with difficult intubation was evaluated in few studies but no significant findings were reported [10-11].

But in my study ML is showing diagnostic accuracy and NPV of 91.3% and 92.5% respectively. Kappa value of 0.542 p <0.01 so agreement is existed but comparatively weaker with ULBT (kappa value of 0.688, diagnostic accuracy of 93.8% NPV of 94.5%).

5. Conclusion

Compared to the other test like HMD, TSD, ML which are quantitative in nature, ULBT is an independent and qualitative parameter, thereby enhancing its potential value of being diagnostic in airway assessment.

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