

Comparison of upper lip bite test with Mallampati test in the prediction of difficult intubation at a tertiary care hospital of Pakistan

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Abstract

Objective: To determine the accuracy of the Upper lip bite test and Mallampati test in predicting difficult endotracheal intubation.

Methods: The cross-sectional study was conducted at the Aga Khan University Hospital, a tertiary care facility in Karachi, Pakistan. Between June 1, 2007 and May 31, 2008, 324 adult patients undergoing elective surgeries requiring general anaesthesia with endotracheal intubations were enrolled. Pre-operatively upper lip bite test and Mallampati test were performed for the assessment of airway by a specifically trained observer. Laryngoscopic view was rated by using Cormack and Lehane laryngoscopic grading once the patient was fully anaesthetised using standard anaesthesia technique. Completed data sheets were analysed using SPSS version 10. McNemar test and rank correlation coefficient were used to compare the upper lip bite test and the Mallampati test.

Results: Of the 324 patients, 56 (17.3%) were classified as cases of difficult intubation. Upper lip bite test showed significantly higher accuracy, positive predictive value and negative predictive value than the Mallampati test. Comparison of specificity, however, did not reveal any significant difference between the two tests.

Conclusion: Upper lip bite test is an acceptable alternative as a single test to predict difficult intubation in addition to other tests of airway assessment for the prediction of difficult intubation.

Keywords: Upper lip bite test, Mallampati, Difficult intubation. (JPMA 62: 1012; 2012)

Introduction

Difficult or failed tracheal intubation has been identified as one of the most important causes of death or permanent brain damage during anaesthesia.¹ Difficult intubation has been defined as: (i) A requirement for more than one attempt of intubation or use of special blades/aids; (ii) restricted view on laryngoscopy using Cormack and Lehane classification.² Reported incidence of difficult laryngoscopy and endotracheal intubation varies from 1.5% to 13% in patients undergoing general anaesthesia.³ The incidence of abandoned/failed intubation is approximately 0.05%-0.35% whereas that of 'can't ventilate' or 'can't intubate' is around 0.01%-0.02%.⁴

Many methods have been used to predict difficult laryngoscopy and tracheal intubation, including Mallampati test, interincisal gap, subluxation of mandible, thyromental distance, length of mandibular rim, chin protrusion and atlanto-occipital extension.⁵ In clinical settings, the assessment should be simple and convenient to the clinician and of high predictive power.⁶ The Mallampati test is a commonly used test to predict difficult intubation.⁵

Recently upper lip bite test have been described as a useful tool for the prediction of difficult intubation.⁵ We,

therefore, designed the study to compare the two tests for predicting difficult intubation in adult patients undergoing elective surgeries requiring endotracheal intubation.

Patients and Methods

After approval from the Ethical Review Committee of Aga Khan University Hospital, Karachi, Pakistan and written informed consent, 324 adult patients (>18 years of age) undergoing elective surgeries requiring general anaesthesia with endotracheal intubations were enrolled during June 1, 2007 and May 31, 2008. Edentulous patients, those unable to open the mouth or with limited cervical movement or requiring rapid sequence induction were excluded.

Both upper lip bite test and Mallampati test was done pre-operatively by the primary investigator who was not involved in per-operative clinical care of the patients. Classification of the oropharyngeal view was done according to the Mallampati test for which the patients were asked to sit up and open their mouth and protrude their tongue without phonation. The oropharyngeal structures were visualised with the help of flash light and graded accordingly. Grade I: soft palate, fauces, uvula and pillars; grade II: soft palate, fauces and uvula; grade III: soft palate and base of uvula; grade IV: soft palate was not visualised. Grade I and II predicted easy

intubation, while grade III and IV predicted difficult intubation.⁷

Classification of the jaw protrusion was done by the upper lip bite test. In this examination, patients were asked to bite their upper lip with lower incisors and was graded accordingly. Grade I: lower incisors could bite upper lip above vermilion line; grade II: lower incisors could bite upper lip below vermilion line; grade III: lower incisors could not bite the upper lip. Grade I and II predicted easy intubation, while grade III predicted difficult intubation.⁵

Anaesthesiologists having at least one-year experience in anaesthesia was allowed to do laryngoscopy and intubation. They were unaware of the pre-operative upper lip bite test and Mallampati test grades of the patient.

All patients were anaesthetised using standard anaesthesia technique with full muscle relaxation. Laryngoscopy was done with Macintosh laryngoscope blade size 3 or 4, and laryngoscopic view of the first attempt at intubation was graded and recorded according to Cormack and Lehane classification with the patient in the sniffing position but without applying external laryngeal pressure. Grade I: full view of glottis; grade II: glottis partly exposed (anterior commissure not seen); grade III: Only epiglottis seen, grade IV: epiglottis not seen. Grade I and II represented easy intubation, while grades III and IV represented difficult intubation.⁵

The completed data sheets were analysed by SPSS version 10 software. The sensitivity, specificity, positive and negative predictive values (NPV), and accuracy with

classification.

Results

Of the total, 56 (17.3%) had difficult intubation at laryngoscopy grade III and IV.

The mean Body Mass Index of the patients was 24.9 (15.8 ± 33.7) with no significant difference in easy versus difficult intubations and other biometric data. (Table-1).

Based on upper lip bite test 256 (79%) patients were predicted to have easy laryngoscopy [grade I in 97(37.8%) and grade II in 159(62.2%) patients respectively], and 68(21%) had grade III upper lip bite test, predicting difficult laryngoscopy.

Compared to the upper lip bite test, easy laryngoscopy were predicted in 291(89.9%) patients [140(48%) and 151(52%) patients having grade I and II Mallampati respectively], while 33 (10.1%) had grade III Mallampati, predicting difficult laryngoscopy. No patient had grade IV Mallampati.

On the basis of Cormack & Lehane laryngoscopic view grading, easy laryngoscopy were found in 268(82.7%) patients [grade I in 231(86.2%) and grade II in 37(13.8%) patients respectively], while 56(17.3%) patients had grade III and none had grade IV intubation.

Among these 56 patients having difficult laryngoscopic view, 11(19.6%) had grade III Mallampati score, whereas 49(87.5%) had grade III upper lip bite test (Table-2).

All of these patients were successfully intubated after a mean number of 2 laryngoscopic attempts (range 1-3),

Table-1: Biometric patients data.

	All patients N= 324	Cormack & Lehane Grade I & II Easy laryngoscopy	Cormack & Lehane Grade III & IV Difficult laryngoscopy
Men (%)	125 (38.5%)	99 (36.9%)	26(46.4%)
Women (%)	199 (61.5%)	169 (63.1%)	30 (53.6%)
Age (years) (95% CI)	43 (18-85)	41.73 (18-85)	49.24 (20-80)
Height (cms) (95% CI)	162 (142-186)	162.1 (142-186)	162.6 (144-182)
Weight (kgs) (95% CI)	65 (40-95)	65.5 (40-93)	66.3 (44-95)

n= numbers, %= percentage, cms= centimetres, kgs= kilogramme, CI= confidence interval.

95% confidence interval were calculated to see which test was better. A p value < 0.05 was treated as significant. The sample size was calculated to achieve 80% power and to detect a difference of 0.08(8%) between upper lip bite test and Mallampati test. McNemar test and rank correlation coefficient were used to compare the association and correlation between the two tests. Both these tests were used to predict difficult airways and ultimately were compared with the Cormack and Lehane

Table-2: Relationship between the results of two predicting tests and laryngoscopy grades.

Predicting test	Laryngoscopic grade Easy (I - II)	Laryngoscopic grade Difficult (III- IV)
Upper lip bite test		
Easy (I- II)	249	7
Difficult (III)	19	49
Mallampati test		
Easy (I- II)	246	45
Difficult (III –IV)	22	11

Table-3: Comparison of Predictive values for the ULBT and MT to predict difficult intubation.

Statistical Test	Upper lip bite test	Mallampati Test
True Positive (TP)	49 (15.1%)	11 (3.4%)
False Positive (FP)	19 (5.9%)	22 (6.8%)
True Negative (TN)	249 (76.9%)	246 (75.9%)
False Negative (FN)	7 (2.1%)	45 (13.9%)
Accuracy %	91.9	79.3
Sensitivity % (95% CI)	87.5 (74.9-94.3)	19.6 (10.9-33.4)
Specificity % (95% CI)	92.9 (88.9-95.5)	91.8 (87.6-94.6)
Positive Predictive Value (PPV) % (95% CI)	71.6 (59.1-81.7)	33.3 (18.6-51.9)
Negative Predictive Value (NPV) % (95% CI)	97.3 (94.2-98.8)	84.8 (80-88.6)

CI= Confidence interval. ULBT= Upper lip bite test. MT= Mallampati test.

requiring external laryngeal pressure in 40(71.4%) and use of gum elastic bougie in the remaining 16(28.6%). No patient had post-operative morbidity and mortality associated with difficult intubation and there was no failed intubation.

Using the McNemar's test, statistically significant differences were observed between the two tests ($p < 0.05$), showing higher level of sensitivity (87.5%) and accuracy (91.9%) for the upper lip bite test than the Mallampati test, which has sensitivity and accuracy of 19.6% and 79.3% respectively, indicating that the upper lip bite test is a good predictor of difficult intubation (Table-3).

Discussion

Difficult or failed tracheal intubation has been identified as one of the most important causes of death or permanent brain damage during anaesthesia.¹ Reported incidence of a difficult laryngoscopy and endotracheal intubation varies from 1.5% to 13% in patients undergoing general anaesthesia.^{3,6,8,9} This variation might be due to the different reference standard used for difficult intubation among studies which were based on Cormack and Lehane intubation grades,¹⁰ number of laryngoscopic attempts¹¹ and use of Backward Upward Rightward Pressure (BURP) manoeuvre.⁵ In our study, the incidence was found to be 17.3% which is higher compared to previous studies.^{3,7,8}

Many methods to assess the airway, such as Mallampati test, thyromental distance, interincisor gap, length of mandibular rim, chin protrusion, atlanto-occipital extension and upper lip bite test⁵ have been described in literature, but all have their limitations and no single test alone is 100% sensitive and specific. Combination of these different tests may increase their predictive value for difficult intubation.

The objective of our study was to determine the accuracy of upper lip bite test (ULBT) and Mallampati test

(MT) in predicting difficult intubation and relating their sensitivity, specificity and positive predictive values (PPV) against actual laryngoscopic view by using the gold standard, Cormack and Lehane grading.

The results showed that the accuracy (91.9%), sensitivity (87.5%), PPV (71.6%) and NPV (97.3%) of upper lip bite test were higher than the Mallampati test, while specificity of both tests were similar.

A similar study compared the ULBT and modified MT, and showed that former was more accurate (88.7% versus 66.8%), while sensitivity, NPV and PPV were similar in both tests.⁵

Accuracy, specificity and NPV of ULBT in our study is comparable to an earlier study¹² (91.9%, 92.9% and 97.3% versus 88%, 88.7% and 98.4% respectively), and some other studies.^{10,13,14} Sensitivity (87.5% versus 76.5%) and PPV (71.6% versus 28.9%) of ULBT was higher in our study compared to earlier studies.^{5,10,12,13} The probable reasons are lack of interobserver variance in our study as well as ethnic difference. The anthropological literature well documents human ethnic craniofacial variation, and the dental literature confirms significant racial variation in mandibular and maxillary morphology and morphometry.¹⁵⁻¹⁷

MT accuracy, specificity and PPV were higher (79.3%, 91.8% and 33.3% versus 67.7%, 82.4% and 13% respectively), while sensitivity and NPV were less in our study (19.6% and 84.8% versus 82.4% and 98.4% respectively) compared to literature.^{5,10}

Although sensitivity of MT was significantly less in our study compared to earlier studies,^{5,10} it was comparable to others,^{18,19} who found it to be 25% and 27% respectively. These studies were done in Asian population and may have reflected some ethnic correlation with sensitivity of MT. This possibility is also supported by the finding of another study³ which also found low sensitivity (42%) of MT.

Another probable reason for "low sensitivity" in our study may be the absence of interobserver reliability factor as all the patients were assessed by the primary investigator. The effect of interobserver reliability has been confirmed by studies^{1,10,20} which have shown poor interobserver reliability for MT compared to other tests. The main strengths of our study were that both ULBT and MT were performed by the primary investigator, which reduced the risks of interobserver variation. The limitation of our study is that sometimes patients do not completely understand and follow the instructions as is true for MT, but it can be minimised if the anaesthesiologist can demonstrate the test in front of the patient to increase patient compliance and understanding. The other limitations of ULBT is that it can't be performed in edentulous, patients with restricted mouth-opening as well in

non-cooperative patients.

Conclusion

The study showed that ULBT has a higher level of accuracy compared to MT. Due to better sensitivity and PPV, the ULBT appears to be a better choice for the pre-operative airway assessment with its limitation that this cannot be performed in certain patients. It can easily be performed as a bedside test due to its simplicity and easy interpretation and can be used alone or in combination with other tests for the prediction of difficult intubation.

References

1. Hilditch WG, Kopka A, Crawfordet, Asbury AJ. Interobserver reliability between a nurse and anaesthetist of tests used for predicting difficult tracheal intubation. *Anaesthesia* 2004; 59: 881-4.
2. Yentis SM. Predicting difficult intubation worthwhile exercises or pointless ritual. *Anaesthesia* 2002; 57: 105-9.
3. Siddiqui R, Kazi WA. Predicting difficult intubation, a comparison between Mallampati classification and Wilson Risk-Sum. *J Coll Physician Surg Pak* 2005; 15: 253-6.
4. Naguib M, Scamman FL, O' Sullivan C, Aker J, Ross AF, Kosmach S, et al. Predictive performance of three multivariate difficult tracheal intubation. *Anesth Analg* 2006; 102: 818-24.
5. 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: 595-9.
6. Hung O, Mills J. Predictions and clinical decisions: a fine balance. *Can J Anaesth* 2000; 47: 721-4.
7. Samsoon GL, Young JRB. Difficult tracheal intubation: a retrospective study. *Anaesthesia* 1987; 42: 487-90.
8. Wong SH, Hung CT. Prevalence and prediction of difficult intubation in Chinese women. *Anaesth Intensive Care* 1999; 27: 49-52.
9. Ezri T, Evron S, Hadad H, Roth Y. [Tracheostomy and endotracheal intubation: a short history]. *Harefuah* 2005; 144: 891-3.
10. Elberhart LH, Arndt C, Cierpka T, Schwaneckamp J, Wulf H, Putzke C. The reliability and validity of the upper lip bite test with Mallampati classification to predict difficult laryngoscopy: an external prospective evaluation. *Anesth Analg* 2005; 101: 284-9.
11. Brodsky JB, Lemmens HJ, Brock Utne JG, Vierre M, Saidam LJ. Morbid obesity and tracheal intubation. *Anesth Analg* 2002; 94: 732-6.
12. Khan ZH, Mohammadi M, Rasouti MR, Farrokhnia F, Khan RH. The diagnostic value of the upper lip bite test combined with sternomental distance, thyromental distance, and interincisor distance for prediction of easy laryngoscopy and intubation: a prospective study. *Anesth Analg* 2009; 109: 822-4.
13. Salimi A, 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; 46: 61-5.
14. Myneni N, O'Leary AM, Sandison M, Roberts K. Evaluation of the upper lip bite test in predicting difficult laryngoscopy. *J Clin Anesth* 2010; 22: 174-8.
15. Hanihara T, Ishida H, Dodo Y. Characterization of biological diversity through analysis of discrete cranial traits. *Am J Phys Anthropol* 2003; 121: 241-51.
16. Badawi-Fayad J, Cabanis EA. Three-dimensional Procrustes analysis of modern human craniofacial form. *Anat Rec (Hoboken)* 2007; 290: 268-76.
17. Perez SI, Bernal V, Gonzalez PN. Differences between sliding semi-landmark methods in geometric morphometrics, with an application to human craniofacial and dental variation. *J Anat* 2006; 208: 769-84.
18. Vani V, Kamath SK, Naik LD. The palm print as a sensitive predictor of difficult laryngoscopy in diabetics: a comparison with other airway evaluation indices. *J Postgrad Med* 2000; 46: 75-9.
19. Yeo SW, Chong JL, Thomas E. Difficult intubation: a prospective study. *Singapore Med J* 1992; 33: 362-4.
20. Karkouti K, Rose DK, Ferris LE, Wigglesworth DF, Meisami-Fard TM, Lee H. Inter-observer reliability of ten tests used for predicting difficult tracheal intubation. *Can J Anaesth* 1996; 43: 553-9.