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Research Article

A comparison of Mallampati scoring, upper lip bite test and sternomental distance in predicting difficult intubation

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ABSTRACT

Background: Difficult or failed tracheal intubation has been identified as one of the most important causes of death or permanent brain damage during anaesthesia. The present study has aimed to compare modified Mallampati score, Upper lip bite test and sternomental distance for predicting difficult intubation in adult patients.
Methods: In this study 199 patients aged 18-60 years were recruited who were undergoing elective surgeries requiring endotracheal intubation. All patients were evaluated using modified Mallampati score, upper lip bite test and sternomental distance. Laryngoscopy was assessed by an attending anaesthesiologist blinded to the measurements and graded according to Cormack and Lehane's grading system. Specificity, sensitivity, predictive positive value (PPV), predictive negative value (PNV), accuracy and agreement with larygoscopic grading were calculated for each parameter.
Results: Specificities for modified Mallampati, upper lip bite test and sternomental distance were 65.6, 98.9 and 94%, respectively. All the tests had a NPV more than 90%, indicating that, these tests can be good predictors of easy intubation. Sternomental distance showed greatest agreement with laryngoscopic grading (kappa = 0.536, P<0.001) as well as maximum area under the ROC curve (0.955).
Conclusions: The high specificity, NPV, PPV and accuracy of sternomental distance compared to other tests makes it the single best test in predicting difficulty intubation. However, a combination of all three tests was found to be more sensitive and had higher discriminative power compared to any single test alone.

Keywords: Difficult intubation, Predictive airway test, General anesthesia

INTRODUCTION

In this era of high technology, we still face an ageless problem in anaesthesia - the difficult airway. Difficult or failed tracheal intubation is one of the most important cause of permanent brain damage during anaesthesia.[1,2] Incidence of difficult laryngoscopy and endotracheal intubation varies from 1.3% to 13% in patients undergoing general anaesthesia.[3-7]

The incidence of abandoned/failed intubation is approximately 0.05%-0.35%.[8] Endotracheal intubation may be difficult due to coexisting diseases or abnormal physical features like restricted neck or jaw movements.[8] Mallampati et al, proposed a grading system to anticipate difficult intubation, which considers visualization of faucial pillars, soft palate and base of uvula.[4] The upper lip bite test (ULBT) was proposed as a simple bed side technique by Khan et al, which involves the assessment of jaw subluxation and presence of buck teeth.[9] Savva et al, proposed sternomental distance (distance from the suprasternal notch to the mentum) as the predictor of difficult laryngoscopy and intubation.[10] Other clinical predictors of difficult intubation include thyromental distance, receding mandible, buck teeth and obesity.[11] However, there is no single airway assessment test which

can alone predict difficult airway. The search for an ideal predictive test that has ease of applicability, reliability and accuracy still continues.

Present study attempt to find out the best possible difficult airway predictor. The objective of this study is to compare modified Mallampatti score, upper lip bite test (ULBT) and Sternomental distance (SMD) in predicting difficult intubation in adult patients undergoing elective surgeries requiring general anaesthesia.

METHODS

It was a prospective, comparative, single blinded study at Government Medical College, Calicut. Institutional ethical review committee approval (ethical committee approval, dated 09th March 2011) was obtained prior to the study. Patients aged 18 to 60 years undergoing elective surgical procedures requiring general anaesthesia and belonging to ASA class I and II were included in the study.

The patient with previous history of difficult intubation, anatomical deformities of neck and face, edentulous, BMI >30 Kg/m^2, pregnant women and patient who cannot sit upright was excluded. After obtaining informed consent, participants were assessed in the preoperative holding area using modified Mallampati grading, ULBT and SMD by the principal investigator. Modified Mallampati 3 and 4, ULBT 3, SMD <12.5cm was considered as predictors of difficult intubation. Patient was then shifted to operation theatre.

An emergency airway cart was kept ready in the operation theatre, which includes McCoy laryngoscope, bougie, stylet, laryngoscope blade of different sizes, LMA (Laryngeal Mask Airway) of appropriate size, endotracheal tube of different sizes. All patients were premedicated with injection midazolam 0.5mg, injection emeset 4mg and injection gycopyrrolate 0.2mg, injection fentanyl 2mg/kg. Monitors used were SPO_2, ECG, NIBP (non-invasive blood pressure), and $ETCO_2$ (end tidal carbon dioxide) and additional monitors as required for each case. All the patients were induced with injection thiopentone sodium 5mg/kg IV.

If bag and mask ventilation was adequate, suxamethonium chloride 1.5mg/kg IV was given and ventilated with 100% oxygen. The head was placed in the sniffing morning air position and laryngoscopy was performed with a Macintosh No.3, No. 4 blade and grade of glottic view according to Cormack Lehane (C-L) classification (grade I, II, III, IV) was noted.

The experienced anesthesiologist (5years experience in anaesthesia) who documented the laryngeal view by the Cormack-Lehane classification was blinded to pre-operative airway assessment to minimize the observer bias. Cormack-lehane score III and IV is considered as difficult intubation. After assessing Cormack Lehane classification, all patients were intubated with proper sized endotracheal tube.

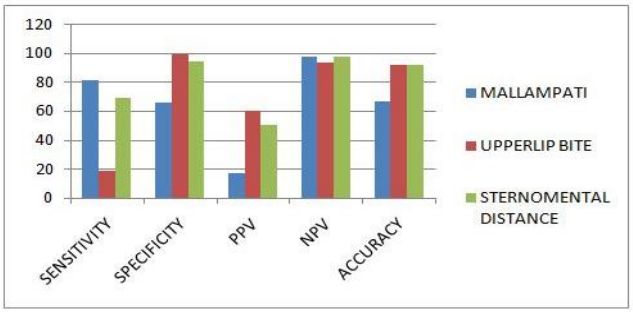
For each of the measured parameters, sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy were calculated separately and in combination. Kappa statistics were used for measuring agreement between the tests and ROC was applied for determination of cut points. A p value $\leq$0.05 was considered significant. Statistical analyses were performed using SPSS software version 16.0 (SPSS, Chicago, IL, USA).

RESULTS

Out of 199 patients included in the study, 60 (30.2%) were males and 139 (69.8%) were females. Difficult laryngoscopy (C–L grades III and IV) was seen in 16 (8%) patients. In modified Mallampati scoring, 29 (14.6%) belonged to class 1, 94 (47.2%) in class 2, 75 (37.7%) in class 3 and 1 (0.5%) in class 4.

Patients in class 1 and 2 (61.5%) are predicted as easy intubation and class 3 and class 4 (38%) are predicted as difficult intubation. In ULBT, majority belonged to class 2 [123 (61.8%)] and 71 (35.7%) belonged to class 1. Five (2.5%) patients in class 3 were predicted as difficult intubation. In SMD test, 15 (7.5%) patients with SMD <12.5cm were predicted to have difficult intubation.

Different predictive tests versus C–L grades are depicted in Table 1. A significant agreement was found between Mallampatti score, ULBT, SMD and the laryngoscopic view (P<0.001) and the maximum agreement was between SMD and C-L grading.



PPV-Positive predictive value, NPV- Negative predictive value

Figure 1: Comparison of specificity, sensitivity, PPV, NPV and accuracy of mallampati, ULBT and SMD tests.

Modified Mallampati score when compared with C-L grading showed 81.2% sensitivity and 65.6% specificity. The PPV and NPV was 17.1% and 97.5% respectively with accuracy 66.5%. ULBT versus C-L grading showed 18.8% sensitivity, specificity 98.9%, PPV of 60%, NPV of 93.2% with accuracy 92%. Sternomental distance versus C- L grade showed 68.8% sensitivity, 94% specificity, 50% PPV, 97.1% NPV with 91.5% accuracy

(Figure 1). By using receiver operating characteristic (ROC curve) analysis, the best cuts off points of the tests were determined. Area under the curve was 0.747 for modified Mallampati test, 0.647 for ULBT and 0.955 for SMD. 'One or more test positive' means, entire test was done in parallel. That is, if any one of the test shows difficult intubation, we take it as difficult intubation. The results obtained are shown in Table 2. When all three tests were done in parallel, the sensitivity increased to 100% and specificity to 64.5% (Kappa 0.26).

Table 1: Agreement of modified Mallampatti score, upper lip bite test and sternomental distance with laryngoscopic view.

		Laryngoscopic view		Kappa coefficient	P value
		III, IV	I, II		
Modified Mallampatti	III, IV	13 (6.5)	63 (31.7)	0.173	<0.001
	I, II	3 (1.5)	120 (60.3)		
Upper lip bite grade	III	3 (1.5)	2 (1.0)	0.257	<0.001
	I, II	13 (6.5)	181 (91.0)		
Sternomental distance	≤12.5 cm	11 (5.5)	11 (5.5)	0.536	<0.001
	>12.5 cm	5 (2.5)	172 (86.5)		

Percent is calculated by dividing every cell number by 199, Figures in parentheses are in percentage.

Table 2: All the 3 tests are done in parallel.

1 or more test positive	Cormack and Lehane grade		Total
	≥3	2 or less	
Positive	16	65	81
Negative	0	118	118
Total	16	183	199

DISCUSSION

Airway management remains an important challenge in the practice of anaesthesia and preoperative airway assessment facilitates appropriate measures to be taken in dealing with difficult intubation.

The incidence of difficult intubation in our study was 16 (8%). Of these, 13 (6.5%) were correctly predicted as difficult by Modified Mallampati score whereas only 3 (1.5%) were predicted as difficult by ULBT and 11(5.5%) were correctly predicted by SMD test.

The sensitivity of Modified Mallampati test in our study was similar to the study by Khan et al, but higher compared with other studies by Savva et al, and Bhat et al.[8,9,12] The specificity of Mallampati test in our study was comparable with Khan et al, and Leopold et al.[9,13] This was less compared to study by Bhat et al.[8]

The wide variation in reported specificity and sensitivity in various studies may be because of inter-observer variability seen in Modified Mallampati scoring. This may be due to absence of a definite demarcation between class 2 and class 3 and between class 3 and class 4, and effect of phonation on the oropharyngeal classification leading to high inter observer variability.[13-17] Another limitation includes the fact that it does not assess neck mobility which is another important factor in predicting difficult intubation. This is a limitation for ULBT also. Sensitivity of ULBT in our study was comparable with other studies by Bhat et al, and Leopold et al.[8,13] We were unable to replicate the high sensitivity seen in Khan et al study, probably due to the low incidence of ULBT 3 class in our study.[9] The specificity of ULBT in our study was comparable with Bhat et al study, and higher compared to Leopold et al, and Khan et al trials.[8,9,13] The advantage of ULBT is its ease to perform within seconds by demonstrating it to the patient. It does not require any equipment hence very easy to perform as a bedside test. The classes of ULBT are clearly demarcated and delineated making inter observer variability highly unlikely. One of its major limitations is its inability to assess in edentulous patients.[9,13]

Sensitivity and specificity of SMD in our study was comparable with study conducted in Albania.[18] SMD can be an indicator of head and neck mobility. Head extension is believed to be an important factor in determining the ease or difficulty of intubation. Area under curve of receiver operating characteristics (AUC of ROC) for all the three groups as a measure of discriminating power of a predictive test was calculated because it is independent from incidence of difficult intubation. AUC of ROC curve was 0.65 for ULBT in the present study which was comparable to Leopold's trial, and less compared with Khan et al.[13,19] AUC of ROC

curve for modified Mallampati test was 0.747 in our study, which was similar to Khan et al, but more compared to Leopold's trial.[13,19] AUC of ROC curve for SMD was 0.955 in our study, which was higher compared to Khan et al trial.[19] AUC value more than 0.7 is considered to be clinically relevant.

Among the three tests, the best test is SMD having maximum agreement with gold standard C- L grading. Sensitivity, specificity, PPV, NPV and accuracy is also high for SMD compared to modified Mallampati test and ULBT. When all the three tests were combined, sensitivity increased to 100%, which means all the 16 difficult intubation, could be correctly identified. So it is always better to combine the three tests. The NPV for all the groups was more than 90% proving that these tests are better predictors of easy intubation rather than as positive predictors of difficult intubation which had a very low incidence.

CONCLUSION

In conclusion, the single best test in our study is SMD. A combination of ULBT, SMD and modified Mallampati test done in parallel is more sensitive and had a higher discriminative power compared to any single test alone.

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