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Research Article

PREDICTION OF DIFFICULT INTUBATION: IS THERE A GOLD STANDARD?

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A B S T R A C T

Background: Failure to maintain a patent airway after induction of general anesthesia remains a common cause of anesthesia-related mortality. Because of potentially serious consequences of failed tracheal intubation, considerable attention has been focused on methods to predict patients in whom laryngoscopy and intubation might be difficult.Combination of different test and scores are developed, but none of them have proven to be totally reliable. **Methods:** We evaluated the relationship between preoperative airway assessment scores used in common practice, by comparing modified Mallampati, upper lip bite test andThyromental distance with glottis exposure obtained during direct laryngoscopy in 250 patients.**Results:** The incidence of difficult intubation in our trial was (43) 17.2%. Of these only 27 were correctly predicted as difficult by Modified Mallampati test where as only 2 were predicted as difficult by Upper lip bite test and 39 were predicted by Thyromental distance.**Conclusion:** Among the three indices, Thyromental distance has got highest sensitivity (90.7%) and specificity (94.6%). However, it is better to combine all three indices for accurate prediction of difficult intubation.

INTRODUCTION

In this era of high technology, we still face an ageless problem in anaesthesia – the difficult airway. [1] Difficult or failed tracheal intubation has been identified as one of the most important causes of death or permanent brain damage during anaesthesia.[2] Airway compromise is the most common cause of death and serious injuries in anaesthesia today.[3] Thus the primary responsibility of the anaesthesiologist is to preserve and protect the airway during all phases of anaesthesia. The first clinical step to the safe conduct of anaesthesia is airway evaluation.

Reported incidence of difficult laryngoscopy and endotracheal intubation varies from 1.3% to 13% in patients undergoing general anaesthesia depending on the criteria used to define it.[4,5,6,7,8] The incidence of abandoned/failed intubation is approximately 0.05%-0.35% where as that of 'can't ventilate' or 'can't intubate' is around 0.01%-0.02%. Endotracheal intubation may be rendered difficult or impossible due to coexisting diseases or abnormal physical features like restricted neck movements, restricted jaw movements, or restricted mouth opening. [9]

Mallampati *et al* proposed a grading system (classes 1 to 3) to anticipate such cases, which considers the pre-operative ability to visualize the faucial pillars, soft palate and base of uvula which was later modified by Samsoon and Young to four classes.[10] In 2003, Khan *et al* proposed and studied a new test the Upper Lip Bite Test (a simple bed side technique) which involves the assessment of jaw subluxation, and presence of buck teeth in a single test which they concluded would improve its reliability and reduce inter-observer variability.[11]

Predictive value of Thyromental distance in comparison with other commonly used indices was evaluated Patil *et al* and found to be useful especially in obese patients. [12]

Other clinical predictors of difficult intubation include sterno-mental distance, receding mandible, buck teeth and obesity.[13] We therefore designed the study to compare the three tests (modified Mallampati test, Upper lip bite test, Thyromental distance) for predicting difficult intubation in adult patients undergoing elective surgeries requiring endotracheal intubation.

Approval of Institutional scientific and Ethics committees were obtained prior to commencement of the study. American society of anesthesiologists (ASA) physical status 1-11, of either sex in the age group of 18-65 years scheduled to receive general anesthesia requiring endotracheal intubation were included in the study. Patients with a history of previous surgery, burns or trauma to the airways or to the cranial, cervical, and facial regions, patients with tumors or mass in the above mentioned regions, patients with restricted mobility of the neck and mandible, inability to sit, edentulous or need awake intubation, previous history of difficult intubation were excluded from the study.

MATERIALS AND METHODS

It was a prospective, comparative, single blinded study evaluating the relationship between preoperative airway assessments like modified Mallampati test, Upper lip bite test, Thyromental distance with glottis exposure obtained during direct laryngoscopy. Anaesthesiologist assessing glottis exposure will be blinded to preoperative airway assessment, but other investigators are not.

A sample of 250 was determined to be appropriate for this study. Sample was selected from the elective cases posted in the main theatre of Govt. Medical college Thrissur. Informed consent was obtained from the participants. They were assessed in the preoperative holding area using Modified Mallampati test, Upper lip bite test and Thyromental distance by the principal investigator. Modified Mallampati 3 and 4, upper lip bite test 3, Thyromental distance less than 6.5cm was considered as predictors of difficult intubation. Then the patient shifted to operation theatre. An emergency airway cart was kept ready in the operation theatre which include 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 Inj. Midazolam 0.5mg, Inj. Ondansetron 4mg and Inj. Glycopyrrolate 0.2mg, Inj. Fentanyl 2mcg/kg. IV canula of 18 G was used. Monitors used were SpO2, ECG, NIBP (non invasive blood pressure) and ETCO2 (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 sniffing morning air position and laryngoscopy was performed with a McInthosh No.3, No.4 blade and initial grade of glottis view classified into GRADE 1,2,3,4 according to Cormack Lehane classification.[14]

- Class 1: The vocal cords are visible
- Class 2: Vocal cords are only partly visible
- Class 3: Only the epiglottis is seen
- Class 4: The epiglottis cannot be seen

The experienced anesthesiologist (5 years of experience in anaesthesia) who documented the laryngeal view by the Cormack-Lehane classification was blinded to preoperative airway assessment to minimize the observer bias. Cormack-Lehane score 3 and 4 is considered as difficult intubation. After assessing Cormack Lehane classification all patients were intubated with proper sized endotracheal tube. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of each test and in combination is calculated. Statistical significance of each test is compared using KAPPA STATISTICS and a P value of less than 0.05 was considered statistically significant.

RESULTS

Study design included a sample size of 250. Among them 117 are males and 133 are females.

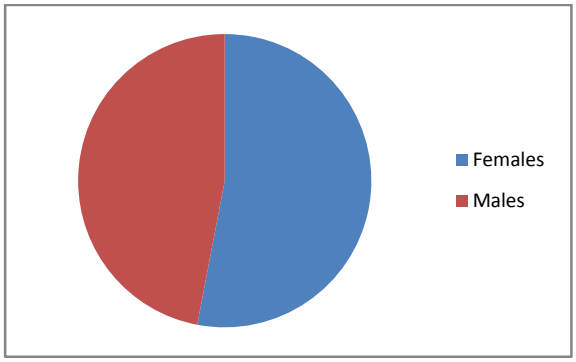

Figure 1 Demographic distribution of patients

Table 1 Modified Mallampati classification Vs Cormack and Lehane's classification

Mallampati grade	Cormack and Lehane grade		Total
	>=3	2 or less	
>=3	27	50	77
2 or less	16	157	173
Total	43	207	250

Sensitivity: a/a+c =27/43= 62.8%, Specificity: d/d+b = 157/207= 75.8%,Positive predictive value= a/a+b = 27/77= 35.06%, Negative predictive value: d/c+d= 157/173= 90.75%, Accuracy: a+d/a+b+c+d: 184/250= 73.6%, P value<0.001, KAPPA: 0.299.

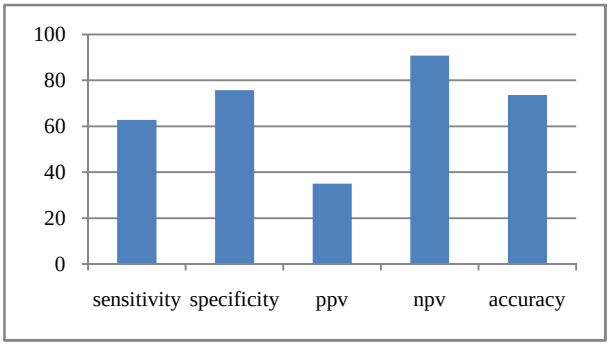

Figure 2 Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of Mallampati test

Table 2 Upper Lip Bite Test Vs Cormack and Lehane classification of glottis exposure

Upper Lip bite grade	Cormack and Lehane grade		Total
	>=3	2 or less	
>=3	2	1	3
2 or less	41	206	247
Total	43	207	250

Sensitivity: a/a+c= 2/43= 4.6% Specificity: d/b+d = 206/207 =99.5%, Positive predictive value= a/a+b = 2/3= 66.66%, Negative predictive value = d/c+d = 206/247 = 83.4%, Accuracy= a+d/a+b+c+d = 208/250 = 83.2%, P value <0.001, KAPPA: 0.0

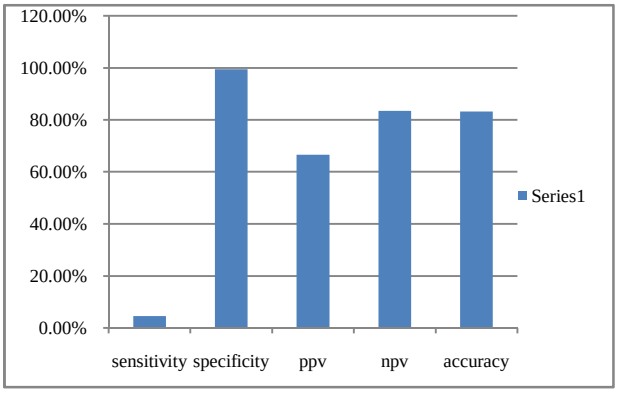

Figure 3 Sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of upper lip bite test.

Table 3 Thyromental distance Vs Cormack and Lehane's Classification of glottis exposure.

TMD	Cormack and Lehane grade		Total
	>=3	2 or less	
<6.5 cm	39	11	50
≥6.5 cm	4	196	200
Total	43	207	250

Sensitivity: a/a+c = 39/43 = 90.7%,Specificity: d/b+d = 196/207= 94.6%, Positive predictive value = a/a+b = 39/50 = 78%, Negative predictive value = d/c+d =196/200= 98%, Accuracy = a+d/a+b+c+d=94%, KAPPA: 0.80

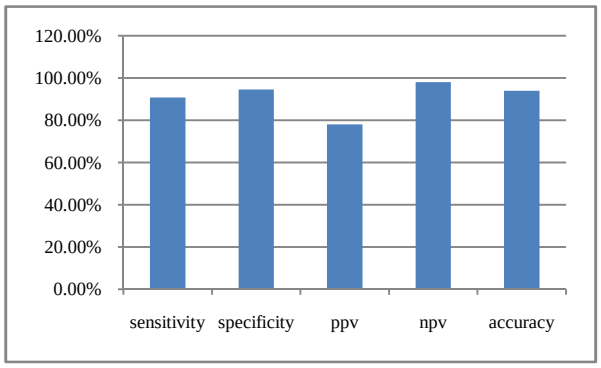

Figure 4 Sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of thyromental distance

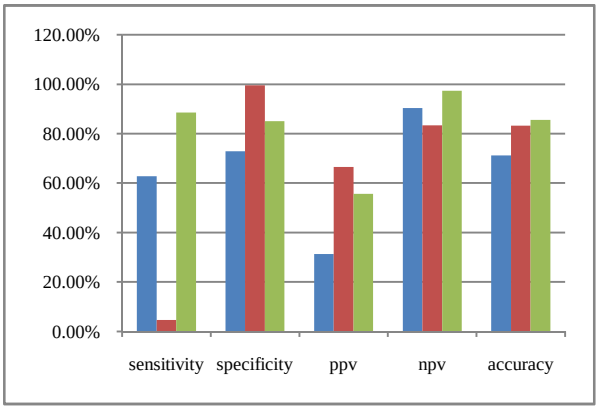

Figure 5 Comparison of specificity, sensitivity, and accuracy of Mallampati (blue), Upper lip bite test(red) and Thyromental distance(green)

DISCUSSION

The search for tests that will predict difficulty in intubation with ease of applicability, reliability still continuing in the modern era. Modified Mallampati classification has been in use for many years and one of its major limitation is the absence of a definite demarcation between class 2 & class 3 and between class 3 & class 4 group and effect of phonation on the oropharyngeal visibility leading to higher inter observer variability and decreased reliability. [15,16,17] Another limitation includes the fact that it does not assess neck mobility which is another important factor in predicting difficult intubation.

Upper lip bite test uses a combination of jaw subluxation and buck teeth. It is used as an alternative to the widely used test, the Modified Mallampati test. ULBT is easy to perform within seconds by demonstrating it to the patient. It doesn't 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 when using this test. One of its major limitation is its inability to assess in edentulous patients. [18] Like Modified Mallampati test it also does not assess neck mobility.

Thyromental distance (Patil's test) measurement is a simple bedside evaluation of distance from mentum to thyroid notch in a fully extended neck. A TMD of more than or equal to 6.5cm is a reliable indicator for easy laryngoscopy and intubation.

The incidence of difficult intubation in our trial was 17.2%, 43 out of 250 patients. Of these only 27 were correctly predicted as difficult by Modified Mallampati test where as only 2 were predicted as difficult by Upper lip bite test and 39 were correctly predicted by thyromentaldistance.

In our study we found the sensitivity of Modified Mallampati test was 62.8% which was similar to the study conducted by Sava *et al (64%)* and Bhat *et al* (59%) but this was lower compared to study conducted by Khan *et al* (82.4%).[19] The specificity of Mallampati test in our study was 75.8% which was higher than that of Khan *et al (*66.8%) and Leopold *et al* 61%. The wide variation reported in specificity and sensitivity in various studies may be because of incorrect evaluation of the test because of inter observer variability seen in Modified Mallampati Class assessment especially change in the visualization with phonation which usually occurs involuntarily and poor demarcation between the various classes.

Sensitivity of upper lip bite test in our study is 4.6%. The original study by Khan *et al* had a sensitivity of 76.5%. We were unable to replicate the high sensitivity of the original study, the cause of which may be the less incidence of ULBT 3 class in our study. The specificity of ULBT in our study was 99.5% comparable with study conducted in Jipmer (99.1%) which is much higher compared to Leopold *et al* (92.5%) and Khan *et al* (88.7%) trials.

Sensitivity of Thyromental distance<6.5cm in our study is 90.7% and specificity is 94.6% in predicting difficult intubation and positive predictive value of 78%. Merah et al found that sensitivity, specificity and positive predictive value of TMD were 15.4%, 98.1% and 22.2% respectively.[20] Their sensitivity were lower than other studies ; which suggested that this difference may be due to anthropometric specialities in the study population.

When we compare three tests, the best test is Thyromental distance. All the test were significant (p< 0.05) and among these, Thyromental distance had maximum Kappa value of 0.80, showing maximum agreement with gold standard test that is Cormack and Lehane grade. All the five parameters- sensitivity, specificity, positive predictive value, negative predictive value and accuracy is also high for Thyromental distance compared to other two tests. If we combine all the three tests, we can increase the sensitivity to 100%, that is all the 43 difficult intubation can be correctly identified. So it is always better to combine the three tests.

Table 4 Results when all the tests are done in parallel

one or more test positive	Cormack and Lehane grade		Total
	>=3	2 or less	
Positive	43	59	102
Negative	0	148	148
Total	43	207	250

Sensitivity: 100%, Specificity: 71.5%, KAPPA: 0.46

Positive predictive value of Mallampati was 35.06 % and is much lower compared to other tests. The negative predictive value for all the group was more than 80% proving that these tests are better used for their prediction of easy intubation rather than as positive predictors of difficult intubation which has a very low incidence.

CONCLUSION

The single best test to predict difficulty is Thyromental distance. A combination of Modified Mallampati test, Upper lip bite test and Thyromental distance is more sensitive with higher discriminative power compared to any single test, to predict difficult intubation suggesting further research in quest of a single gold standardfor predicting difficult intubation.

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