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PREDICTION OF DIFFICULT LARYNGOSCOPY USING MODIFIED MALLAMPATI TEST, UPPER LIP BITE TEST AND RATIO OF HEIGHT TO THYROMENTAL DISTANCE

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ABSTRACT **BACKGROUND=**The incidence of difficult intubation in patients undergoing general anaesthesia is estimated to be approximately 1.5-13%, where as failure to intubate is 0.05 -0.35%. Preoperative airway assessment should be highly sensitive to predict maximum number of patients with difficult laryngoscopy correctly, and highly specific to predict easy laryngoscopy correctly. Various methods have been used for prediction of difficult laryngoscopy. We conducted this study with primary aim to evaluate the diagnostic accuracy of modified mallampatitest, ratio of patient's height to thyromental distance and upper lip bite test as single and in combination for prediction of difficult laryngoscopy.

METHODS =This prospective, observational study was conducted in 151 adult patients belonging to ASA I-III undergoing elective surgery under general anaesthesia. All three tests were performed in all the patients preoperatively and glottis exposure was recorded by Cormack-lehane's classification during intubation. Sensitivity, specificity, accuracy, positive predictive value(PPV) and negative predictive value (NPV) were used for comparison.

RESULT S=In our study; the sensitivity, the specificity, positive predictive value, negative predictive value, accuracy, positive likelihood ratio and AUC of ROC for modified Mallampati test, RHTMD, the upper lip bite test and the combination of tests are 72.73%, 94.29%, 50%, 97.78%, 92.72% 12.73 and 0.7390; 90.91%, 32.14%, 9.52%, 97.83%, 36.42%, 1.35 and 0.5370; 9.09%, 98.57%, 33.33%, 93.24%, 92.05%, 6.36 and 0.6330, and 81.82%, 94,29%, 52.94%, 98.51%, 93.38%, 14.33 and 0.757 respectively. The AUC of ROC, the main end point of present study is significantly higher for the modified Mallampati test than the upper lip bite test and RHTMD.

CONCLUSION=We found modified mallampati test can be used as a single preoperative bedside screening test for prediction of difficult laryngoscopy, but a combination of modified mallampati test, ratio of patient's height to thyromental distance and upper lip bite test has better prediction value than applied individually.

INTRODUCTION

Fundamental responsibility of an anesthesiologist is to maintain an adequate gas exchange through a patent airway. Failure to maintain a patent airway and interruption of gas exchange during general anesthesia for even a few minutes can result in catastrophic outcome such as cerebral damage and even death. Anaesthesia in a patient with a difficult airway can lead to direct airway trauma and morbidity from hypoxia and hypercarbia. Difficult laryngoscopy is described in 1.5 to 13% of patients. The identification of patients with difficult airway is vital in the preoperative evaluation and for the planning of anaesthesia management, so that endotracheal intubation and positive pressure ventilation can be achieved safely by alternative methods of tracheal intubation.

many methods have been introduced in the past to overcome these problems and to identify the patients who will be difficult to intubate. Initially, the airway assessment was carried out using a single factor, but soon it was realized that no single test is a good predictor of difficult airway and concluded that visualization of larynx during intubation is affected by many factors. then the concept of multivariate factors came into existence. By using multivariate factors, one can overcome the deficiency which may occur with individual factor and anticipate difficult intubation with much better accuracy. Even with use of multivariate factors, prediction is not full proof. There have been instances when a patient predicted to have difficult intubation had an easy intubation and vice versa.

Our study was designed to compare the predictive value of the modified mallampati test with the ratio of patient`s height to thyromental distance and the upper lip bite test for the prediction of difficult laryngoscopy. Our study aims, to compare the ability of above tests as a single test and in combination, to predict difficult airway and to compare the results with cormack-lehane`s laryngoscopic view.

MATERIALS AND METHODS

After obtaining approval from ethic committee in our institution and taking written informed consent from the patients, this observational study was performed on 151 patients belonging to ASA physical status I-III. These patients were scheduled for elective surgery under general anaesthesia requiring endotracheal intubation. The other inclusion criteria were patients who had no previous history of burns or trauma to the airway, had no tumors or mass in laryngeal, facial and cervical region, had no restricted mobility of the neck and mandible(eg. rheumatoid arthritis or cervical disorders). Patients data which included sex, age, weight, height and body mass inder(BMI) werecollected. The following three predictive test measurements were performed on all the patients:

Modified Mallampati Test: Samsoon and Young's modification of Mallampati's test was recorded as oropharyngeal structures that were visible on maximal mouth opening. Here each patient while seated with head in neutral position was asked to open the mouth maximally and to protrude the tongue as far as possible without phonation and the oropharyngeal structures visible were observed using a pen torch and graded as follows;

Grade I: Good visualization of soft palate, fauces, uvula and tonsillar pillars.
Grade II: Pillars obscured by the base of the tongue but the soft palate, fauces and uvula visible.
Grade III: Soft palate and base of uvula visible.

Grade IV: Soft palate not visible.

Grade I and II was considered as easy laryngoscopy while grade III and IV as difficult laryngoscopy.

Ratio of Height to Thyromental distance (RHTMD): Here first thyromental distance was measured in cm with a measuring tape from the bony point of the mentum to the upper border of thyroid cartilage while head was fully extended and mouth closed and patient's height was measured from the vertex to heel in standing position in cm, then the ratio of patient's height to thyromental distance was calculated as follows;

RHTMD = Height in cm / TMD in cm

Upper Lip Bite Test: This was done by assessing the ability of patient to cover the mucosa of the upper lip with lower incisors. Here while seated in neutral position at the eye level of investigator, patient was asked to bite his \ her upper lip with lower incisors as for as possible. The test was demonstrated by the examiner first, performed by the participants twice and graded as:

Grade I: If the lower incisors could bite the upper lip above the vermillion line
Grade II: If the lower incisors could bite the upper lip below the vermillion line
Grade III: If the lower incisors could not bite the upper lip

Grade I and II described as easy laryngoscopy while grade III described as difficult laryngoscopy.

On arrival in the operating room, routine monitors which include NIBP, ECG, Pulseoximetry and EtCO2 were attached. Standard anaesthestic protocol was followed in all patients.

Patients were preoxygenated with 100% oxygen for three minutes and were administered intravenous glycopyrrolate 0.2 mg and fentanyl 2 mcg / kg. Induction of anesthesia was done with injection Sodium thiopentone, 4 mg/kg body weight IV bolus and injection succinyl choline 2 mg/kg body weight IV given to facilitate intubation. Single anesthesiologist with three years of experience in anesthesia who was not informed of preoperative airway examination results performed the laryngoscopy using Mcintosh blade size 3 and evaluates difficulty of laryngoscopy at first attempt with the patient in sniffing position but without applying external laryngeal pressure. The view is classified as per Cormack and Lehane's scale.

This scale is graded as:
Grade I: Full glottic opening visible.
Grade II: Only posterior commissure or arytenoids visible.
Grade III: Only epiglottis visible.
Grade IV: None of the above visible.

Grade I &II of Cormack-Lehane's classification was described as easy visualization/easy laryngoscopy. Grade III & IV of Cormack-Lehane's classification was described as difficult visualization /difficult laryngoscpy.

After evaluation, endotracheal intubation was done and surgery was performed under standard anaesthesia.

Using these clinical data (for the Mallampati score, the RHTMD, the ULBT and the Cormack Lehane's classification) recorded for each patient, the sensitivity, the specificity, the positive predictive value, the negative predictive value, the accuracy and positive likelihood ratio of each test were calculated. Secondly combination of predictors was also formulated.

The area under ROC (AUC) was used as the main end point of the study to determine whether or not the score was clinically valuable. A value of 0.5 area under the ROC indicates that the variable performs no better than chance and a value of 1.0 implies perfect discrimination. A larger area under the ROC curve denotes more reliability and good discrimination of the scoring system.

The data were compared using chi square test and other calculation were performed using the SPSS version 21.0. P value of < 0.05 is taken as significant.

RESULTS
Comparison of patients of difficult and easy laryngoscopy with age groups

Age in years	Difficult	%	Easy	%	Total
16-25	0	00	43	30.71	43
26-35	2	18.18	37	26.43	39
36-45	5	45.45	33	23.57	38
46-55	2	18.18	19	13.57	21
56-65	2	18.18	8	5.71	10
Total	11	100	140	100	151

Chi-square=8.1371 P = 0.0872

Comparison of patients of difficult and easy laryngoscopy with gender

Sex	Difficult	%	Easy	%	Total
Male	07	63.63	59	42.14	66
Female	04	36.36	81	57.86	85
Total	11	100	140	100	151

Chi-square= 1.9157, P = 0.1663

Comparison of patients of difficult and easy laryngoscopy with Weight groups

Weight in kg	Difficult	%	Easy	%	Total
31-40	00	00	07	5.00	07
41-50	02	18.18	24	17.14	26
51-60	02	18.18	43	30.71	45
61-70	04	36.36	39	27.86	43
71-80	02	18.18	17	12.14	19
>81	01	9.09	10	7.14	11
Total	11	100	140	100	151

Chi-square= 1.7092 P = 0.8896

Comparison of patients of difficult and easy laryngoscopy with height groups

Height in cm	Difficult	%	Easy	%	No. of cases
141-150	02	18.18	17	12.14	19
151-160	03	27.27	62	44.29	65
161-170	05	45.45	50	35.71	55
171-180	01	9.09	11	7.86	12
Total	11	100	140	100	151

Chi-square=1.2674 P = 0.7373

Comparison of patients of difficult and easy laryngoscopy with BMI

BMI	Difficult	%	Easy	%	Total
<18.49	01	9.09	11	7.86	12
18.5-24.99	05	45.45	78	55.71	83
25-29.99	05	45.45	44	31.43	49
>30	00	00	07	5.00	07
Total	11	100	140	100	151

Chi-square=1.3833 P = 0.7094

SHOWS THE VALUES OF DIFFERENT PARAMETERS FOR MMT ,ULBT,RHTMD AND MMT+ULBT+RHTMD

	MMT	ULBT	RHTMD	MMT+ULBT+RHTMD

SENSITIVITY	72.73%	9.09%	90.91%	81.82%
SPECIFICITY	94.29%	98.57%	32.14%	94.29%
POSITIVE PREDICTIVE VALUE	50.00%	33.33%	9.52%	52.94%
NEGATIVE PREDICTIVE VALUE	97.78%	92.72%	97.83%	98.51%
CORRECTLY CLASSIFIED	92.72%	93.24%	7.28%	81.82%
AREA UNDER CURVE	0.7390	0.6330	0.5370	0.7570
CONFIDENCE INTERVAL	0.5790 0.8980	0.2650 1.0000	0.4400 0.6340	0.6040 0.9100
ACCURACY	92.72%	92.05%	36.42%	93.38%
POSITIVE LIKELIHOOD RATIO	12.73	1.35	1.35	14.33
P VALUE	0.0020	0.4310	0.4620	0.0010

DISCUSSION

ASA Task Force defined difficult laryngoscopy as "not possible to visualize any portion of the vocal cords with conventional larynoscopy".The importance of preoperative prediction of a difficult airway is obvious; 85% of all mistakes regarding airway management results in permanent cerebral damage and up to 30% of all anaesthetic deaths can be attributed to the management of difficult airwaySeveral preoperative airway assessment tests; mouth opening or inter incisor gap, head and neck movement, Wilson risk score, horizontal length of mandible, sternomental distance may be used to predict difficult intubations but sensitivity and positive predictive value of these individual parameters are low (33-77%) while false positive results are high. Research is going on to device simple bed side test to anticipate difficult laryngoscopy which has high sensitivity, specificity, positive predictive value, negative predictive value, likelihood ratio with minimal false positive and false negative results. Several clinical tests have been proposed for preoperatively identifying patients who may have difficult laryngoscopy but unfortunately there is no test or group of tests that can accurately predict difficult laryngoscopy. Preoperative airway assessment should be highly sensitive to predict maximum number of patients with difficult laryngoscopy correctly, and highly specific to predict easy laryngoscopy correctly. Test should also have a high positive predictive value (so that only few patients with easy laryngoscopy are subjected to the protocols for difficult laryngoscopy), with few negative predictions (to avoid deleterious and even life threatening consequences). Likelihood ratio for a positive test result may be useful measure to judge the efficacy of a predictive tool in daily practice. We conducted this study to evaluate sensitivity, specificity, positive predictive value, negative predictive value, positive likelihood ratio, accuracy and AUC of ROC for modified Mallampati test, RHTMD and the upper lip bite test in isolation and in combination, with an attempt to determine a more comprehensive and accurate as well as simple and clinically applicable to day to day basis parameter for predicting difficult laryngoscopy.The reported incidence of difficult laryngoscopy varies from 1.3 – 13% in general population depending on the criteria used to describe it.37The incidence of difficult laryngoscopy in our study is 7.28% without external laryngeal pressure which is comparable to that observed by earlier studies. In our study the mean age in difficult group is 44.86 ± 10.86 years and 34.01 ± 12.07 years in easy group with P value of 0.0872. The mean weight in our study is 63.18 ± 13.28 kg and 60.81 ± 12.41 kg in difficult and easy laryngoscopy groups respectively with P value of 0.8896.The mean BMI is increased in difficultlaryngoscopy group with a value of 24.09 ± 3.67 as compared to mean BMI of 23.87 ± 4.37 in easy laryngoscopy group.In our study mean height in difficult group is 161.35 ± 9.04 cm and 159.54 ± 7.82 cm in easy group and we did not find any association between height and difficult

laryngoscopy with a P value of 0.7373.In our study there is an increased occurrence of difficult laryngoscopy in male sex about 7[11] compared to 4[11] in female group, but it is statistically not significant. We found the sensitivity, the specificity, the PPV, the NPV and AUC for modified Mallampati test as 72.73%, 94.29%, 50.00%, 97.78%, and 0.7390 respectivelyIn our study the values of the sensitivity, the specificity, the positive predictive value, the negative predictive value and AUC for the upper lip bite test were 9.09%, 98.57%, 33.33%, 93.24% and 0.6330 respectively.In our study RHTMD is the most sensitive of the single test with a sensitivity of 90.91% with a highest NPV of 97.83%, but at the cost of least positive predictive value and specificity than other two tests.We calculated only the combination of all three tests to avoid the bias. In our study the combination of all the tests increased the value of all parameters for the prediction of difficult laryngoscopy with a sensitivity of 81.82%, specificity of 94.29%, positive predictive value of 52.94%, negative predictive value of 98.51% and AUC of 0.757.The main end point of present study is the AUC of ROC is significantly higher for the modified Mallampati test than the upper lip bite test and the RHTMD, indicating that modified Mallampati test has a better predictive value than the other two tests. We also found that RHTMD may be used as single pre-operative bed side screening test for the prediction of difficult laryngoscopy as compared to upper lip bite test, but in combination with modified Mallampati test, their predictive value is increased.

CONCLUSION
1) We found modified Mallampati class III and IV has a better predictive value as a single preoperative bed side screening test for the prediction of difficult laryngoscopy than the RHTMD and the upper lip bite test.
2) RHTMD may be used as a single preoperative bedside screening test for the prediction of difficult laryngoscopy, but a combination of modified Mallampati test, RHTMD and upper lip bite test has a better predictive value than when applied individually.

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