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Comparison of Modified Mallampati Test and Upper Lip Bite Test in Prediction of Difficult Endotracheal Intubation: A Prospective Study

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ABSTRACT

Introduction: Unanticipated difficult laryngoscopic tracheal intubation accounts for a significant proportion of adverse anaesthetic outcome in clinical practice.

Hence, it is important to identify patients with difficult airway preoperatively.

In our study, we have compared the upper lip bite test with modified Mallampati classification in predicting difficulty in endotracheal intubation.

Materials and methods: The study was conducted on 150 ASA I patients of either sex, aged more than18 years scheduled to undergo elective surgery under general anesthesia and endotracheal intubation. Pre-operatively airways of the patients were evaluated using modified Mallampati test and upper lip bite test.

MMT class III and class IV and ULBT class III were considered potentially difficult intubation. Experienced anesthesiologists, unaware of pre-operative airway evaluation, will perform laryngoscopy and grade the glottic view as per Cormack and Lehane's classification. Grade III and IV were considered as difficult intubation. Sensitivity, specificity, accuracy, positive and negative predictive values of ULBT and MMT were calculated.

Results: MMT was more sensitive (71.43%) than ULBT (28.57%)). MMT had a specificity of 81.82 as compared to 96.5% for ULBT. Positive predictive value for MMT is 16.3% and 28.57% for ULBT.

Negative predictive value was 98.32% and 96.50% for MMT and ULBT, respectively. Accuracy of MMT was 81.33% while it was 93.33% for ULBT.

Conclusion: Modified Mallampati test is an inherently better test at predicting difficult endotracheal intubation when compared to upper lip bite test. Both modified Mallampati and upper lip bite test are better predictors of easy intubation rather than as positive predictors of difficult intubation.

Keywords: Modified mallampati test, Upper lip bite test

INTRODUCTION

Much of medicine involves identifying patients at particular risk of experiencing a complication, so that measures can be taken to avert it. Unanticipated difficult laryngoscopic tracheal intubation remains a primary concern of the anesthesiologists. Fortunately it is a rare occurrence with a reported incidence ranging from 1.3 to 13% in patients undergoing surgery [1,2]. The incidence is higher in obstetric patients [3-6]. However it still accounts for a significant proportion of adverse anesthetic outcome in clinical practice. The single largest source of unfavorable outcome in the American Society of Anesthesiologists closed claims study was for adverse respiratory episodes which accounted for 37% of the liability claims of which difficult tracheal intubation was the culprit in 42% [7]. Given these statistics, it is clear that management of the airway is paramount to safe perioperative care.

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Many times tested methods such as Mallampati technique has been used to overcome the conundrum of unanticipated difficult laryngoscopic tracheal intubation. However, these tests are not totally reliable [8-13].

The ULBT which involves the assessment of jaw subluxation and presence of buck teeth in a single test claims to have improved reliability and reduced interobserver variability.

In our study, we have compared the upper lip bite test with modified Mallampati classification in predicting difficulty in endotracheal intubation.

MATERIALS AND METHODS

The ethical committee approval was obtained and an observational blinded study was done prospectively in the Department of Anesthesiology, in a tertiary care teaching hospital in Kerala, India. The study was conducted on 150 ASA I patients of either sex, aged more than18 years scheduled for elective surgery under general anesthesia and endotracheal intubation. Surgical specialties involved were general surgery and orthopedics. Edentulous patients, patients with BMI>30, those unable to open the mouth, and any factor predicting difficult intubation were excluded from the study.

Pre-op evaluation and consent

Detailed history, systemic examination, relevant and routine investigations were carried out. Procedure was explained to the patient and an informed written consent was obtained. Eligible patients fulfilling the inclusion criteria were included in the study. Pre-operatively two anesthesiologists not involved in intubating the airways of the patients evaluated the patients by using the modified Mallampati test or the upper lip bite test.

Classification of the oropharyngeal view is done according to the MMT [14,15]:

Class I - Soft palate, fauces, uvula and pillars seen.

Class II - Soft palate, fauces and uvula seen

Class III - Soft palate and base of uvula seen

Class IV - Soft palate not visible

The examination to determine oropharyngeal view is done with the aid of the torch light. The patients in sitting position with mouth fully open, tongue maximally protruded and not phonating.

The Upper Lip Bite Test was performed according to the following criteria [1]:

Class 1: Lower incisors can bite upper lip above the vermilion line.

Class 2: Lower incisors can bite upper lip below the vermilion line.

Class 3: Lower incisors cannot bite the upper lip.

The laryngeal view will be graded according to the method described by Cormack and Lehane as [3]:

Grade 1- Full view of glottis

Grade 2- Glottis partially exposed anterior commissure not visible.

Grade 3- Only epiglottis seen

Grade 4- Epiglottis not seen

No external laryngeal pressure is applied while recording laryngeal view. A grade 1 or 2 is considered to represent easy intubation and a grade of 3 or 4 to represent difficult intubation.

Experienced anesthesiologists (more than 1 year experience), who had not performed pre-operative modified Mallampati and upper lip bite classes, will assess laryngoscopic view at intubation, on the operating room table. The head will be placed in the sniffing position and initial laryngoscopy will be performed with a macintosh No. 3 blade. However, if difficulty is encountered and the first attempt gives class III, IV laryngoscopic view, external laryngeal pressure is applied, change of blade or adjustment of head position may be done as the situation demands.

Data were analyzed using computer software, Statistical Package for Social Sciences (SPSS) version 10. Data are expressed in frequency and percentage as well as mean and standard deviation. To elucidate the associations and comparisons between different parameters, Chi square (χ^2) test was used as nonparametric test. Sensitivity, specificity, positive and negative predictive values were also elucidated to compare MMT and ULBT with the gold standard Cormack and Lehane grading. For all statistical evaluations, a two-tailed probability of value, <0.05 was considered significant.

RESULTS

Males constituted 58% of the study group whereas females formed only 42% in the study population. Chi square analysis showed no statistical significance (P>0.05) between gender and the three grading systems. The mean age of patients was 44 ± 11 years. No relationship (P>0.05) was found between age and MMT, ULBT or CL grading individually. The mean BMI was 22.17 kg/m^2 ± 3.59. There was no statistical significance (P>0.05) between BMI and the three evaluation tools.

Table 1. Distribution of study subjects according to Modified Mallampati Test (MMT).

MMT	Frequency	Percent
Class 1	85	56.7
Class 2	34	22.7
Class 3	26	17.3
Class 4	5	3.3

Table 2. Distribution of the study group according to Upper lip bite test (ULBT).

ULBT	Frequency	Percent
Class 1	114	76.0
Class 2	29	19.3
Class 3	7	4.7

Table 3. Distribution of Cormack and Lehane's grades of glottic exposure.

CL Grade	Frequency	Percent
Grade 1	133	88.7
Grade 2	10	6.7
Grade 3	5	3.3
Grade 4	2	1.3

Table 4. Distribution of three grading systems in study population.

Grade	MMT	ULBT	CL Grade
Easy intubation	119	143	143
	79.30%	95.30%	95.30%
Difficult intubation	31	7	7
	20.70%	4.70%	4.70%

Table 5. Validity of Mallampatti and ULBT.

	ULBT	Mallampatti
Sensitivity	28.57	71.43
Specificity	96.50	81.82
Positive Predictive Value	28.50	16.13
Negative Predictive Value	96.50	98.32
Accuracy	93.33	81.33
Likelyhood Ratio +	08.17	03.93
Likelyhood Ratio -	00.74	00.34

Out of 82 MMT class 1 patients, 69 were ULBT class1 and 13ULBT class2.

29 patients with ULBT class 1, 2 with ULBT class 2 and 1 patient with ULBT class 3 had MMT class2.

Out of 26 MMT class 3 patients, 10 were ULBT class 1, 14 ULBT class 2 and 2 ULBT class 3.

From the 5 MMT class 4 patients, 1 was ULBT class 1 and 4 ULBT class 3.

Significant correlation was found between MMT and CL grading ($P<0.05$, r=–0.271), ULBT and CL ($P<0.05$, r=-0.0269) as well as MMT and ULBT ($P<0.05$, r=–0.373).

1 patient with MMT class 1 out of 85 patients, 1 patient with class 2 out of 34 patients, 2 patients with class 3 out of 26 patients and 3 patients with class 4 out of 5 patients had CL grade 3 and 4. A highly significant relationship ($P<0.001$) has been elucidated between CL grading and MMT.

4 patients out of 114 class 1 ULBT patients had grade 3 or 4 Cormack and Lehane's, 1 out of 29 patients with class 2 ULBT had grade 3 Cormack and Lehane's and 2 patients out of 7 with class 3 ULBT had grade 3 glottic exposures.

Sensitivity of ULBT was found to be too low with 28.57 which were found to be significant and specificity was high with 96.50. A low rate of positive predictive value of 28.57 was obtained for ULBT whereas the negative predictive value was 96.50. The accuracy of the test was also high (93.33).

Sensitivity of MMT against CL grade was found to be 71.43 and specificity was 81.82, which was found to be significant. A low rate of positive predictive value of 16.13 was obtained for MMT whereas the negative predictive value was 98.32. The accuracy of the test was also high (81.33).

DISCUSSION

Unanticipated difficult tracheal intubation is a significant source of morbidity and mortality in anesthetic practice. The incidence of difficult intubation in the operating room varies between 1.3% to 13% depending on the criteria used to

define it [3,13-14,16-22]. Upper lip bite test (ULBT) has been proposed as an alternative to the widely practiced modified Mallampati test (MMT) [23]. Both the tests are bed side tests, easily demonstrable to patients and they do not need any equipment.

In this study both MMT and ULBT is compared in 150 patients to predict difficult intubation which is evaluated using Cormack-Lehane (CL) grade. The incidence of difficult intubation in the present trial was 4.7%. The incidence of difficult intubation in Khan's trial was 5.7% [1] where as in Leopold's trial it was 12% [24]. Discrepancies in the incidence of difficult intubations in different studies may be attributed to the fact that sometimes the cases in which pressure was applied to the larynx were excluded from the 'difficult intubation' group.

The sensitivity of MMT in our study was 71.43% as compared to 28.57% for ULBT. A similar sensitivity of 70.2% was reported by Leopold et al [24] for MMT. Much lower sensitivities for MMT were reported by Savva et al. (64%) [8] and Bhat et al. (59%) [23] in their trials. Sensitivity of ULBT is 28.57% in this study which is comparable to that of Bhat et al. (20.5%) [23]. The original study by Khan et al. had a sensitivity of 76.5% for ULBT [1]. The difference in sensitivity could be due to the high incidence of ULBT Class 3 in Khan's trial (15%). The current study demonstrated a specificity of 81.82% for MMT and 96.5% for ULBT. Lower specificities for MMT have been observed in studies conducted by Hester et al. (75%) [25] and Leopold et al. (61%) [24] trials. Wide range of MMT specificities (61-84%) may be due to factors such as involuntary phonation and poor demarcation between the various classes. Hussain et al. found a higher specificity for ULBT (88.7%) than the MMT (66.8%) [1]. In this study positive predictive value for MMT is 16.3% and 28.57% for ULBT. The positive predictive value for MMT in this study is comparable to that of Khan et al. (13%) [1] and Leopold et al. (19.5%) [24] trials. The positive predictive value of ULBT in this study is similar to that of Khan et al. trial (28.9%) [1]. The negative predictive value was more than 90% for both the tests individually (98.32% - MMT, 96.50% -ULBT), thus stressing upon the fact that these tests can be good predictors of easy intubation rather than as positive predictors of difficult intubation which has a very low incidence. This was one of the conclusions made by Leopold et al. [24]. The accuracy of prediction was frequent in the original study describing the ULBT by Khan et al. [1]. The accuracy of ULBT was 88% compared to MMT 66.7%. This was replicated in the trial by Leopold et al. [24], 84.9% for ULBT and 62.1% for MMT. In our study, ULBT has a higher accuracy of 93.33% compared to that of MMT 81.33%.

An ideal test to predict difficult intubation should have high sensitivity so that maximum number of patients who are truly difficult to intubate can be identified. Hence sensitivity of a test may be a more valuable parameter for predicting difficult intubation than its specificity. It should also have a high PPV, so that false positives can be minimized. The high sensitivity of MMT in our study is appealing, but its accompanying low positive predictive value (16.13%) could result in extra time to overcome the difficulties of anticipated difficult intubations by provision of alternative measures such as fiber optic intubation. In anesthesia practice we are mostly concerned with unanticipated difficult airway (false negatives) which may have grave outcomes. In our study, incidence of false negative for MMT was 28.60% and 71.40% for ULBT. The negative predictive value was more than 90% for both the tests individually (98.32% - MMT, 96.50% -ULBT), thus stressing upon the fact that these tests can be good predictors of easy intubation rather than as positive predictors of difficult intubation which has a very low incidence.

LIMITATIONS OF THE STUDY

This study was conducted exclusively with elective surgical patients. Emergency patients and those who were recognized to be difficult airway were excluded. Hence it may not be applicable to all subgroups of the general population. ULBT requires the patient's cooperation, ability to move the mouth and the presence of teeth; only participants meeting those criteria were included. Furthermore the inter-observer reliability was not evaluated and that would influence the result.

CONCLUSION

Modified Mallampati test is an inherently better test at predicting difficult endotracheal intubation when compared to upper lip bite test.

Both modified Mallampati and upper lip bite test are better predictors of easy intubation rather than as positive predictors of difficult intubation.

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