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Original Research Article

"COMPARISON OF MODIFIED MALLAMPATI TEST V/S UPPER LIP BITE TEST FOR PREDICTION OF DIFFICULT LARYNGOSCOPY", A PROSPECTIVE OBSERVATIONAL STUDY AT A TERTIARY CARE CENTRE

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ABSTRACT

Background: The reported incidence of difficult intubation varies widely across studies, generally ranging between 1% and 13%. Unexpected difficult airways or failed intubation for even a few minutes can disrupt gas exchange and lead to brain damage, cerebral hypoxia, or death. Up to 30-40% of anaesthesia-related deaths are caused by poor airway management. Preoperative prediction of difficult intubation can significantly reduce these risks. Initially, the Mallampati classification was used [1]; later, it was modified [2]. This study evaluates the Modified Mallampati test (MMT) and Upper Lip Bite Test (ULBT) [3] for their ability to predict difficult direct laryngoscopy. The objective is to analyse the positive predictive value (PPV), negative predictive value (NPV), sensitivity, specificity, and accuracy of the ULBT and the MMT. To compare the results of both tests in predicting difficult laryngoscopy.

Materials and Methods: We conducted a prospective observational study involving 225 patients who underwent elective surgery with general anaesthesia and required endotracheal intubation. The MMT and ULBT were assessed preoperatively. The Cormack-Lehane (CL) classification was recorded during intubation under direct laryngoscopy on the day of surgery.

Results: Among 225 patients, the incidence of difficult laryngoscopy, as per CL grading, was approximately 23.6% (53 patients). The sensitivity, specificity, PPV, NPV, and accuracy of the Modified Mallampati test were 52.83%, 92.44%, 68.29%, 86.41%, and 83.11%, respectively. The corresponding values for the ULBT were 16.98%, 99.42%, 90%, 79.53%, and 80%.

Conclusion: No single test reliably predicts difficult laryngoscopy. Combining tests improves prediction. MMT and ULBT are moderate predictors.

Keywords: Difficult Laryngoscopy, Modified Mallampati Test, Upper Lip Bite Test.

INTRODUCTION

Airway-related complications remain a significant contributor to perioperative morbidity and mortality in anaesthesia practice. As noted in Cormack RS et al. [4], poor glottic visibility during laryngoscopy may indicate that the provider faces challenges with laryngoscopy and intubation. Clinicians must identify patients who might require difficult tracheal intubation. The American Society of Anaesthesiologists (ASA) states that a conventionally trained anaesthesiologist encounters difficult endotracheal intubation if they need three attempts with a standard laryngoscope or take more than 10 minutes. Before surgery, clinicians evaluate clinical & physical variables to recognise difficult laryngoscopy cases. Variations in diagnostic accuracy across studies are due to differences in the

frequency of difficult laryngoscopy, statistical power, test thresholds, & patient attributes. [1-5]

Depending on the definition, the rate of difficult intubation ranges from 0.1% to 10.1%. Many methods exist to define or estimate difficult intubation, but low sensitivity and specificity make prediction difficult.[6] The CL grade is a well-known system for anticipating difficult intubation during direct laryngoscopy. Patients with a CL grade of III or IV have a higher risk of failed intubation attempts. However, the ASA defines actual difficult intubation, while the CL grade only indicates likelihood. Cormack-Lehane (CL) grading is a classification system for the laryngeal view during direct laryngoscopy, but it does not always equal difficult intubation because it only measures visualization, not the ease of passing the tube. A "difficult intubation" involves multiple factors beyond simply seeing the vocal cords, such as instrument manoeuvrability, patient anatomy, and the technique used. Neither fully captures the challenges encountered during intubation. Repeated laryngoscopy attempts have been associated with a higher incidence of airway trauma and adverse cardiovascular and respiratory events such as arrhythmia, regurgitation, heart failure, stroke, and airway injury. The more the intubation attempts, the higher the frequency of difficult intubation.[7]

Despite new prediction techniques, these methods have limited sensitivity & specificity.

The LEMON approach integrates multiple clinical parameters for rapid airway assessment in emergency settings (look externally, evaluate the 3-3-2 rule, Mallampati score, obstruction, neck mobility). It blends tests that require the patient to be alert and cooperative with simple steps like 'look externally'.[8]

Clinicians use several tests to identify patients at risk for difficult laryngoscopy before surgery. These tests include thyromental distance, Wilson's score, jaw length, sterno-mental distance, inter-incisor gap, mandibular subluxation, chin protrusion, and atlanto-occipital extension. Although several bedside airway assessment tools are available, none demonstrate sufficient accuracy when used in isolation.

Aim and Objectives

Aim: Compare the effectiveness of MMT & ULBT in predicting difficult laryngoscopy.

Objectives:

1. To analyse the positive predictive value (PPV), negative predictive value (NPV), sensitivity, specificity, and accuracy of the ULBT & MMT.
2. To compare the results of ULBT & MMT to predict difficult laryngoscopy

MATERIALS AND METHODS

We conducted this Prospective observational comparative clinical study at a tertiary care hospital over 18 months, from July 2022 to December 2023. After obtaining informed consent from patients and approval from the Institutional Ethical Committee (IEC letter no. IIMSR/IEC/PG/2022/27). The study was conducted at the Department of Anaesthesia, JIIU'S, IIMSR, Warudi, Badnapur, Jalna, Maharashtra, India.

We included patients aged 18 to 60 years who underwent elective surgery under general anaesthesia and had ASA I or II status. We excluded patients who refused participation, had edentulous status, cervical spine pathology, emergency cases, abnormal airways, neck contractures, radiation therapy in the neck region or mental impairment.

Sample Size: Assuming a 15% prevalence of difficult airways and 4% allowable error, we calculated the sample size as n = 4 PQ / E2 (Where 'P' is the prevalence, 'Q' = (100-P) & 'E' is the permissible error of 'P') [9]. So, taking 'P' = 15, 'Q' = (100-15) = 85 and 'E' = 5%. Therefore, n = 4 * 15 * 85 / 52 = 5100 / 25 = 204, So, n=204. Allowing for a 10% non-response rate, we analysed a total of 225 patients by consecutive Sampling

Procedure: A detailed preoperative airway evaluation, including MMT and ULBT, was done prior to surgery. On the surgery day, after anaesthesia induction with Propofol and Succinylcholine, direct laryngoscopy was performed. CL grades were noted as per view. Standard intubation was performed using appropriate equipment or by applying external pressure to the larynx. If grades III or IV were observed, a bougie, stylet, or McCoy blade was used to facilitate intubation. All patients were intubated effectively. In rare 'can't-intubate' cases, an LMA was used.

Biostatistics: True positive (TP) = difficult intubation (by CL grade), which was predicted to be difficult (by MMT/ULBT).

False positive (FP) = easy intubation (by CL grade), which was predicted to be difficult (by MMT/ULBT).

True negative (TN) = easy intubation (by CL grade), which was predicted to be easy (by MMT/ULBT).

False negative (FN) = difficult intubation (by CL grade), which was predicted to be easy (by MMT/ULBT).

RESULTS

The study included 225 subjects and recorded the following data.

Table 1: Distribution of Patients according to Age-group, Gender and BMI.

Age in years	No of patients	BMI classification	Number of patients	Percent
<20 Years	16	Underweight (<18.5)	16	7.1
21-30	70	Normal (18.5-24.9)	115	51.1
31-40	53	Overweight (25.0-29.9)	73	32.4
41-50	53	Obesity (>30.0)	21	9.3
51-60	22	Total	225	100
>60	10	**Mean±SD**	24.19±4.45	
Mean age	37.85±13.17 years	**Gender**	**Male/Female**	**Total**
			190/35	225

Table 2: Distribution of Patients according to Cormack Lehane grade

CL grade	Number of Patients	Percentage
Grade I	78	34.7
Grade II	94	41.8
Grade III	47	20.9
Grade IV	6	2.7
Total	225	100.0

Table 3: Distribution of Patients according to MMT & ULBT

Modified Mallampati test	Number of Patients	Percentage	Upper lip bite test	Number of Patients	Percentage
Class I	80	35.6	Class I	132	58.7
Class II	104	46.2	Class II	83	36.9
Class III	36	16.0	Class III	10	4.4
Class IV	5	2.2	Total	225	100.0
Total	225	100.0			

Table 4: Outcome of MMT classification in CL grade

Modified Mallampati Test classification		Cormack Lehane Grade	
		Found Easy	Found Difficult
Predicted Easy	184	159	25
Predicted Difficult	41	13	28
Total	225	172	53

Table 5: Outcome of MMT classification in CL grade statistical data

Statistics	Value	95% CI
Sensitivity	52.83%	38.64% to 66.70%
Specificity	92.44%	87.42% to 95.91%
Positive Predictive Value	68.29%	54.64% to 79.39%
Negative Predictive Value	86.41%	82.66% to 89.46%
Accuracy	83.11%	77.56% to 87.76%

Table 6: Outcome of ULBT IN CL grade

Upper Lip Bite Test	Upper Lip Bite Test	CL GRADE	CL GRADE
		Found Easy	Found Difficult
Predicted Easy	215	171	44
Predicted Difficult	10	01	09
Total	225	172	53

Table 7: Outcome of ULBT IN CL GRADE Statistical data

Statistics	Value	95% CI
Sensitivity	16.98%	8.07% to 29.80%
Specificity	99.42%	96.80% to 99.99%
Positive Predictive Value	90.00%	53.85% to 98.58%
Negative Predictive Value	79.53%	77.47% to 81.45%
Accuracy	80.00%	74.17% to 85.02%

DISCUSSION

This study analysed data from 225 patients to evaluate predictors of difficult laryngoscopy, including age, gender, BMI, comorbidities, and the effectiveness of predictive tools such as MMT & the ULBT.

Modified Mallampati Score: It determines the size of the tongue in relation to the oropharynx and the ability to open the mouth.[10] In our study, Classes I and II are considered the predicted easy group, while Classes III and IV are considered the predicted difficult group. Of 225 patients, approximately 184 were in the predicted easy laryngoscopy group, while the remaining 41 were in the predicted difficult group.

The MMT showed moderate sensitivity (52.83%) and high specificity (92.44%), with a significant number

of true positives and true negatives. However, the presence of false negatives indicates that while the MMT is useful, it may not detect all difficult cases, as noted by Haq and Ullah.[11] Safavi et al,[12] also observed that the MMT's predictive accuracy improves when combined with other tests, such as ULBT, thereby reducing the likelihood of false negatives & positives.

The high negative predictive value (86.41%) indicates that the MMT is particularly effective at predicting easy intubations, but the moderate positive predictive value (68.29%) suggests that when it predicts difficulty, there is still a considerable chance of a false positive.

Upper LIP Bite Test: In 2003, Khan and his colleagues introduced the ULBT [3], which checks for both jaw subluxation and buck teeth.

In this study, Classes I and II were considered predictors of easy laryngoscopy, while Class III was considered a predictor of difficult laryngoscopy. Of 225 participants, Class I accounted for 58.7%, Class II for 36.9%, and Class III for 4.4%. Considering all study participants, 215 (95.6%) were classified under the easy laryngoscopy group. Only 4.4% (13) were in the difficult laryngoscopy category.

The ULBT showed high specificity (99.42%) but lower sensitivity (16.98%) in predicting difficult laryngoscopies, meaning it is particularly reliable for ruling out difficult intubations but less effective at identifying them. These findings are consistent with earlier studies reporting similar diagnostic performance, including those by Kolarkar et al. [13] (2015) and Dar et al.[14] The high true negative rate suggests that when the ULBT predicts easy intubation, it is likely accurate, consistent with findings by Kolarkar et al. [13] and Sinharay & Chavan.[15] However, the significant number of false negatives indicates that the ULBT may miss some difficult cases (Safavi et al [12] Dar et al [14]). The ULBT's lower sensitivity can be explained by the higher incidence of difficult intubation in our study, with a large proportion of false-negative results.

The overall accuracy was 83.11% for MMT and 80.00% for ULBT. This comparison highlights the trade-offs between sensitivity and specificity in the two tests. The MMT's higher sensitivity makes it better at identifying difficult intubations, whereas the ULBT's higher specificity makes it more reliable for ruling them out. The ULBT's higher PPV and specificity indicate that it is particularly useful in settings where false positives need to be minimised, as noted by Kolarkar et al [13] and Safavi et al [12] The overall accuracy of both tests suggests that they are complementary tools, and their combined use is recommended to maximise predictive accuracy for difficult intubations (Haq & Ullah,[11]).

In our study population, the relatively higher incidence of difficult laryngoscopy may be attributed to demographic and anatomical variations, highlighting the need for population-specific airway assessment strategies

CONCLUSION

This study underscores the critical importance of accurately predicting difficult laryngoscopy and intubation. The findings indicate that although individual predictive tests, such as the MMT & ULBT, offer valuable insights, neither test alone is sufficient for a comprehensive assessment due to their limited sensitivity and specificity.

The MMT, with moderate sensitivity and high specificity, is effective at ruling out difficult intubations but may yield false positives, leading to over-preparation in some cases. Conversely, the ULBT shows very high specificity, making it reliable for confirming easy intubations, but its low sensitivity means it may miss some challenging cases. The CL grading system further supports these findings, showing a significant correlation between predicted and actual intubation difficulties. Given that combining the MMT and ULBT allows a more balanced approach, reducing the likelihood of both false negatives and false positives.

Additionally, the study emphasises the need for personalised airway management strategies that account for factors such as age, BMI, and comorbidities. The reported instances of trauma and the requirement for multiple intubation attempts in some cases highlight the importance of being prepared with advanced airway management tools and techniques. In conclusion, a comprehensive approach that integrates predictive tests with thorough preoperative assessment is crucial for anticipating and effectively managing difficult intubations, ultimately enhancing patient safety and outcomes.

The low sensitivity of ULBT observed in this study may result from its reliance on mandibular mobility and dentition, which might not directly relate to glottic visualisation during laryngoscopy. Conversely, MMT indicates the oropharyngeal space and tongue size, making it a comparatively better predictor of a difficult airway. However, neither test alone proved sufficiently accurate, emphasising the importance of combined airway assessment strategies.

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