Section: Anaesthesia

Original Research Article

STUDY COMPARING DIFFERENT AIRWAY ASSESSMENT TESTS IN PREDICTING DIFFICULT LARYNGOSCOPY

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Abstract

Background: Difficult endotracheal intubation is one of the most challenging operations in anesthesia. We conducted this study with primary aim to evaluate and validate the predictive value of 'standard airway predictors' like modified Mallampati test, thyromental distance (TMD) and new airway predictor like upper lip bite test (ULBT) for predicting difficult laryngoscopy in geriatric patients. **Materials and Methods:** This prospective, observational study was conducted on 100 patients above 65 years of age of eithersex, scheduled for elective surgery under general anaesthesia requiring endotracheal intubation. The age, weight, height, body mass index (BMI) and airway parameters were recorded. The laryngoscopic view was assessed by modified Cormack-Lehane scale. Standard formulae were used to calculate validity indexes. **Result:** The Upper Lip Bite Test (ULBT) shows the highest sensitivity (91.1%) and specificity (85.7%), indicating it is the most accurate predictor of difficult laryngoscopy. The Positive PredictiveValue (PPV) of ULBT is 96%, and the Negative Predictive Value (NPV)is 72%, with a Likelihood Ratio (LR+) of 6.38 and an Odds Ratio (OR) of 61.714, making it the most reliable test. **Conclusion:** ULBT has moderate sensitivity and PPV, and high specificity, NPVand accuracy. So, it appears that ULBT is a useful bedside test forevaluation of patient airway before GA.

INTRODUCTION

To evaluate and validate various preoperative airway assessment tests in geriatric patients is of paramount importance because, firstly, the elderly population has been increasing tremendously since last few decades and is considered as the fastest growing group of the population in many parts of the world.[1,2] It has been observed that more than 50% of this increasing elderly group need one or two surgeries in their life time.[3,4] Secondly With age, teeth wear and loss, protein and collagen synthesis reduction, and bone loss and muscle atrophy results in aged face (chin protrusion, cheek retraction and drooping), jaw restriction (temporo-madibular joint disc displacement and osteoarthritis), neck and back stiffness, and kyphotic deformities (degeneration of spinal articular cartilage, intervertebral discs, and spinal osteoporosis). These age-related changes in anatomy are compatible with the predictors of a difficult airway.[5] However, studies very limited are available comparing various predictors of airway to predict difficult laryngoscopy in geriatric patients. Thirdly, it is reported that of all the anaesthetic deaths in all age groups, 30– 40% are attributed to inability to manage difficult airway Moreover, geriatric patients are vulnerable to airway associated complications such as aspiration, oxygen desaturation, haemodynamic instability because of decreased functional reserve. Hence, it is imperative to predict difficult laryngoscopy and intubation accurately in this age. However, the age-related changes in anatomy and its implications on difficult airway are not explored enough to avoid unanticipated difficult airway in geriatric patients.

So, we conducted this prospective study with primary aim to evaluate and validate the predictive value of 'standard airway predictors' like modified Mallampati test (MMT), thyromental distance (TMD), and 'new airway predictor like upper lip bite test (ULBT) for predicting difficult laryngoscopy in geriatric patients.

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MATERIALS AND METHODS

This prospective, double blinded, observational study was conducted after obtaining institutional ethical committee approval at a tertiary care hospital. One hundred patients above 65 yearsof age, either sex, belonging to American Society of Anesthesiologists (ASA) physical status I and II, scheduled for elective surgery under general anaesthesia requiring endotracheal intubation were recruited for this study. Written informed consent was taken from all the patients.

Exclusion criteria includes Patients with obvious airway malformation, Cervical spine disease, Edentulous patients, Those who require emergency and awake intubation and Non-cooperative Patients During. pre-anaesthesia check-up, the patient's age, sex, weight, height, ASA physical status and body mass index (BMI) were recorded. The airway assessment was done by two anaesthesiologists, involved in the study to avoid inter-observer variability. The airway was assessed after removing the dentures, if present. MMT, TMD, and ULBT were measured by the standard methods.

ULBT (in edentulous patients): Patient was asked to roll the lower lip over the upper lip as far as possible and graded as –

Class zero: The lower lip rolling over the upper lip reaching as high as the columella;

Class I: The lower lip catching the upper lip, completely above the vermilion line fully covering and passing past the vermilion reaching a point midway between the vermilion and the columella;

Class II: The lower lip catches the upper lip at the level of the vermillion line or positioning itself just above it (2 mm);

Class III: The lower lip just caresses the upper lip, but falls short of obliterating the vermillion line.

In the operating room, after taking baseline vitals and preoxygenation with 100% oxygen for 5 minutes, general anaesthesia was induced with fentanyl 2 µg/kg and propofol 2-3 mg/kg. Muscle relaxation was achieved by vecuronium 0.1 mg/kg or succinyl choline (2 mg/kg), decided by in charge anaesthesiologists according to preoperative assessment of the airway. Bag-mask ventilation was then performed for three minutes (inj. vecuronium) or one minute (inj. succinyl choline). Laryngoscopy was performed in sniffing position by an experienced anaesthesiologist (more than 10 years experience), not involved in airway assessment, using Macintosh #3, 4 blades. Sniffing position for laryngoscopy was achieved by placing a pillow (height – 8 cm) under the patient's head.[6]

The laryngeal view was assessed by using modified Cormack and Lehane system (MCLS) as: grade 1: full glottic exposure, grade 2a: partial view of the glottis, grade 2b: only the arytenoids or the very posterior origin of the cords visible, grade 3: only epiglottis visible, grade 4: neither glottis nor epiglottis visible. The MCLS grade 2b, 3 and 4 were considered as difficult laryngoscopy.[7]

External laryngeal pressure (ELP) was applied to obtain optimal laryngeal view for intubation, whenever required. However, ELP was not used for the reporting of laryngeal view. The patient's trachea was then intubated and confirmed by bilateral auscultation over the lung fields and capnography.

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 22.

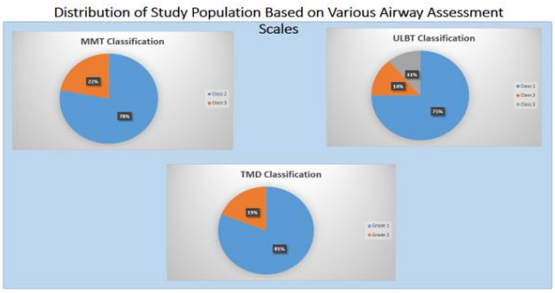
Based on the study by pratibha panjiar et al(2021) to evaluate and validate the predictive value of standard airway indicators and new airway indicators the sample size was calculated for a 95 % Confidence level , 7.14% assumed incidence of ULBT , and a precision rate of 5% , a sample size of 100 is recommended.

Sampling technique being time bound sampling.

RESULTS

A total of 100 patients were enrolled in the study. The characteristics of all patients are shown in Pie chart.

There were no significant differences in weight, height and BMI between patients with easy intubation and patients with difficult intubation. The incidence of difficult laryngoscopy was 25% (35 patients). All the difficult intubations were managed by using external laryngeal pressure and with the help of stylet or bougie. There were no failed intubations.



This table presents the distribution of the study population based on different classification scales. The Modified Mallampati Test (MMT) shows that 78% of the patients fall under Class 2, while 22% are in Class 3, indicating the majority have a relatively easier airway. The ULBT classification shows that 75% of patients are in Class 1, suggesting a majority with easier airway visualization. The Cormack-Lehane Grading (CLG) indicates that 47% of patients have a full glottic exposure (Grade 1), while 32% have a partial view (Grade 2A), 14% have only arytenoids visible (Grade 2B), and 7% have a challenging laryngoscopy (Grade 3). Lastly, the Thyromental Distance (TMD) classification shows that 81% of patients have an optimum airway (Grade 1), and 19% have a moderate airway (Grade 2).

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This table categorizes the study population into easy and difficult airways based on different scales. The Modified Mallampati Test (MMT) and the Thyromental Distance (TMD) both show that 78% and 81% of patients, respectively, fall into the easy category.. The ULBT classification shows that 75% of patients have easy airways, while 25% have difficult airways. The Cormack-Lehane Grading (CLG) indicates that 79% of patients have easy airways, while 21% are classified as difficult.

This table compares the diagnostic accuracy of different airway assessment scales against the Cormack-Lehane Grading (CLG). The Upper Lip Bite Test (ULBT) shows the highest sensitivity (91.1%) and specificity (85.7%), indicating it is the most accurate predictor of difficult laryngoscopy. The Positive Predictive Value (PPV) of ULBT is 96%, and the Negative Predictive Value (NPV) is 72%, with a Likelihood Ratio (LR+) of 6.38 and an Odds Ratio (OR) of 61.714, making it the most reliable test. The Modified Mallampati Test (MMT) also shows high sensitivity (89.9%) but lower specificity (66.7%) compared to ULBT. The Thyromental Distance (TMD) and ASA classification have lower sensitivity and specificity values, indicating they are less reliable predictors compared to ULBT and MMT.

Table 1: Distribution of Study Population Based on Various Airway Assessment Scales

Classification	Frequency	Percentage
MMT Classification		
Class 2	78	78%
Class 3	22	22%
ULBT Classification		
Class 1	75	75%
Class 2	14	14%
Class 3	11	11%
CLG		
Grade 1	47	47%
Grade 2A	32	32%
Grade 2B	14	14%
Grade 3	7	7%
TMD Classification		
Grade 1	81	81%
Grade 2	19	19%

Table 2: Categorization of Airway Difficulty Based on Various Assessment

Classification	Easy	Difficult
	Frequency (%)	Frequency (%)
MMT	78 (78%)	22 (22%)
ULBT	75 (75%)	25 (25%)
CLG	79 (79%)	21 (21%)
TMD	81 (81%)	19 (19%)

Table 3: Diagnostic Accuracy of Airway Assessment Scales Compared to Cormack-Lehane Grading (CLG)

Classification	TP	TN	FP	FN	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	LR+	LR-	OR
MMT	71	14	7	8	89.9	66.7	91	63.6	2.696	0.152	17.75
ULBT	72	18	3	7	91.1	85.7	96	72	6.38	0.103	61.714
TMD	70	10	11	9	88.6	47.6	86.4	52.6	1.692	0.239	7.071

Inference

1. **Sensitivity**
   - ❖ The ULBT has the highest sensitivity among the tests, indicating it is the most reliable in correctly identifying patients with difficult airways. MMT follows closely, TMD have similar sensitivity but are less reliable than ULBT and MMT.
2. **Specificity**
   - ❖ The ULBT also shows the highest specificity, meaning it is the most accurate in identifying patients without difficult airways. MMT is the next best, followed by TMD has the lowest specificity.
3. **Positive Predictive Value (PPV)**
   - ❖ ULBT ranks highest for PPV, suggesting it is the best at predicting difficult laryngoscopy when the test is positive. MMT follows, with TMD trailing behind.
4. **Negative Predictive Value (NPV)**
   - ❖ Again, ULBT has the highest NPV, indicating it is the most effective at ruling out difficult laryngoscopy when the test is negative. MMT, TMD, follow in descending order.
5. **Likelihood Ratio Positive (LR+)**
   - ❖ The ULBT has the highest LR+, signifying it is the most effective at increasing the probability of difficult laryngoscopy when the test result is positive. MMT, TMD, follow respectively.
6. **Likelihood Ratio Negative (LR-)**
   - ❖ ULBT has the lowest LR-, meaning it is the best at decreasing the probability of difficult

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laryngoscopy when the test result is negative. This is followed by MMT, TMD, having the highest LR-.

7. **Odds Ratio (OR)**
   - ❖ The ULBT demonstrates the highest OR, indicating it is the strongest predictor of difficult laryngoscopy overall. MMT ranks second, followed by TMD

Overall, the Upper Lip Bite Test (ULBT) consistently ranks highest across all diagnostic criteria, making it the most reliable and effective test for predicting difficult laryngoscopy compared to the Modified Mallampati Test (MMT), and Thyromental Distance (TMD). The Modified Mallampati Test (MMT) generally ranks second, while the Thyromental Distance (TMD) is less reliable but still valuable in specific contexts

DISCUSSION

It is very important to validate the diagnostic accuracy of various airway predictors in elderly patients as they have different anatomy as compared to young adults because of degenerative changes (decreased strength of airway muscles, head and neck joint changes, atrophy of alveolar bone, osteoarthritis) which may result in unanticipated difficult airway. The geriatric assessment incorporates all facets of a conventional medical history, including main problem, current illness, past and current medical problems, family and social history, demographic data, and a review of systems.[8]

Among the ‘new airway predictors', the ULBT showed highest accuracy, PPV and odds ratio as compared to MMT and TMD.

Upper lip bite test (ULBT) is one of the various bedside tests used for prediction of difficult laryngoscopic intubation.[9] The ULBT assesses the range and freedom of mandibular movement and the architecture of the teeth simultaneously.[10]

Limitations of our study were firstly, the diagnostic accuracy of studied airway predictors in elderly were not compared with young adults. Secondly, medical conditions of the patient (diabetes, rheumatoid arthritis, obstructive sleep apnoea (OSA), osteoarthritis) that might affect the airway were not recorded and analysed. Thirdly, the incidence of difficult endotracheal intubation was not assessed in our study which is the ultimate objective of the airway assessment. In geriatric patients with missing and/or loose teeth, it is difficult to intubate the trachea even with grade I laryngoscopic view.

CONCLUSION

ULBT has moderate sensitivity and PPV, and high specificity, NPV and accuracy. So, it appears that ULBTis a useful bedside test for evaluation of patient airway before the general anesthesia. However, further studies comparing various airway predictors specially ‘new airway predictors’ in geriatric patients are much needed to validate these parameters and to preventunanticipated difficult airway in these patients with limited functional reserve.

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