Section: Anaesthesia

Original Research Article

PREOPERATIVE PREDICTION OF DIFFICULT INTUBATION: A COMPARATIVE STUDY OF UPPER LIP BITE TEST AND RATIO OF HEIGHT TO THYROMENTAL DISTANCE WITH OTHER BEDSIDE AIRWAY ASSESSMENT TESTS

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Abstract

Background: Various studies were conducted in different parts of the world on various airway assessment tests for prediction of difficult intubation pre-operatively since many decades. Hence our aim is to study & evaluate upper lip bite test and ratio of height to thyromental distance with other bedside airway assessment tests. **Materials and Methods:** A prospective, observational cross-sectional study was conducted in the department of Anaesthesiology and Critical Care, The Bangalore Hospital, Bangalore, Karnataka from June 2017 to May 2019. Total 45 adult patients undergoing elective surgery requiring general anaesthesia with endotracheal intubation were studied. **Results:** The most sensitive test was found to be the Head & neck movements (HNM) (92.30%). This implies that a HNM< 80º has the least chance of wrongly predicting a difficult intubation to be easy. The most specific test was found to be MMT & ULBT (100%). This implies that MMT of grade III, IV & ULBT of grade 3has the least chance of wrongly predicting an easy intubation to be easy. The test that gave the highest positive predictive value was MMT & ULBT (100%). This implies that MMT of grade III, IV & ULBT of grade 3 has the highest chance of predicting a difficult intubation to be in fact difficult. The most diagnostically accurate test was found to be the Ratio of Height to Thyromental Distance (RHTMD) (accuracy of 86.7%) followed by Thyromental Distance (TMD) (Accuracy of 84.4%). HNM was found to be a poor diagnostic test. **Conclusion:** In conclusion no screening test is 100% sensitive or specific so it's inevitable to miss some difficult intubations. No test is 100% free of false negatives using either single or multiple predictors.

INTRODUCTION

Airway management refers to the practice of establishing and securing a patients airway and endotracheal intubation remains the gold standard for emergency airway management. Airway management is encountered by the anaesthesiologist during the conduct of anaesthesia or resuscitation of the critically ill patients every day. Closed claims analysis revealed that death or brain damage occurred in 85% of the cases of adverse respiratory events under anaesthesia and the mechanism of injury for the same was a difficult tracheal intubation in 17% of the cases.[1] In the patients undergoing surgery incident of difficult intubation varies from 1.5% to 13% according to data reported.[2] The incidence of failed endotracheal intubation is 0.05% - 0.35%, whereas the incidence of cannot ventilate, cannot intubate is around 0.0001% -0.02%.[3]

Anaesthesia in a patient with a difficult airway can lead to both direct airway trauma as well as morbidity from hypoxia and hypercarbia. Direct airway trauma occurs because the management of a difficult airway involves the application of more physical force to the patient's airway than is normally used. Much of the morbidity specifically attributable to managing a difficult airway comes

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from an interruption of gas exchange (hypoxia and hypercapnea), which may then cause brain damage and cardiovascular activation or depression. About 50-70% cardiac arrest during general anaesthesia are because of difficult intubation that causes inadequate oxygenation and/or ventilation, which about 55-93% of them cause death or brain death.[4-6]

The ideal method for preoperative airway assessment should have a high sensitivity Mild specificity and result in minimal false positive and false negative predictions. While a false positive outcome may result in greater expenditure of time or cause inconvenience (e.g. Nulling up equipment such as a fibreoptic bronchoscope), the result of a false negative outcome could be catastrophic (brain damage or mortality).

Aims and Objectives

To evaluate the sensitivity, specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV), and for six bedside airway assessment criteria, namely, Inter-Incisor Gap (IIG), Modified Mullampatti Test (MMT), Head and Neck Movement (HNM), Thyromental Distance (TMD), Upper Lip Bite Test (ULBT), and Ratio of Height to Thyromental Distance (RHTMD) in isolation, with an attempt to determine if ULBT and RHTMD are more comprehensive and accurate tests as compared to IIG, MMT, HNM, and TMD, in the preoperative prediction of difficult intubation.

MATERIALS AND METHODS

After obtaining approval from the Institutional Ethics Committee (IEC) a prospective, observational cross-sectional study was conducted in the department of Anaesthesiology and Critical Care, The Bangalore Hospital, Bangalore, Karnataka from June 2017 to May 2019. A Total of 45 adult patients undergoing elective surgery requiring general anaesthesia with endotracheal intubation were studied.

Inclusion Criteria

- Patients undergoing elective surgery under general anaesthesia with endotracheal intubation
- Age >18 years and <60 years of both sex
- ASA physical status Grade I and grade II patients
- Elective planned surgeries

Exclusion Criteria

- Consent not given.
- ASA Grade III or IV
- Age <18 yrs or >60 yrs
- Patients unable to sit or stand erect
- Pregnant females
- Patients requiring awake intubation
- Patients having obvious airway malformation
- Patients with diabetes mellitus, rheumatoid arthritis, ankylosing spondylitis.
- Patients with neck swellings
- Edentulous patients.
- Patients with temporomandibular joint ankylosis, mandibular fracture, post burn contractures, cervical spine pathology.
- Patients with contraindication to i.v succinylcoline.

Methodology

Following routine pre-anaesthetic check-up by the attending anaesthesiologist, written, informed, and valid consent was taken from each selected patient.

Preoperative assessment:

The airway was assessed preoperatively in the Operation Theatre Pre-Induction room on the day of surgery by the same anaesthesiologist in all study subjects to avoid inter-observer error.

Preoperative Checklist:

Anaesthesia machine and circuits were checked.

The following instruments were kept ready

- Face masks: Of appropriate sizes
- Airways: Oral and Nasopharyngeal
- Laryngoscope with appropriate sized blades
- Endotracheal tubes (ETT): appropriate sizes and one size smaller.
- Malleable Stylet for Endotracheal tube
- Ventilating bougie
- Laryngeal Mask Airways (LMA) of appropriate sizes
- Functioning suction apparatus
- Combitube
- Magill's forceps
- Fibreoptic bronchoscope, video laryngoscope
- Multiparameter monitor: ECG,SpO2,NIBP,EtCO2

The following emergency drugs were kept ready: Inj Atropine, Inj Adrenaline, Inj Lignocaine (2%), and Inj NaHCO3.

Intraoperative assessment

Standardized anaesthetic protocol was followed in all patients. In the operating room a18 G intravenous cannula was inserted and ringer lactate infusion was started. Standard monitors such as NIBP, ECG, SPO2 were attached and measured.

All patients were administered intravenous Inj.Ranitidine 50 mg, Inj.Ondansetron 4 mg, Inj.Glycopyrrolate 0.2 mg(0.004mg/kg), Inj.Midazolam (0.03 mg/kg) and Inj.Fentanyl (1mcg/kg).

Following preoxygenation with 100% oxygen for 3 minutes, anesthesia was induced with Inj.Propofol (2 mg/kg) IV and after confirming mask ventilation was possible, Inj.Succinylcholine (1.5 mg/kg) IV was given to facilitate endotracheal intubation. The lungs were ventilated with 100% oxygen with help of a facemask for 3 minutes.

Laryngoscopy was performed after cessation of fasciculation. With the patient's head in sniffing position, laryngoscopy was performed with a Macintosh no. 3 or 4 laryngoscope blade by an anesthesiologist (of at least two year experience) who was blinded to the results of preoperative airway assessment. Glottic visualization were

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assessed and noted according to modified Cormack and Lehane classification by the same person.
Grade 1 - vocal cords visible,
Grade 2 - only posterior commissure or arytenoids visible,
Grade 3 - only epiglottis visible, and
Grade 4 - none of the above visible without any external laryngeal manipulation.
During direct laryngoscopy, if CL Grade III or Grade IV view was present, patient kept in difficult laryngoscopy group, and if CL Grade I or Grade II was present, patient kept in easy laryngoscopy group and considered as easy visualization of the larynx.
After assessment if needed, cricoid pressure was permitted for intubation. After evaluation and endotracheal intubation, surgery was performed under standard anesthesia.

Statistical Analysis

All information were collected in a data sheet and a Master Chart was prepared.
The Statistical software namely SPSS 18.0, and R environment ver.3.2.2 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.
Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean - SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance.
Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups (Inter group analysis) on metric parameters.
Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups, Non-parametric setting for Qualitative data analysis. Fisher Exact test used when cell samples are very small. Bayesian diagnostic tests were used to find the diagnostic performance of various tests with respect to the prediction.

RESULTS

The present study included 45 patients; the distribution of their age has been depicted as fallows, the highest number of patients fell in the age group of 31-40yrs (33.3%) followed by age group 41-50 yrs (22.2%). Mean age group included was 39.22 yrs. Male constituted 53.3% and female constituted 46.7% of the study population.

Table 1: Distribution of Sample Population as Per Age and Gender

Age in years	Gender		Total
	Female	Male	
<20	0(0%)	2(8.3%)	2(4.4%)
20-30	4(19%)	5(20.8%)	9(20%)
31-40	9(42.9%)	6(25%)	15(33.3%)
41-50	4(19%)	6(25%)	10(22.2%)
51-60	4(19%)	5(20.8%)	9(20%)
Total	21(100%)	24(100%)	45(100%)

In this study, age group of 31- 40 yrs constituted 33.3% of the study population out of which 60 % were females.

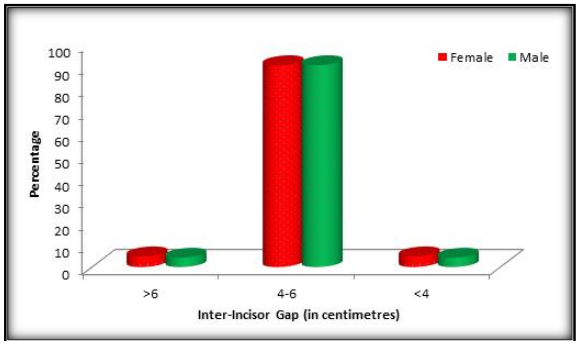

Figure 1: Interincisor Gap (IIG)

P=0.728, Not Significant, Fisher Exact Test
In this study, IIG of 4- 6 cm constituted 91.11% of the study population out of which 53.65% were males. The values were statistically not found to be significant. The values were statistically not found to be significant.

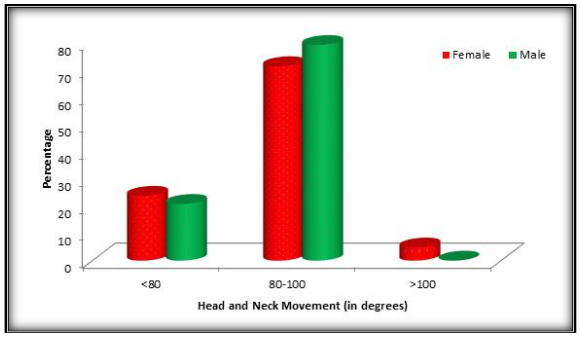

Figure 2: Head and Neck Movement

P=0.723, Not Significant, Fisher Exact Test
In this study, HNM of 80-100º constituted 75.6% of the study population out of which 55.88% were males. The HNM values were statistically not found to be significant with respect to gender distribution of population.
MODIFIED MALLAMPATI TEST (MMT)
Taking MMT alone as a predictor of difficult intubation in 45 patients, MMT grade I & II were predicted to have easy intubation. MMT grade III & IV were predicted to have difficult intubation.

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Table 2: Modified Mallampati Test (MMT)

Modified Mallampati Test Grade	Predictor	Gender		Total
		Female	Male	
1	Easy	8(38.1%)	13(54.2%)	21(46.7%)
2	Easy	12(57.1%)	9(37.5%)	21(46.7%)
3	Difficult	0(0%)	1(4.2%)	1(2.2%)
4	Difficult	1(4.8%)	1(4.2%)	2(4.4%)
Total		21(100%)	24(100%)	45(100%)

P=0.539, Not Significant, Fisher Exact Test
In this study, MMT of grade I & grade II constituted 46.7 % each of the study population out of which 48.8 % were males. The MMT values were statistically not found to be significant with respect to gender distribution of population.

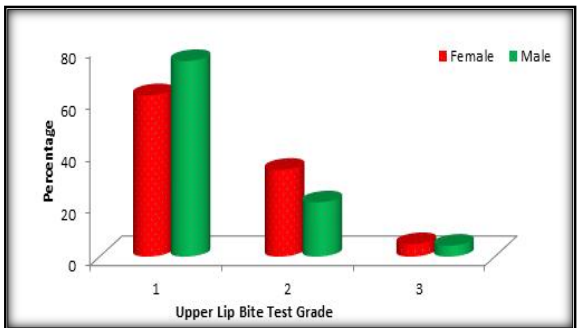

Figure 3: Upper Lip Bite Test Grade

P=0.744, Not Significant, Fisher Exact Test
In this study, ULBT of Grade 1 cm constituted 68.9% of the study population out of which 58.06 % were males. The ULBT values were statistically not found to be significant with respect to gender distribution of population.

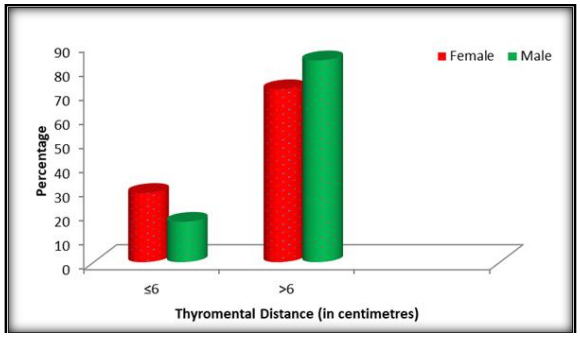

Figure 4: Thyromental Distance

In this study, TMD of >6 cm constituted 77.77% of the study population out of which 57.14% were males.

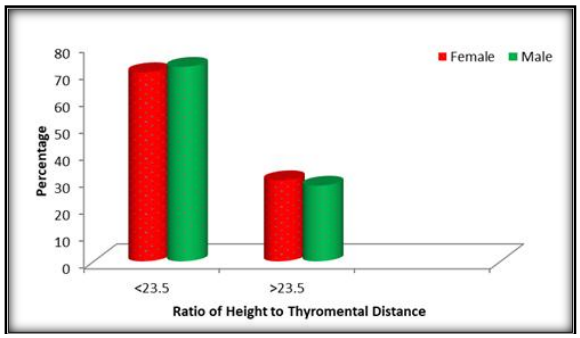

Figure 5: Ratio of Height to Thyromental Distance Studied

In this study, RHTMD of <23.5cm constituted 71.11% of the study population out of which 56.25 % were males.

Table 3: Comparison of Clinical Variables According to Gender

Variables	Gender		Mean
	Female	Male	
Age in years	39.62±10.37	38.88±13.23	39.22±11.85
Height (cm)	153.24±8.17	161.25±10.91	157.51±10.43
Weight (kg)	55.71±9.73	62.54±15.22	59.36±13.27
Inter-Incisor Gap (in centimetres)	4.57±0.71	4.85±0.74	4.72±0.73
Modified Mallampatti Test Grade	1.71±0.72	1.58±0.78	1.64±0.74
Head and Neck Movement (in degrees)	81.24±7.13	80.42±2.69	80.80±5.20
Thyromental Distance (in centimetres)	7.04±1.49	7.75±1.33	7.42±1.44
Upper Lip Bite Test Grade	1.43±0.60	1.29±0.55	1.36±0.57
Ratio of Height to Thyromental Distance	22.33±5.21	21.00±4.37	21.62±4.77
Laryngoscopic View (based on Cormack-Lehane grading)	1.90±1.04	1.79±0.98	1.84±1.00

Average age, height, weight, IIG, TMD was higher in males compared to females.
Average MMP, HNM, ULBT, RHTMD was higher in females compared to males.

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Table 4: Correlation of Demographic Variables with Laryngoscopic View

Variables	Laryngoscopic View		Total	P value
	Grade I & II (n=32)	Grade III & IV (n=13)	(n=45)	
Age in years				
● <20	1(3.1%)	1(7.7%)	2(4.4%)	0.19
● 20-30	8(25%)	1(7.7%)	9(20%)	
● 31-40	8(25%)	7(53.8%)	15(33.3%)	
● 41-50	9(28.1%)	1(7.7%)	10(22.2%)	
● 51-60	6(18.8%)	3(23.1%)	9(20%)	
Gender				
● Female	15(46.9%)	6(46.2%)	21(46.7%)	0.965
● Male	17(53.1%)	7(53.8%)	24(53.3%)	
Height (cm)				
● <150	5(15.6%)	2(15.4%)	7(15.6%)	0.961
● 150-160	15(46.9%)	7(53.8%)	22(48.9%)	
● 161-170	7(21.9%)	3(23.1%)	10(22.2%)	
● 171-180	5(15.6%)	1(7.7%)	6(13.3%)	
Weight (kg)				
● <50	8(25%)	0(0%)	8(17.8%)	0.091+
● 50-60	13(40.6%)	10(76.9%)	23(51.1%)	
● 61-70	6(18.8%)	2(15.4%)	8(17.8%)	
● >70	5(15.6%)	1(7.7%)	6(13.3%)	

There was no significant difference in the age, sex, height distribution of patients having easy intubation and having difficult intubation. So the distribution with respect to these demographic parameters was same across the patients with easy and difficult intubation.
The distribution of weight with respect to ease of intubation was found to be statistically significant.

Table 5: Correlation of Test Parameters in Relation to L V of Patients Studied

Variables	Laryngoscopic View				Total
	Grade 1 (n=23)	Grade II (n=9)	Grade III (n=10)	Grade IV (n=3)	(n=45)
IIG					
● Grade I	1(4.34%)	1(11.11%)	0	0	2(4.44%)
● Grade II	21(91.30%)	8(88.88%)	9(100%)	3(100%)	41(91.11%)
● Grade III	1(4.34%)	0	1	0	2(4.44%)
MMT					
● Grade I & II	23(100%)	9(100%)	7(70%)	3(100%)	42(93.3%)
● Grade III & IV	0(0%)	0(0%)	3(30%)	0(0%)	3(6.7%)
HNM					
● Grade I	20(86.9%)	3(33.33%)	9(90%)	1(100%)	35(77.7%)
● Grade II	3(13%)	6(66.7%)	1(10%)	0(0%)	10(22.2%)
TMD					
● >6cm	22(95.65%)	9(100%)	4(40%)	0	35(77.8%)
● ≤6cm	1(4.34%)	0(0%)	6(60%)	3(100%)	10(22.2%)
ULBT					
● Class I & II	23(100%)	9(100%)	9(90%)	2(66.7%)	43(95.6%)
● Class III	0(0%)	0(0%)	1(10%)	1(33.3%)	2(4.4%)
RHTMD					
● Grade I	21(91.3%)	8(88.9%)	2(20%)	1(33.3%)	32(71.1%)
● Grade II	2(8.7%)	1(11.1%)	8(80%)	2(66.7%)	13(28.9%)

Table 6: Comparison of Test Parameters and Intubation in The Study Subjects

Criteria	Observation					Correlation					
	TP	FP	FN	TN	Total	Se	Sp	PPV	NPV	Accuracy	P value
IIG	7	11	6	21	45	53.9	65.6	38.9	77.8	62.2	0.227
MMT	3	0	10	32	45	23.1	100	100	76.2	77.8	0.020*
HNM	12	22	1	10	45	92.3	31.3	35.3	90.9	48.9	0.136
TMD	8	2	5	30	45	61.5	93.75	80	85.7	84.4	<0.001**
ULBT	2	0	11	32	45	15.4	100	100	74.4	75.5	0.079+
RHTMD	10	3	3	29	45	76.3	90.6	76.9	90.6	86.7	<0.001**

Among six pre-operative assessment tests, HNM test had highest sensitivity (92.3%) and MMT & ULBT test had highest specificity (100%). ULBT test had lowest sensitivity (15.4%) while HNM had the lowest specificity (31.3%). Correlation of ULBT & MMT with laryngoscopic view was found to be statistically significant. Correlation of TMD & RHTMD with laryngoscopic view was found to be strongly statistically significant.

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DISCUSSION

In the present study, Preoperative assessment included six parameters namely, Inter-Incisor Gap (IIG), Modified Mallampatti Test (MMT), Head and Neck Movement (HNM), Thyromental Distance (TMD), Upper Lip Bite Test (ULBT), and Ratio of Height to Thyromental Distance (RHTMD). After induction of anaesthesia, laryngoscopic view (LV) was graded as per Cormack - Lehane classification.

DEMOGRAPHIC DATA

The age of the patients in this study ranged from 18 to 60 years. The mean age was 39.22 +/- 11 years. The sex distribution was almost equal in this study with 24 males and 21 females. The height of the patients in this study ranged from 140 to 189cms. The mean height was 157.51±10.43 cms. The weight of the patients in this study ranged from 30 to 100 kgs. The mean weight was 59.36±13.27kgs.

The comparison of demographic data revealed a statistically insignificant distribution of demographic data into groups of easy intubation and difficult intubation

INCIDENCE OF DIFFICULT INTUBATION (DI)

The incidence of DI in the present study was 28.90% which is comparable with other studies in Wilson et al. found an incidence of DI of 13%.7 in Tse et al. found an incidence of DI 13.16% .8 D. Savva's study it was 4.86%.[9] In a study by Kuriakose R et al the high incidence of DI (32.9%) was found due to the high incidence of facio-oro-maxillary and neck malignancies in their study group.[10] The study done by Philip et al. reported the incidence of DI was 16%.[11]

INTERINCISOR GAP (IIG)

The mean IIG of the patients in this study was 4.72±0.73. An IIG of <4cms was considered abnormal. 2 patients had an IIG of <4cms (Grade 3 IIG) out of which 1 patient experienced a difficult intubation.

In this study for IIG, the sensitivity, specificity, PPV, NPV, and accuracy of IIG were found to be 53.9%, 65.6%, 38.9%, 77.8%, 62.2% respectively which is also similar with other studies by Philip et al.11, Shobha et al.[12]

Wilson et al. suggested an interincisor gap of <5cms as a predictor of difficult intubation.[7] Savva et al. in his study found no correlation between interincisor gap and view on laryngoscopy. According to D. Savva, laryngoscopy may be more difficult in those patients whose interincisor gap is less than 2cms rather than 5cms as suggested by Wilson and colleagues.[9]

In the study conducted by Kuriakose et al on 234 patients with facio-oro-maxillary and neck malignancies, IIG was found to have a sensitivity, specificity, and PPV of 29.87%, 99.36%, and 95.83% respectively.[10]

Important to note is that the cut-off value for IIG used in this study was 4cms. The other studies mentioned above have used cut-off values between 2cms to 5cms.

HEAD AND NECK MOVEMENT (HNM)

The mean HNM in this study was 80.80±5.20°. A HNM of <80° was considered abnormal. 10 patients had HNM <80° (Grade 2 HNM). Of these 10 patients, 1 patient experienced difficult intubation.

In this study, the sensitivity, specificity, PPV, NPV, and accuracy of HNM were 92.3%, 31.3%, 35.3%, 90.9%, 48.9% respectively. HNM was found to be a fairly accurate diagnostic test (AUC).

Wilson et al. used a cut-off value of 90° of HNM in their 1988 study.[7] Rose and Cohen in their 1994 study on 18,205 patients found that decreased visualization of the hypopharynx only was associated with 81.8%, 6.7%, 5.2%, and 3.7% respectively of easy, awkward, difficult, and those requiring alternative methods of intubation.[13]

Tse et al. in a 1995 study used a cut-off of 80° head extension as an indicator of difficult intubation and reported a sensitivity, specificity, PPV, and NPV of 10%, 93%, 18%, and 87% respectively.[8]

In the study conducted by Kuriakose et al in 2003 on 234 patients with facio-oro- maxillary and neck malignancies, AOJE gave a sensitivity, specificity, and PPV of 2.5%, 100%, and 100% respectively.[10,11,12]

The high Negative Predictive Values given by HNM in previous studies as well as in the present study imply that a negative result of HNM truly indicates easy intubation.

MODIFIED MALLAMPATTI TEST (MMT)

A Modified Mallampatti Grade of III or IV was considered abnormal in this study. 1 patients had a Grade III MMT class and 2 patient had a Grade IV MMT class. Of these 3 patients, all 3 patients experienced difficult intubation.

In this study, the sensitivity, specificity, PPV, NPV, and Accuracy of MMT were found to be 23.1%, 100%, 100%, 76.2%, 77.8% respectively. MMT was found to be fairly accurate diagnostic test. The authors concluded that MMT does not reliably predict difficult intubation but the high NPV meant that a negative result indicates truly easy intubation.8 This is correlate to other studies also.[9,15,16,17,14]

The study conducted by Kuriakose et al revealed a high sensitivity (81.81%) of MMT owing to the decreased mouth opening, increase in size of tongue, and decrease in mobility of tongue in the sample of patients with facio-oro-maxillary and neck malignancy. The reported specificity and PPV were 75.15% and 61.76% respectively.[10]

Since the values for sensitivity, specificity, and PPV for MMT vary widely over various studies conducted, including the present study, a result cannot be drawn regarding the same. However, MMT seems to consistently give high Negative Predictive Values in various studies, including the present study, thus implying that a negative result of MMT truly indicates easy intubation.

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THYROMENTAL DISTANCE (TMD)

The mean TMD in this study was 7.42±1.44cms. A TMD of ≤6cms was considered abnormal.[10] patients had TMD <6cms (Grades 3 TMD). Of these, 9 patients experienced difficult intubation.

In this study, the sensitivity, specificity, PPV, NPV, and accuracy of TMD were 61.5%, 93.75%, 80%, 85.7%, 84.4% respectively. The number of False Positive outcomes was 2 out of 45. TMD was found to be an excellent test in terms of diagnostic accuracy.

In the study by Mathew et al on 44 patients, TMD <6cms correlated well MMT grade III and IV and had a higher probability of difficult intubation.10 The study by Frerk on 244 patients reported a sensitivity, specificity, and PPV of 90.9%, 81.5%, and 18.8% respectively for TMD <7cms.15 Savva et al. in his study reported a sensitivity, specificity, and PPV of 64.7%), 81.4%, and 15.1% respectively for TMD <6.5cms.[9]

In the study by Rose and Cohen on 18.205 patients, decreased TMD only was associated with 73.2%, 11.3%, 10.6%, and 2.6% respectively of easy, awkward, difficult, and requiring alternate methods of intubation.[13]

The improved sensitivity (66.23%) of TMD in the 2003 study by Kuriakose et al on 234 patients of facio-oro-maxillary and neck malignancies was attributed to the reduction in the thyromental distance caused by the tumour itself with surrounding inflammation and fibrosis all of which contributed to an increased chance of difficult intubation.[10]

On the basis of previous studies as well as the present, the impact of cut-off values of 6.5cms or 7cms of TMD on sensitivity remains inconclusive. A cut-off value of 6cms of TMD in the present study however gave a better specificity.

UPPER LIP BITE TEST (ULBT)

The number of patients with Grade 2 ULBT in this study was 12 and with Grade 3 ULBT was 2. Of 2 patients with grade 3 ULBT, both experienced difficult intubation. In this study ULBT failed to be as a bedside test in predicting DVL. The descriptive reason was the small number of the cases with ULBT grade III (4.4%). On the other hand in patients who had ULBT I and II the probability of DVL was low which is comparable with previous studies.

In this study, the sensitivity, specificity, PPV, NPV, and LR of ULBT were 94.44%, 95.05%, 65.38%, 99.43%, and 19.1 respectively. The number of False Positive outcomes was 9 out of 200 (4.5%). ULBT was found to be an excellent test in terms of diagnostic accuracy (AUC 0.947).

Wilson et al utilized slux grade (translational movement at TMJ), receding mandible, and protruding maxillary incisors (buck teeth) as three separate criteria in their risk score for preoperative airway assessment. These three parameters are simultaneously assessed in the grading of ULBT.[7]

On the basis of previous studies.[18,19,20,21,11,12] ULBT consistently proves to be a highly sensitive test, giving high Negative Predictive Values, implying that an abnormal ULBT class will accurately predict a difficult intubation, with the least chance of a false positive outcome.

RATIO OF HEIGHT TO THYROMENTAL DISTANCE (RHTMD)

The mean RHTMD in this study was 21.62±4.77. A RHTMD of >23.5 was considered abnormal. 13 patients had a RHTMD >23.5 (Grade 2 RHTMD). Of these 10 patients, all experienced difficult intubation.

In this study, the sensitivity, specificity, PPV, NPV and accuracy of RHTMD were 76.3%, 90.6%, 76.9%, 90.6%, 86.7% respectively. RHTMD was found to be an excellent test in terms of diagnostic accuracy.

Schmitt HJ et al in their study on 270 Caucasian patients evaluated the TMD and RHTMD preoperatively. While both tests gave a sensitivity of 81%, RHTMD gave a greater specificity (91 %) than TMD (73%).[22]

The study by Kobbuaban et al evaluated RHTMD versus IIG, TMD, HNM, and MMT. The odds ratio (95% C.I.) of RHTMD, MMT, and HNM were 6.72, 2.96, and 2.73 respectively thus establishing RHTMD as a useful screening test for difficult laryngoscopy.[23]

On the basis of previous studies as well as the present one, RHTMD consistently proves to be a fairly specific test implying that it has a low chance of giving a false positive outcome.[24,25,11,12]

Thus, as a final note to discussion, though no single test or combination of tests has proved absolutely effective in the preoperative prediction of difficult intubation till date, Upper Lip Bite Test (ULBT), and Ratio of Height to Thyromental Distance (RHTMD) alone, as also in combination with Thyromental Distance (TMD) could be investigated further as better predictors of the difficult airway in apparently normal patients requiring endotracheal intubation.

CONCLUSION

To conclude, no screening test is 100% sensitive or specific so it's inevitable to miss some difficult intubations. No test is 100% free of false negatives. Using single or multiple predictors, assessment of the airway should be done in the preoperative evaluation of the patient and patient should be graded as easy or difficult intubation keeping the pitfalls of these tests in mind. One should keep the difficult airway cart ready and be prepared to follow the institutional protocol for the management of unanticipated difficult airway and avoid serious complications thus bringing down the morbidity & mortality associated with difficult airway.

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