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ORIGINAL RESEARCH

An Observational Study to Compare Airway Assessment Tests in Combination or Individually with Intubation Difficulty Scale in Patients Undergoing Direct Laryngoscopy and Endotracheal Intubation

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ABSTRACT

Background: There are many studies on upper airway measurement on Western population. This study aims to know the incidence of difficult intubation in the Northern Indian population and also to determine the validity of bedside tests individually and in combination in predicting difficult intubation.

Material and Methods: In this study, 99 patients enrolled aged between 18–60 years of American Society of Anesthesiologists I, II and III, scheduled for surgery under general anesthesia requiring endotracheal intubation. Anaesthesiologist recorded parameters in pre anaesthetic check up of different parameters like Upper Lip Bite Test (ULBT), Sternomental Distance (SMD), Ratio of Height-to-Thyromental Distance (RHTMD), Modified Mallampati Classification (MMC), Dellikans and Calders test.after standard induction laryngoscopy was performed and intubation difficulty level was assessed using intubation difficulty scale (IDS).

Results: MMC was found significant with P-value is <0.05 and has higher sensitivity in combination with Dellikan and Calders test.

Conclusion: MMC is a better predictor individually or when combined with other tests done at bedside for prediction of difficult laryngoscopy as compared to other tests.

Keywords: Difficult Airway, Direct Laryngoscopy, Endotracheal Intubation.

INTRODUCTION

The Endotracheal Intubation as well as the airway management still remains the most basic concept among the anesthesiologist as it is very much important for maintaining proper ventilation and oxygenation to avoid the life threatening consequences.[1]

The preoperative detection of the patients who have a risk for difficult intubation is usually considered to be the primary step for airway management. This allows the anaesthesiologist to evaluate risk and plan for the use of alternative airway devices if necessary.[2-4]

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 03, 2023

According to the American Society of Anaesthesiologists, when an experienced anaesthetist faces difficulty in maintaining ventilation of upper airway with Bag and Mask and tracheal intubation is known as Difficult Airway.

Inability to maintain proper airway of patient can lead to catastrophic situations. Foreseeing the difficulty in airway management can help to reduce the level of associated morbidity and mortality.[5,6]

This particular study has been conducted for finding out the validity of several test like the following ones: Upper Lip Bite Test (ULBT), Sternomental Distance (SMD), Ratio of Height-to-Thyromental Distance (RHTMD), Modified Mallampati Classification (MMC), Dellikans and Calders test.[7]

The anthropological literature also emphasised the ethnic heterogeneity in population craniofacial configuration. There are racial differences in their morphology and anatomical changes.[8] There are many studies done on upper airway western population and their results cant be used for Northern Indian population to predict difficult intubation because of the differences in craniofacial features. We assumed that airway measurements will be different in North Indian population then Caucasians and set some bedside test based on their predictive values which can be used on North Indian population for future references.

After finding out the validity of the tests individually a combination will also be carried out along with the results for comparing them with the IDS score that is assessed at the time of direct laryngoscopy as well as intubation.

Several tests were formulated for assessment at bedside for difficulty in unanticipated intubation. Though there are several tests who had poor discriminative power while they are being used alone on a comparison with the other type of tests.[9-11]

However, no data has been published till date to show the frequency of the predictive tests in their uses or how useful can turn out to be after being possible by the anaesthetists.[12]

MATERIAL & METHODS

This prospective observational study was time bound and started after getting approval from the College Ethical Committee on 26/7/2021, till June 2022 and conducted in Department of Anaesthesiology, Teerthanker Mahaveer Medical College & Research Centre, Moradabad after obtaining approval from clinical trial registry of India with CTRI Number - 2021/09/036439

Inclusion Criteria

Patient giving written informed consent. American Society of Anaesthesiologists (ASA) I, II, III undergoing elective General Anaesthesia. Patient aged between of 18-65 years. Patients BMI with 18.5 – 22.9 kg/m2

Exclusion Criteria

Patients who had head and neck pathologies, trauma, radiation, cervical spine pathology required specific manipulation. Potential difficult airway anomaly. Patients who needed rapid sequence induction/intubation under cricoid pressure (obstetric cases included) or awake intubation.

Pre anaesthetic evaluation was done for all patients prior to surgery. All parameters was checked in PAC or in preoperative room (in case of emergency surgery). After taking the written consent from patient in his own language. Demographic data was also collected. Following tests were performed in pre anaesthetic assessment- Modified Mallampatti Classification, Ratio of Height to Thyromental Distance (RHTMD), Dellikan Test, Calder Test, Upper lip bite test (ULBT), Sternomental Distance (SMD). Investigation done as per patients age and co-morbidities. All the patients were advised nil per orally from midnight. Inside OT, all ASA standard monitors attached and readings were recorded. As IV line was secured with an 18-20 G cannula as per patient requirement. Endotracheal intubation was

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 03, 2023

done as per institution protocol. Expert anaesthetist performed intubation and assess the level of difficulty during laryngoscopy who was not aware of preoperative findings. Laryngoscopy was done by Macintosh blade ¾ and with head in sniffing position and trachea was intubated. The laryngoscopic view graded according to IDS scoring and predictive values of the tests were measured for six parameters at the end of intubation. Adnet et al gave intubation difficulty scale (IDS) on the basis of seven variables associated with difficult intubation.[13]

IDS SCORE

PARAMETER	SCORE
Number of attempts >1	N1
Number of operators >1	N2
Number of alternative techniques	N3
Cormack grade-1	N4
Lifting force required Normal Increased	N5=0 N5=1
Laryngeal pressure Not Applied Applied	N6=0 N6=1
Vocal cord mobility Abduction Adduction TOTAL IDS SCORE= SUM OF SCORE	N7=0 N7=1 N1-N7

score 0 to 5 -no or slight difficulty

>5 moderate to major difficulty.

According to previous data 8% incidence of difficult intubation in Indian population.

STATISTICAL ANALYSIS

We used chi square test, one way ANOVA Test and t-test. AUC under ROC curve was determined using the cut off values. SPSS 20 version was used for analysis. To test predictive values we used Sensitivity, specificity, NPV, PPV values were recorded in tabulated form. P-value <0.005 was considered as significant.

RESULTS

We enrolled 99 adult patients who were scheduled for elective surgery under general anaesthesia with tracheal Intubation. Demographic details were noted and predictive values of different parameters were also tabulated. 9 cases of difficult intubation were there when compared with IDS scale.

Table 1: Representation of demography

Category	Mean± SD
Age	36.2±12
Height	158.6±4.1
Weight	59.3±9.6
BMI	21.18±1.45

Table 2: Representation of Frequency distribution of parameters.

Parameter	Nature of Intubation	No of cases N (%)
RHTMD GRADE I	Easy Intubation	78(78.8)
Grade II	Difficult Intubation	21(21.2)
MMC	Easy Intubation	45(45.5)

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 03, 2023

CLASS I &II		
CLASS III&IV	Difficult Intubation	54(54.5)
SMD GRADE I	Easy Intubation	56(56.6)
GRADE II	Difficult Intubation	43(43.4)
ULBT GRADE1 &II	Easy Intubation	96(97)
GRADE III	Difficult Intubation	3(3)
IDS Category IDS < 0-5	Easy Intubation	90(90.9)
IDS >5	Moderate Intubation	9(9.1)
	Difficult Intubation	0(0)

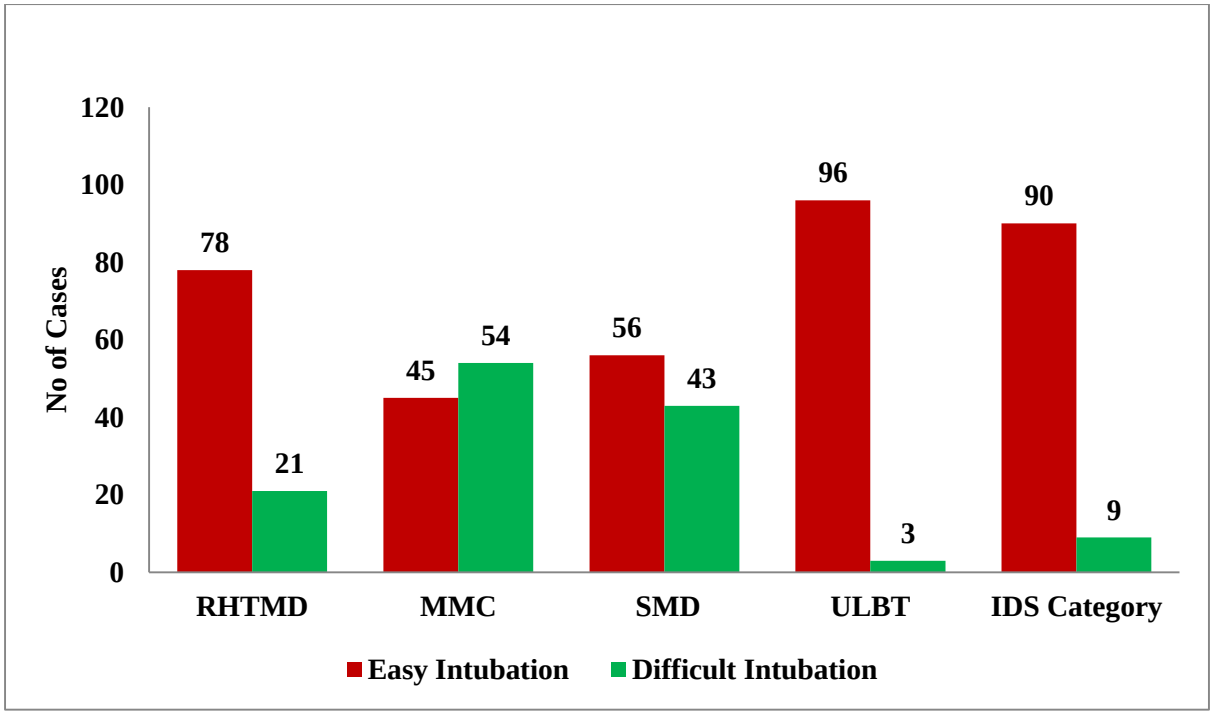

Table 3: -Predictive values for RHTMD, SMD, MMC, ULBT, DELIKANS AND CALDERS and their combinations to predict the occurrence of difficult intubation according to the IDS scale

	AUC Curve	Sensitivity (%)	95% CI	Specificity (%)	95% CI	PPV	NPV	P-Value
RHTMD	0.43	0.50	(0.23, 7.0)	0.68	(0.31, 0.89)	0.32	0.52	0.242
SMD	0.37			0.36	(0.21, 0.71)	0.31	0.48	0.022
MMC	1.00	1.0	--	0.32	(0.1, 0.51)	--	--	0.001
ULBT	0.55	0.41	(0.02, 0.61)	0.43	(0.09, 0.52)	0.21	0.48	0.378
DELLIKAN & CALDERS TEST	1.00	1.0	--	1.0	--	--	--	0.001
MMC + ULBT	0.936	0.96	(0.3, 1.0)	0.95	(0.3, 1.0)	0.28	0.26	0.001
MMC+ RHTMD	0.600	0.74	(0.21, 0.80)	0.79	(0.3, 0.95)	0.22	0.24	0.71
MMC+	0.628	0.72	(0.11,	0.71	(0.29, 0.96)	0.26	0.29	0.73

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 03, 2023

SMD			0.82)					
MMC+ DELLIKANS TEST	1.00	1.0	--	1.0	--	--	--	0.001
MMC+ CALDERS TEST	1.00	1.0	--	1.0	--	--	--	0.001

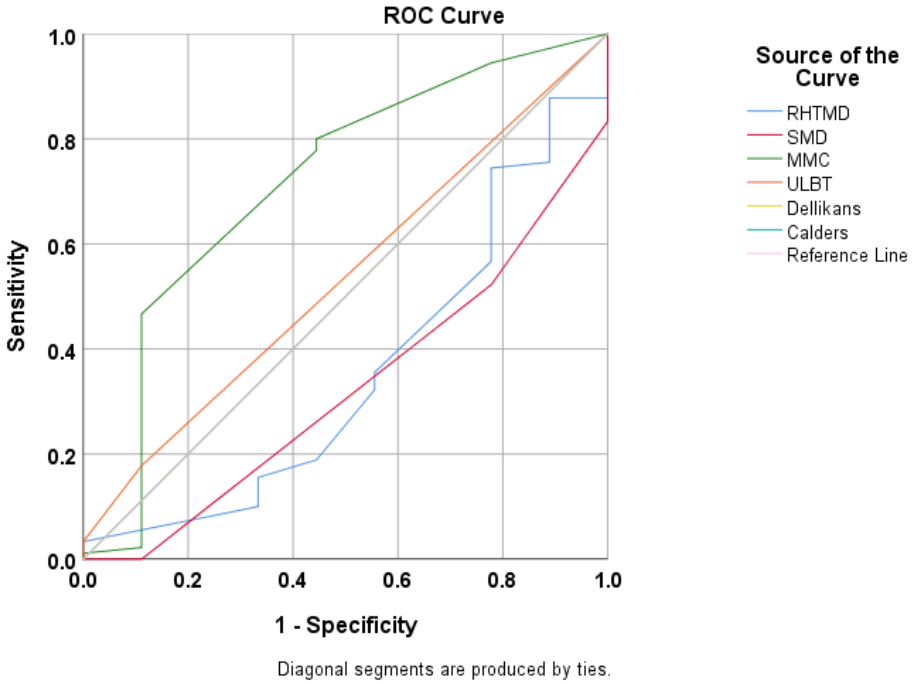

Figure 1: ROC CURVE for INDIVIDUAL TEST

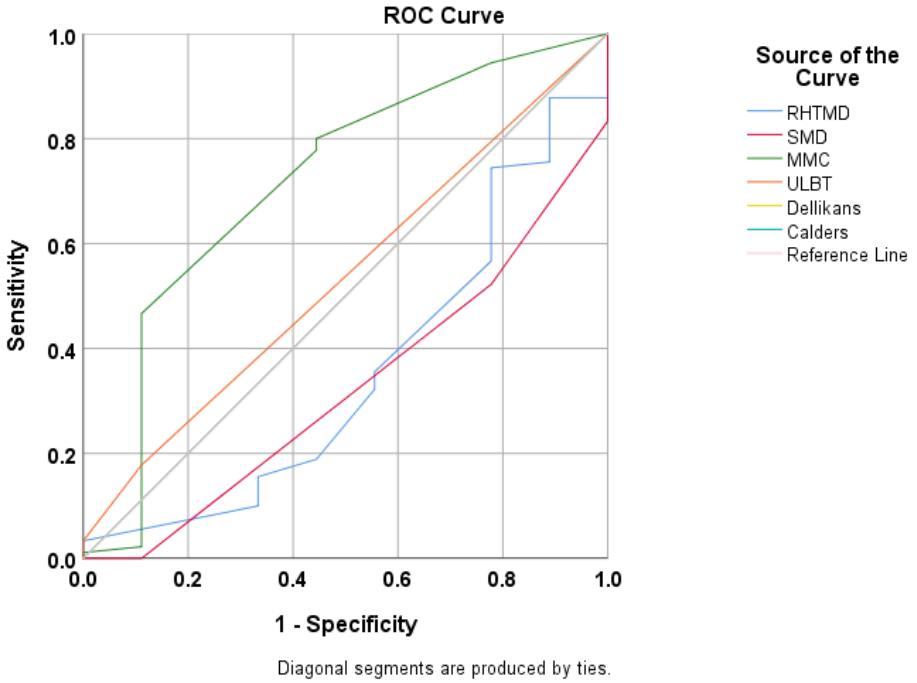

Figure 1

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 03, 2023

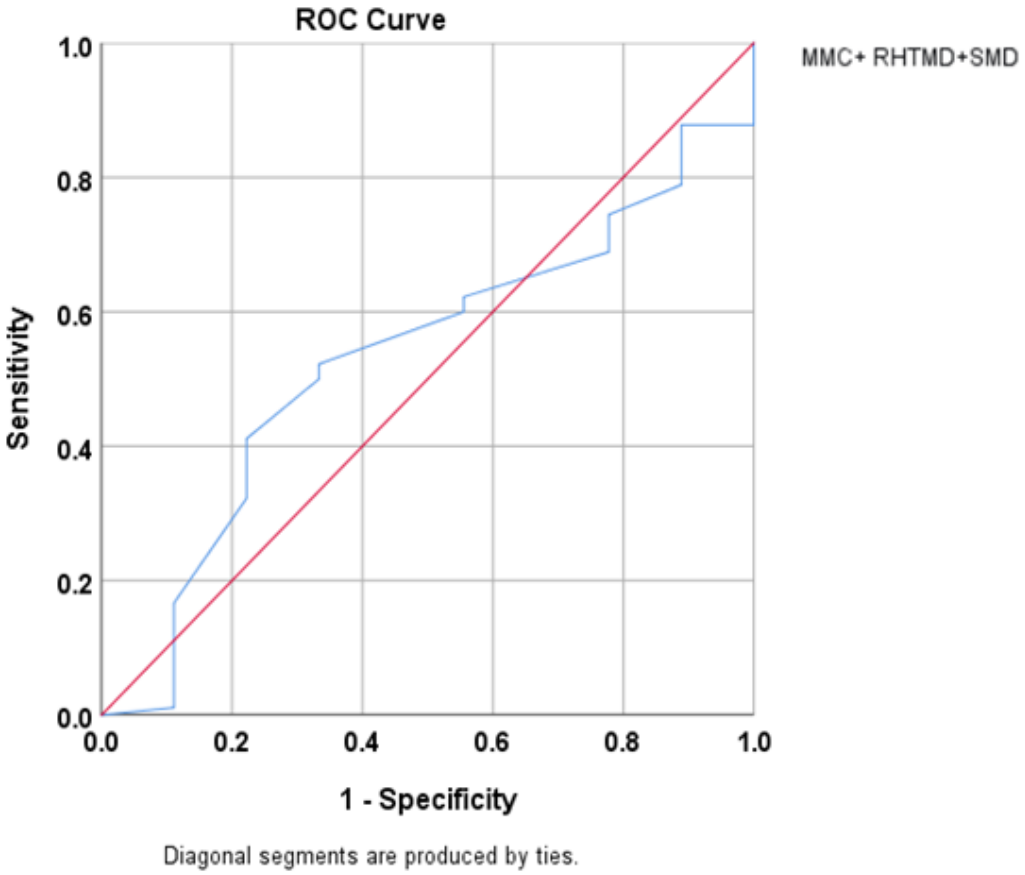

Figure 2: ROC for MMC+RHTMD+SMD

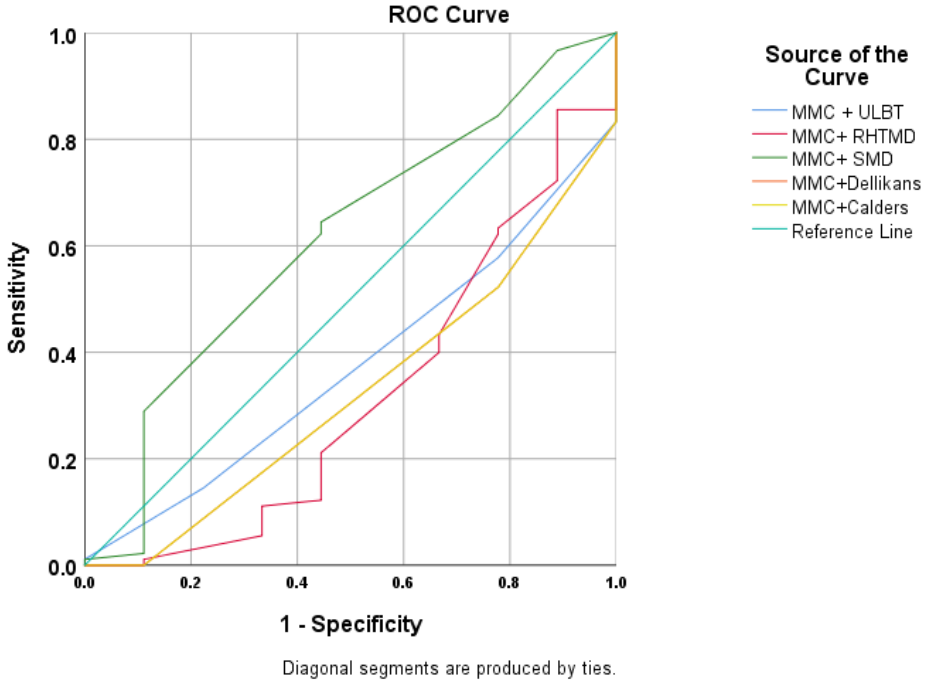

Figure 3: ROC curve in combination of tests with MMC

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 03, 2023

Table 3 and Fig.1, Fig.2 & Fig.3 represent the effect of Tests, where
The main endpoint of this study, the AUC of the ROC, was significantly lower for the SMD (AUC, 0.37; 95% CI, 0.1-0.51) than the RHTMD (AUC, 0.43; 95% CI, 0.23-0.70; P=0.242) , the ULBT score (AUC, 0.55; 95% CI, 0.02-0.61; P=0.378), MMC(AUC,1.00;P- 0.001), Dellikans and calders (AUC, 1.00 ;p-0.001)
Predictive values of the three single or combined predictors are shown in Table 3. For Predicting Difficult Intubation ULBT Grade 3, MMC Grade 3, RHTMD Grade 2, SMD grade3 were taken as as the cutoff points by using discrimination analysis. The MMC was the most sensitive of the single tests. The SMD was the least sensitive of the single tests with a sensitivity of 0.37%. The RHTMD had the highest NPV and the AUC of ROC curve among single tests.
The combination with the best results was the Mallampati with Dellikans and Calders with specificity, AUC of ROC curve of 1.00% of both. The various other combinations resulted in decreased specificity, the PPV, and the AUC of ROC curve

DISCUSSION

The airway assessment is mandatory to be performed in pre anaesthetic checkup. With increasing advancement various techniques and equipment have been developed to combat the problem of difficult airway but this cannot overpower the importance of difficult airway for an anaesthesiologist. Unfortunately, no single test or group of tests has been established for anticipating difficult laryngoscopies which should have accurate sensitivity and specificity to assess difficult airway.

Variations noticed among the characteristics of the patients on the basis of the ethnicity or race is responsible for insurance in the rate of incidence of the difficult intubation as well as difficult laryngoscopy. Differences in population could be the cause of statistical data variances.[14]

During the preoperative period experienced anaesthesiologist demonstrated the videos of airway assessment and explained properly in the patient's own language. Observer bias was reduced as the anaesthetist inside the OT was unaware of the recordings of the parameters done preoperatively by the anaesthesiologist. The laryngoscope blades used were the same to reduce instrumental bias.

According to our study, Modified Mallampatti Classification (MMC) has highest sensitivity and specificity. In comparison to other predictive tests, MMC also has greater PPV, NPV [Figure 3]. The use of MMC in combination with other predictors have also increased its diagnostic utility. We found that MMC has same predictive values individually and when when combined with DELLIKAN & CALDER TEST.

The test ULBT resulted in very low sensitivity and specificity (55% and 41% respectively). The AUC curve was found to be 0.55 and the p value was found to be insignificant. Hence, we combine the ULBT along with MMC in our study and the results showed increased in the percentage of sensitivity and specificity (93.6% and 95 % respectively). In the similar study Koirala et al.[15] compared ULBT with MMT for the prediction of difficulty in intubation in their study and demonstrated the sensitivity of 50%, specificity of 100%, PPV 100% and NPV 100%. Unlike Eberhart LH et al. did study in 2005,[16] and reassess the predictive values of ULBT; came out to be sensitivity of 28.2%, specificity of 92.5%, PPV of 33.6%, and NPV of 90.6%. Hester et al.[17] published their study in 2007 found that the ULBT had a 55% sensitivity, 97% specificity, 83% PPV, and 90% NPV.

In above three studies mentioned ULBT were compared with Modified Mallampati Test.
In our study RHTMD has 50% sensitivity and 68% specificity with a non-significant p value.

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 03, 2023

However, increment in the results can be witnessed when it is combined with MMC with AUC curve of 0.93, sensitivity and specificity of 96% and 95%, respectively. Unlike our results, Schmitt et al.[18] found that RHTMD better parameter which has higher predictive value to assess difficulty in laryngoscopy as it allows measurement of different body proportion. Krobbuaban et al.[19] and Krishna et al.[20] also used RHTMD which had 23.5 cm of cut off limit and taken as a risk factor and found mixed results. However, RHTMD can also be employed as a reliable substitute.

Since there was no inter-observer variability in our study and there were disparities in the ethnic composition of the participants, our conclusion differed from Krobbuban et al.[19]

In a similar study Basunia et al[21] used Dellikans test which had least sensitivity, TMD and Calders test which showed more sensitivity. When used in combination MP with Calder and MP with SMD were more sensitive.

Significant differences in mandibular and maxillary morphology and morphometry are confirmed by the dental literature as well as well documented variations in human craniofacial structure in the anthropological literature.

Difficult laryngoscopy cases came 5.33%, which was comparable to the reported incidence of 1.5%-13%. The sensitivity of RHTMD in our study is 50 % which is lower as compared to Suvarana et al[22] which is possible due to lower cut off value adopted. The lower sensitivity means that there chances that we can miss case of difficult laryngoscopy. Our study showed specificity of RHTMD 68% which was comparable with earlier reports. Unlike our study, Suvarana et al.[22] showed RHTMD as better test for screening of patients at bedside for anticipation of difficulty in laryngoscopy.

We used IDS score as a gold standard test to compare the level of difficulty in intubation which was proposed in 1997 with the objective in mind to "provide a uniform approach to compare studies related to difficult intubation, and with the aim of determining the relative values of risk factors of intubation difficulty."[13] Since then, IDS more than 5 has been used as the definition of difficult intubation in different populations, in particular by Combes and Dhonneur[23], and recently by Gonazalez et al.[24]

Limitations

There are also some restrictions on the MMC score for difficult laryngoscopy prediction. Patients without teeth should avoid it. The anthropological literature also emphasised the ethnic heterogeneity in population craniofacial configuration. MMC cannot be applied for all populations as there are racial differences in their morphology and anatomical changes. Additionally, each population predictive power for difficult laryngoscopy must be determined separately.

This study identified the potential outcomes which caused the difference in the findings of earlier research that require discussion. Despite the fact that many cases are predictable, some still go undetected before intubation, resulting in putting the patient at risk for unanticipated dangers unanticipated challenges for the anesthesiologist. The outcome of the study is also impacted by interobserver variability. For MMC and their combined tests, interobserver variation is significant.

Additional studies with bigger sample sizes and diverse demographics are advised for documentation. The outcome of the study is also impacted by interobserver variability. For MMC and their combined tests, interobserver variation is significant.

CONCLUSION

In preop evaluation MMC showed better accuracy, specificity, positive predictive value, and high sensitivity, so can be considered as a standard screening test for preoperative predictions of challenging endotracheal intubations. However, combining MMC with Dellikan or Calder test has proved to be best in comparison to the other airways assessments.

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 03, 2023

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ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 03, 2023

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