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Prospective Single Blinded Study Of Six Airway Assessment Tests Compared Individually With Cormack & Lehane Score In Predicting Difficult Intubation

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Abstract : *Problem of unanticipated difficult intubation is worldwide and search continues for tests that are reliable, accurate & rapid to predict difficult intubation. Our aim was to compare the ability to predict difficult intubation from six preoperative airway tests- Upper lip bite test, Modified Mallampati, Interincisor gap, Head & Neck movements, Thyromental distance, Ratio of height to Thyromental distance, compared individually & to confirm the same with Cormack Lehane score for difficult intubation. Airway was assessed in preanesthetic checkup using these six tests by the principle investigator & anesthesiologist assessing glottic exposure was blinded from the preoperative test results. Sensitivity, specificity, positive & negative predictive values & accuracy of each tests was calculated. Statistical significance was compared using Kappa statistics & p value <0.05 was considered significant. All the tests were significant, of which Modified Mallampati showed maximum agreement with gold standard Cormack Lehane score. However, a combination of tests in parallel is more sensitive and has higher predictivity than single tests alone.*
Keywords: *Airway, Cormack Lehane, Intubation*

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I. Introduction

Problem of unanticipated difficult intubation is worldwide. Studies all over the world have shown that airway related morbidity & mortality is significant. During anesthesia, difficult or failed intubation has been identified as the most important cause of death or brain damage [1]. Difficult tracheal intubation accounts for 17% of the respiratory related injuries. Incidence of difficult laryngoscopy and endotracheal intubation varies from 1.5%-9.7% in patients undergoing general anesthesia [2] [3]. Search continues for tests that are reliable, accurate & rapid to predict difficult intubation. By a proper preoperative airway assessment, we will be able to recognize the potential for a difficult airway, giving us enough time for optimal preparation, proper selection of equipment's & techniques, enabling us to get experienced personnel to assist us in difficult airway management.

Aims & Objectives-To compare the ability to predict difficult intubation from the six preoperative airway assessment tests- Upper lip bite test (ULBT), Modified Mallampati test (MMT), Interincisor gap(IIG), Head & Neck movements(HNM), Thyromental distance(TMD), Ratio of height to Thyromental distance(RHTMD) compared individually & to confirm the same with gold standard Cormack & Lehane score for difficult intubation.

II. Materials & Methods

It was a prospective, comparative, single blinded study conducted at a tertiary hospital over a period of 2 years on 500 patients selected randomly undergoing elective general anesthesia. Approval of local ethical committee & informed written consent from patients were obtained. Inclusion criteria: Patients aged 18-65years & ASA class I& II. Exclusion criteria: previous h/o difficult intubation, edentulous, head & neck deformity, pregnant, BMI >40kg/m^2. Airway was assessed in preanesthetic checkup using six tests by the principle investigator. Anesthesiologist assessing glottic exposure was blinded from the preoperative airway assessment test results. Predictors of difficult intubation was considered as: ULBT class3, MMT class 3 & 4, Thyromental distance ≤ 6cms, Interincisor gap ≤ 4cms, Head & neck movements ≤ 80^0, Ratio of height to Thyromental distance ≥ 23.5 cms, which was compared with Cormack & Lehane grade 3 & 4.

2.1 Statistical analysis

Sensitivity, specificity, positive & negative predictive value (PPV, NPV) & accuracy of each test was calculated. Statistical significance of each test compared using kappa statistics. P value <0.05 was considered statistically significant.

III. Results & Observations

Among the 500 patients, 224 (44.8%) were males & 276(55.2%) were females. 410 patients were ASA grade I & 90 were ASA grade II.

Table1: Age distribution

Age group(years)	No of patients
18-20	24
21-30	89
31-40	113
41-50	135
51-60	105
61-70	34

Table 2: Height distribution

Height (cms)	No of patients
150-155	13
156-160	109
161-165	132
166-170	160
171-175	69
176-180	17

Table 3: Weight distribution

Weight (kg)	No of patients
40-50	32
51-60	228
61-70	196
71-80	42
81-90	2

Table 4: Comparison of ULBT with Cormack Lehane

ULBT	Cormack Lehane score		
	Difficult	Easy	
Difficult	14	3	17
Easy	34	449	483
	48	452	

Table 5: Comparison of MMT with Cormack Lehane

MMT	Cormack Lehane score		
	Difficult	Easy	
Difficult	31	13	44
Easy	17	439	456
	48	452	

Table 6: Comparison of TMD with Cormack Lehane

TMD	Cormack Lehane score		
	Difficult	Easy	
Difficult	10	1	11
Easy	38	451	489
	48	452	

Table 7: Comparison of IIG with Cormack Lehane

IIG	Cormack Lehane score		
	Difficult	Easy	
Difficult	23	3	26
Easy	25	449	474
	48	452	

Table 8: Comparison of HNM with Cormack Lehane

IIG	Cormack Lehane score		
	Difficult	Easy	
Difficult	4	6	10
Easy	44	446	490
	48	452	

Table 9: Comparison of RHTMD with Cormack Lehane

RHTMD	Cormack Lehane score		
	Difficult	Easy	
Difficult	10	2	12
Easy	38	450	488
	48	452	

Table 10: Sensitivity, specificity, PPV & NPV calculation with Cormack Lehane as gold standard

Parameter	Sensitivity(%)	Specificity(%)	PPV(%)	NPV(%)	Diagnostic Accuracy(%)
ULBT	29.2	99.3	82.4	93.0	92.6
MMT	64.6	97.1	70.5	96.3	94.0
TMD	20.8	99.8	90.9	92.2	92.2
IIG	47.9	99.3	88.5	94.7	91.3
HNM	8.3	98.7	40.0	91.0	90.0
RHTMD	20.8	99.6	83.3	92.2	92.0

Table 11: Tests for agreement: Kappa statistics

Parameter	Kappa value	P value
ULBT	0.401	<0.001
MMT	0.641	<0.001
TMD	0.314	<0.001
IIG	0.594	<0.001
HNM	0.108	0.010
RHTMD	0.307	<0.001

IV. Discussion

Maintaining a patent airway is essential for adequate oxygenation & ventilation & inability to do so, even for a short period of time, can be a threat to life.

One of the major limitations of MMT is the ambiguous definition of classes [4] & effect of phonation on the oropharyngeal classification leading to high interobserver variability [5] & decreased reliability[6]. Another limitation is that it omits the assessment of neck mobility which is another important factor in predicting difficult intubation [7]. ULBT is a quick bedside test to perform and is easily understood by the patient as it can be demonstrated. The classes are clearly demarcated & delineated making interobserver variability highly unlikely. One of its major limitations is its inability to assess in edentulous patients. A wide range of cut-off values are quoted for TMD ranging from 4-7cms in different studies [8]. In this study, we have taken TMD ≤ 6 cms to predict difficult intubation. RHTMD, introduced by Schmitt et al [9] has better predictive value for predicting difficult laryngoscopy than TMD as it allows for individual body proportions which is not allowed in TMD. Krobbuaben et al [10] & Krishna et al [11] assumed RHTMD ≥ 23.5 cms as risk factor for predicting difficult laryngoscopy.

The incidence of difficult intubation in our study was 9.6%, 48 out of 500. The incidence of difficult intubation in Khan's trial was 5.7% whereas in Leopold's trial it was 12%. Sensitivity of ULBT in our study was 29.2% which is comparable with study conducted in JIPMER by RR Bhat et al [12] (20.5%) & Leopold et al trial [6] (28.2%). We were unable to replicate the high sensitivity of the original study, the cause of which may be the low incidence of ULBT class 3 in our study. The specificity of ULBT in our study was 99.3% comparable with study conducted by RR Bhat et al [12] (99.1%) which is much higher compared to Leopold et al [6] (92.5%) & Khan et al [13] (88.7%) trials.

In our study, we found the sensitivity of MMT was 64.6% which was similar to many other studies like that of Savva et al [14] (64%) & RR Bhat et al (59%) but this was lower compared with the study conducted by Khan et al [13] (82.4%). The specificity of MMT in our study was 97.1% & which was slightly high compared to study done by RR Bhat et al [12] (83.5%) & Oates et al [5] (82%). This was very high compared to Khan et al [13] (66.8%) & Leopold et al [6] which was 61%. Studies which used MMT as predictor of difficult intubation had a wide range of specificity & sensitivity which could be due to interobserver variability. In our study, tests were carried out by the same investigator thereby avoiding interobserver variability. Sensitivity & specificity of TMD in our study was 20.8% & 99.8% respectively. Sensitivity & specificity of RHTMD was also similar to that of TMD (20.8% & 99.6%). The results are comparable to the study conducted by Merah NA & Wong DT et al [15]. Sensitivity of IIG in our study was 47.9% & specificity was 99.3% which was slightly high compared to the study conducted by Merah NA & Wong DT et al.

NPV of all the six preoperative airway assessment tests were > 90% & so were predictors of easy intubation rather than predictors of difficult intubation. When we compare all these tests, we cannot select any one of them as the single best test. All the tests were significant with p value of <0.05 & among these MMT had maximum kappa value of 0.641, showing maximum agreement with gold standard test that is Cormack Lehane

grade. Other parameters like sensitivity, NPV & accuracy was also high for MMT. ULBT, TMD & RHTMD had higher specificity & PPV than MMT & almost similar diagnostic accuracy, but sensitivity of these tests was very low compared to MMT. IIG was also having comparable specificity & diagnostic accuracy of MMT but sensitivity & NPV was lower than that of MMT. HNM had lowest sensitivity, PPV & NPV & diagnostic accuracy among all the tests, hence it becomes an unreliable test to predict difficult intubation.

If we combine all these tests, we can increase the sensitivity to 100%, that is all the 48 difficult intubations can be correctly identified. Rather than relying on individual tests for predicting difficult intubation, a combination of tests will give us a better idea.

V. Conclusion

From our study we conclude that, any single test alone cannot be used for predicting difficult intubation. A combination of tests in parallel is more sensitive & has higher predictability compared to any single test alone. All these tests are better predictors of easy intubation rather than difficult due to high negative predictive value. Our limitations were that the present study was conducted only for elective cases & was not applicable for general population. Hence, in the future study could be extended to emergency cases, in elderly & obstetric group, on larger sample size, higher ASA grade & in different ethnicities.

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