Original Article

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Clinical Assessment of Airway and Its Correlation with Laryngoscopy Grading

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Abstract

Background: Difficult intubation is a major concern for the anesthesiologist and becomes more serious when it is unexpected. The preoperative assessment for recognition of difficult airway in advance is the best method of preventing damage caused by the inability to maintain the airway.

Aim: This study was carried out to evaluate the efficacy of clinical tests which can predict the difficult laryngoscopy and intubation in patients undergoing elective surgery requiring general anesthesia. Then to compare and correlate the laryngoscopic grading obtained with the findings of airway assessment tests.

Materials and Methods: A total 250 adult patients of age group 18-70 years of either sex of ASA Class I and II, undergoing elective surgery for various procedures requiring general anesthesia with endotracheal intubation were included in this study. Preclinical evaluation is carried out by measuring body mass index, modified Mallampati test (Samsoon and Young) and Patils Thyromental test. These tests were then correlated with laryngoscopic grading as per Cormack and Lehane. Data are presented as the mean ± standard deviation. Fisher's extract test and the Chi-square test were applied for the statistical analysis. Results having $P < 0.05$ were considered statistically significant.

Result: No method either individual or in combination with other, identifies all cases of difficult intubation. Modified Mallampati test a thyromental test were significantly correlate with laryngoscopic grading for difficult intubation.

Key words: Anaesthesia, Difficult intubation, Cormack Lehane Laryngoscopy Grading, Modified Mallampati test, Patils Thyromental Test

INTRODUCTION

The most vital element providing functional respiration is the airway. Difficulty in introducing the endotracheal tube through the laryngeal aperture is a major threat for an anesthetist. Failure to identify potential airway problems can lead to a paralyzed patient who can neither be ventilated nor intubated. Airway compromise is the most common cause of death or serious injury in anesthesia. Inadequate ventilation, esophageal intubation, and difficult tracheal intubation are the three main causes of serious injury or deaths that were identified in closed claim analysis of American society of anaesthetists.[1] Prediction of difficult intubation is not a problem in obvious adverse orofacial and cervical anatomical factors such as short muscular neck, receding mandible, protruding upper incisor, temperomandibular joint arthritis or trismus, long high arched palate and increased alveolar mental distance or pathological factors such as ankylosing spondylitis of cervical spine, post burn neck contracture, fractures of mandible, maxilla and cervical spine, acromegaly, goiter, neoplasm of pharynx and larynx or congenital abnormalities such as micrognathia, pierre robin syndrome, cleft lip, and palate.[2,3] However, several patients of normal appearance unexpectedly present great difficulty at intubation. Radiological techniques for prediction of difficult intubation are time consuming, costly and as such cannot be routinely employed.

So, the need for anatomical factors that can predict difficult intubation which are quick, easy, accurate and

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can be routinely employed. Airway assessment, availability of resources (including personnel and equipment), and a preformulated plan have also lowered the incidence for difficult intubation.

The existing tests as Mallampati grading, Patils thyromental grading have been shown in various studies to have high false positive rate (when used alone).[4,5] Thus, the aim of this study is to combine the reading of two tests to improve the predictability of difficult intubation.

MATERIALS AND METHODS

This study was conducted in the Department of Anesthesiology, NSCB Medical College Jabalpur. It involves the airway assessment of 250 patients of age group 18 years to 70 years of either sex, and who had to undergo either routine or emergency procedure requiring endotracheal intubation. Patients having obvious adverse anatomical, pathology or congenital factors are excluded from the study. Data were collected in a standard form and following main features of the patient were noted age, weight, body mass index (BMI), thyromental distance, oropharyngeal classification and laryngoscopic grading. Modified Mallampati test and Patils thyromental test were performed for airway evaluation. The thyromental distance was measured from the thyroid notch and mental prominence with neck fully extended. The measurement was made by a ruler scale.

These airway tests are then correlated to laryngoscopic grading (of Cormack and Lehane) using Macintosh laryngoscope of blade size 3. In this study, difficult endotracheal intubation is define as less than adequate exposure by direct laryngoscopy, i.e., Grade III and Grade IV, while Grade I and Grade II are considered adequate. The direct laryngoscopy is done in the sniffing position. (i.e., neck flexed and atlanto occipital joint extended).

To minimize uncertainty and inaccuracy of numerical grading system, schematic diagrams are provided for classification of the view of the oropharynx and of glottis, according to Mallampati as modified by Somsoon and a Young[6] and to Cormack and Lehane classifications[7] in Figures 1 and 2.

Same induction and intubation protocol was used in all patients. Various comparisons are made according to the data collected.

Statistics

Data are presented as the mean ± standard deviation and Fisher's exact *t*-test and the Chi-square test were applied in the statistical analysis. Results with $P < 0.05$ were considered statistically significant.

The statistical significance of the data was analyzed to assess the usefulness of these two anatomical factors in predicting the level of difficulty encountered during laryngoscopy and intubation and comparison of the efficacy of two factors combined with single factor.

RESULTS

The observations are based on the study conducted on 250 patients who required general anesthesia for their surgery.

Demographic data regarding age, sex, weight and height of the patients were comparable.

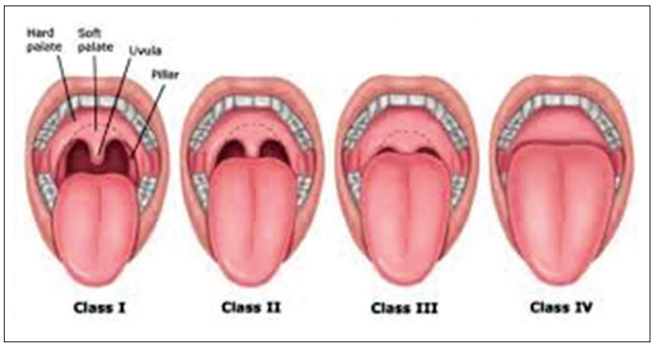

Figure 1: modified Mallampati classification

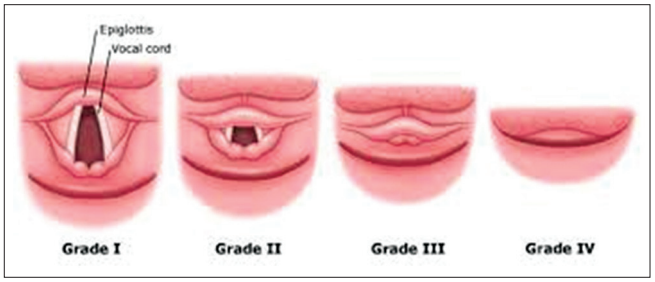

Figure 2: Cormack lahane laryngoscopic grading

Table 1: Distribution of patients according to BMI and thyromental distance

Parameter	No of patient	Total
BMI		250
18-25	234	
26-30	11	
31-35	5	
Thyromental distance		250
>6.5	167	
6.5-6	68	
<6.0	15	

BMI: Body mass index

Table 1 shows that 234 patients were of 18-25 (kg/mt^2) BMI group and only 5 patients were in 31-35 (kg/mt^2) BMI group. Out of 250 patients only 15 patients had thyromental distance of <6.0 cm.

Table 2 shows that out of 250, 172 patients had class I and 33 patients had class III airway, while according to Laryngoscopy grading 190 patients were in grade I and 11 patients in grade III.

According to table 3, 226 patients belong to BMI group of 18-25 (kg/mt^2) which were categorised as easy, while only 4 patients in BMI group of 31-35 (kg/mt^2) were in the easy subgroup of laryngoscopic grading.

According to Table 4, of 33 Class III airway patients, 2 patients had Grade I laryngoscopic view, whereas 8 patients had Grade III laryngoscopic view. Chi-square value was 118.63. Degree of freedom was 6 $P < 0.001$ (highly significant).

According to Table 5, of 68 patients of 6-6.5 cm thyromental distane group 46 patients had Grade I laryngoscopic view while only 2 patients had Grade III laryngoscopic view. Chi-square value was 123.19. Degree of freedom was 4 $P < 0.001$ (highly significant). Table 6 shows statistical analysis of both tests.

Table 2: Distribution of patients according to modified Mallampati class and Cormack and Lehane grading of laryngoscopy

Parameter	I	II	III	IV	Total
Class of airway	172	43	33	2	250
Laryngoscopy grading	190	49	11	0	250

Table 3: Relationship of BMI distribution and grade of laryngoscopy

BMI (kg/mt^2)	No. of patients laryngoscopy grading		Total
	Easy I and II	Difficult III and IV	
18-25	226	8	234
26-30	9	2	11
31-35	4	1	5
Total	239	11	250

BMI: Body mass index

Table 4: Relationship between class of airway and grade of laryngoscopy

Class of airway	No. of patients	Grade of laryngoscopy (no. of patients)			
		I	II	III	IV
Class I	172	157	15	0	0
Class II	43	30	10	3	0
Class III	33	2	23	8	0
Class IV	2	1	1	0	0
Total	250	190	49	11	0

DISCUSSION

Difficult intubation is a major concern for the anesthetist and becomes more serious when it is unexpected. Difficult laryngoscopy and intubation continue to cause morbidity and mortality associated with anesthesia. The reason for difficult laryngoscopies are not completely identified. Although the incident of difficult and failed tracheal intubation is comparatively low, unexpected difficulties and poorly managed situation may produce life-threatening conditions such as cerebral damage or even death.

It is the unexpected difficult intubation that leads to disaster. Predicting problem at intubation should not be difficult where there is obvious pathology involving neck, maxilla-facial, pharyngeal, and laryngeal structures, whether or not this is associated with specific medical condition or congenital syndromes. However, several patients of apparently normal appearance unexpectedly present great difficulties at intubation. A study of anatomical factors in these patients should improve ability to predict and manage a potential failed intubation. The importance must be stressed of correct positioning of head and neck during direct laryngoscopy in order to achieve alignment of axis of mouth, pharynx, and larynx to permit tracheal intubation. The position of flexion of lower cervical spine

Table 5: Relationship of thyromental distance and laryngoscopy grading

Thyromental distance (cm)	No. of patients	No. of patients on laryngoscopy grading			
		I	II	III	IV
>6.5	167	138	29	0	0
6-6.5	68	46	20	2	0
<6.0	15	5	1	9	0
Total	250	189	50	11	0

Table 6: Predictive value of Airway classification and Thyromental distance

Statistical analysis	Airway classification (%)	Thyromental distance (%)
Sensitivity	72.72	100
Specificity	88.0	69.87
PPV	22.85	19.25
FPR	11.29	30.12
FNR	27.27	0

PPV: Positive predictive value, FPR: False Positive Rate, FNR – False Negative Rate

combined with extension of the head at atlanto-occipital joint has been well described.[8,9]

The incident of airway difficulty in the general surgical population varies greatly depending on its degree. A Grades II or III laryngoscopic view requiring multiple attempts and or blades is relatively common and occurs in 100-1800 of 10000 patient or 1-8%. As the degree of difficulty increase to definite Grade III laryngoscopic view, then the incidence is generally slightly less and ranges from 100 to 400 of 10000 patients or 1-4%. The incidence of failed tracheal intubation is still less and ranges from 5 to 35 of 10000 patients or 0.05% to 0.35%; the high and low ends of this range are associated with obstetric and other surgical patients, respectively.[3]

It is clear that unexpected airway difficulty occurs commonly, that some cases of anticipated difficulty are simple to manage, and that better routine predictors of airway difficulty are needed.

There was small number of patients in whom difficulty in laryngoscopy and intubation is encountered even though they are not affected by any of these conditions. Radiographic technique to measure posterior depth of mandible or atlanto-occipital distance are expensive, time consuming and as such cannot be routinely employed.[10,11] It is therefore desirable to develop a clinical method which is applicable and objective for detecting cases in whom laryngoscopy and intubation is likely to be difficult. Various preoperative methods have been described to detect difficulty in intubation such as modified Mallampati test, Patils Thyromental distance test and Wilson's score.

This study is conducted on 250 adult patient admitted for various surgical procedure who required endotracheal intubation for general anesthesia, to evaluate the efficacy of two pre operative clinical tests i.e., modified Mallampati test and Patils thyromental distance as anatomical factors in predicting difficult laryngoscopy and endotracheal intubation by using both tests in combination.

The present study showed no statistical significance between age, sex and difficulty in laryngoscopy. Similar studies showed no significant difference in age and sex ratio of patients in two groups of easy and difficult laryngoscopies.[12,13]

This study showed significant relationship between BMI and difficulty in laryngoscopy. This correlated well with other studies.[12,13] The most important factors determining ease of examination was the posterior depth of mandible.[14] Other factors of importance were an increase in the anterior depth of mandible and reduction in the distance between the occiput and spinous process of c1 vertebra.[10]

Mallampati hypothesized that the size of the base of the tongue, as assessed by visualization of oropharyngeal structures could be used as a clinical test to predict subsequent difficulty at laryngoscopy and intubation. When tongue is maximally protruded in seated patient, there is concealment of faucial pillars and uvula by the base of the tongue and if the base of tongue is disproportionately large, it overshadows the larynx, rendering the exposure of the larynx by direct laryngoscopy poor and difficult.[15]

Evaluation of difficulty in laryngoscopy was carried out on the basis of gradation criteria described by Cormack and Lehane.[7] Grades I and II were considered adequate exposure (easy laryngoscopies)and Grades III and IV inadequate exposure (difficult laryngoscopies).

In this study, there were 95.6% of patients who had easy laryngoscopic grading while there were 11% of patients who had difficult laryngoscopic grading. The reason for wide variation in reported incidence of difficult laryngoscopy may be related to confusion regarding grading system of view documented by anesthesiologist, i.e., whether it was initial view or best view on laryngoscopy.[16] It is seen that external laryngeal pressure, changing laryngoscope blades and changing neck position can alter the view at laryngoscopy.[3,12]

In our study, thyromental distance a of $\leq$ 6 cm was considered to predict a difficult laryngoscopy and obtained a sensitivity of 100% and specificity of 69.87%. This distance reflects the ease of displacement of the tongue by the laryngoscope blade by giving an estimate of mandibular space.

Difference in proportion may be because of different methods of measuring thyromental distance followed in these studies. There is variation in measurement of thyromental distance because of inside versus outside of mentum and full extension of neck versus neutral head position. Lewis *et al.*[17] observed that it is preferable to perform the test in the sitting position with the head in extension and distance measured from the inside of the mentum to thyroid cartilage. There is much variation in the size of fat pad on the bony point of the skin (outer mentum).

In this study, comparative analysis of class of airway and level of difficulty in laryngoscopy as predicted, the incidence of difficult laryngoscopy was extremely high in patients with Class III or IV airway and very low in patients with Class I or II airway. Statistically, there was significant correlation between airway class and laryngoscopy grades.

The modified Mallampati test has high false positive rate of 11.29% and high false negative rate of 27.27%. In this study,

thyromental distance versus difficulty in laryngoscopy, the sensitivity, specificity and positive predictive value was found out to be 100%, 69.87% and 19.25% respectively. Our result also in corroboration with other studies.[13,14,18,19]

In this study, comparative analysis of thyromental distance and level of difficulty in laryngoscopy showed that incidence of difficult laryngoscopy was extremely high in patients with distance of 6 cm or less and very low in patients with thyromental distance more than 6.5 cm. statistically, there was significant correlation between the thyromental distance and laryngoscopy grades.

This test also has a high false positive rate of 30.12%.

When both the thyromental distance test and modified Mallampati test are used in combination in the patient, the specificity for detection of cases of difficult laryngoscopy has greatly increased as compared to the results of single test and therefore the false positive rate will also decrease.

Analysis of the present study showed that when both tests are positive in a patients, is taken as predictor of difficult intubation, specificity has greatly improved and false positive rate has decrease significantly.

CONCLUSION

Thus, we concluded that there was correlation between BMI and difficulty in laryngoscopic view. When the two tests are used in combination, then specificity increase, sensitivity remain same, false positive results decrease and false negative results increase. Neither the single test nor the combination of two tests is 100% sensitive or specific. These predictive tests either used alone or in combination can be used as useful adjunct to the pre anesthetic checkup to detect those cases in whom laryngoscopy and intubation is likely to be difficult but they should not be relied on absolutely.

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