



## Assessment of Airway In Pediatric Patients During Pre –Anesthetic Check Up And Incidence of Difficult Intubation

### KEYWORDS

Anesthesia, Intubation, TMD, HMD, IIG

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**ABSTRACT** Aim: To study the assessment of airway in pediatric patients during pre –anesthetic check up and incidence of difficult intubation.

**Background** Difficult airway is defined as the clinical situation in which a conventionally trained anesthesiologist experiences difficulty either with face mask ventilation of the upper airway or difficulty with tracheal intubation or both. Incidence of difficult intubation occurs in 1.5-8.5% of general anaesthetics. A rational approach to airway assessment, therefore, naturally includes a detailed history, a careful physical examination and inspection of relevant X-rays whenever possible. The inability to intubate a patient is an acknowledged fear among anesthesia professionals. To allay this fear, researchers have developed methods for predicting whether intubation of a particular patient will be easy or difficult. All preoperative airway assessments are evaluated according to their respective sensitivity, specificity, and positive predictive value.

**Materials and Method** 100 pediatric patients aged 1-12 of either sex with ASA grade I & II, scheduled for an elective surgical procedure under general anesthesia were studied. These patients ranged between 1-12 years of age. During pre-anesthetic assessment distance of mentum to thyroid notch when neck is fully extended. It reflects the location of vocal cords, distance of hyoid bone to the mentum, opening of oral cavity and movement of temporomandibular joint on the opening of mouth were studied. An assessment of airways was carried out by Modified Mallampati and modification of modified Mallampati criteria, using tongue depressor over anterior 2/3rd of the tongue.

The frequency of abnormal distances like mentum to thyroid notch (TMD), mentum to hyoid notch (HMD), interincisor gap (IIG) and different grades of oropharynx on inspection were studied by modified Mallampati and modification of modified Mallampati criteria.

**Results** The total number of patients with difficult laryngoscopy (grade III and grade IV larynx) was 1 (1%). The total number of patients with difficult pharynx on inspection were 9 (9%) by modified Mallampati criteria and 2 (2%) by modification of modified Mallampati criteria.

The incidence of thyromental distance (TMD) < 3 fingers, was found in 3 (3%) patients. HMD < 2 fingers was found in 2 patients.

**Conclusion** These simple tests for assessment of pediatric airway may be used for better predictability, save time, and avoid unnecessary use of sophisticated equipments

### Introduction

One of the primary responsibilities of anesthesiologist is to secure and maintain a patient airway which is essential for adequate oxygenation and ventilation, failure to do so can be life threatening [1]. Tracheal intubation by direct laryngoscopy is an essential skill for anesthesiologists. While tracheal intubation can usually be accomplished with ease by direct laryngoscopy, it is sometimes difficult or impossible because of coexisting diseases or abnormal physical features [2]. When recognized before attempting tracheal intubation, most of the difficult airways can be secured by the use of specialized tracheal intubation techniques, which require special training, experience, assistance and equipment. An unrecognized difficult airway before attempting intubation can be catastrophic because the patient's spontaneous respiratory efforts may have been obtunded by anesthetics or muscle relaxants. Thus identifying the patients whose airway cannot be reliably secured by simple direct laryngoscope. It is an important skill for anesthesiologists and all acute or critical care physicians. The pediatric airway differs from adult airway; hence the pre-

dictors of difficult airway in an adult may not apply to a pediatric patient [3]. There are certain differences between adult and pediatric airway like children are obligatory nose breathers, have a large tongue and head, infants epiglottis lies at an angle of 45° to posterior pharyngeal wall & is V shaped.

**Aim:** The present study was carried out to correlate certain criteria during pre-anesthetic check up with that of laryngoscopic view of oral structures. The study was also aimed to assess the predictability, specificity, and sensitivity of the test and incidence of difficult intubation.

### Materials and methods

This study included 100 pediatric patients in the Department of Anesthesiology and Intensive care, Owaisi group of Hospitals, Hyderabad after obtaining permission from Institutional Review Board (IRB) approval. An informed consent was taken from the parents or guardian of the patient. Total One hundred consecutive patients of either sex coming for elective, non malignant and non head and neck pediatric surgery in the age range of 1-12 years were

selected. All the patients belong to American society of Anesthesiologist (ASA) grade I or II. The patients with apparent predictors of difficult intubation or uncooperative or tracheostomised or patients with endotracheal tube in situ were excluded.

Pre-anaesthetic check up like thyro-mental distance (TMD), hypo-mental distance (HMD), movement of temporomandibular joint (TMJ) upon opening of mouth, inter-incisor gap (IIG), modified Mallampati and modification of modified Mallampati grading with the laryngoscopic view of oral structure

**Study Design**

During pre-anesthetic assessment, distance of mentum to thyroid notch when neck is fully extended, distance of hyoid bone to the mentum were measured. The opening of oral cavity and movement of tempomandibular joint were assessed. This was carried out in pre-anesthetic room. After airway assessment, patients were treated with Midazolam 0.05 mg/kg body wt I.V and Glycopyrrolate 4-8 µgm/kg body wt I.V as a premedication regime, just 10-15 minutes prior to induction of anesthesia.

After pre-medication, the patients were shifted to the operation theatre and place supine on operation theatre (OT) table without the aid of the pillow. All the patients were induced b using thiopentone soium (5-7 mg/kg body wt) till the loss of verbal response.

Fentanyl (1-2 µg /kg body wt) and Rocuronium (0.5 mg/kg body wt I.V) were used to achieve analgesia and muscle relaxation respectively. Following adequate relaxation as judged by loss of fourth twitch I the train of four (using PNS), laryngoscopy was done for grading the laryngoscopic view based on the Cormack and Leanne’s criteria. After grading the laryngoscopic view, patients were intubated with appropriate sized cuffed endotracheal tube. The parameters assessed during the pre-anesthetic assessment were correlated with the grade of laryngoscopic view so as to observe the parameter which shows best correlation with ease of laryngoscopy and intubation in terms of sensitivity and specificity.

**Results**

**Table 1: Cormack & Lehane grading during laryngoscopy**

Grade	Description
I	Visualization of entire laryngeal aperture
II	Visualization of only posterior commissure of laryngeal aperture
III	Visualization of only epiglottis.
IV	Visualization of just the soft palate.

**Table 2: Distribution of patients according to visibility of Oropharynx based on the method used**

Grades	modified Mallampati	modification of modified Mallampati
I	68%	96%
II	23%	2%
III	5%	2%
IV	4%	0%
Total	100%	100%

This table shows that number of patients in grade I, II, III, and IV are found to be 68%, 23%, 5% and 4% respectively by modified Mallampati grading. It also depicts the number of patients in grade I, II, and III are found to be 96%, 2%, and 2% respectively by modification of modified Mal-

lampati grading and none of the patient belongs to grade IV.

**Table 3: Distribution of Patients based on Thyromental, Hypomental distance and Inter-Incisor Gap**

	Thyro-Mental Distance		Hypo-Mental Distance		Inter-Incisor Gap	
	Normal (>3 pts fingers)	97%	Normal (>2 pts fingers)	98%	Normal (>3pts fingers wide)	97%
1						
2	Decreased (3< pts fingers)	3%	Decreased (<2 pts fingers)	2%	Decreased (<3pts fingers wide)	3%
Total		100%		100%		100%

This table shows that out of 100 patients TMD found to be normal (>3 pts fingers) in 97 patients and decreased (<3 pts fingers) in 3 patients. It also reveals that out of 100 patients HMD found to be normal (>2 pts fingers) in 98 patients and decreased (<2 pts fingers) in 2 patients. The data shows that out of 100 patients IIG found to be normal (>3 pts fingers) in 97 patients and decreased (<3 pts fingers) in 3 patients.

**Table 4: Distribution of patients according to visibility of cords on Direct Laryngoscopy**

Grades	Larygoscopic View	
	Easy	Difficult
I	68	0
II	23	0
III	5	0
IV	3	1
Total	99	1

This table shows that laryngoscopy of was found to be easy (Grade I & II Cormack – Lehanne) in 99 patients out of 100 and laryngoscopy was difficult (Grade III Cormack – Lehanne) only in 1 patient.

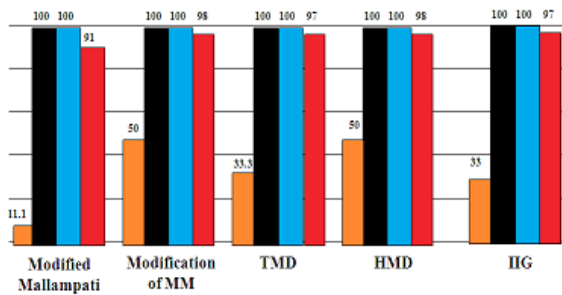
**Table 5: Correlation between Thyro-mental, Hypo-mental distance and Inter-Incisor Gap Vs Laryngoscopic View**

<3 Fingers (n=3)	Thyro-mental Distance		Hypo-mental Distance		Inter-Incisor Gap		
	>3 Fingers (n=97)	<2 Fingers (n=2)	>2 Fingers (n=98)	<2 Fingers (n=3)	>2 Fingers (n=97)		
Laryngoscopic View	Easy	2	97	1	98	2	97
	Difficult	1	0	1	0	1	0

Table 5 shows correlation between different pre anesthetic parameters and laryngoscopic view. The thyro-mental distance predicts difficulty in intubation in 3 patients out of 100, while actually laryngoscopy was found to be difficult only in one patient and laryngoscopy was easy in all those patients in whom thyro-mental distance predicts easy intubation. Hypo – mental distance predicts difficulty in intubation in 2 patients out of 100, while actually laryngoscopy was found to be difficult only in one patient and laryngoscopy was easy in all those patients in whom Hypo-mental distance predicts easy intubation. Inter-Incisor Gap predicts difficulty in intubation in 3 patients out of 100, while actually laryngoscopy was found to be difficult only in one patient and laryngoscopy was easy in all those patients in whom Inter-Incisor Gap predicts easy intubation.

**Figure 1: Predictive values of the various screening test**

## used or the assessment of airway



## Discussion

Difficult tracheal intubation using direct laryngoscopy is reported to occur with an incidence of approximately 6% in anesthesiology [5]. Previous reports of the incidence of difficult intubation in adults were 1-3% and failed intubation rate was 0.05%-0.2% [4]. The 2-11% of incidence of difficult airway has been reported by several investigators [5-8]. In a study by Belhouse et al (1989) it was reported that there are improved ways of predicting the risk of difficult intubation in patients and can thereby prepare for any unexpected difficulty [9].

To assess pre-operative difficulty in intubation Mallampati et al (1985) described an airway classification based on the clinical evaluation of the pharynx [10]. There were several modification of the above classification based on usefulness, reliability and predictability. It was modified by Samsoon and Young in 1987 by including a fourth grade, i.e., visibility of hard palate only [11]. According to Mallampati classification, tongue base is a source of airway obstruction in the unconscious or anesthetized state and is in close proximity to the laryngeal inlet. Evaluation of its proportion may be considered as a primary method to predict difficulty in tracheal intubation. As a massive tongue not only overshadows the larynx but also masks the visibility of pharyngeal space and other structures, including soft palate, uvula [12].

This classification however, does not take into consideration other anatomical factors that might influence laryngoscopy and intubation, like neck mobility of the temporomandibular joint. Furthermore, it is not a useful pre-operative screening test because it produces too many false negatives and has false positive rate of 50% prediction rate. Assessment of airway can be done by a number of criteria such as Mallampati grading, modified Mallampati, thyromental distance (TMD), the hypomental distance (HMD), mobility of the temporo-mandibular joint, inter incisor gap (IIG) etc. There are several studies in adult patients but very few studies has been carried out to predict difficult airway in pediatric patients [11]. However, none of the criteria is foolproof in predicting difficult intubation and search for better predictive criteria continues.

The present study was carried out to study the correlation between the existing criteria such as the TMD, HMD, mobility of the temporo-mandibular joint, inter incisor gap (IIG) and the visibility of oropharynx by the modified Mallampati criteria and modification of modified Mallampati grading [12] with the visibility of cords on direct laryngoscopy i.e., Cormack & Lehane class assuming that depressing the tongue would better correlate with the laryngoscopic view.

In our study the incidence of difficult airway i.e., grade III

and grade IV oropharynx on inspection was noted in 9 patients (9%) by modified Mallampati criteria (5 patients in grade III and 4 in grade IV). Only one patient was actually difficult to intubate (Cormack & Lehane, grade III) i.e., only 1% of the patients were found to have a difficult airway on laryngoscopy which is considerably greater than the 0.05% suggested by Cormack & Lehane (1984) [13]. The probable reason for this was the small sample size in our study.

Incidence of expected difficult airway was found in 2% of patients by modification of modified Mallampati while the actual incidence was just 1% by Cormack & Lehane grading. The positive predictive value for modified Mallampati grading was found to be 11.1% and that for our modification of modified Mallampati grading was 50%. The negative predictive value for both the methods was 100%. Therefore it can be safely concluded that depression of tongue while assessing Mallampati grading is a better method for assessment of difficult airway. The sensitivity of both the tests was found to be 100%. Our study was comparable to that of Jacobean et al [14] who reported that modified Mallampati assessment was 100% sensitive.

Various studies demonstrated that the measurement of thyromental distance in adults was a good predictor of difficulty in intubation. However, there are no reports on the predictive value in pediatric patients. In the present study 3 patients had a TMD < 3 fingers (approx. 4 cms) out of which only one was difficult to intubate (Cormack & Lehane grade III). The positive predictive value of this test was found to be 33% with a negative Mallampati grading but less than the modification of modified Mallampati.

According to Mathew et al [15], the distance TMD < 6 cm showed a good correlation with grade III and grade IV oropharynx on direct laryngoscopy. On the other hand those with distance of >6cms had a grade I and II oropharynx and a lower possibility of difficult intubation may be anticipated in them. It was also suggested that patients with a thyromental distance greater than 4 cm can be easily intubated [16]. In contrast, when the TMD was less than or equal to 4 cm, and the Mallampati score is 1 or 2 tracheal intubation is difficult in 48% of patients and in 79% if the Mallampati score is 3 or 4.

There was an improved positive predictive value from 17% to 64%, when Mallampati III and IV combined together with thyromental distance of less than 6.5 cms [17]. The problem with these predictors is that it assumes that all anesthetists are equally skilled at intubation.

Ihohom et al (1993) also suggested that combining the Mallampati III/IV with either thyromental distance <6.5 cms or a sternomental distance < 12.5cm decreased the sensitivity (from 40 to 25 and 20% respectively), but maintained a negative predictive value of 93% [18]. The specificity and positive predictive values increased from 89 and 27% respectively for Mallampati alone to 100%. His findings suggest that the Mallampati classification, in conjunction with measurement of the thyromental and sternomental distances, may be useful routine screening test for preoperative prediction of difficult tracheal intubation. However Schmitt and Kirmse (2002), stressed that the "ratio of height to thyromental distance" is more logical and sensitive criterion than the thyromental distance used alone [19].

In the present study the distance of mentum to the hyoid bone (HMD) was found to be less than 2 fingers in 2 patients (2%). Out of these, difficult laryngoscopy was found in 1 patient. Positive predictive value was 50% and negative predictive value of 100%.

Wong and Hung (1999) suggested that shorter the distance between the prominent edges of the hyoid bony point of the chin with the head fully extended i.e. the more difficult the intubation [20]. Wilson et al (1988) also suggested that the inter-incisor gap (IIG) is one of the powerful predictors of difficult intubation [21]. In our present study, only 3 patients had an inter-incisor gap (IIG) of less than 3 fingers. Out of these 3 patients, difficult laryngoscopy was found to be in 1% patients. Positive predictive value was found to be 33% which is equal to that of TMD.

Thus from the above discussion it can be inferred that the tests used to predict difficult airway in adult patients can be applied to pediatric patients. All the tests are hundred percent sensitive in pediatric patients. Therefore no patient of difficult intubation can be missed if any of these tests are used. But any test that over predicts the incidence of expected difficult airway can cause wastage of time and resources in preparing for securing of the airway in such patients. Therefore a combination of two or more tests can improve the predictive value of these tests as shown by various studies [16, 22].

The present study also suggested a modification of the modified Mallampati grading, i.e., tongue depression while assessing the oropharyngeal view. This has given promising results in the form of better predictive values as compared to the modified Mallampati grading. However a larger study is needed to extrapolate these findings on the general population. One lacuna in our study is that we have not used this modification in combination with other predictors of difficult airway, which may further improve the predictive value of this test.

However until that time when we have a perfect assessment tool for prediction of difficult airway, caution is the only tool we have when planning an intubation. As has been shown previously and in this study, all the predictors have a very high sensitivity in pediatric patients, therefore if a patient is expected to have a difficult intubation according to any of the above criteria, full preparations should be made for difficult intubation.

### Conclusion

Modified Mallampati, thyromental distance, hypomenal distance, inter-incisor gap and all these criteria are well established in predicting the difficult airway in adults. In the present study, these criteria were used in pediatric patients and it was found that sensitivity of all the criteria was 100%. Although these tests tend to over predict the incidence of difficult airway, the advantage is that tests are used. All the criteria show a good correlation with the laryngoscopic view as per the Cormack and Lehane grading.

In the present study, a modification of the modified Mallampati grading, i.e., tongue depression while assessing the oropharyngeal view was used. Better predictive values have been achieved with this modification as compared to the modified Mallampati grading. However a larger study is needed to extrapolate these findings on the general population.

Positive predictive value of modification of modified Mallampati and thyromental distance (HMD) was found to be higher (50%) as compared to other predictors (TMD, IIG, and Modified Mallampati) used to assess the airway.

Use of the combination of modification of modified Mallampati and thyromental distance in assessing the airway in pediatric patients will further increase the predictive value of these tests. No single tool has been shown to be perfect as far as prediction of difficult airway is concerned however various studies also suggested that the combination of two or more tests can improve the predictive value of these tests. To assess the pediatric airways these simple tests can be used for better predictability and cost effectiveness. Better assessment of airway will definitely lead to less preoperative complications and better patient outcome which otherwise could have lead to fatal consequences.

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