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Evaluation of Predictors for Difficult Laryngoscopy and Intubation in Pediatric Population

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Abstract

Background: Airway management is very essential in medical speciality, difficulty in airway access can lead to hypoxic brain damage, cardiac arrest and even death or morbidity. A difficult airway in pediatric airway examination can be stressful condition for all involved. Hence in order to avoid the morbidity and mortality it is essential to evaluate airway in preoperative examination and identify potentially difficult airway. In order to find the predictors of difficult airway we conducted a study in 200 patients with age limit of 3-6 years scheduled for elective surgeries under general anesthesia. We studied the following tests: Interincisor distance (IID), MMC (Modified Mallampati classification), Thyromental distance (TMD) and CLG (Cormack Lehane Grade). We correlated EVL (easy visualization of larynx) CLG I, IIa, IIb and DVL (difficult visualization) CLG III, IV with above parameters. It was observed that there was no such difference in EVL and DVL with IID, MMC and TMD. While MMC-I showed statistically significant difference between EVL and DVL. Sensitivity of TMD was 84.69% and specificity was 98.5%. with MMC.

Conclusion: Thyromental distance was good predictor for difficult laryngoscopy and intubation.

Keywords: Pediatric population; Difficult airway predictors.

Introduction

The training of airway examination is emphasized in anesthesia practice and when visualization of anatomic structures of the airway becomes difficult; more scientific approach of its evaluation and management becomes necessary[1] unexpected difficulty with intubation is an important cause of morbidity and mortality. One of the reason for anesthesia related cardiac arrest, death and brain injury in healthy children is due to difficulty in airway management.[2,3] In order to avoid complications there are multiple tests for prediction of difficult airway which can be used preoperatively.

The skills of airway management are important in every medical speciality. Respiratory events like inadequate ventilation, oesophageal intubation and difficult tracheal intubation are common in clinical practice of anesthesiology.[4]

Difficult airway in pediatric patient can be a stressful situation.[5] Examination of airway in pediatric population using predefined parameters during pre anesthetic checkup may help us to recognize difficult airway.[6]

Anatomic differences are observed according to age, most of the studies are carried out in adults, as pediatric patients are uncooperative and lack of observation in airway examination, may indicate

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the need of more studies in pediatric airway assessment.[7]

Although forecasting and predicting is tough, in view of complications, considerable amount of focus has been given to predict difficult intubation in patients.

Preoperative airway assessment in pediatric age group is an essential parameter to anticipate difficult airway and intubation, in order to avoid complication.[8] Until now there has not been a single unique observation to predict a difficult airway.

Aim was to evaluate predictors for difficult laryngoscopy and intubation in pediatric population. Following parameters were studied: Inter Incisor Distance (IID), Modified Mallampati classification (MMC), Thyromental Distance (TMD) and Cormack Lehane Grade during Laryngoscopy (CLG).

Material and Methods

An observational cross sectional study was conducted, after taking approval of ethical committee, in ASAI/II/III pediatric patient of either sex between 3-6 years scheduled to undergo elective surgery under general anesthesia. We included children between 3-6 years of age belonging to ASA-I,II,III. Children with congenital upper airway malformations, swelling in head and neck regions, scars around oral cavity and neck, mentally challenged and obese children were excluded. Informed consent was taken from parents/guardians of the children. A detailed preoperative history especially with reference to airway was recorded. Standard airway examination including:

- Interincisor Distance: Distance between upper and lower teeth in centimeters(cms)
- Modified Mallampati Class: seen after opening of mouth and protrusion of tongue.
- Thyromental Distance: Distance from mentum to thyroid cartilage (cms)
- Cormack Lehane Grading noted after laryngoscopy

The patient was taken in the operation theater after standard protocol of pre medication. Monitors were attached & IV line secured. Patients were premedicated prior to surgery. Patient taken into operation theater and injection Ondensatron 2 mg and injection Fentanyl (1.5 mcg/kg) given. Patient was preoxygentated with 100% oxygen for 3 to 4 mins. Under effect of Succinylcholine 2 mg/kg, patient was ventilated with 100% oxygen and laryngoscopy was performed and Cormack Lehane Grade was noted. Patient was intubated using an uncuffed Endotracheal Tube (ETT) appropriate for age, by senior anesthesiologist. Noninvasive blood pressure, ECG, temperature and SpO_2 were monitored throughout the procedure. Anesthesia was maintained as per requirement of surgery following which patient was reversed and extubated and then shifted to postoperative room.

The entire data is statistically analyzed using Statistical Package for Social Sciences (SPSS ver 21.0, IBM Corporation, USA) for MS Windows.

Obeservation and Results

Table 1: Distribution of cases according to Cormack Lehane Grading

Cormack Lehane Grading	No. of cases	% of cases
I	120	60.0
IIA	61	30.5
IIB	15	7.5
III	4	2.0
Total	200	100.0

Table 2: Distribution of cases according to difficulty level.

Visualization score	Status	No. of cases	% of cases
I to IIB	Easy	196	98.0
III	Difficult	4	2.0
Total	–	100	100.0

Table 3: Distribution of mean age according to Cormack Lehane Grading.

	Cormack Lehane Grade				P-value
	Easy (n=196)		Difficult (n=4)		
	Mean	SD	Mean	SD	
Age (years)	4.41	1.15	3.50	1.00	0.116^{NS}

P-values by independent sample t test. P-value <0.05 is considered to be statistically significant. NS-Statistically non-significant.

Table 4: The sex distribution of cases studied according to visualization difficulty score.

	Visualization Difficulty Score				P-value
	Easy (n=196)		Difficult (n=4)		
Sex	n	%	n	%	
Male	132	67.3	1	25.0	0.110^{NS}
Female	64	32.7	3	75.0	
Total	196	100.0	4	100.0	

P-values by Chi-Square test (Fisher's exact probability test). P-value <0.05 is considered to be statistically significant. NS-Statistically non-significant.

Table 5: Distribution of means of various bed side parameters inter-incisor distance (IID) and thyromental distance (TMD) according to Cormack Lehane Grade

	Cormack Lehane Grade				P-value
	Easy (n=196)		Difficult (n=4)		
Parameters	Mean	SD	Mean	SD	
IID (cm)	3.19	0.40	3.32	0.54	0.513^{NS}
TMD (cm)	4.66	0.52	4.50	0.67	0.535^{NS}

P-values by independent sample t test. P-value <0.05 is considered to be statistically significant. NS-Statistically non-significant.

Table 6: The distribution of modified Mallampati class among the cases studied according to Cormack Lehne Grade

	Cormack Lehane Grade				P-value
	Easy (n=196)		Difficult (n=4)		
Mallampati class	n	%	n	%	
I	168	85.7	3	75.0	0.003**
II	25	12.8	0	0.0	
III	3	1.5	1	25.0	
Total	196	100.0	4	100.0	

P-values by Chi-Square test (Fisher's exact probability test). P-value <0.05 is considered to be statistically significant. **P-value<0.01.

Table 7: Distribution of area under the ROC curves (AUC) for all bed side parameters studied inter-incisor distance (IID) and thyromental distance (TMD) for the prediction of difficult Visualization score.

Parameter	Optimal Cut-Off Based on ROC	AUC ± SE	95% CI of AUC	P-value
IID (cm)	3.05 cm	0.447±0.168	0.118–0.776	0.717^{NS}
TMD (cm)	4.05 cm	0.595±0.170	0.261–0.929	0.516^{NS}
Modified Mallampati Class	II	0.570±0.164	0.249–0.890	0.634^{NS}

NS - P-value>0.05 (Statistically non-significant). Reference value = 0.500. SE – Standard Error.

Table 7 shows the result of receiver operating characteristics (ROC) curve analysis in predicting the difficult visualization. The distribution of area under the curve (AUC) did not differ significantly for IID, TMD and modified mallampati class (MMC) for the prediction of difficult Visualization score from the reference value of 0.500 (P-value >0.05 for all). Based on the ROC analysis, the optimal cut-offs of IID, TMD and MMC measurements for the prediction of difficult Visualization score is 3.05 cm, 4.05 cm and II respectively with area under the curves being 0.447, 0.595 and 0.570 respectively.

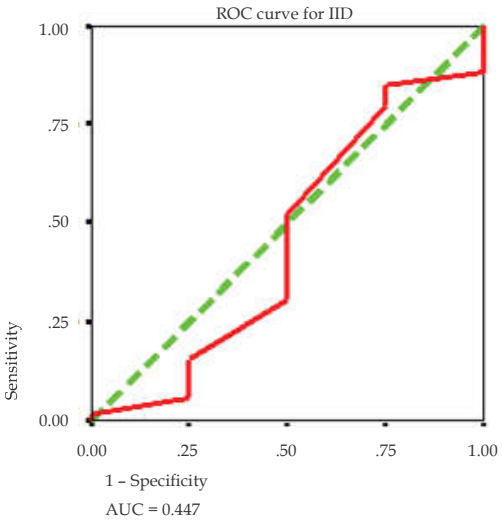

Fig. 7.1: Receiver operating characteristic (ROC) analysis for IID. Dotted line is a reference line

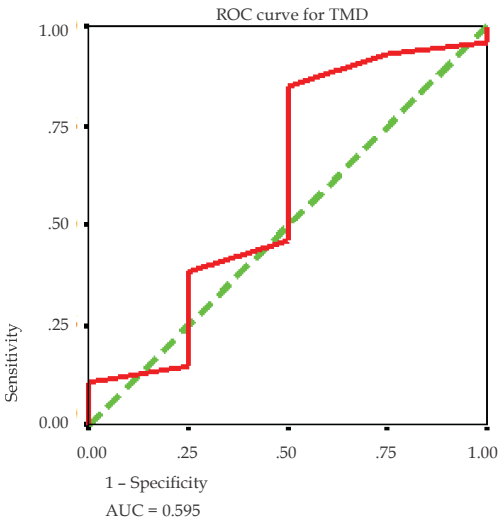

Fig. 7.2: Receiver operating characteristic (ROC) analysis for thyromental distance (TMD), dotted line is a reference line.

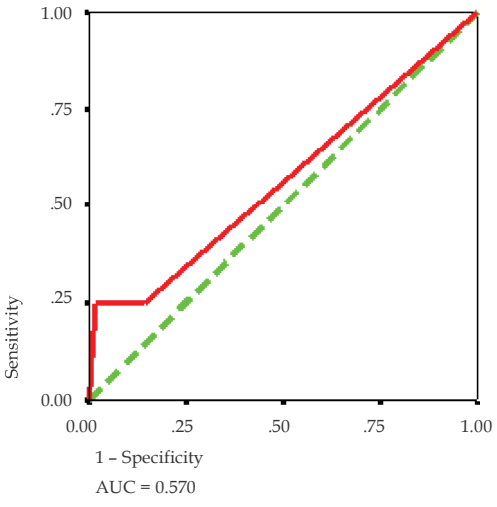

Fig. 7.3: Receiver operating characteristic (ROC) analysis for Modified mallampati score, dotted line is a reference line.

Table 8: The distribution of measures of diagnostic efficacy measures of various bed side parameters [Sensitivity and Specificity] for the prediction Cormack Lehane Grade.

Parameters (Cut-off)	Sensitivity (%)	Specificity (%)
IID (cm) (>3.05 cm)	52.04	50.00
TMD (cm) (<4.05 cm)	84.69	50.00
MMC (>II)	25.00	98.50

There was no statistically significant correlation between Modified Cormack Lehane Grading and other parameters except Modified Mallampati Class which differs significantly between easy and difficult visualization groups (p-value <0.01).

Discussion

The airway management remains an important challenge for anesthesiologist and proper preoperative assessment enables us to take appropriate measures during difficult intubation. We conducted the study in 200 patients of both the sexes, the age between 3-6 years and ASA Grade I,II,III. We observed Interincisor distance (IID), Modified Mallampati Class (MMC), Thyromental distance(TMD) and Cormack Lehane group(CLG).

In our study age, sex and ASA distribution was statistically insignificant. In CLG distribution of grades was as follows: 60% of cases- GradeI, 38% Grade IIA/IIB, 2% grade III. None of the patient had grade IV. EVL was seen in 98% of the cases and DVL in 2%.

The bedside tests IID and TMD were not statistically significant with easy and difficult visualisation in our observation. Similarly NB Rafique[1] observed that mean TMD did not differ between EVL and DVL in our observation. While Krobbuaban et al. stated the IID was not a predictor of difficult laryngoscopy and visualisation, but he also said that ratio of height to TMD had higher sensitivity and the study was conducted in adults which cannot be correlated with pediatric population.

The MMC distribution in our study was observed to be statistically significant. In Class I of MMC, EVL was in 168 cases while DVL was seen in 3 cases. While Class III had 3 cases of EVL and 1 case of DVL. But Lundstrom H[2] showed a good relation between Modified Mallampati Class and Cormack Lehane Grade in his study of pediatric age group, which is contradicting our study.

When specificity and sensitivity were studied with IID, TMD, MMC. TMD was more sensitive with 84.69% while MMC was more specific with 98.5%. Similarly Shiga et al.[3] suggested that the most useful bedside test for prediction was found to be combination of the Mallampati classification and Thyromental distance. Frek et al.[4] also stated that when Thyromental distance and Modified Mallampati Class were combined they have greater sensitivity and specificity which is similar to our study, but when used alone they were poor predictors. In contrast, the combination of MMT and TMD was not an adequate predictor of a difficult intubation in a study by Koh et al.[5]

The study by Bhavdip P et al.[6] stated that MMC alone is not a good predictor of difficult intubation in adults, when TMD and SMD were added to MMC for preoperative assessment prediction was improved. This is not good test in children because of continous growth and increasing height.

We considered sensitivity the most important parameter as our target was to identify more number of difficult intubation cases to avoid the potentially serious outcome of unanticipated difficult tracheal intubation. There are no routine tests to assess airway preoperatively in pediatric population and are several limitations as the incidence of difficult airway in pediatric population is very rare, unless there is a dysmorphic feature. The sample size of study population is very small so we could not reach a conclusion with above said tests.

Summary and Conclusion

The present study was conducted in 200 patients between 3-6 years age, of ASA Grade I, II and III undergoing elective surgeries. Preoperatively all the patients were assessed for IID, TMD and MMC. After standard induction protocol, laryngoscopy was performed under effect of muscle relaxant and laryngoscopic view was assessed by Cormack Lehane Grading. Later preoperative assessment of above mention parameters were compared with EVL and DVL of larynx with Cormack Lehane's grading. Sensitivity of TMD was 84.69% and Specificity of MMC was 98.5%. Following observations:

1. Thyromental Distance is a good predictor for difficult laryngoscopy and intubation in pediatric age group.
2. Multiple bed side parameters when combined together have better results than when used alone.

Ongoing future researches will be required to determine the algorithm for prediction of difficult airway in pediatric population. The anesthesiologist must be prepared with multiple predefined practical plans for unanticipated difficult airway management in children.

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