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PREDICTION OF INCIDENCE OF DIFFICULT INTUBATION BY MODIFIED MALLAMPATI TEST (MMT) AND INTUBATION DIFFICULTY SCALE (IDS) SCORE IN PATIENTS UNDERGOING GENERAL ANAESTHESIA

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ABSTRACT

BACKGROUND: Difficult airway management is major cause of morbidity and mortality in anaesthesia practice. The prevalence of difficult intubation - 0.1% to 10.1%. The aim of current study was to predict incidence of difficult intubation using Modified Mallampati test and Intubation Difficulty Scale.

MATERIALS & METHODS: After Institutional ethical committee approval, a hospital based observational study was done by recruiting 70 subjects with the American society of anaesthesiologists Class 1, 2 undergoing elective surgeries under general anaesthesia by endotracheal intubation. Modified Mallampati Test (MMT) was assessed preoperatively. Intubation difficulty scale (IDS) score was recorded during intubation. The primary outcome includes the prediction of difficult intubation as described by IDS score, patients were classified into two groups with IDS score of ≥ 5 and < 5 as the difficult and easy intubation groups, respectively. Data analysed using Receiver operating characteristic (ROC) curve and Area under Curve (AUC).

RESULTS: The mean age of subjects was 36.81 ± 13.08 years. The percentage of difficult intubation was 5.7% by IDS and 28.6% by MMT. 94.2% had IDS score<5. Age and Body mass index correlates with increased IDS score predicting difficult intubation ($p \leq 0.05$; r = 0.499, r = 0.51) respectively. The AUC for IDS score was 0.727 (p = 0.003) which was statistically significant. The sensitivity of the IDS score was 15% and specificity was 98%.

CONCLUSION: The MMT being the gold standard and IDS scoring system a validated method based on subjective and objective criteria, used to evaluate a global degree of intubation difficulty to decrease the incidence of airway related complications by using simple maneuvers and techniques.

KEYWORDS: Intubation Difficulty Scale, Mallampati, Airway.

INTRODUCTION

Difficult airway management is the major cause of morbidity and mortality in anaesthesia practice. The prevalence of difficult intubation is 0.1% to 10.1%.[1] The American Society of Anesthesiologists (ASA Task force 1993) defines Difficult intubation as 'when insertion of an endotracheal tube with conventional laryngoscopy requires more than three attempts or more than 10 minutes'. In 2003 the updated guidelines revises difficult intubation as 'requiring multiple attempts'.[2,3]

The American Society of Anesthesiologists (ASA) Closed claims database (1990) reported respiratory events (35%) as the largest source of adverse anaesthetic outcomes due to inadequate ventilation (38%), esophageal intubation (18%) and difficult intubation (17%). Around 85% of the respiratory related claims involved in death and permanent brain damage.[3] Hence American Society of Anesthesiologists (ASA) adopted the "Practice Guidelines for Management of the Difficult Airway" (1993) to reduce the likelihood of adverse outcomes which has been updated in 2003, 2013 and 2022.[4,5,6]

Several independent bedside tests like Modified Mallampati test (MMT), Sternomental distance, Upper-lip bite test, mouth opening etc. are measured to predict a difficult airway. But none of the independent tests have been able to predict the difficult airway with consistent accuracy.

In 1997, Adnet et al. proposed a quantitative score for difficult intubation, known as the Intubation Difficulty Scale (IDS) is a scoring system based on both subjective and objective criteria.[7] The IDS has a baseline score of zero and the score increases in relation to all efforts of an anesthesiologist performed to achieve a successful intubation. So this scoring system can evaluate various degrees of intubation difficulty.

Aims & Objectives

To predict the incidence of difficult intubation using Modified Mallampati test (MMT) and Intubation Difficulty Scale (IDS) score in patients undergoing General anaesthesia.

MATERIALS & METHODS

This was a Prospective observational study, conducted on recruiting 70 subjects, undergoing elective surgical procedures under general anaesthesia by endotracheal intubation from January 2020 to December 2020. The study was approved by the Institutional ethical committee and informed consent was taken.

The study included subjects from 18 to 65 years of both gender, belonging to ASA grade I and grade II undergoing elective surgery requiring general anaesthesia with direct laryngoscopy and endotracheal intubation. We excluded the subjects with BMI >35Kg/m^2, subjects with history of previous surgeries, burns, trauma involving head and neck or congenital / acquired - head and neck mass or tumour or with restricted mobility of neck and mandible. The subjects who was expected of difficult intubation and those who had a history of difficult intubation at the preoperative visit or if the first attempt of airway management required a different method other than endotracheal intubation (i.e. fiberoptic laryngoscopy or a supraglottic airway device) were also excluded.

A detailed history, complete physical and systemic examination was done. Routine blood investigations obtained. Participant's height, weight, and body mass index was recorded. Preoperative airway assessment - Modified Mallampati Test (MMT) was assesed by the same anesthesiologist to avoid inter-observer variability. Standard monitoring by electrocardiography, non-invasive blood pressure, pulse oximeter, and end-tidal carbon dioxide were applied before induction of general anesthesia.

All patients pre-oxygenated with 100% 02 at 6L/min, premedicated with Inj. Glycopyrrolate 0.01 mg/kg, Inj. Midazolam 0.05 mg/kg, Inj. Fentanyl 2 mics/kg and Inj. Ondansetron 0.1 mg/kg. Induced with Inj. Propofol 2mg/kg IV & relaxed with Inj. Succinylcholine 2mg/kg IV. After cessation of fasciculations, patient's head will be put in sniffing position- neck flexed and the head extended with a pillow under the head, laryngoscopy performed using a Macintosh blade No. 3/4 based on body

weight. Every case, the endotracheal tube of size between 7.0 to 8.0 was used without the assist of a stylet.

Each operator rated the Intubation difficulty scale (IDS) score after he or she completed the intubation by scoring seven variables of IDS. Subjects classified into two groups with IDS score of ≥5 and <5 as the difficult and easy intubation groups, respectively.

Statistical Analysis

Descriptive statistics of the explanatory and outcome variables were calculated by mean, standard deviation for quantitative variables, frequency and proportions for qualitative variables. Fisher exact test was applied between MMT and IDS score to determine the association. Pearson's correlation was applied to correlate between age, BMI and IDS score. Receiver operating characteristic (ROC) curve was drawn along with area under curves to calculate the specificity and sensitivity for different cut off values of IDS. The level of significance was set at 5%. **SPSS (Statistical Package for Social Sciences)** version 20. [IBM SPSS statistics (IBM corp. Armonk, NY, USA released 2011)] was used to perform the statistical analysis.

RESULTS

The study included 70 subjects in the analysis. The demographic characteristics of the participants are summarized in Table 1. Majority of subjects under ASA1 category (90%).The study included subjects of age group 18-65 year, 36.8 year being mean age. Subjects with BMI from 15.8-33.3 kg/m2 were included. Age and Body Mass Index (BMI) correlates with increased IDS score predicting difficult intubation (p≤0.05; r = 0.499, r = 0.51) respectively (Table 2) which was statistically significant.

Parameters	Mean ± SD	Range
Age (years)	36.81 ± 13.1	18 – 65
Weight (kg)	61.69 ± 12	36-99
Height (cm)	160.3 ± 9.8	142 – 185
BMI (kg/m2)	23.94 ±3.8	15.8 - 33.3
Gender (M:F)	31:39	44.3%: 55.7%
ASA 1:2	63:7	90%: 10%
Table 1: Demographic Characteristics of Study Subjects		

Pearson Correlation	Age v/s IDS Score	BMI v/s IDS Score
r value	0.499	0.51
p value	.000*	.000*

Table 2: Correlation of Age and BMI with Difficult Intubation

IDS score	MMT				Total
	1	2	3	4	
0	14	8	3	0	25
	20.0%	11.4%	4.3%	0.0%	35.7%
1	3	4	1	0	8
	4.3%	5.7%	1.4%	0.0%	11.4%
2	2	7	4	0	13
	2.9%	10.0%	5.7%	0.0%	18.6%
3	3	4	7	0	14
	4.3%	5.7%	10.0%	0.0%	20.0%
4	2	2	2	0	6
	2.9%	2.9%	2.9%	0.0%	8.6%
5	0	1	1	0	2
	0.0%	1.4%	1.4%	0.0%	2.9%
6	0	0	1	1	2
	0.0%	0.0%	1.4%	1.4%	2.9%
Total	24	26	19	1	70
	34.3%	37.1%	27.1%	1.4%	100.0%

Table 3: Distribution of MMT & IDS Scores among Patients

The IDS score ranged from 0 to 6. The number of patients presenting IDS score 0 were 25(35.7%), between 1 and 4 was 41 (58.5%) and unexpected difficult intubation with the IDS > 5 was 4 (5.7%) patients. Preoperative airway assessment by Modified mallampati showed difficult intubation i.e MP ≥ 3 in 20(28.6%) subjects. Distribution of MMT &IDS score summarized in Table 3 & Figure 1.

Among the distribution of individual factors composing the IDS scores within the study subjects, use of other alternative intubation techniques, the Cormack-Lehane grade, use of additional lifting force during intubation and application of external laryngeal pressure was related to predicting higher total IDS scores. Almost 50% of subjects required laryngeal pressure & 40% of subjects required additional lifting force during intubation.

Total 14 cases (20%) required alternative techniques like, the additional use of a stylet or boogie to complete the intubation. 6 cases required more than 1 attempt and 1 cases that required 2 more assistants were all difficult intubation cases with the IDS > 5. There was no case of 'cannot ventilate, cannot intubate'. The application of external laryngeal pressure or additional lifting force was the techniques most often used during intubation.
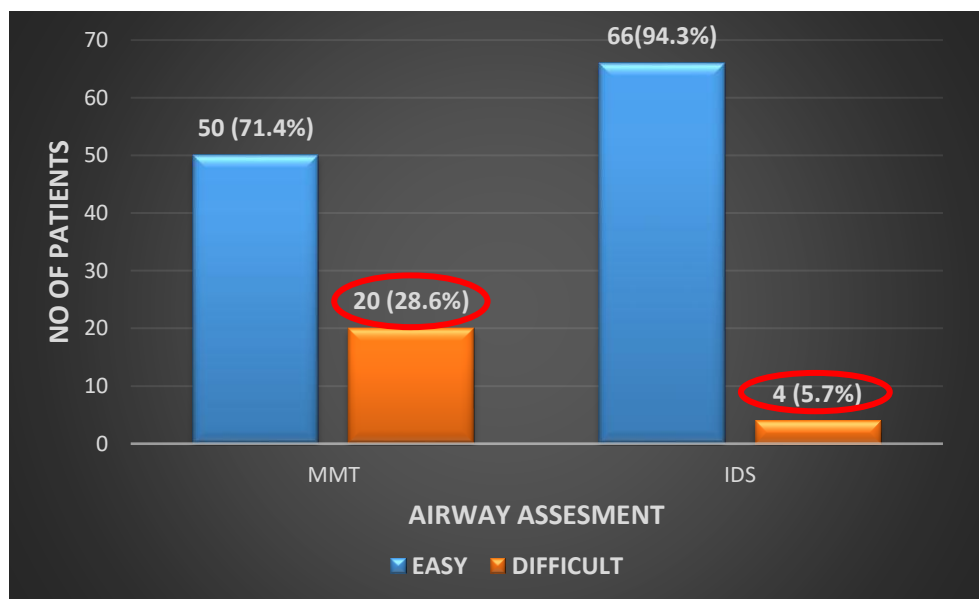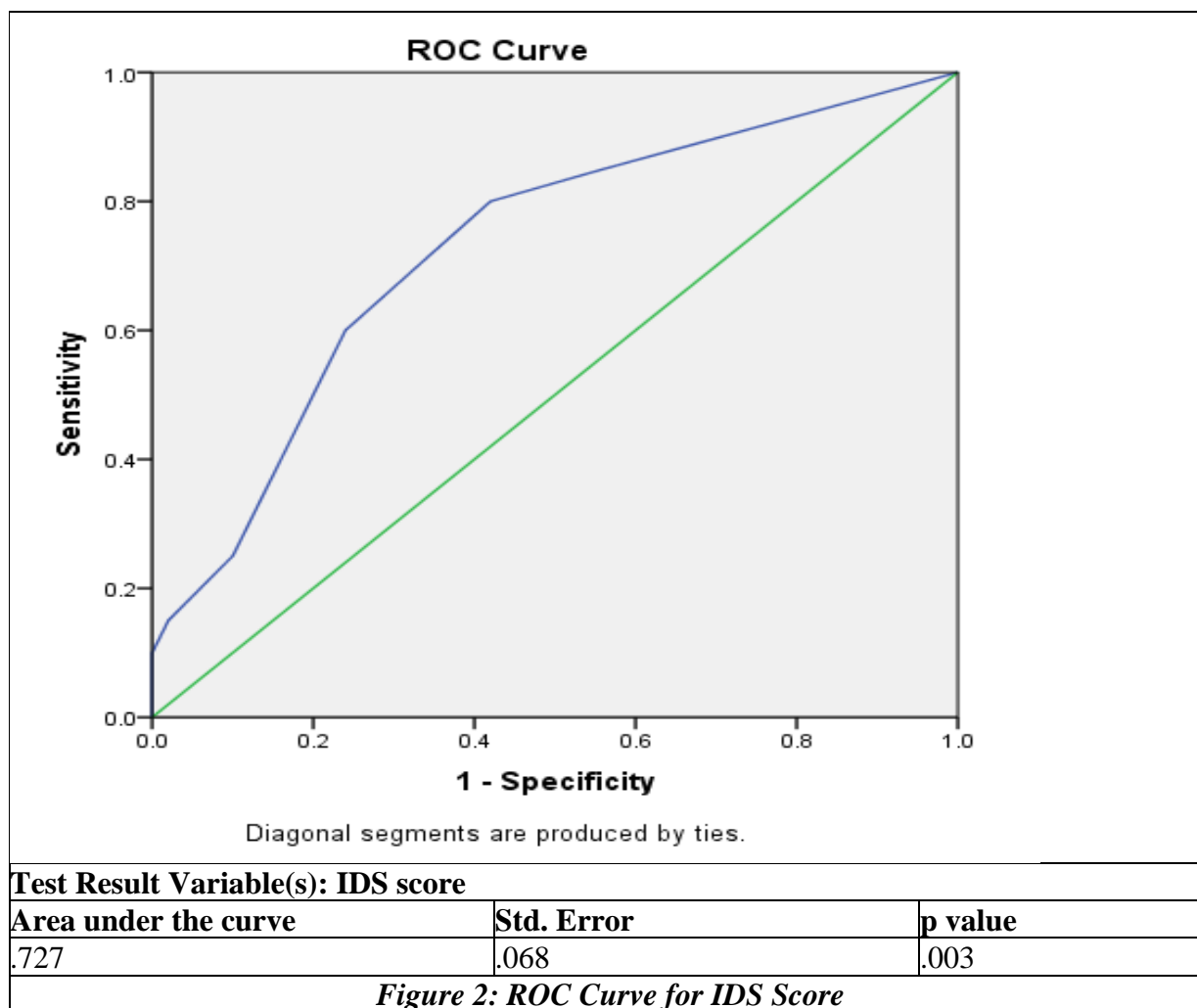
Figure 1: Airway Assessment Based on MMT & IDS

Fisher exact test was applied between MMT and IDS score to determine the association. There was statistically insignificant association between MMT and IDS score with respect to ease of intubation at p = 0.067 (Table 4).

IDS	MMT		Total	p value*
	Easy	Difficult		
Easy	49	17	66	
	70.0%	24.3%	94.3%	
Difficult	1	3	4	0.067
	1.4%	4.3%	5.7%	
Total	50	20	70	
	71.4%	28.6%	100.0%	

Table 4: Association of MMT & IDS Score in Difficult Intubation

Receiver operating characteristic (ROC) curve was drawn along with area under curves to calculate the specificity and sensitivity for different cut off values of IDS. **Area under the curve** for IDS score was 0.727 with Std. Error of 0.068 at p value 0.003, which was significant.

Test Result Variable(s): IDS score		
Area under the curve	**Std. Error**	**p value**
.727	.068	.003

Figure 2: ROC Curve for IDS Score

DISCUSSION

In the present study, we evaluated the incidence of unexpected difficult intubation by using the IDS system. The individual components of IDS scores were analysed, the cause for difficult intubation could be predicted and kind of modality used by the attending anesthesiologists to overcome the unexpected difficult intubation cases. The correlation between gold standard MMT and IDS system was done. The association of MMT and IDS scores in predicting difficult intubation was estimated.

The incidence of difficult intubation in previous studies ranged from 5-20%.[8-10] The incidence of difficult intubation (IDS ≥ 5) in our study was about 5.7 % which was similar to study by Vaibhav et al, incidence was 8%. Study by Vidhya S et al reported 12% as the rate of incidence of difficult intubation. Adnet et al. have reported that only 55% of the intubation cases demonstrated an IDS score of 0, and that 37% of the patients encountered presented minor or moderate difficulties. This could be due to different cut off values and definition of difficult intubation used in both studies. We had lower incidence of difficult intubation as our patient selection criteria excluded patients with expected difficulty at pre anaesthetic checkup.

The mean age of study subjects were around 37 years. Advanced age had higher prevalence of difficult intubation as patient may present with poor dental status, stiff joints of the neck and mandible as a result of degeneration and aging process resulting in incomplete exposure of the glottis. Although this study evaluated patients whom had no factors predicting difficult intubation at the preanesthetic visit, there is evidence that certain uncontrolled medical condition may predispose the patient to risk of difficult intubation.[11]

In this study, subjects with expected difficult airway were excluded. Mallampati test being gold standard used routinely for airway assessment at preop set up. The IDS is a multifactor scoring system

can be used to evaluate both laryngoscopy and intubation parameters.[12,13] The Cormack-Lehane grade demonstrated a significantly high correlation for predicting total IDS score, but the correlation of vocal cord mobility and total IDS score was low. Difficult laryngoscopic glottis exposure with Cormack–Lehane grade 3 or 4, has long been used as one of the definitive criteria for a difficult intubation and has an incidence ranging from 0.3% to 13.0%. The factors associated with high Cormack-Lehane grade was male gender, increasing age, Obesity and increasing BMI.

Single intubation attempt was required in 91.4% of patients by applying a simple maneuver such as additional lifting force and laryngeal pressure. This was in accordance with previous study by Koh W et al.[9] Our hospital was a tertiary care center with primary attending anesthesiologist was a trainee (resident or fellow), then a supplementary faculty member gave further assistance. Hence probably majority of subjects required laryngeal pressure & additional lifting force during intubation which was dependent on operator factor too.

Around 20% of cases required alternate techniques during intubation. There was no case of 'cannot ventilate, cannot intubate'.

There were few limitations of the study, as study included smaller sample size, tool efficiency based on grade of attending anaesthesiologist, no available alternative techniques for intubation.

Recently, an evidence on the use of a video assisted devices has been increased and the Practice Guidelines for Management of the Difficult Airway by the ASA has been updated acknowledging the introduction of the newer video assisted devices as an initial approach to intubation and one of the alternative approaches for difficult intubations. Video laryngoscopes improve the visualization of the glottis, but do not always guarantee an improved overall success rate of intubation.[3,14,15]

The ideal test for predicting a difficult airway would be one with a high sensitivity and a high specificity. However sensitivity of the test i.e. its ability to accurately predict the true positives, is most important. This allows the anaesthesiologist to plan for securing the airway safely and to avoid any serious outcomes of unanticipated airway related catastrophe.

CONCLUSION

MMT being the gold standard has been used since long time for predicting difficult endotracheal intubation. IDS scoring system is based on subjective and objective criteria, has been used as a validated method to evaluate a global degree of intubation difficulty. MMT is a simple visual assessment, while IDS is a more comprehensive scoring system considers various factors related to intubation difficulty including operator factor. Both the tools can be used to recognize patients at risk for difficult intubation, but IDS gives more accurate assessment when used in conjunction with other assessment.

Further prospective studies are required to find more effective methods to predict difficult intubation and studies either utilizing video-assisted devices against conventional methods to lower the prevalence of unexpected difficult intubation are required.

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