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Clinical Investigation

Incidence of Difficult Intubation in Obese & Non-Obese Patients Using Intubation Difficulty Scale

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Abstract

Introduction: *Unanticipated difficult intubation is challenging to anaesthesiologists. The global epidemic of overweight and obesity is rapidly becoming a major health problem and anaesthetists frequently encounter such patients whose airway management is their major responsibility. Intubation Difficulty Scale (IDS) had been used as a validated difficulty score to define difficult intubation. In this study, we intend to find out the incidence of difficult intubation in obese and non-obese patients using Intubation Difficulty Scale.*

Objectives: *The primary objective of the study is to assess the incidence of Intubation Difficulty Scale (IDS) score ≥ 5 in obese and non-obese patients. The secondary objective is to assess the performance of Modified Mallampati Classification, Mouth opening, Thyromental distance and Sternomental distance in predicting Intubation Difficulty Scale (IDS) score ≥5 in obese and non-obese patients.*

Methods: *This study is a prospective cohort study. The study population was from the Department of Anaesthesiology, Government Medical College, Thiruvananthapuram with ASA- physical status I & II patients in the age groups 18 to 60 years, scheduled to undergo surgery requiring General Anaesthesia with controlled ventilation using an Endotracheal tube. After obtaining informed written consent and Institutional Research Committee and Ethical Committee clearance, 140 patients requiring General Anaesthesia were categorized into 70 each based on the Body Mass Index (BMI) into obese (BMI≥ 25kg/m^2) and non- obese (BMI<25kg/m^2)groups. Preoperative airway assessment included Modified Mallampati Classification, mouth opening, Thyromental distance and Sternomental distance. IDS score ≥ 5 was termed Difficult Intubation.*

Data was entered in Microsoft Excel and data analyzed using SPSS software version 16. All the quantitative data were analyzed by computing percentages and descriptive statistics, ie: mean, standard deviation and standard error of mean and qualitative data by means of proportions. Suitable statistical tests were applied and results were considered statistically significant whenever p- value of ≤0.05 was obtained.

Results: *Overall in 140 patients, the incidence of difficult intubation was found to be 16.4%. 27.1% of obese patients and 5.7% of non-obese patients had difficult intubation. Obese patients were more difficult to intubate than non- obese patients. Obstructive Sleep Apnea (OSA), Modified Mallampati Classification III/IV, Thyromental distance (TMD) < 6.5cms and Sternomental distance (SMD)< 12.5cms were found to be associated with IDS score ≥ 5. SMD <12.5cms was found to be the single best predictor of difficult intubation. IDS score is helpful in evaluating the predictive factors of difficult intubation.*

Conclusions: *Obese patients are more difficult to intubate than non-obese patients. It is preferable to have a second skilled Anaesthesiologist, during intubation of obese patients with OSA, MMC III/IV, TMD <6.5cms and SMD <12.5cms.*

Keywords: *Difficult intubation, intubation difficulty scale, obese, non-obese.*

Introduction

Difficulty in airway management is an important cause of morbidity and mortality in anaesthetic practice. Unanticipated difficult intubation is challenging to anaesthesiologists. Nearly 30% of anaesthesia deaths can be attributed to a compromised airway. Analysis of the American Society of Anaesthesiologists (ASA) Closed Claims Project data base has shown that the development of an airway emergency increases the odds of death or brain damage by 15 fold[2]

The global epidemic of overweight and obesity - "globesity"- is rapidly becoming a major health problem and anaesthetists frequently encounter such patients whose airway management is their major responsibility. Tracheal intubation of obese patients can be challenging due to impaired respiratory mechanics and increased sensitivity to the adverse effects of apnea and hypoxia. According to WHO, overweight and obesity is defined as Body Mass Index (BMI) ≥25 & ≥30 respectively. The WHO Expert Consultation [8] concluded that the proportion of Asian population with a high risk of Type II diabetes and cardiovascular disease is substantial at BMIs lower than the existing WHO cut-off point for overweight. Hence, the Health Ministry of India redefined overweight and obesity as BMI of 23-24.9 and ≥ 25 respectively.

Benumof defined difficult endotracheal intubation as Cormack-Lehane (CL) grade III with several attempts. According to ASA(1993), difficult intubation is defined as 3 attempts at endotracheal intubation when an average laryngoscope is used or when endotracheal intubation takes 10min or more. ASA (2013) redefined difficult intubation as tracheal intubation requiring multiple attempts, in the presence or absence of tracheal pathology.

Intubation Difficulty Scale (IDS) was introduced by Adnet et al. in 1997, which includes 7 objective parameters to assess intubation. IDS has been used as a validated difficulty score to define difficult intubation. Juvin[9] assessed the performance of IDS in predicting difficult intubation in France. Studies using IDS in the Indian population to predict difficult intubation are very limited. No such studies have been done previously in Government Medical College, Thiruvananthapuram.

Materials and Methods

After obtaining Institutional Research Committee and Ethical Committee approval for the study, 140 patients with ASA Physical status I and II, aged 1 8 - 6 0 years, of either sex, posted for surgery requiring general anaesthesia with controlled ventilation using an endotracheal tube and satisfying the inclusion and exclusion criteria were enrolled for the study. Informed written consent was taken from each patient.

Inclusion Criteria

- Patients, 18-60yrs of age, of either sex, with BMI ≥25 assigned to obese group (O) and BMI <25 assigned to non-obese group (NO)
- American Society of Anesthesiologists (ASA) Physical Status I and II patients
- Those willing to give informed written consent

Exclusion Criteria

- Patients with upper airway pathology (tumours, fractures), cervical spine injury and neck swelling
- Pregnant patients
- Those who are not willing to give consent

Sample Size

In the parent study analysis, difficult endotracheal intubation was reported in 15.5% of obese patients and 2.2% of non-obese patients. So applying the formula,

Sample size, $\mathbf{N=\{(Z_{\alpha+}Z_{\beta})^2(P_1Q_1+P_2Q_2)\}/(P_1-P_2)^2}$

$Z_\alpha=1.96$ $Z_\beta=0.82$

$P_1=15.5$ $P_2=2.2$

$Q1=100-P_1$ $Q_2=100-P_2$

$N=\{(1.96_{+}0.82)^2(15.5 \times 84.5 + 2.2 \times 97.8)\}/(15.5-2.2)^2$

The calculated sample size required for the present study was obtained as 66.63 per group which was approximated to 70 per group.

Methodology

Patient's height in standing position and weight were measured and BMI calculated as Weight (kg)/Height(m)^2. Patients with BMI ≥25 were assigned to obese group (O) and those with BMI <25 assigned to non-obese group (NO). All preoperative airway assessments were done by a competent anaesthetist. All patients were given oral Pantoprazole 40mg and Alprazolam 0.25mg on the night and morning of surgery.

All patients were kept nil per oral for atleast 10 hours. In the operating room, patient were attached to standard monitors. Suitable IV line secured. All patients received premedication with IV Midazolam lmg, IV Glycopyrrolate 0.2mg and IV Metoclopramide 0.2mg/kg half an hour before surgery. Difficult intubation cart was made available in place. Patients were pre-oxygenated with 100% 0_2 for 3min, following which anaesthesia induced with l-2mcg/kg Fentanyl IV and 2mg/kg Propofol IV. The ability to mask ventilate was checked and succinylcholine l-1.5mg/kg IV given.

Patients were positioned in sniffing in morning air position. Laryngoscopy and intubation were performed after complete muscle relaxation by the same competent anaesthetist. For laryngoscopy, a Macintosh 3 / 4 size blade and for intubation, portex endotracheal tube of internal diameters 7/7.5mm for females and 8/8.5mm for males were used. Patients with Cormack-Lehane (CL) grade III or IV on laryngoscopy were termed as difficult laryngoscopy.

The whole intubation process was scored by using seven measurable variables of Intubation Difficulty Scale; a score of zero considered as an easy endotracheal intubation, score of 1-4 as slightly difficult intubation and ≥5 as moderate to difficult intubation. For interpretation purpose, score ≥5 considered as difficult intubation.

Measure of Outcome

- Parameters included in airway examination:

PARAMETER	METHOD	RANGE &UNITS
MMC (Modified Mallampati Classification)	Patient sitting, head in neutral position, mouth fully opened, tongue maximally protruded, no phonation	1. Soft palate, uvula, fauces, anterior & posterior tonsillar pillars 2. Soft palate, uvula, fauces 3. Soft palate, base of uvula 4. Hard palate only
MO (Mouth Opening)	Distance betweenlower border of upperincisor and upper border of lower incisor. In edentulous patients, distance between upper and lower gingiva considered	In centimeters using a ruler >3 finger breadth / 5 cms – normal
TMD (Thyromental Distance)	Patient sitting, head extended, mouthclosed, distance from thyroid notch to mentum	In centimeters using a ruler 6.5cms- normal 6-6.5cms- difficult <6 cms- very difficult
SMD (Sternomental Distance)	Patient sitting, head extended, mouthclosed, distance fromsternal notch to mentum	In centimeters using a Ruler >12 .5cms- normal <12.5cms- difficult

Intubation Difficulty Scale:

PARAMETER	SCORE
No: of attempts >1	N1
No: of operators >1	N2
No: of alternative techniques	N3
Cormack - Lehane Grading Grade I Grade II Grade III Grade IV	 N4=0 N4=l N4=2 N4=3
Lifting force required Normal Increased	 N5=0 N5=l
Laryngeal pressure Not applied Applied	 N6=0 N6 =l
Vocal cord mobility Abduction Adduction	 N7=0 N7=l

N1- Every additional attempt, add 1 point
N2- Every additional operator, add 1 point
N3-Each alternative technique, add 1 point (repositioning of patient, change of blade, endotracheal tube, addition of stylet or use of fibreoptic / laryngeal mask airway)
Total score ≥ 5 - difficult intubation

Observations and Results

A sample of 140 patients undergoing surgery under general anaesthesia with controlled ventilation using an endotracheal tube, were enrolled for the study after obtaining informed written consent.

The observations made were tabulated and analyzed using appropriate statistical tools. Obese and non - obese patients were comparable with respect to their age and gender.

Comparison of sample based on Body Mass Index

GROUP	No:	MEAN	Std. DEVIATION	t value	p value
NON OBESE	70	41.1	14.4	0.4980	0.619
OBESE	70	42.1	10.8		

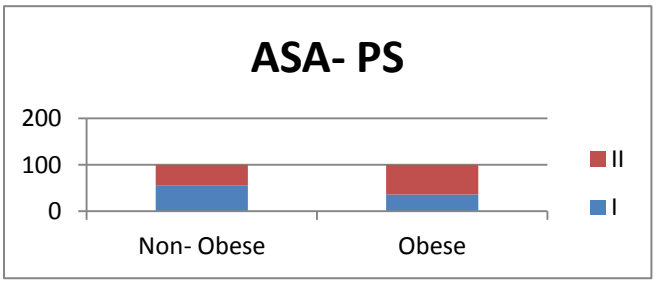
Comparison of sample based on Gender

SEX	GROUP				TOTAL	
	NON OBESE		OBESE			
	No:	%	No:	%	No:	%
FEMALE	39	55.7	30	42.9	69	49.3
MALE	31	44.3	40	57.1	71	50.7
TOTAL	70	100	70	100	140	100

Chi square = 2.3, p =0.128

There was a significant difference observed between obese and non-obese groups with respect to ASA-PS, OSA, Modified Mallampati

Comparison of sample based on ASA- PS



Classification (MMC) and IDS Score.

Comparison of sample based as ASA – PS

ASA PS	GROUP				TOTAL	
	NON OBESE		OBESE			
	No:	%	No:	%	No:	%
1	39	55.7	25	35.7	64	45.7
II	31	44.3	45	64.3	76	54.3
TOTAL	70	100	70	100	140	100

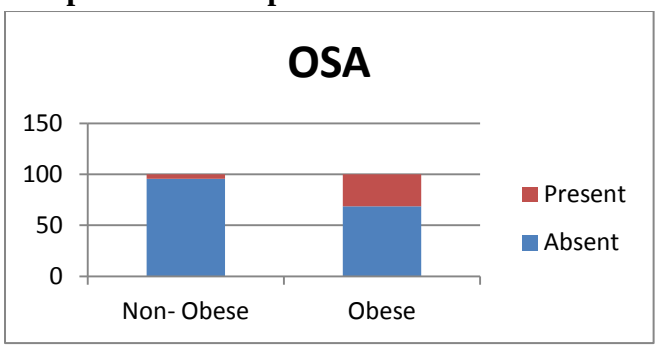
Chi square = 5.6, p =0.018

Comparison of sample based on OSA

OSA	GROUP				TOTAL	
	NON OBESE		OBESE			
	No:	%	No:	%	No:	%
ABSENT	67	95.7	48	68.6	115	82.1
PRESENT	3	4.3	22	31.4	25	17.9
TOTAL	70	100	70	100	140	100

Chi square = 17.5, p=0.000

Comparison of sample based on OSA

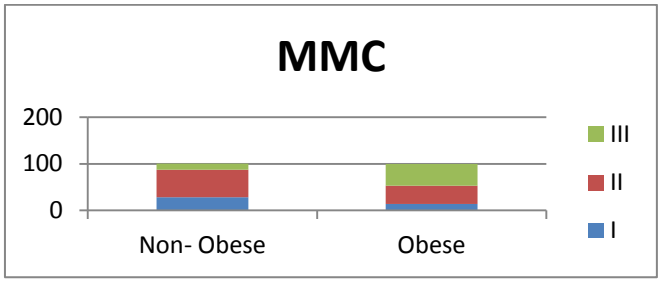


Comparison of sample based on MMC

MMC	GROUP				TOTAL	
	NON OBESE		OBESE			
	No:	%	No:	%	No:	%
1	20	28.6	10	14.3	30	21.4
II	41	58.6	27	38.6	68	48.6
III	9	12.9	33	47.1	42	30.0
TOTAL	70	100	70	100	140	100

Chi square = 19.9, p=0.000

Graph 3: Comparison of sample based on MMC



Comparison of sample based on TMD(cms)

GROUP	No:	MEAN	Std. DEVIATION	t value	p value
NON OBESE	70	8.1	1.1	1.8400	0.074
OBESE	70	7.7	1.3		

Comparison of sample based on SMD (cms)

GROUP	No:	MEAN	Std. DEVIATION	t value	p value
NON OBESE	70	14.9	1.6	1.620	0.107
OBESE	70	14.4	1.9		

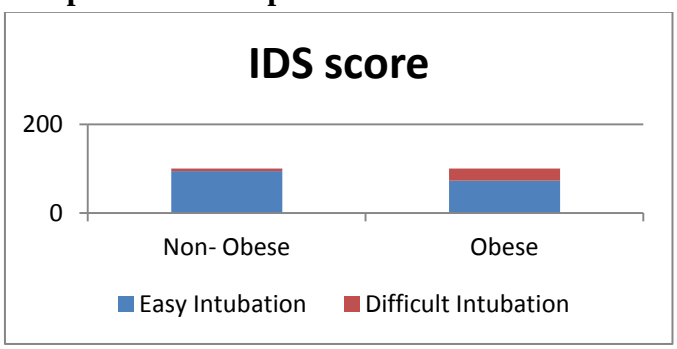
Obese and non obese groups were compared with respect to TMD & SMD and were found to be statistically insignificant based on the p-value.

Comparison of sample based on IDS score

IDS SCORE	GROUP				TOTAL	
	NON OBESE		OBESE			
	No:	%	No:	%	No:	%
EASY INTUBATION	66	94.3	51	72.9	117	83.6
DIFFICULT INTUBATION	4	5.7	19	27.1	23	16.4
TOTAL	70	100	70	100	140	100

Chi square = 11.7, p=0.001

Comparison of sample based on IDS score



The above observation shows that there is a statistically significant difference in the ease of intubation among obese and non-obese patients based on IDS Score.

In the present study, about 42.9% of the females and 57.1% of the males were obese. About 64.3% of the obese patients belonged to ASA PS II category. Obstructive Sleep Apnea was observed in 31.4% of the obese patients.

Difficult intubation (IDS ≥5) was observed in 27.1% of the obese and 5.7% of the non-obese group.

Patients with IDS ≥5 (difficult intubation) were compared against those with IDS <5 (easy intubation) as shown in the tables that follow.

Comparison of sample between IDS score and Age

IDS SCORE	AGE(yrs)						TOTAL	
	<40		40-59		>60			
	No	%	No	%	No:	%	No:	%
EASY INTUBATION	53	85.5	57	85.1	7	63.6	117	83.6
DIFFICULT INTUBATION	9	14.5	10	14.9	4	36.4	23	16.4
TOTAL	62	100	67	100	11		140	100

Chi square = 3.5, p=0.177

Comparison of sample between IDS score and Gender

IDS SCORE AND SEX						
IDS SCORE CLASSIFICATION	SEX				TOTAL	
	FEMALE		MALE			
	No:	%	No:	%	No:	%
EASY INTUBATION	61	88.4	56	78.9	117	83.6
DIFFICULT INTUBATION	8	11.6	15	21.1	23	16.4
TOTAL	69	100	71	100	140	100

Chi square =2.3, p=0.128

Comparison of sample between IDS score and ASA – PS

IDS SCORE AND ASA PS						
IDS SCORE CLASSIFICATION	ASA PS				TOTAL	
	I		II			
	No:	%	No:	%	No:	%
EASY INTUBATION	57	89.1	60	78.9	117	83.6
DIFFICULT INTUBATION	7	10.9	16	21.1	23	16.4
TOTAL	64	100	76	100	140	100

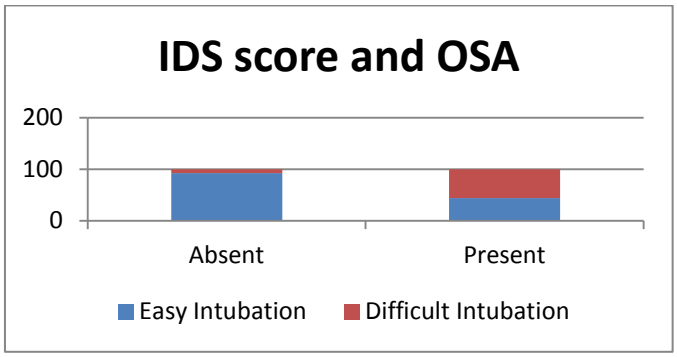
Chi square =2.6, p=0.108

However, no statistically significant difference was observed among IDS ≥5 (Difficult Intubation) with respect to Age, Sex or ASA-PS according to p-value

IDS SCORE AND OSA						
IDS SCORE CLASSIFICATION	OSA				TOTAL	
	ABSENT		PRESENT			
	No:	%	No:	%	No:	%
EASY INTUBATION	106	92.2	11	44	117	83.6
DIFFICULT INTUBATION	9	7.8	14	56	23	16.4
TOTAL	115	100	25	100	140	100

Chi square =34.7, p=0.000

Comparison of sample between IDS score and OSA



Comparison of sample between IDS score and MO

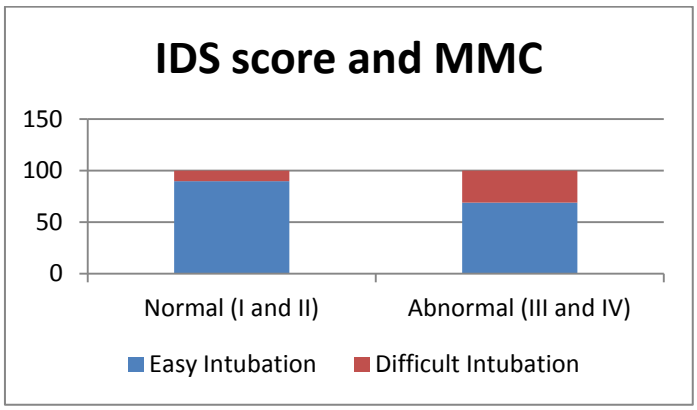
IDS SCORE AND MO						
IDS SCORE CLASSIFICATION	MO(cms)				TOTAL	
	2F		3F			
	No:	%	No:	%	No:	%
EASY INTUBATION	38	74.5	79	88.8	117	83.6
DIFFICULT INTUBATION	13	25.5	10	11.2	23	16.4
TOTAL	51	100	89	100	140	100

Chi square =4.8, p = 0.028

IDS SCORE AND MMC						
IDS SCORE CLASSIFICATION	MMC				TOTAL	
	NORMAL (I & II)		ABNORMAL (III & IV)			
	No:	%	No:	%	No:	%
EASY INTUBATION	88	89.8	29	69	117	83.6
DIFFICULT INTUBATION	10	10.2	13	31	23	16.4
TOTAL	98	100	42	100	140	100

Chi square =9.2, p = 0.002

Comparison of sample between IDS score and MMC



Comparison of sample between IDS score and TMD

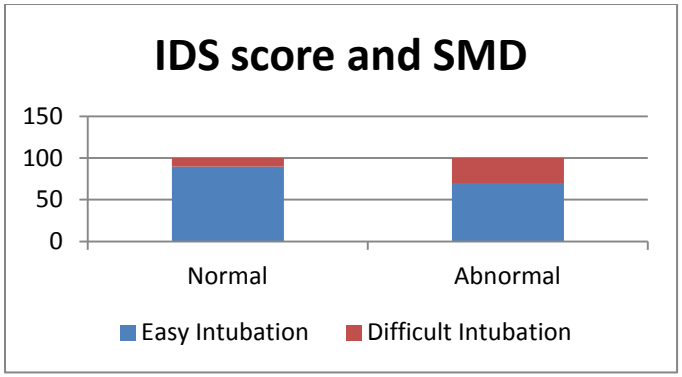
IDS SCORE AND TMD						
IDS SCORE CLASSIFICATION	TMD(cms) NORMAL (≥ 6.5)		ABNORMAL (<6.5)		TOTAL	
	No:	%	No:	%	No:	%
EASY INTUBATION	112	87.5	5	41.7	117	83.6
DIFFICULT INTUBATION	16	12.5	7	58.3	23	16.4
TOTAL	128	100	12	100	140	100

Chi square = 16.7, p=0.000

IDS SCORE AND SMD						
IDS SCORE CLASSIFICATION	SMD(cms) NORMAL (≥ 12.5)		ABNORMAL (<12.5)		TOTAL	
	No:	%	No:	%	No:	%
EASY INTUBATION	114	86.4	3	37.5	117	83.6
DIFFICULT INTUBATION	18	13.6	5	62.5	23	16.4
TOTAL	132	100	8	100	140	100

Chi square = 13.1, p=0.000

Comparison of sample between IDS score and SMD



Statistically significant difference was observed among IDS ≥5 (difficult intubation) with respect to OSA, MMC, TMD and SMD, according to p-value.

From the above data, significant predictors of difficult intubation were found to be OSA, MMC, TMD and SMD. In the present study, neither the obese nor the non-obese group had MO <2F. However, 25.5% of those patients with a MO =2F had difficult intubation.

Ten out of ninety eight patients who had normal modified Mallampati class had difficult intubation.

Among the bedside screening tests used in this study, SMD <12.5cms was found to the single most predictor of difficult intubation. Five out of eight patients with SMD <12.5cms had difficult intubation.

Interestingly, 56% of patients with OSA had difficult intubation.

Discussion

Airway management is a core skill of an anaesthesiologist. It is therefore imperative for an anaesthesiologist to identify the probable difficulty for intubation, to prevent morbidity and mortality resulting from unexpected difficult intubation. In the definitions for difficult intubation, Benum of or ASA have not included factors such as change of operators, alternative techniques used, lifting force applied during laryngoscopy, laryngeal pressure applied or even condition of the vocal cords.

For standardizing and characterizing the complexity of tracheal intubation, Adnet et al introduced Intubation Difficulty Scale in 1997. The objective of IDS is to "provide a uniform approach to compare studies related to difficult intubation, and with the aim of determining the relative values of risk factors of intubation difficulty". Since then IDS more than 5 has been used as the definition of difficult intubation in the studies by Combes and Dhonneur in the prehospital settings, and also by Amathieu et al in thyroid surgery. Gonzalez et al has used IDS to evaluate risk factors for difficult intubation in obese patients. Preoperative evaluation is very important, but the fact that which of these anatomical landmarks and clinical factors are the best predictors of difficult intubation are unknown yet.

From the present study, it was inferred that obese patients were more difficult to intubate compared to the non-obese patients based on Intubation Difficulty Scale. 27.1% of obese patients and 5.7% of non-obese patients had difficult intubation as per our study. Overall in 140 patients, the incidence of difficult intubation was 16.4%. This is concurrent with the studies done by Kim et al, Seo et al and Juvin et al who observed 13.8%, 11.8% and 15% incidence of difficult intubation among obese group respectively. Lavi

et al in their study had concluded that obese group had a higher IDS score due to poor glottis exposure, need for laryngeal pressure to improve glottis exposure and increased lifting force during laryngoscopy. Overall prevalence of difficult intubation was estimated to be 4.7-7.5% according to a meta-analysis. Wong and Hung in their study found that Asians were more difficult to intubate compared to Caucasians.

Kheterpal and Shiga et al have found that patients with BMI >30 had a higher incidence of difficult intubation compared to non-obese patients. However, Brodsky and Neligan et al in their study stated that the grade of obesity had in significant association with difficult intubation. Moon et al and Rose and Cohen had observed that age >40yrs was a significant predictor of difficult intubation. Ezri stated that the airway class increases with aging due to changes in the joint architecture and dental condition.

According to a meta - analysis, MMC was found to have poor prognostic value in identifying difficult intubation. This is supported by our study, wherein only thirteen had IDS ≥5 out of forty two with MMC III/IV. Arne et al, in their study showed that TMD<6cms predicts difficult intubation. This is also supported by our study, where 58.3% of those with abnormal TMD had difficult intubation.

There is also significant correlation between SMD <12.5cms and difficult intubation in the present study similar to the studies given by Shiga et al. 62.5% of those patients with SMD <12.5cms had IDS ≥5 in our study. SMD indirectly signifies head and neck mobility and only relatively few studies had addressed the importance of SMD. All patients in our study had normal MO (2F & 3F), however, 25.5% of patients with MO=2F had difficult intubation.

Identification of predictors of difficult intubation is crucial to distinguish between an anticipated and unanticipated difficult airway and to take appropriate precautions. Male gender, OSA and obesity with MMC III & IV have been described as predictors of difficult intubation in the studies by Kheterpal et al and Neligan et al. According to our study, OSA, MMC III & IV, TMD<6.5cms and SMD <12.5cms were found to be the predictors of difficult intubation. SMD <12.5cms appeared to be the single best predictor of difficult intubation in our study.

Conclusion

After analyzing the results of the present study, we found that the incidence of difficult intubation in obese patients is 27.1% and in non-obese patients is 5.7%. Overall incidence of difficult intubation in 140 patients was 16.4%. OSA, MMC III/IV, TMD <6.5cms and SMD <12.5cms were associated with IDS score ≥5.

In conclusion, obese patients are more difficult to intubate than non-obese patients. It is preferable to have a second skilled Anaesthesiologist, during intubation of obese patients with OSA, MMC III/IV, TMD <6.5cms and SMD <12.5cms. SMD <12.5cms is the single best predictor of difficult intubation in obese patients. IDS score is helpful in evaluating the predictive factors of difficult intubation.

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