

A study to rank predictors of Preoperative Airway Assessment on the basis of accuracy of prediction while performing Laryngoscopy in Obese patients

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Abstract:

Background and Aims : The anaesthesiologist must have the ability to recognize those patients who may present with difficult airway & must be able to formulate a plan of action to deal with such problem. Unfortunately, the classic predictors of difficult intubation are shown to be less reliable in obese population. So, a study design was formulated to rank the bedside tests for predicting difficult intubation in obese patients according to accuracy.

Materials and Methods : The study was carried out in 350 bedded Superspeciality Hospital of Bhopal, Madhya Pradesh for a period of 1 year. 205 obese patients participated in the study. Six variables that may predict difficult intubation were taken for the study. Each predictor was separately assessed for the predictability of difficult intubation on intubation difficulty scale, and strength of association was found between predictor and IDS score. Statistical analysis using statistical software SPSS Version 20 was performed.

Results : We analyzed that independently Mallampati, TMD, Delikan test can help to predict difficult airway in obese patients with accuracy of more than 70%. So, according to accuracy of prediction for difficult intubation in obese patients we can rank predictors in our study as-Modified Mallampati grading, Thyromental distance, Delikan test, Mandibular recession, Mouth opening and Buck teeth.

Conclusion : This study showed that in some patients IDS scoring was ≥ 5 were not predicted to be difficult by our routine preoperative tests.

Keywords: Modified Mallampati grading, Thyromental distance, Delikan test, Mandibular recession, Mouth opening, Buck teeth, Intubation difficulty scale (IDS)

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I. Introduction:

Endotracheal intubation procedures are considered to be more difficult to perform in obese patients than in patients with normal body mass index (BMI). Difficult laryngoscopy and intubation in obese patients is usually because of short neck, large tongue, and significant redundant pharyngeal soft tissue, large chest and breast. Although, traditional methods of assessing the airway by Mallampati score and Wilson risk sum score are accepted widely, these tests suffer from poor sensitivity with only moderate specificity and have limited positive predictive value.

The Mallampati score estimates the size of tongue relative to the oral cavity and may indicate possibly whether displacement of the tongue by the laryngoscope blade is likely to be easy or difficult. In addition, it assesses whether the mouth can be opened adequately to permit intubation. The Mallampati test assesses pharyngeal structure and also head and neck mobility. Recent investigation suggested, craniocervical extension relates to mouth opening, and limited head or neck mobility may result in a poor Mallampati score.

Mouth opening indicates the movement of temporomandibular joint and that limited mouth opening hinders exposure of the larynx significantly. Several studies based on multivariate analysis indicated that limited mouth opening is strongly associated with difficult intubation, but meta-analysis suggests, mouth opening is not a useful test.

Measurements of head and neck movement (delikan test), presence or absence of receding mandible, the presence of prominent maxillary incisors (buck teeth) and all the above parameters yielded poor to moderate sensitivity and moderate to fair specificity in various previous study and meta-analysis.

Thyromental distance is considered to be an indicator of mandibular space. There is heterogeneity due to the variety of test thresholds: cutoff points varied from 4.0 to 7.0 cm. This wide range in test sensitivity may result in heterogeneity.

An attempt is therefore made to rank the bedside tests for predicting difficult intubation in obese patients according to accuracy of prediction.

II. Materials and Methods:

2.1 Site of the study : Prospective observational study was conducted in pre-anaesthetic clinic (PAC) & operation theatre of 350 bedded Superspeciality Hospital, Bhopal ,Madhya Pradesh, India. Institutional ethics & scientific committee approval obtained .Written informed consent was obtained from all the patients. Study was done for a period of 1year .

2.2 Sample size and justification of sample size calculation-

Sample size for study will be according, to the hospital based study sample size , based on confidence interval $N=t^2 \times p(1-p) \div e^2$

Where t= 95% confidence interval (t=1.96 standard value at 95%)

p= prevalence / incidence%

e= allowed error 5% = 0.05

The overall incidence of difficult intubation calculated was 15.8 % in obese patients according to meta-analysis¹⁰, therefore 205 obese patients participated in our study.

2.3 Inclusion criteria -

1. Adults of both sexes between 25 to 65 years , scheduled for elective surgeries.
2. ASA physical status I & II.
3. BMI \geq 30

2.4 Exclusion criteria

1. Patients with pre-existing cardiac , renal or hepatic dysfunction.
2. Patients with known distortion of anatomy (like head and neck cancer)
3. Use of cervical collar
4. Obstetric patients
5. Inability to sit
6. Patients refusal

2.5 Method of study

All the preoperative airway assessment were done evening before surgery by a single observer. Six variables that may predict difficult intubation were taken for the study. They are as follows:

1. Modified Mallampati grading –without phonation

Grade I : Faucial pillars, uvula, soft & hard palate visible

Grade II : Uvula, soft & hard palate visible.

Grade III : Base of uvula or none, soft & hard palate visible.

Grade IV : Only hard palate visible.

Grade I & II easy laryngoscopic view of the glottis.

Grade III & IV difficult laryngoscopy.

2. Thyromental distance -

This is the distance between the thyroid notch & mental symphysis when the neck is fully extended.

>6.5cm : No issues with laryngoscopy and intubation.

6 – 6.5cm : laryngoscopy and intubation difficult but possible

<6cm : laryngoscopy may be impossible.

3. Mouth opening -

2 Finger - Patient is asked to open his mouth wide & place his two finger (index & middle) in the opening.If this is >3cm then M.O. is adequate.

3 Finger - Patients is asked to extend his head & place three average sized fingers (index, middle, & ring) in the submandibular space. This tells of an adequate space in front of the larynx for the tongue to be compressed & also the ease with which the laryngeal & pharyngeal axis will fall in line when the a-o joint is extended.

4. Delikan test –

The patients is asked to look straight ahead .The head held in neutral position. Index finger of the left hand of the clinician is placed under the tip of the jaw while the index finger of the right hand is placed on the patients occipital tuberosity. The patient is now asked to look at the ceiling .If the left index finger become higher than

the right, extension is considered normal. If the left index finger remains at the same level of the right or lower, extension is abnormal.

Normal =Not Difficult, Abnormal =Difficult Intubation

5. Receding mandible-

Involuntary anterior overriding of the maxillary teeth on the mandibular teeth

Absent =Not Difficult, Present =Difficult Intubation,

6. Buck teeth-

Prominent upper incisors

Absent =Not Difficult, Present =Difficult Intubation

Patients were labeled as difficult intubation when any of the following conditions are present-

- Mandibular recession present
- Thyromental distance \leq 6.5cm
- Modified mallampati grading 3 & 4
- Mouth opening less than 2 finger
- Presence of buck teeth
- Delikan test abnormal

Also each predictor was separately assessed for the predictability of difficult intubation on intubation difficulty scale¹, and strength of association was found between the predictor and IDS score.

Intubation difficulty scale (IDS) comprised of seven variables associated with difficulty intubation. They were as follows:

N1- Number of additional intubation attempts

N2- Number of additional operators

N3- Number of alternative intubation technique used

N4- Glottis exposure as defined by Cormack and Lehane

Grade 1 ,N4=0

Grade 2 , N4=1

Grade 3 ,N4=2

Grade 4 , N4=3

N5- Lifting force applied during laryngoscopy

(N5 =0 if inconsiderable , N5=1 if considerable assessed subjectively)

N6- Need to apply external laryngeal pressure to improve glottic visualization.

(N6=0 if no external pressure used, N6=1 if external laryngeal pressure used)

N7- Position of vocal cords at intubation.

(N7=0 if abducted, N7=1 if adducted)

An IDS score is the sum of N1 through N7.

A score of 0 indicate intubation under ideal condition, performed on the first attempt by the first operator, who used single technique and applied minimal force to insert the tube through a fully visualized glottis.

An IDS score from 1 to 5 indicate slight difficulty, an IDS score of \geq 5 indicate moderate to major difficulty.

So ,we will divide patients into two groups according to IDS score,

Score $<$ 5 - Easy & slight difficulty

Score \geq 5 - Major difficulty

2.6 Statistical Analysis –

Statistical analysis performed using statistical software SPSS Version 20. Chisquare test used to find the association between predictors and IDS score. Also p value calculated . p value less than 0.05 indicated a significant difference.

III. Results :

We compared obese patients with an IDS score $<$ 5 & IDS \geq 5. Chisquare test was used to find association between predictors and IDS score. Out of total 205 patients 15 patients had IDS score \geq 5 and 190 patients had IDS score $<$ 5.

Table: 1 Distribution Of Patients With Respect To Mandibular Recession & Ids Score

		IDS Score		Total	Chi Sq	P Value
		Easy & Slight Difficult	Major Difficult			
MANDIBULAR RECESSION	DIFFICULT	20	6	26		
		76.9%	23.1%	100.0%		
	NOT DIFFICULT	170	9	179	10.905	0.001
		95.0%	5.0%	100.0%		
Total		190	15	205		
		92.7%	7.3%	100.0%		

Out of 26 predicted difficult intubation 20 were easy & slight difficult and 6 were major difficult intubation according to IDS score & out of 179 predicted not difficult intubation 170 were easy & slight difficult and 9 were major difficult intubation patients .p value was significant with value of 0.001 .

Table: 2 Distribution Of Patients With Respect To Tmd & Ids Score

		IDS Score		Total	Chi Sq	P Value
		Easy & Slight difficulty	Major Difficult			
TMD	DIFFICULT	38	6	44		
		86.4%	13.6%	100.0%	3.299	0.069
	NOT DIFFICULT	152	9	161		
		94.4%	5.6%	100.0%		
Total		190	15	205		
		92.7%	7.3%	100.0%		

Out of 44 predicted difficult intubation 38 were easy & slight difficult and 6 were major difficult intubation according to IDS score & out of 161 predicted not difficult intubation 152 were easy & slight difficult and 9 were major difficult intubation patients p value not significant.

Table 3 : Distribution Of Patients With Respect To Mallampati & Ids Score

		IDS Score		Total	Chi Sq	P Value
		Easy & Slight Difficult	Major Difficult			
MALLAMPATI	DIFFICULT	37	10	47		
		78.7%	21.3%	100.0%	17.523	<0.0001
	NOT DIFFICULT	153	5	158		
		96.8%	3.2%	100.0%		
Total		190	15	205		
		92.7%	7.3%	100.0%		

Out of 47 predicted difficult intubation 37 were easy & slight difficult and 10 were major difficult intubation according to IDS score & out of 158 predicted not difficult intubation 153 were easy & slight difficult and 5 were major difficult intubation patients p value was significant.

Table 4 : Distribution Of Patients With Respect To Mouth Opening & Ids Score

		IDS Score		Total	Chi Sq	P Value
		Easy & Slight Difficult	Major Difficult			
MOUTH OPENING	DIFFICULT	13	4	17		
		76.5%	23.5%	100.0%	7.185	0.007
	NOT DIFFICULT	177	11	188		
		94.1%	5.9%	100.0%		
Total		190	15	205		
		92.7%	7.3%	100.0%		

Out of 17 predicted difficult intubation 13 were easy & slight difficult and 4 were major difficult intubation according to IDS score & out of 188 predicted not difficult intubation 177 were easy & slight difficult and 11 were major difficult intubation patients. p value was significant..

Table 5 : Distribution Of Patients With Respect To Buck Teeth & Ids Score

		IDS Score		Total	Chi Sq	P Value
		Easy & Slight Difficult	Major Difficult			
BUCK TEETH	DIFFICULT	30	3	33		
		90.9%	9.1%	100.0%	0.182	0.669

	NOT DIFFICULT	160	12	172		
		93.0%	7.0%	100.0%		
Total		190	15	205		
		92.7%	7.3%	100.0%		

Out of 33 predicted difficult intubation 30 were easy & slight difficult and 3 were major difficult intubation according to IDS score & out of 172 predicted not difficult intubation 160 were easy & slight difficult and 12 were major difficult intubation patients. p value not significant.

Table 6 : Distribution Of Patients With Respect To Delikan Test & Ids Score

		IDS Score		Total	Chi Sq	P Value
		Easy & Slight Difficult	Major Difficult			
DELIKAN TEST	DIFFICULT	22	6	28	9.522	0.002
		78.6%	21.4%	100.0%		
	NOT DIFFICULT	168	9	177		
94.9%		5.1%	100.0%			
Total		190	15	205		
		92.7%	7.3%	100.0%		

Out of 28 predicted difficult intubation 22 were easy & slight difficult and 6 were major difficult intubation according to IDS score & out of 177 predicted not difficult intubation 168 were easy & slight difficult and 9 were major difficult intubation patients. p value was significant with value of 0.002

We analyzed that independently Mallampati, TMD, Delikan test can help us to predict difficult airway in obese patients with a accuracy of more than 70%. Among them Mallampati grading has the highest sensitivity for predicting difficult airway in obese population. Also Mallampati grading has significant strength of association for predicting difficult intubation in the obese patients, when compared with IDS score.

According to accuracy of prediction for difficult intubation in obese patients we can rank predictors in our study performed as-

1. Modified Mallampati grading
2. Thyromental distance
3. Delikan test
4. Mandibular recession
5. Mouth opening
6. Buck teeth

IV. Discussion :

Difficulty in the endotracheal intubation constitutes an essential predisposing factor of morbidity as well as mortality, especially when it is not anticipated preoperatively. This unexpected difficulty in intubation is probably the result of lack of accurate predictive tests and inadequate preoperative assessment of the airway. Risk factors if identified at preoperative visit help to alert the anesthesiologist so that any alternative methods of securing the airway can be used or additional expertise sort beforehand.

The literature is rich with studies and meta-analyses attempting to determine the best single method or combination of methods to aid the anesthesiologist in predicting difficult intubation.

Brodsky et al² studied 100 morbidly obese patients to identify factors which complicate direct laryngoscopy and tracheal intubation. Height, weight, width of mouth opening, thyromental distance, neck circumference and Mallampati score were recorded among them. Large neck circumference and the high Mallampati score were the only predictors of potential intubation problems, obesity alone was not predictive of difficult tracheal intubation.

In our study also mallampati grading has been the best predictor of difficult intubation in obese population with thyromental distance and delikan test being the next predictor according to accuracy of prediction irrespective of patients BMI.

A recent editorial by Yentis³ has made clear how hard it is to predict difficult intubation because of its low rate of occurrence and questioned whether attempts at prediction are likely to be useful. The diagnostic accuracy of these screening tests had varied from trial to trial⁷, probably because of differences in incidence of difficult intubation, inadequate statistical power, different test thresholds, or differences in patient characteristics.

The need for clinically relevant definition of difficult intubation prompted us to use the Adnet et al¹, Benumof et al⁴ IDS score, which improved the reliability of identifying difficult tracheal intubation than to difficult laryngoscopy alone.

Juvin et al⁵ compared the predictors of difficult airway in obese patients with an Intubation Difficulty Scale (IDS) Score <5 and obese patients with an IDS Score ≥5. Variables taken are mallampati grading, mouth opening, mandibular recession, buck teeth and neck movement and found the p value for these factor, to know the significant association. They found that only the mallampati grading had significant association with a p value of <.0001 and concluded that along the classic risk factors for difficult intubation mallampati score of III or IV is a risk factor in obese and demonstrated that tracheal intubation & not laryngoscopy was more difficult in obese patients.

In our study we compared obese patients on IDS score, taking each predictor and finding out the p value to find out significant association between predictors & IDS score. We found that mallampati grading, mouth opening, mandibular recession, & delikan test was significantly associated with difficult intubation on IDS score.

This slight variation may be because of large sample size of 205 patients compared to 129 patients of the Juvin et al⁵.

Our study also found out that even the patients who were not difficult intubation on Cormack lehane grading were found to have slight difficulty & in some cases major difficulty while intubating them, which confirmed the finding of Juvin et al⁵ study of demonstrating that tracheal intubation not laryngoscopy was more difficult in obese patients.

Kim et al⁶ study of difficult tracheal intubation in 123 obese (BMI ≥ 27.5 kg/m²) and 125 non-obese patients, NC/TMD ratio calculated compared with that of established predictors including high BMI, Mallampati grading, Wilson score, NC, width of mouth opening, TMD in obese patients. The Mallampati grading, sensitivity of 58.8% & specificity of 89.6, thyromental distance of 58.8% & 90.6% respectively. The mallampati grading, Wilson score, and NC/TMD independently predicted difficult intubation in obese patients. But among these three indices, NC/TMD showed the highest sensitivity and predictive value, in obese patients.

In our study also mallampati grading has a sensitivity of 49.3% & specificity of 92.9% & that of thyromental distance being 41.5% & 90.6% but a new search can be done for NC/TMD ratio as good predictor for difficult intubation in obese patients.

Budde AO et al⁷ designed a pilot study to determine if indirect laryngoscopy might prove useful in the obese population. There results were consistent with previous studies, which have demonstrated that no one of the commonly performed tests alone has proven to be adequate in predicting difficult intubation in the obese population. Indirect mirror laryngoscopy is a relatively simple method of assessing airway anatomy with a tendency towards statistical significance in predicting difficult laryngoscopy

Ezri et al⁸ used ultrasound to quantify neck soft tissue at the level of the vocal cords and suprasternal notch and demonstrated that, in an obese population, the best predictor of difficult intubation was distribution of fat in these areas. While clearly a useful technique, the availability and time required for performing this examination may prohibit many anesthesiologists to undergo such examination.

Our results are consistent with previous studies, which have demonstrated that commonly performed preoperative assessment tests has proven to be adequate in predicting difficult intubation in obese population. But search should be made to find other predictors which can predict difficult airway more easily and accurately in obese population.

V. Conclusion:

This study showed that in some patients IDS scoring was ≥5 who were not predicted to be difficult by our routine preoperative tests. So studies aimed at identifying new predictors of difficult intubation in obese patients should be done. But in obese patients skilled anesthetic assistance and a wide range of equipment to facilitate intubation should be available. As always the patients must have an individualized management plan and the chosen techniques must be familiar to all involved staff, with a clear back-up plan when unexpected difficulties in airway management arises.

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