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KEY WORDS: Modified Mallampati Classification (MMC), Neck Circumference (NC), Upper Lip Bite Test (ULBT), Morbidly Obese Airway Assessment

A COMPARATIVE STUDY OF MODIFIED MALLAMPATI CLASSIFICATION WITH NECK CIRCUMFERENCE ALONG WITH UPPER LIP BITE TEST IN MORBIDLY OBESE PATIENTS

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ABSTRACT

INTRODUCTION Anaesthesia in morbidly obese patients can present many challenges. The overriding concern of most anaesthesiologists is airway management, as obese patients have been thought to be at greater risk of difficult airway and/or difficult intubation, when compared with the general population.
The term 'difficult airway' has been defined by the American Society of Anaesthesiologists (ASA) taskforce as the clinical situation in which a conventionally trained anaesthesiologist experiences problems with mask ventilation or tracheal intubation or both.
AIMS AND OBJECTIVES- To assess the positive predictive value,sensitivity and specificity of MMPC, NC along with ULBT and compare it with Cormack Lehane grading intraoperatively.
MATERIALS AND METHOD-
Preoperative airway assessment of 200 patients posted for surgery under general anaesthesia was carried out to evaluate the usefulness of multiple screening tests in predicting the ease or difficulty of laryngoscopy in obese patients undergoing laparoscopic bariatric surgery. Modified Mallampati test grade III or IV, Upper Lip Bite test grade III, Neck Circumference >40cm were considered as predictors of difficult laryngoscopy.
Laryngoscopy was considered difficult if the view on laryngoscopy was Cormack and Lehane grade III or IV. The results were evaluated on the basis of sensitivity, specificity, positive and negative predictive value and accuracy of these tests.
RESULT- Group A (ULBT+MMPC) identified 65% of the patients with difficult intubation (sensitivity of 92.86 % & specificity of 33.3 %), whereas Group B (ULBT+NC) identified 75% of the patients with difficult airway (sensitivity 93.75% & specificity of 25%). Pearson Correlation analysis was applied to know the correlation between the various tests and the Cormack Lehane Classification, both the groups had p value of 0.001 , which was highly significant.
CONCLUSION- When multiple predictors are taken into consideration there was a considerable reduction in false negatives with significant improvement in accuracy of test and hence prediction of difficult laryngoscopy was made easy. Application of multiple predictors in combination can reduce the frequency of unanticipated difficulty and unnecessary interventions related to over prediction of airway difficulty.

INTRODUCTION

The overriding concern of most anaesthesiologists in morbidly obese patients is airway management, as obese patients have been thought to be at greater risk of difficult airway and/or difficult intubation, when compared with the general population.

Intubation difficulties are determined by several variables, such as the differences in physical characteristics among patients (oral opening, thyroid to chin length, mobility of the neck and Mallampati score), as well as the operating physician's experience and the instrument used for the procedure.

However, parameters described independently do not show proper operational sensibility or specificity for intubation difficulties in obese patients.

Reduced neck mobility and oral opening are often the cause of most difficulties faced when intubating these patients. Other factors are neck circumference greater than 40 cm, short neck, and alterations or pathologies such as sleep apnea, hypercapnia, alveolar hypoventilation syndrome, snoring and diabetes mellitus. This study was designed to compare and evaluate various airway assessment tests in combination to predict difficult intubation in obese patients posted for laparoscopic bariatric surgery.
Vander Linde, Roelofse and Steenkamp in 1983 suggested that no single anatomical factor determined the ease of direct laryngoscopy, but rather a combination of them.

In 1983, Mallampati SR hypothesized that concealment of faucial pillars and uvula by the base of the tongue rendered the exposure of larynx by direct laryngoscopy difficult. He developed a simple grading system that involves preoperative ability to visualize faucial pillars, soft palate and base of uvula as a means of predicting the degree of difficulty in laryngeal exposure.

The patients were divided into 3 classes.
Class 1: Faucial pillars, soft palate and uvula could be seen.
Class 2: Faucial pillars and soft palate could be seen but uvula masked by the base of the tongue.
Class 3: Only soft palate could be visualized.

He also graded the extent of exposure of glottis during laryngoscopy is expressed on a scale of 1 to 4 as follows.

Grade 1: Glottis (including anterior and posterior commissure) could be fully exposed.
Grade 2: Glottis could be partly exposed (Anterior commissure not visualized).
Grade 3: Glottis could not be exposed (only corniculate cartilages seen)

Grade 4: Glottis including corniculate cartilages couldn't be exposed.

Grade 1 and 2 were considered adequate exposure and grade 3 and 4inadequate exposure.

Even edentulous/obese patients had laryngeal exposure consistent with visibility of faucial pillars and uvula.

Cormack and Lehane in 1984 described a classification of the laryngeal view to denote the degree of difficulty with intubation.

They graded laryngeal view into 4 grades depending on the exposure of larynx at laryngoscopy.

Grade I: Whole of the vocal cords visible.
Grade II: Only posterior commissure visible.
Grade III: Only epiglottis visible.
Grade IV: None of the above visible.

In 1987, Samsoon and Young modified Mallampati classification into four classes, the fourth class represents an extreme form of class 3 in which only hard palate could be visualized but not the soft palate. As it is not physically possible to measure the size of the posterior part of the tongue relative to the capacity of oropharyngeal cavity, this method of assessment gives an indirect means of evaluating their relative proportionality.

In their study they classified the visibility of oropharyngeal structures into four classes and correlated them with laryngeal view based on Cormack and Lehane's classification. This test is performed in a seated patient who opens his mouth as wide as he can and protrudes the tongue as far as possible, while the observes looks from the patient eye level and inspects the pharyngeal structures with a pen torch. It is important when performing this test that the patient does not phonate since this can alter what is seen. The view is then graded as:

Class I: Soft palate, fauces, uvula and pillars seen.
Class II: Soft palate, fauces and uvula seen.
Class III: Soft palate and base of uvula seen.
Class IV: Soft palate not visible

They found significant associations of class I and II with Cormack and Lehane's laryngeal view of grade I/II and class III and IV with Cormack and Lehane's grade III/IV.

Cook in 2000 felt that Cormack and Lehane's classification of laryngeal view is applied inaccurately by many anaesthetists and that its sensitivity being too low in delineating increasing difficulty with intubation. He modified the classification of laryngeal view and subdivided grade II into IIa and IIb, grade III into IIIa and IIIb.

Grade I: Most of the vocal cords visible
Grade IIa: Posterior cord visible
Grade IIb: Only arytenoids visible
Grade IIIa: Epiglottis visible and liftable
Grade IIIb: Epiglottis adherent to pharynx and not liftable. Grade IV: No laryngeal structure seen.

In 2008, He´le`ne Gonzalez,Vincent Minville et al Prospectively compared the incidence of difficult tracheal intubationin 70 obese [body mass index (BMI) 30 kg/m2] and 61 lean patients (BMI 30kg/m2). The patient data, were compared between lean and obese patients. Preoperative measurements [BMI, neck circumference (at the level of the thyroid cartilage), width of mouth opening, sternomental distance, and thyromental distance], medical history of obstructive sleep apnea syndrome, and several scores (Mallampati, Wilson, El Ganzouri) were recorded. The view during direct laryngoscopy was graded, and the IDS (incidence of difficult intubation) was recorded. It was concluded that difficult tracheal intubation is more frequent in obese than in lean patients.

Zahid Hussain Khan and Shahriar Arbabi in 2013, in a prospective study recorded personal and demographic data of 4500 patients clinical examination and ULBT results were recorded and during induction of anaesthesia laryngoscopic grading was evaluated and recorded in questionnaires Negative predictive values (NPVs) were high in all tests. ULBT had the highest specificity and NPV compared with the other tests. The positive predictive value for all the tests had been low, but marginally high in the ULBT. They cocluded that although all the tests used had relatively acceptable predictive values, combination of tests appeared to be more predictive.

J.Eiamcharoenwit , A.Suwanpratheep et al in August 2017 performed neck circumference and other airway assessment tests for the prediction of difficult intubation in obese parturients undergoing cesarean delivery. Parturients with a body mass index ≥30 kg/m2, undergoing a cesarean delivery employing conventional tracheal intubation, were enrolled. Preoperative neck circumference, sternomental distance and modified Mallampati test were examined. They concluded that neck circumference, sternomental distance, modified Mallampati test and the ratio of neck circumference to the sternomental distance show limited performance as screening tests to predict difficult intubation among obese parturients.

MATERIALS AND METHOD

Study design : A prospective observational study
Study Setting: OT Complex, SAIMS
Duration of Study: 1 year (October 2015- March 2016)
Study Population: 200 Patients undergoing elective bariatric surgeries at OT complex, SAIMS

Inclusion criteria:
Age 16-60 years
Both males and females
In patients with mouth opening > 3 fingers
ASA grade I/II/III
BMI more than 40 kg/m2

Scheduled for elective morbid obesity surgery under general anaesthesia

Exclusion criteria:
Undergoing emergency surgeries
With gross anatomical abnormality in head and neck.
Unable to sit.
Unable to open mouth.

Radiation induced scarring or post burn contracture of peri-oral region or neck. Physiological impediment(example oedema of head and neck region)

Laryngeal mass.
Limitation of the movement at the cervical spine.
Edentulous patients.

PREOPERATIVE ASSESSMENT-

A detailed history and general examination was performed. Demographic data was collected from all the patients including age, sex, weight, height, BMI. Patients were divided into two groups, 100 patients each group (group A & Group B) . 100 patients for Upper Lip Bite test (ULBT)and Modified Mallampati Classification (MMT); and 100 patients for Upper Lip Bite test (ULBT)and Neck Circumference (NC). The predictive value of both the groups were confirmed by Cormack & Lehane grading intraoperatively while laryngoscopy under general anaesthesia. The following screening tests were used in present study.

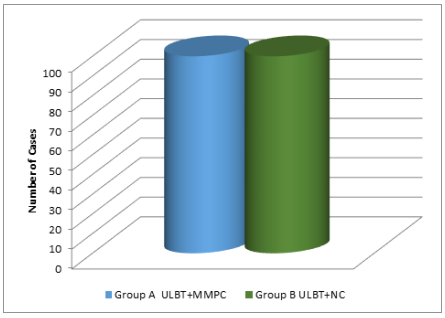
OBSERVATIONS AND RESULT

Results were expressed as mean and standard deviation (SD). Analysis of data between the groups were performed using student 't' test for difference of two sample means. p values < 0.05 were considered to indicate statistical significance. Pearson

Correlation analysis was applied to know the correlation between the various tests and the Cormack Lehane Classification in obese patients.

Table No 1: Group Distribution

	Group A	Group B
Case	ULBT+MMPC	ULBT+NC
Number	100	100

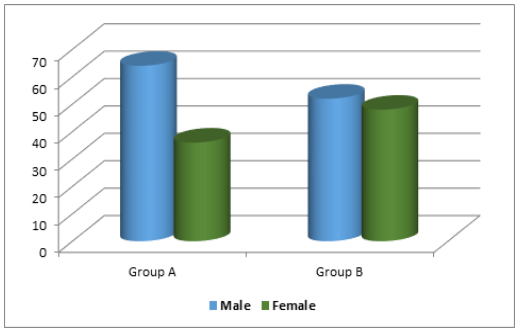


Graph No 1: Group Distribution

Gender Distribution

Of the cases included in the study in Group A males were 64 in number (~64%) and female 36 in number (~36%) and Group B males were 52 in number (~52%), showing a strong male predilection, as opposed to only 48% of cases in the female category in both group and with Male: Female ratio of 2:1.

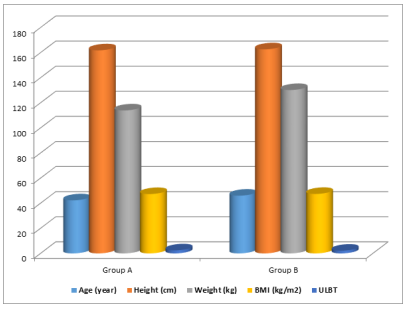
	Group A	Group B
Male	64(64%)	52(52%)
Female	36(36%)	48(48%)
TOTAL	100	100



Graph No. 2: Gender Distribution

Table No. 3: Demographic Profile

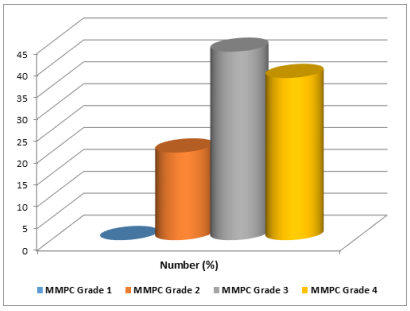
	Group A	Group B	p value
Age (year)	42.30±16.51	46.01±33.05	0.317
Height (cm)	161.82±9.14	162.64±9.52	0.536
Weight (kg)	113.94±25.88	130.20±28.57	0.000
BMI (kg/m2)	47.31±4.93	47.40±5.69	0.905
ULBT	2.44±0.70	2.17±0.69	0.007



Graph No. 3: Demographic Profile

Table No. 4: Distribution of Patients According to MMPC

MMPC Grade	Number (%)
1	0
2	20(20%)
3	43(43%)
4	37(37%)
TOTAL	100

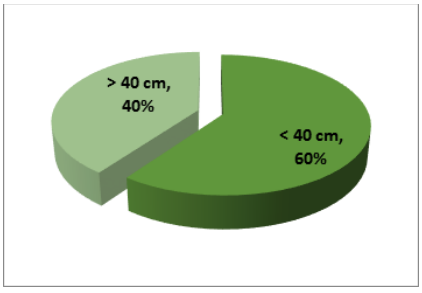


Graph No. 4: Distribution of Patients According to MMPC

Group B: Distribution according Neck Circumference (NC)-The above table shows the distribution of patients according to neck circumference. The cut-off value for neck circumference was taken as 40 cm. There were 60(60%) having a neck circumference less than 40 cm and 40(40%) patients were having neck circumference more than 40 cm.

Table No. 5: Distribution of Patients According to NC

Neck Circumference (NC)	Number (%)
< 40 cm	60(60%)
> 40 cm	40(40%)
TOTAL	100



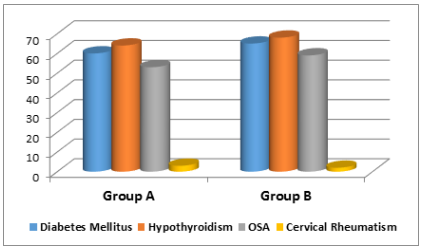
Graph No. 5: Distribution of Patients According to NC

Associated Co-morbidities

In the present study, diabetes mellitus was present in 60(60%) in Group A and 65(65%) in Group B. Hypothyroidism was present in 64(64%) in Group A and 68(68%) in Group B. Cervical rheumatism was present in 3 (3%) in Group Aand 2 (2%) in Group B.The OSA was present in 53(53%) and 59(59%) in Group A and Group B of the patients.

Table No. 6: Associated Co-morbidities

Pathological Condition	Group A	Group B
Diabetes Mellitus	60(60%)	65(65%)
Hypothyroidism	64(64%)	68(68%)
OSA	53(53%)	59(59%)
Cervical Rheumatism	3(3%)	2(2%)



Graph No. 6: Associated Co-morbidities

In the present study, MMPC identified 45% true positive patients. In 10 patients it could not identify difficult intubation (10% false negative). It had a sensitivity of 81.82 %. 30 patients had easy intubation (30% false positive) and hence its positive predictive value was low 60%. In 10 patients actually had easy intubation (10% true negative). It had a specificity of 25 % with negative predictive value of 50%.

NC identified 68% true positive patients. In 5 patients it could not identify difficult intubation (5% false negative). It had a sensitivity of 93.15%. In fact 5 patients had easy Intubation (5% false positive) and hence its positive predictive value was 77.27%. 10 patients actually had easy intubation (20% true negative). It had a specificity of 20 % with negative predictive value of 50%.

ULBT identified 50% true positive patients. In 10 patients it could not identify difficult intubation (10% false negative). It had a sensitivity of 83.33%. In 25 patients had easy Intubation (25% false positive) and hence its positive predictive value was 66.66%. 15 patients actually had easy intubation (15%true negative). It had a specificity of 37.5 % with negative predictive value of 60%.

Table No 7: Various tests for prediction of easy and difficult on CLGrading

	TP	TN	FP	FN	Sens (%)	Spec (%)	PPV (%)	NPV (%)	Accuracy (%)
MMPC	45	10	30	10	81.82	25	60	50	57.89
NC	68	20	5	5	93.15	20	77.27	50	74.0
ULBT	50	15	25	10	83.33	37.5	66.66	60	65.0

In the present study, Group A identified 65% true positive patients. In 5 patients it could not identify difficult intubation (5% false negative). It had a sensitivity of 92.86 %. 20 patients had easy intubation (20% false positive) and hence its positive predictive value was low 76.4%. 10 patients actually had easy intubation (10% true negative). It had a specificity of 33.3 % with negative predictive value of 75%. In multiple regression correlation of ULBT+MMPT the R square was 0.331, F=48.51, P value =0.001, df =1and Partial Correlation was 0.575.

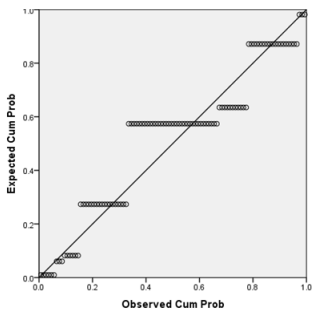
Group B identified 75% true positive patients. In 5 patients it could not identify difficult intubation (5% false negative). It had a sensitivity of 93.75%. In fact 15 patients had easy intubation (15% false positive) and hence its positive predictive value was 83.33%. 10 patients actually had easy intubation (20% true negative). It had a specificity of 25 % with negative predictive value of 80%. In multiple regression correlation of ULBT+NC the R square was 0.129, F=14.526, P value =0.001, df =1and Partial Correlation was 0.359.

Table No 8: Combined tests for prediction of easy and difficulty on CL Grading

	TP	TN	FP	FN	Sens (%)	Spec (%)	PPV (%)	NPV (%)	Accuracy (%)
ULBT+MMPC	65	10	20	5	92.86	33.3	76.4	66.6	75
ULBT+NC	75	5	15	5	93.75	25	83.33	50	80

Table No 9: Multiple Regression Correlation: ULBT+MMPT

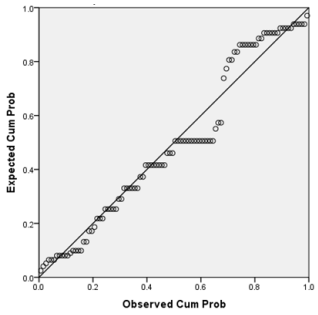
R square	F	P value	df	Partial Correlation
0.331	48.51	0.001	1	0.575



No.7: Normal P-P plot of Regression Standardized Residual Dependent Variable: ULBT+ MMPT

Table No 10: Multiple Regression Correlation: ULBT+NC

R square	F	P value	df	Partial Correlation
0.129	14.526	0.001	1	0.359



Graph No 8: Normal P-P plot of Regression Standardized Residual Dependent Variable: ULBT+ NC

Correlation Analysis of Various Tests with Cormack Lehane Classification:

Pearson Correlation analysis was applied to know the correlation between various tests in combination and Cormack Lehane Classification. In the above table, it can be clearly seen that in both the groups the p value obtained is 0.001, which is highly significant showing that with the increasing MMPC and NC value there is significant increase in the difficult laryngoscopy .

Table No. 11: Pearson Correlation Analysis of Various Tests with Cormack Lehane Classification

	Group A	Group B
MMPT	P = 0.001	P = 0.001
NC	P = 0.001	P = 0.001

DISCUSSION

This study was conducted in the Department of Anaesthesiology and Critical Care, Sri Aurobindo Medical College and Post Graduate Institute, Indore from October 2015 to June 2017. A total of 200 patients, 100 patients in each group- Group A(ULBT+MMPC) and Group B(ULBT+NC) were included in the study. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of the tests in combinations were calculated using the standard formulae. The possibility of a correlation between difficult laryngoscopy and an assessed variable in obese patient was explored.

Group A identified 65% of the patients with difficult intubation, with sensitivity of 92.86 % and specificity of 33.3 %, whereas Group B identified 75% of the patients with difficult airway. It had a sensitivity of 93.75 and specificity of 25 %.

P value obtained was 0.001 in both the groups A & B, which is highly significant showing that with increasing ULBT+MMPC value there is significant increase in the difficult laryngoscopy and similarly with the increasing value of ULBT+ NC, so it was concluded that both the combinations provided the best prediction of difficult laryngoscopy with a significant association with CL Grade (P value =0.001).

It is believed that airway access is more difficult in obese than in non-obese patients due to the anatomic changes resulting from excess weight. In obese patients, there is a reversed relationship between weight and pharyngeal area due to fat deposition on cervical structures .

Failure in managing the airway is the most significant cause of morbidity and mortality in anaesthetized patients. Preoperative evaluation is important to predict difficult airway for the purpose of which several airway assessment tests have been described.

However, which test(s) are the best predictors are still debated.

Thus, we thought it worthwhile to determine the ability to predict difficult laryngoscopy from the following airway assessment tests in combination.

Muscle relaxation was achieved by the use of IV suxamethonium 1mg/kg, (a prior defasciculating dose of atracurium 10 mg IV was also given) following which laryngoscopy was performed after 60 seconds. 'Stacking' was achieved by placing 2 or 3 or 4 sponge pillows under the lower neck & head, depending on the body weight.

In nonobese patients, the "sniffing position" is often achieved with head elevation and neck extension. In these cases, elevating the head, neck, and upper body of morbidly obese patients with sheets or pads to obtain "ear to sternal notch" positioning has been shown to improve laryngoscopic view during intubation.

Laryngoscopy was performed using an appropriate size macintosh blade, by an experienced anaesthesiologist (minimum 1 year experience). Glottic visualization was assessed using Cormack & Lehane Classification, without the use of any external laryngeal manipulation or change of laryngoscope blade, as per the demand of the situation, was permitted. However, for the purpose of the study, the best CL grade without external laryngeal manipulation was recorded. The maneuvers used to facilitate laryngoscopy were also noted.

Since none of tests in isolation have a high discriminative power for prediction of difficult laryngoscopy, numerous investigators have attempted to formulate various airway assessment test combinations to add some incremental diagnostic value in comparison to the value of each test alone.

In the context of airway management, the consequences of a false negative result, i.e., an unanticipated difficult laryngoscopy may be deleterious and endanger life. Therefore, decreasing false negative prediction takes precedence over decreasing false positive prediction (i.e. a patient is labelled as a likely case of difficult laryngoscopy when infact he is not). Hence, sensitivity is far more important than specificity as regards airway assessment tests.

A limitation of our study is that our sample size is not very large. In addition, we followed a standardized protocol of induction of anaesthesia and laryngoscopy. Although, this methodology is useful for scientific comparision, it does not take into account the heterogeneity of clinical practice. Another drawback was that the operator was aware of the preoperative airway assessment results. Other lacunae may be lack of uniformity in describing or grading laryngeal views.

CONCLUSION

The preoperative airway assessment of morbidly obese patients, planned for laparoscopic bariatric surgery was conducted using multiple screening tests in combination, to evaluate the usefulness in predicting difficulty in laryngoscopy. Among them Modified Mallampati test grade III or IV, Upper lip bite test grade II & III, Neck circumference >40cm were considered as predictors of difficult laryngoscopy. Cormack and Lehane grade III or IV laryngoscopic view confirmed difficult laryngoscopy. The results were evaluated on the basis of sensitivity, specificity, positive or negative predictive value and accuracy of these tests.

Combination of tests increased the accuracy and hence a better prediction of difficult laryngoscopy.

Based on our findings, we suggest that-

- Simple and easy airway assessment tests in combination of ULBT along with MMT and NC may prove useful in predicting difficult laryngoscopy in morbidly obese patients undergoing laparoscopic bariatric surgery.
- Combination of tests increased the accuracy and hence a better prediction of difficult laryngoscopy

In summary, the morbidly obese patient requiring intubation may present challenges.

A comprehensive pre-intubation airway assessment may identify "anatomic predictors" associated with a difficult intubation. Preparation, including having access to alternative airway and rescue devices, proper patient positioning, and optimizing preoxygenation, is necessary to facilitate successful intubation in this group of patients.

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