Original Research Article

TO COMPARE THE RATIO OF NECK CIRCUMFERENCE TO THYROMENTAL DISTANCE RATIO WITH MALLAMPATI GRADING FOR PREDICTING DIFFICULT INTUBATION IN OBESE PATIENTS UNDERGOING ELECTIVE SURGERY UNDER GENERAL ANAESTHESIA

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Abstract

Background: Obesity may be defined as a health condition in which excess of fat deposition occurs and has become a major health challenge. As per World Health Organization (WHO), individuals whose body mass index (BMI) greater than or equal to 30 kg per square meter of body surface is termed as obese. Hence, in the present study , we aspired to explore a preoperative predictor of difficult intubation, named ratio of neck circumference to thyromental distance which needs no special equipment, minimal time for performance, not uncomfortable to the patient and is non-invasive. Also, the present study compares neck circumference/ thyromental distance ratio (NC/TM distance ratio) with Mallampati score and neck circumference as reliable tests for predicting intubation difficulty in obese patients. **Materials and Methods:** Difficulty of intubation was assessed by anesthetist by filling up intubation difficulty score (validated IDS score) after intubation. Intubation difficulty score consists of seven variables from N1 to N7. The sum of N1 to N7 gives total IDS score. Any score of greater than or equal to five was considered to be difficult intubation and score less than five considered to be easy intubation. **Result:** Neck circumference to thyromental distance ratio was the significant predictor of difficult intubation at cut off point of >4.6 with area under curve of 0.726 for correctly predicting difficult intubation. The patients who had difficult intubation, 78.12% of patients had neck circumference to thyromental distance ratio >4.6. If neck circumference to thyromental distance ratio >4.6, then there was 37.30% probability of difficult intubation and if Neck circumference to thyromental distance ratio<=4.6, then 91.60% chances of easy intubation. Among patients who had easy intubation, 64.41% of patients had Neck circumference to thyromental distance ratio<=4.6. On comparing area under curve of Neck circumference to thyromental distance ratio with Mallampati score for predicting difficult intubation, Neck circumference to thyromental distance ratio had significantly better area under curve (0.713 vs 0.574, p value=0.0249) with higher sensitivity (78.12% vs 56.25%) and higher specificity (64.41% vs 58.47%). **Conclusion:** The incidence of intubation difficulty among obese patients was as high as 21.33% Discriminatory power of neck circumference to thyromental distance ratio (AUC 0.726; 95% CI: 0.648 to 0.796) was acceptable. Neck circumference to thyromental distance ratio was found to be the significant predictor of difficult intubation at cut off point of >4.6 with area under curve of 0.726 for correctly predicting difficult intubation.

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International Journal of Academic Medicine and Pharmacy (www.academicmed.org)
ISSN (O): 2687-5365; ISSN (P): 2753-6556

INTRODUCTION

Obesity is characterized by the accumulation of excessive fat deposits, and it poses a significant health problem. According to the World Health Organization (WHO), those with a body mass index (BMI) of 30kg/m² or higher are considered obese.[1] Anesthesiologists are very concerned by the challenging visibility of the larynx in obese patients, as this might result in problematic intubation. This issue is responsible for 17% of airway trauma and contributes to significant morbidity and mortality during the perioperative period. The control of the airway in patients scheduled for general anesthesia has always been of paramount concern for an anesthesiologist. Predicting problematic intubation is a highly tough assignment for an anaesthesiologist, influenced by patient variables, clinical situations, risk assessment, clinical judgement, and the abilities of the anaesthesiologist.[2]

According to the ASA guidelines, difficult endotracheal intubation is defined as either more than three attempts or more than 10 minutes required to properly insert a tracheal tube using standard laryngoscopy.[3]

The American Society of Anesthesiologists (ASA) conducted a closed claim data study on adverse respiratory events and discovered that one-third of deaths were completely related to anesthesia, namely due to the failure to maintain the airway.

Our study will evaluate two parameters, namely neck circumference and thyromental distance, which have moderate sensitivity and good specificity in predicting difficult intubation. The hypothesis posits that by calculating the ratio of the aforementioned two predictors, it will yield improved sensitivity and specificity, therefore serving as an effective bedside screening tool for predicting difficult intubation. The hypothesis posits that by calculating the ratio between the aforementioned indices, a novel predictor of challenging intubation may be derived, which is expected to yield superior statistical and clinical results. Therefore, in this study, our goal was to investigate a preoperative indicator of challenging intubation called the ratio of neck circumference to thyromental distance. This indicator does not require any specialized equipment, can be performed quickly, is not uncomfortable for the patient, and is non-invasive. The current study examines the effectiveness of the neck circumference/thyromental distance ratio (NC/TM distance ratio) in comparison to the Mallampati score and neck circumference as accurate measures for predicting intubation difficulty in obese patients.

MATERIALS AND METHODS

The study included 150 eligible patients who were scheduled for elective surgery under general anesthesia, according to the specified inclusion criteria.

Inclusion Criteria
- Patients must be at least 18 years old.
- Patients must fall into ASA class I, II, or III.
- Both male and female patients are eligible.
- Patients must have a BMI of 30 kg/m2 or higher.
- Obstructive sleep apnea patients
- Patients must be undergoing surgery that requires tracheal intubation.

Evaluation During the Procedure
The anesthetist evaluated the difficulty of intubation by completing the Intubation Difficulty Score (IDS), which is a validated scoring system, after the intubation procedure. The intubation difficulty score has seven variables, labeled N1 to N7. The cumulative sum of N1 to N7 yields the overall IDS score. A difficulty score of five or higher was classified as difficult intubation, while a score below five was classified as easy intubation.

The IDS included various parameters like: Number of additional attempts at intubation, number of additional operator, number of alternative intubation technique used, laryngoscopic view as defined by Cormack and Lehane, application of lifting force during laryngoscopy, need to apply external laryngeal pressure for optimized glottic exposure, position of the vocal cords at intubation.

Statistical analysis: The statistical analysis was conducted using SPSS (Statistical Package for Social Sciences) software version 22. The data was expressed using frequency/percentages, as well as the mean and standard deviation. The chi-square test was employed to assess statistical significance. A significance level of $P<0.05$ was used.

RESULTS

In the study, 47(31.33%) patients belonged to age group 41-50 years, 45(30.00%) to age group 31-40 years, 28(18.67%) to age group 51-60 years, 15(10.00%) to age group 61-70 years, 8(5.33%) to age group 21-30 years. Age group was >70 years of only 7 out of 150 patients (4.67%). Mean value of age(years) of study subjects was 47.06 ± 12.3 with median(25th-75th percentile) of 45(38-54). Out of 150 cases, 122(81.33%) patients were females and 28(18.67%) patients were males. ASA status of 96(64.00%) cases was 1, 50(33.33%) cases was 2 and 4(2.67%) cases. Out of 150 cases, 29(19.33%) cases had hypertension, 19(12.67%) cases had diabetes mellitus, 15(10.00%) cases had thyroid and 1(0.67%) case had tuberculosis and EF 40 each. Mean value of height(cm), weight(kg), body mass index(kg/m²), neck circumference(cm) and thyromental distance(cm) of study subjects was 153.55 ± 7.51, 78.3 ± 9.5, 33.22 ± 3.52, 36.81 ± 3.34 and 8.06 ± 1.13 with median (25th-75th percentile) of 153(148-159), 78(71-84.5), 31.85(30.525-35.1), 36.5(34.5-39.5) and 8(7-9) respectively. Mean value of neck circumference to thyromental distance ratio of study subjects was 4.65 ± 0.76 with median (25th-75th percentile) of 4.46(4.012-5.25). Mallampati score of

47(31.33%) cases was III, 43(28.67%) cases were I, 40(26.67%) cases were II and 20(13.33%) cases were IV. Cormack and Lehane grading of 92(61.33%) cases were 1, 38(25.33%) cases was 2, 17(11.33%) cases was 3 and 3(2.00%) cases was 4.

Lifting force was applied during laryngoscope in 57(38.00%) cases, 45(30.00%) cases needed to apply external laryngeal pressure for optimized glottic exposure.

Mean value of number of additional attempts at intubation, number of additional operators and number of alternative intubation techniques used of study subjects was 0.13 ± 0.43, 0.05 ± 0.21 and 0.89 ± 0.99 with median (25th-75th percentile) of 0(0-0), 0(0-0) and 1(0-2) respectively. According to intubation difficulty scale score, 118(78.67%) cases had easy intubation, 32(21.33%) cases had difficult intubation. Mean value of intubation difficulty scale score of study subjects was 2.28 ± 2.35 with median (25th-75th percentile) of 1.5(0-4). Out of 77 cases in whom alternative techniques were used, alternative technique used in 69(89.61%) cases was ramping, 17(22.08%) cases were stylette, 14(18.18%) cases were long blade, 13(16.88%) cases were bougie, 11(14.29%) cases were blade change, 8(10.39%) cases were macoy and 1(1.30%) case was fibre optic. The above table shows that the patients who had difficult intubation, 78.12% of patients had neck circumference to thyromental distance ratio >4.6. If neck circumference to thyromental distance ratio >4.6, then there was 37.30% probability of difficult intubation and if Neck circumference to thyromental distance ratio<=4.6, then 91.60% chances of easy intubation. Among patients who had easy intubation, 64.41% of patients had Neck circumference to thyromental distance ratio<=4.6.

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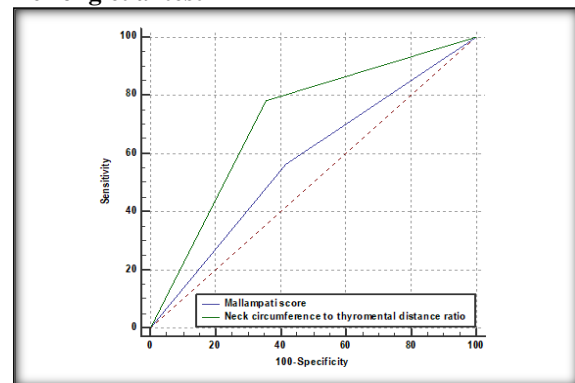
Comparison of area under curve of Mallampati score and Neck circumference to thyromental distance ratio for predicting difficult intubation.

On comparing area under curve of Neck circumference to thyromental distance ratio with Mallampati score for predicting difficult intubation, Neck circumference to thyromental distance ratio had significantly better area under curve (0.713 vs 0.574, p value=0.0249) with higher sensitivity (78.12% vs 56.25%) and higher specificity (64.41% vs 58.47%).

Table 1: Receiver operating characteristic curve of Neck circumference to thyromental distance ratio for predicting difficult intubation.

Variables	Values
Area under the ROC curve (AUC)	0.726
Standard Error	0.0527
95% Confidence interval	0.648 to 0.796
P value	<0.0001
Cut off	>4.6
Sensitivity(95% CI)	78.12%(60.0 - 90.7%)
Specificity(95% CI)	64.41%(55.1 - 73.0%)
PPV(95% CI)	37.3%(25.8 - 50.0%)
NPV(95% CI)	91.6%(83.4 - 96.5%)
Diagnostic accuracy	67.33%

Table 2: Sensitivity, specificity, positive predictive value and negative predictive value of Mallampati score for predicting difficult intubation.

Variables	Values
Sensitivity (95% CI)	56.25%(37.66% to 73.64%)
Specificity (95% CI)	58.47%(49.04% to 67.47%)
AUC (95% CI)	0.57(0.49 to 0.65)
Positive Predictive Value (95% CI)	26.87%(16.76% to 39.10%)
Negative Predictive Value (95% CI)	83.13%(73.32% to 90.46%)
Diagnostic accuracy	58.00%

Table 3: Comparison of area under curve of Mallampati score and Neck circumference to thyromental distance ratio for predicting difficult intubation.

Variables	Mallampati score	Neck circumference to thyromental distance ratio
AUC	0.574	0.713
Standard Error	0.05	0.0432
95% CI	0.490 to 0.654	0.633 to 0.784
Difference between areas	0.139	
Standard Error	0.062	
95% Confidence Interval	0.0175 to 0.261	
P value	0.0249	

Table 4: Correlation of neck circumference to thyromental distance ratio with intubation difficulty score.

Variables	Intubation difficulty score
Neck circumference to thyromental distance ratio	
Correlation coefficient	0.208
P value	0.011

Significant weak positive correlation was seen between neck circumference to thyromental distance ratio with intubation difficulty score with correlation coefficient of 0.208.

DISCUSSION

The current study was conducted at the Department of Anaesthesiology, Rama Medical College, Hapur, Uttar Pradesh. The study involved 150 obese patients who were undergoing surgery with tracheal intubation. The aim of the study was to compare the ratio of neck circumference to thyromental distance with mallampatti grading for predicting difficult intubation in obese patients undergoing elective surgery under general anaesthesia. In 2013, the American Society of Anesthesiologists (ASA) redefined difficult intubation as the need for more than one attempt to insert a breathing tube into the trachea, regardless of any issues with the trachea itself.[4] Adnet F et al created the Intubation Difficulty Scale (IDS) and the scale consists of seven objective characteristics that are used to evaluate intubation. IDS has been used as a validated difficulty score to define difficult intubation.[5] Intubation difficulty scale score was used in the present study to find out the incidence of intubation difficulty among obese individuals coming for elective surgery under general anaesthesia and 21.33% cases had difficult intubation with mean value of 2.28 ± 2.35 with median (25th-75th percentile) of 1.5 (0-4) on intubation difficulty scale score. In the present study the mean value of neck circumference to thyromental distance ratio of study subjects was 4.65 ± 0.76. Among the factors affecting difficulty in intubation, Cormack and Lehane grading was 1 in 61.33% cases, 2 in 25.33% cases, 3 in 11.33%) cases and 4 in 2.00% cases. 38 % cases needed lifting force and 30 % cases needed to external laryngeal pressure for optimized glottic exposure.[6] Mean value of number of additional intubation attempts was 0.13 ± 0.43, number of additional operators was 0.05 ± 0.21 and number of alternative intubation techniques was 0.89 ± 0.99. Out of 77 cases in whom alternative techniques were used were in order of ramping which was used in 89.61% followed by stylette in 22.08% cases, long blade in 18.18% cases, bougie in 16.88% cases, blade change in 14.29% cases, macoy in 10.39% cases and fibre optic in 1.30%.[7] The present study compared NC/TM distance ratio with Mallampati score as well as with neck circumference to find reliable tests for predicting intubation difficulty in obese patients. Discriminatory power of neck circumference to thyromental distance ratio (AUC 0.726; 95% CI: 0.648 to 0.796) was acceptable.[8] Neck circumference to thyromental distance ratio was the significant predictor of difficult intubation at cut off point of >4.6 with area under curve of 0.726 for correctly predicting difficult intubation.[9]

Among the other examinations, the Mallampati scoring system has gained the highest level of popularity, despite its limitations. The Mallampati score is now a routine component of a thorough assessment of the airway, however its ability to accurately predict difficult intubation is limited. One of the adjustments made to the Mallampati scoring system is the one by Samsoon and Young, which adds a fourth class to the descriptions of oropharyngeal exposures.[10] Some drawbacks of the modified Mallampati classification include interobserver variability and reliance on patient compliance. According to a research by Lee A et al, the categorization was not very good at predicting difficult intubations. Additionally, other authors have found that, in order to improve diagnostic accuracy, it should be used in conjunction with other predictors rather than being used alone as a test to predict difficult intubation or laryngoscopy.[11,12] The patients who had difficult intubation, 78.12% of patients had neck circumference to thyromental distance ratio >4.6. If neck circumference to thyromental distance ratio >4.6, then there was 37.30% probability of difficult intubation and if Neck circumference to thyromental distance ratio<=4.6, then 91.60% chances of easy intubation.[13] On the other side, it was found that patients who had difficult intubation, 56.25% of patients had mallampati score >2. If mallampati score >2, then there was 26.87% probability of difficult intubation and if Mallampati score<=2, then 83.13% chances of easy intubation. Among patients who had easy intubation, 64.41% of patients had Neck circumference to thyromental distance ratio<=4.6.[14] The results revealed that among patients who had easy intubation, 58.47% of patients had Mallampati score<=2. According to a meta-analysis by Shiga T et al,[15] the Mallampati classification and thyromental distance together provide the most effective bedside test for prediction of difficult intubation. (positive likelihood ratio, 9.9; 95% confidence interval). On comparing area under curve of Neck circumference to thyromental distance ratio with Mallampati score for predicting difficult intubation in the present study, Neck circumference to thyromental distance ratio had significantly better area under curve (0.713 vs 0.574, p value=0.0249) with higher sensitivity (78.12% vs 56.25%) and higher specificity (64.41% vs 58.47%) to Mallampati score for predicting difficult intubation. Another similar study conducted on Indian obese patients by Pradeep S et al,[16] revealed that the NC/ TMD showed sensitivity (94.74%), specificity (73.33%), PPV (81.82%), NPV (91.67%), and AUC (0.912) which was higher than our study. The current study demonstrates that the NC/TMD ratio is a superior

tool for screening difficult airway in obese individuals, as it exhibits higher sensitivity, specificity, positive predictive value, and area under the receiver operating characteristic curve (AUC-ROC) compared to other predictors. Moreover, this study, conducted among obese individuals in India, has demonstrated that the NC/TMD ratio is an independent risk factor for difficult intubation. This finding is consistent with previous studies conducted on populations in the Western world.

CONCLUSION

To conclude, NC/TMD ratio was found to be a more accurate preoperative predictor of intubation difficulty in obese patients. The study recommends conducting regular preoperative assessment of the airway in obese persons, which should include measuring the circumference of the neck and the NC/TMD ratio. The prevalence of intubation difficulty in obese patients reached a staggering 21.33%. The equipment most frequently utilized to assist with intubation in obese patients, in sequential order, included ramping, stylette, extended blade, bougie, blade change, macoy, and fiber optic. The discriminatory power of the neck circumference to thyromental distance ratio, as measured by the area under the curve (AUC) of 0.726 with a 95% confidence interval (CI) of 0.648 to 0.796, was deemed satisfactory. The ratio of neck circumference to thyromental distance was identified as the major predictor of difficult intubation. The cut-off value for this ratio was determined to be greater than 4.6. The area under the curve for properly predicting difficult intubation was found to be 0.726. When comparing the area under the curve of the ratio of neck circumference to thyromental distance with the Mallampati score for predicting difficult intubation, it was found that the neck circumference to thyromental distance ratio had a significantly better area under the curve (0.713 vs 0.574, p value=0.0249), as well as higher sensitivity (78.12% vs 56.25%) and higher specificity (64.41% vs 58.47%) compared to the Mallampati score for predicting difficult intubation.

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International Journal of Academic Medicine and Pharmacy (www.academicmed.org)
ISSN (O): 2687-5365; ISSN (P): 2753-6556