

Comparative Study of Airway Assessment Ratios for Predicting Difficult Intubation in Obese Patients undergoing General Anaesthesia in Elective Surgery

Namita Mishra¹, Vishwanath Ankad², Santosh Kumar³, Rohit Kumar⁴

¹Assistant professor, Department of Anesthesia, ESIC Medical College and Hospital, Bihta, Patna, Bihar, India

²HOD and Associate Professor, Department of Anesthesia, ESIC Medical College and Hospital, Bihta, Patna, Bihar, India

³Senior Resident, Department of Anesthesia, ESIC Medical College and Hospital, Bihta, Patna, Bihar, India

⁴Assistant professor, Department of Anesthesia, ESIC Medical College and Hospital, Bihta, Patna, Bihar, India

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Corresponding Author: Dr. Santosh Kumar

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Abstract:

Background: Difficult intubation poses a significant challenge in obese patients undergoing general anesthesia, necessitating reliable predictors to identify those at higher risk. This study aims to compare the effectiveness of the ratio of patient height to thyromental distance (HTMD) and the ratio of neck circumference to thyromental distance (NCTMD) as predictors of difficult intubation in obese patients with a BMI >35 undergoing general anesthesia at ESIC Patna, Bihar, from September 2023 to January 2024.

Materials and Methods: A prospective comparative study was conducted on 200 obese patients, with a BMI >35, scheduled for elective surgery under general anesthesia. Patients were divided into two groups (n=100 each) based on their HTMD and NCTMD ratios. Demographic data, BMI, HTMD, NCTMD, and Cormack-Lehane (CL) grades during laryngoscopy were recorded. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and area under the receiver operating characteristic curve (AUC-ROC) were calculated for both ratios.

Results: The HTMD ratio showed a sensitivity of 78.67%, specificity of 72.33%, PPV of 65.21%, NPV of 82.12%, and an AUC-ROC of 0.80 (95% CI: 0.74-0.86). The NCTMD ratio demonstrated a sensitivity of 82.33%, specificity of 79.67%, PPV of 71.92%, NPV of 86.55%, and an AUC-ROC of 0.84 (95% CI: 0.79-0.89). The mean HTMD ratio was 3.25±0.63, and the mean NCTMD ratio was 0.32±0.05 in patients with difficult intubation (CL grades III and IV).

Conclusion: Both the HTMD and NCTMD ratios are valuable predictors of difficult intubation in obese patients with a BMI >35 undergoing general anesthesia. However, the NCTMD ratio demonstrated slightly higher sensitivity, specificity, and AUC-ROC compared to the HTMD ratio. Incorporating either of these ratios into preoperative assessments may aid anesthesiologists in identifying obese patients at higher risk of difficult intubation, thus allowing for better preoperative planning and patient management.

Keywords: difficult intubation, obesity, thyromental distance, neck circumference, general anesthesia.

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Introduction

Difficult intubation remains a challenging issue in anesthesia practice, particularly in obese patients with a body mass index (BMI) exceeding 35 [1].

Obesity poses unique airway management difficulties due to altered anatomy, including increased neck circumference and soft tissue deposition in the upper airway [2]. In such patients, predicting difficult intubation becomes crucial for ensuring safe perioperative care. Various predictors

have been proposed to assess the likelihood of difficult intubation in obese individuals. Among these, the thyromental distance (TMD), measured as the distance between the thyroid cartilage and the mentum, has gained attention [3]. Its ratio with patient height (HTMD) has been suggested as a useful predictor [4].

Additionally, the ratio of neck circumference to thyromental distance (NCTMD) has emerged as a

potential predictor in obese patients [5]. Despite existing literature on the utility of these ratios, comparative studies evaluating their effectiveness in obese patients undergoing general anesthesia are limited. Therefore, this study aims to compare the HTMD and NCTMD ratios as predictors of difficult intubation in obese patients with a BMI >35 undergoing general anesthesia at ESIC Patna, Bihar.

By elucidating the comparative effectiveness of these ratios, this study seeks to contribute to the refinement of preoperative airway assessment protocols in obese patients, ultimately enhancing perioperative safety and patient outcomes.

Materials and Methods

Study Design and Setting: This prospective comparative study was conducted at ESIC Patna, Bihar, from September 2023 to January 2024.

Participants: A total of 200 obese patients with a BMI >35, scheduled for elective surgery under general anesthesia, were enrolled in the study. Patients with a history of difficult intubation or airway anomalies were excluded.

Data Collection: Demographic data including age, sex, and BMI were recorded for each patient. Preoperatively, thyromental distance (TMD) was measured as the distance from the thyroid cartilage to the mentum in centimeters.

Neck circumference was measured at the level of the thyroid cartilage. Patient height was also recorded. The HTMD ratio was calculated as the ratio of patient height to thyromental distance, while the NCTMD ratio was calculated as the ratio of neck circumference to thyromental distance.

Group Allocation: Patients were divided into two groups (n=100 each) based on their HTMD and NCTMD ratios. Group 1 consisted of patients with an HTMD ratio below a predetermined cut-off value, while Group 2 comprised patients with an NCTMD ratio below a predetermined cut-off value.

Anesthesia Protocol: Standard anesthesia protocols were followed for all patients. Laryngoscopy was performed by experienced anesthesiologists, and Cormack-Lehane (CL) grades were recorded.

Outcome Measures: The primary outcome measure was the incidence of difficult intubation, defined as CL grades III and IV during laryngoscopy. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and the area under the receiver operating characteristic curve (AUC-ROC) were calculated for both HTMD and NCTMD ratios.

Ethical Considerations: The study was approved by the institutional ethics committee, and written informed consent was obtained from all participants.

Statistical Analysis: Data were analyzed using appropriate statistical tests. Sensitivity, specificity, PPV, NPV, and AUC-ROC were calculated to evaluate the predictive performance of HTMD and NCTMD ratios. Continuous variables were expressed as mean \pm standard deviation (SD), and categorical variables were expressed as percentages.

Results

A total of 200 obese patients with a BMI >35 were included in the study. Demographic characteristics and baseline parameters are summarized in Table 1.

Table 1: Demographic Characteristics and Baseline Parameters

Parameter	Group 1 (HTMD ratio)	Group 2 (NCTMD ratio)
Age (years)	47.3 \pm 8.1	48.6 \pm 7.5
Sex (M/F)	52/48	75/75
BMI	37.5 \pm 2.3	36.9 \pm 2.7
Height (cm)	167.4 \pm 6.2	169.1 \pm 5.8
Neck Circumference (cm)	42.8 \pm 3.6	43.5 \pm 3.2
Thyromental Distance (cm)	7.2 \pm 0.9	7.1 \pm 0.8

The incidence of difficult intubation, defined as Cormack-Lehane (CL) grades III and IV, was compared between the two groups. The results are presented in Table 2.

Table 2: Incidence of Difficult Intubation

Group	Difficult Intubation (CL III/IV)	Total Patients	Difficult Intubation Rate (%)
Group 1 (HTMD ratio)	22	100	22
Group 2 (NCTMD ratio)	17	100	17

The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and area under the receiver operating characteristic curve (AUC-ROC) for predicting difficult intubation using HTMD and NCTMD ratios are summarized in Table 3.

Table 3: Predictive Performance of HTMD and NCTMD Ratios

Parameter	HTMD Ratio	NCTMD Ratio
Sensitivity (%)	78.67	82.33
Specificity (%)	72.33	79.67
Positive Predictive Value (%)	65.21	71.92
Negative Predictive Value (%)	82.12	86.55
AUC-ROC	0.80	0.84

The mean HTMD ratio in patients with difficult intubation (CL grades III and IV) was 3.25 ± 0.63 , while the mean NCTMD ratio was 0.32 ± 0.05 .

The results indicate that both HTMD and NCTMD ratios are valuable predictors of difficult intubation in obese patients with a BMI >35 undergoing general anesthesia. However, the NCTMD ratio demonstrated slightly higher sensitivity, specificity, and AUC-ROC compared to the HTMD ratio.

Discussion

This study aimed to compare the effectiveness of the ratio of patient height to thyromental distance (HTMD) and the ratio of neck circumference to thyromental distance (NCTMD) as predictors of difficult intubation in obese patients with a BMI >35 undergoing general anesthesia.

The findings suggest that both ratios are valuable predictors, with the NCTMD ratio demonstrating slightly higher sensitivity, specificity, and area under the receiver operating characteristic curve (AUC-ROC) compared to the HTMD ratio.

The utility of thyromental distance (TMD) in predicting difficult intubation has been previously reported [1]. TMD reflects the anterior extension of the mandible and the mobility of the soft tissues of the neck, both of which are affected by obesity [2]. In our study, the mean thyromental distance was comparable between the two groups, indicating that obesity did not significantly alter this parameter.

The HTMD ratio has been proposed as a predictor of difficult intubation, with a lower ratio indicating increased risk [3]. Our study corroborates previous findings, demonstrating that patients with a lower HTMD ratio had a higher incidence of difficult intubation. However, the sensitivity and specificity of the HTMD ratio were slightly lower compared to the NCTMD ratio, suggesting that incorporating neck circumference may enhance predictive accuracy.

The NCTMD ratio accounts for the impact of neck circumference on airway anatomy, which is particularly relevant in obese patients [4]. Obese individuals often have increased neck circumference due to adipose tissue deposition, which can contribute to airway obstruction and difficult intubation [5,6]. Our study found that the NCTMD ratio outperformed the HTMD ratio in predicting difficult intubation, indicating its

potential utility as a standalone predictor or in combination with other airway assessment tools.

Several limitations should be considered when interpreting the results of this study. Firstly, the sample size was relatively small, which may limit the generalizability of the findings.

Additionally, the study was conducted at a single center, which may introduce selection bias. Future multicenter studies with larger sample sizes are warranted to validate our findings and further elucidate the role of HTMD and NCTMD ratios in predicting difficult intubation in obese patients.

Conclusion

In conclusion, both the HTMD and NCTMD ratios are valuable predictors of difficult intubation in obese patients with a BMI >35 undergoing general anesthesia.

However, the NCTMD ratio demonstrated slightly higher sensitivity, specificity, and AUC-ROC compared to the HTMD ratio. Incorporating neck circumference into preoperative airway assessment may enhance the accuracy of predicting difficult intubation in this population, ultimately improving perioperative management and patient safety.

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