Difficult Intubation Predictor: Comparison Between Ratio Of Height To Thyromental Distance, Mallampati Score And Thyromental Distance

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Abstract

Introduction: *The Mallampati score and thyromental distance (TMD) are frequently used to identify challenging laryngoscopies, but their reliability in predicting difficulty is uncertain. This study aims to assess the effectiveness of using the ratio of height to thyromental distance (RHTMD) in predicting difficult visualization of the larynx (DVL) when compared to the Mallampati score and TMD.*

Method: *To achieve this goal, 277 patients who received general anesthesia during elective surgery were evaluated using the Mallampati score, TMD, and RHTMD. The Cormack and Lehane (CL) classification was used to grade the laryngeal view, with CL grade 3 and 4 indicating difficult visualization. The study then determined and compared the area under the curve (AUC), sensitivity, and specificity for each airway predictor.*

Results: *The AUC of RHTMD (85.5%) was better than TMD (82.7%) and significantly better than the Mallampati score (61.4%).*

Conclusion*: RHTMD is more accurate in predicting difficult laryngoscopy than both the Mallampati score and TMD.*

Keywords: *Mallampati score, Thyromental distance, ratio of height to thyromental distance (RHTMD), and difficult visualiation of the larynx*

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Prediktor Kesulitan Intubasi: Perbandingan Antara Rasio Tinggi Badan Terhadap Jarak Tiromental, Skor Mallampati Dan Jarak Tiromental

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Abstrak

Pendahuluan: Skor Mallampati dan jarak tiromental (TMD) sering digunakan untuk memprediksi kesulitan visualisasi laring praoperatif, namun akurasi kedua penanda tersebut masih dipertanyakan. Penelitian ini bertujuan untuk mengevaluasi prediktor kesulitan visualisasi laring dengan rasio tinggi badan terhadap jarak tiromental dibandingkan dengan skor Mallampati dan jarak tiromental.
Metode: Sebanyak 277 pasien yang menjalani anestesi umum untuk bedah elektif dievaluasi dengan menggunakan skor Mallampati, TMD, dan RHTMD. Kesulitan visualisasi laring dinilai berdasarkan klasifikasi Cormack Lehane (CL), dengan skor CL derajat III dan IV dianggap sulit visualisasi. Kemudian, ditentukan dan dibandingkan nilai area dibawah kurva (AUC), sensitifitas, spesifisitas untuk setiap prediktor jalan nafas.
Hasil: AUC dari RHTMD (85,5%) lebih baik dibandingkan dengan TMD (82,7%), dan jauh lebih baik dibandingkan dengan Mallampati skor (61,4%)
Kesimpulan: Akurasi RHTMD memiliki akurasi yang lebih baik dalam memprediksi kesulitan visualisasi laring dibandingkan dengan skor Mallampati dan TMD.

Kata Kunci: jarak tiromental (TMD), rasio tinggi badan terhadap jarak tiromental (RHTMD), skor Mallampati, sulit visualisasi laring

Introduction

Difficult visualization of the larynx often results in difficult intubation. The Cormack Lehane score is utilized in classifying visualization of the larynx. The reported rates of Cormack Lehane degrees III were between 1-4%, and unsuccessful intubation was between 0.05-0.35% for degrees III and IV.[1] Difficult intubation can lead to various drawbacks such as increased morbidity, mortality, and health expenses.[2,3] Therefore, it is crucial to evaluate the risk of visualization difficulties in all patients undergoing surgical procedures. Several predictors are available, such as modified Mallampati test and measurement of thyromental distance; nonetheless, the predictive value of each predictor remains uncertain.

The Mallampati assessment is based on the anatomical structure of the oral cavity with Rudin et al reported its low sensitivity (0.44) and specificity (0.97).[4] Another popular predictor is thyromental distance (TMD). Noorizad et al conducted a study of 379 Iranians to test the diagnostic value of TMD and result in a sensitivity of 0.17 and a specificity of 0.86.[5]

The ratio of height to thyromental distance (RHTMD) is another suggested predictor; nevertheless, no studies have been carried out in Indonesia to establish its sensitivity, specificity, and its cut off point. The aim of this study is to determine the measurement and the cut-off point. This research intends to compare RHTMD with Mallampati and TMD as predictors of difficult intubation.

Methods

The objective of this research was to evaluate the effectiveness of three preoperative examinations in predicting difficult visualization of the larynx, by comparing them with the direct laryngoscopy examination which is considered the gold standard. The study sample consisted of adult patients between the ages of 18-65 who were scheduled for elective surgery under general anesthesia

at Cipto Mangunkusumo General Hospital, Jakarta. We analyzed the characteristics of the the study participants and the predictor variables. Statistical analysis was performed using SPSS version 20.0.

Results

There were 277 participants in this study, and their average age was 41 years. The majority of subjects, 213 (76.9%), belonged to Javanese and Sundanese ethnic groups. Difficult visualization of the larynx was defined as Cormack-Lehane 3-4, and was found in 28 subjects (13.7%). The distribution of Mallampati, TMD, and Cormack Lehane scores can be found in Table 1.

Table 1. Distribution of Mallampati, TMD, and Cormack Lehane

Variabel		N (277)	(%)
Mallampati	1	101	36.5%
	2	171	61.7%
	3	5	1.8%
	4	0	
Cormack Lehane	1	129	46.6%
	2	120	43.3%
	3	27	9.7%
	4	1	0,4%
TMD(mm)	≤65	111	40.1%
	>65	166	59.9%
Easy Visualization Larynx (EVL)		249	86.3%
Difficult Visualization Larynx (DVL)		28	13.7%

Fisher's exact test showed a statistically significant association between Mallampati score and laryngeal visualization difficulties (p<0.05) (Table 2).

Table 2. Mallampati and Larynx Visualization

Mallampati	DVL (n =)	EVL (n =)	p
3 and 4	3 (60%)	2 (40%)	0,008
1 and 2	25 (9,2%)	247 (90,8%)	

*EVL : Easy Visualization Larynx; DVL : Difficult Visualization Larynx

In order to investigate the association between TMD and difficult visualization of the larynx, a cut-off of 65 mm was set. Values below 65 mm were considered as an indicator of difficult intubation, while values exceeding 65 mm were regarded as an indicator of easy intubation. The outcomes of the chi-square test are displayed in Table 3.

Table 3. TMD and Larynx Visualization

TMD	DVL (n =)	EVL (n =)	p
≤ 65	23 (20,7%)	88 (79,3%)	<0.001
> 65	5 (3,0%)	161 (97%)	

*EVL : Easy Visualization Larynx; DVL : Difficult Visualization Larynx

Schmitt's study used a ratio of RHTMD ≥ 25 as a predictor of difficult laryngeal visualization, while a ratio of RHTMD < 25 was considered an easy visualization of the larynx. The results are presented in Table 4. The statistical analysis showed that there was a significant association between RHTMD and visualization of the larynx (p<0.05).

Table 4. RHTMD and Larynx Visualization

RHTMD	DVL (n =)	EVL (n =)	p
≥ 25	23 (27,4%)	61 (72,6%)	<0.001
< 25	5 (2,6%)	188 (97,4%)	

* EVL : Easy Visualization Larynx; DVL : Difficult Visualization Larynx

Sensitivity and specificity of each predictor were tested and the results obtained as shown in table 5.

Table 5. Diagnostic Validity of 3 Predictors

Scale	Sensitivity (%)	Specificity (%)	NPP (%)	NPN (%)
Mallampati	10,7	99.2	60.0	90,8
TMD	82,1	64,7	20,7	97,0
RHTMD	82,1	75,5	27,4	97,4

PPV: positive predictive value; NPV: negative predictive value; TMD: Thyromental Distance; RHTMD: Ratio of Height to Thyromental Distance

The results of the ROC analysis showed that RHTMD had the highest area under the curve (AUC) compared to other scales in predicting difficult laryngeal visualization, with a score of 85.5% (p<0.05). The TMD scale had an AUC of 82.7%, while the Mallampati score had an AUC of 61.4%. However, it should be noted that there are differences in anatomy between the subjects in this study and those in the previous RHTMD study. Therefore, a new intersection point needs to be determined. At a cut-off point of 25.1, which had an AUC of 85.5%, the best sensitivity and specificity were observed.

Discussion

Tests that are used to predict difficult intubation need to have high accuracy, sensitivity, and positive predictive value in order to accurately identify patients who may experience difficulty during intubation. The incidence of difficult intubation can vary between studies and is influenced by various factors, such as the age and ethnicity of the patients or the type of laryngoscope used.[6,7]

The Mallampati score has long been used as a predictor, but its accuracy can be influenced by various factors such as the sitting position, head position, and the atlanto-occipital joint that assesses neck movement. Mallampati examinations should be performed with the patient sitting upright, the head fully extended, the tongue protruding, and making a sound.[8] To minimize the occurrence of false positives or false negatives, the assessment should be conducted twice during the examination.[9]

The use of thyromental distance (TMD) is also an effective way to predict difficult intubation. Our study found that TMD had a sensitivity of 82.1%, specificity of 64.7%, positive predictive value of 20.7%, and negative predictive value of 97% which outperformed Huh's study on the Korean population where the sensitivity was 31%, specificity was 92%, positive predictive value was 35%, and negative predictive value was 91%.[10] The difference in these results may be due to differences in race population. In our study, the RHTMD predictor had better results than by Schmitt et al.[9] RHTMD had a sensitivity of 82.1%, higher than the sensitivity of Mallampati (10.7%), which does not assess neck joint movement, while RHTMD can estimate limitations in neck joint movement. The sensitivity value of RHTMD was almost the same as the sensitivity value of TMD (82.1%), as both assess neck joint movement, but RHTMD considers different heights have different TMD standards; hence, providing better diagnostic value when compared to TMD alone.

Overall, our study found RHTMD to be a better predictor of difficult intubation than Mallampati and TMD, reducing morbidity and mortality in patients undergoing general anesthesia. However, our study has limitations, including the dominance of Sundanese and Javanese ethnic groups, which may limit the generalizability of the results to other ethnic groups. Further research is needed to validate the results in other populations. Additionally, it is important to note that the maximal extension of the head is crucial to reduce the possibility of errors in assessment.

Conclusion

The RHTMD scale has been determined to be a more accurate predictor of difficult laryngeal visualization during general anesthesia compared to the Mallampati score and TMD.

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