Nat. Volatiles & Essent. Oils, 2021; 8(5): 7994-7999

NVEO
Natural Volatiles & Essential Oils

Prediction of Difficult Endotracheal Intubation through Assessment of Anatomical and Anthropometric Indicators

Daryoush Rostami[1], Farkhondeh Sarhaddi[2], Mania Kaveh[3], Kambiz Sadegi[4*]

[1] Department of Anesthesiology, Zabol University of Medical Sciences, Zabol, Iran
[2] Department of Obstetrics and Gynecology, Zabol University of Medical Sciences, Zabol, Iran

*Corresponding author.Email: kamsadegi@yahoo.co.uk

Abstract

Objective*:* Predictions of laryngoscopy and difficult endotracheal intubation have been yet considered as one of the major problems in general anesthesia during surgical procedures. Therefore, this study aimed to evaluate a method for prediction of difficult endotracheal intubation in patients undergoing surgical procedures through assessment of some anatomical and anthropometric indicators, like neck circumference (NC), thyromental distance (TMD) and body mass index (BMI).

Materials and Methods*:* This cross-sectional descriptive and analytical study was carried out at the Amir-Al-Momenin Hospital, Zabol, Iran, during 2020-2021. Two hundreds patients aged 18 to 60 years with American Association of Anesthesiologist (ASA) physical status I and II underwent surgical procedures requiring general anesthesia with airway intubation. The patients were selected using convenience sampling method. Information on age, gender, weight, height, TMD, and NC were compared between two groups of difficult intubation (n=100) and easy intubation (n=100). Univariate and multivariate logistic regression models were used to identify the independent predictors of difficult intubation. Receiver Operating Characteristic (ROC) curve was also used to make different measures for predictive accuracy by comparing the area under the curves.The data were analyzed using Stata V.11 software. A P value less than 0.05 was considered statistically significant.

Results: Of 200 patients, 61(30.5%) experienced difficult intubation. The adjusted odds ratios (P values) for NC, TDM, BMI/TDM and NC/TDM were 1.90(0.7), 0.11(0.007), 127.66(<0.001) and 6.80(<0.001), respectively. ROC curve analysis indicated that largest area under the curve belonged to BMI /TDM.

Conclusion*:* The present study indicated an obvious relationship between some of anatomic indicators, such as TMD/NC and BMI/TMD, with difficult endotracheal intubation. However, the vast experience and skills of anesthesiologists and the use of alternative methods may play an important role in this regard.

Keywords: Difficult Endotracheal ¬Intubation, Anatomical Indicators, Neck Circumference, Thyromental Distance, Body Mass Index

Introduction

Airway management at the time of intubation is considered as a crucial skill for an anesthesiologist to ensure a safe general anesthesia during emergency or elective surgical care (1, 2). Airway anatomy includes nasal cavity, mouth, pharynx, larynx and trachea. Access to trachea is possible through the nose or mouth, but is more common via oral route (3). Nose and mouth cavities are connected to the larynx and esophagus by throat (1). Larynx is involved in voice production and separation of trachea from esophagus (4, 5). Trachea starts form the sixth cervical vertebrae where it continues until the level of carina. Difficult airway or failure to maintain an open airway is associated with morbidity and mortality related to anesthesia (1). Complete airway obstruction for four to ten minutes leads to sudden cardiac arrest (SCA) and irreversible damage to central nervous system (3). Laryngoscopy and difficult endotracheal intubation that mean unsuccessful intubation for more than three attempts or after 10 minutes occur in 1.1 to 5.8% of cases (1). Assessment of airway should be always applied in order to evaluate and approve the medical or surgical procedures requiring intubation to avoid jeopardizing airway protection. The record of previous anesthesia should contain a description of airway problems, the techniques used and the extent of the success in maintaining an open airway. A set of anatomical tests have been proposed to assess difficult

intubation (3). Since different results have been reported regarding the accuracy of such methods, this study aimed to evaluate a method for prediction of difficult endotracheal intubation in patients undergoing surgical procedures requiring general anesthesia through assessment of some anatomical indicators and anthropometric indicators, like neck circumference (NC), thyromental distance (TMD) and body mass index (BMI).

Materials and Methods

This cross-sectional study was carried out at the Amir-Al-Momenin Hospital, Zabol, Sistan-Balochestan Province, Southeast of Iran, during 2020-2021. The study was confirmed by the Ethics Committee of Zabol University of Medical Sciences. Two hundreds patients who underwent surgical procedures requiring general anesthesia with airway intubation were randomly selected for this study using convenience sampling method. The inclusion criteria were as follows: (i) Sistan-Balochestan residents, (ii) aged 18 to 60 years, and (iii) classified as American Association of Anesthesiologist (ASA) physical status I and II. The patients with the following criteria were excluded: (i) undergoing emergency surgical care, (ii) critically ill, (iii) unable to cooperate, (iv) unable to open mouth due to temporomandibular joint dysfunction (TJD), (v) presence of various anatomical destructions and alterations occurring in neck, mouth and airwaylike goiter, rheumatoid arthritis, cromegally, epiglottitis, Ludwig 's angina, retropharyngeal abscess and congenital abnormalities such as cleft palate or cleft lip, (vi) pregnancy, (vii) no teeth, and (viii) unable to extend his/her neck. After all patients signed an informed consent, the purpose of the study was described to them. Furthermore, all personal information remained confidential in order to maintain the principles of research ethics. Patients (n=200) were subsequently divided into two groups of difficult intubation (n=100) and easy intubation (n=100). Prior to surgery, sociodemographic the data regarding age and gender were collected through interview, data, like age and gender, were collected through interviews, while anatomical and anthropometric data, like NC, height and weight, were collected using tape measure and weigh scale. BMI is a value of weight (kg) over square of height (m^2). Furthermore, the patients were asked to sit upright on a bed, close their mouse and extend their neck as far as possible where the shortest distance between thyroid cartilage and hyoid bone was measured to determine TMD using a ruler. The patient was placed in the proper position and laryngoscopy was performed by an expert anesthesiologist using a Macintosh blade (Riester, Germany). The parameters like ectrocardiogram (ECG), pulse oximetry, capnography and blood pressure were monitored during general anesthesia.

Statistical analysis

Data were expressed as the mean ± standard deviation (SE) as well as percent frequency. Fisher's exact test and the independent sample t-test were used to compare the frequencies and mean values of indicators between two groups, respectively. All statistical analyses were performed using Stata V.11 software. A P-value<0.05 was considered to indicate a significant difference in all analyses.

Results

Two hundred patients undergoing surgical procedures were divided into two following groups: (i) difficult intubation (n=100) and (ii) easy intubation (n=100). Our findings showed that the mean (SD) age values are 42.1(11.53) and 35.83 (13.62) for difficult and easy intubation groups, respectively. Table 1 shows the relationship between age and difficult intubation, indicating a significant difference in this regard between two groups (P = 0.002). Our results also revealed that there were only 30(49.2%) male patients with difficult intubation and 31(50.8%) female patients with difficult intubation, indicating no significant difference regarding gender between two groups (P = 0.5) (Table 1).

Table 1: Comparison of clinical, anatomical and anthropometric factors between patients with and without difficult intubation

Risk factors		Intubation		P value
		Difficult	Easy	
Gender No. (%)	Male	30 (49.2%)	70(50.4%)	**0.5**
	Female	31(50.8%)	69(49.6%)	
BMI No. (%)	Underweight	0(0.0%)	21(15.1%)	**0.000**
	Healthy	4(6.6%)	116(83.5%)	
	Overweight	31(50.8%)	2(1.4%)	
	Obesity class I	19(31.1%)	0(0.0%)	
	Obesity class II	4(6.6%)	0(0.0%)	
	Obesity class III	3(4.9%)	0(0.0%)	
Age	Mean (SD)	42.1(11.53%)	35.83(13.62)	**0.002**
Weight	Mean (SD)	81.56(12)	58.22(9.14)	**<0.001**
Height	Mean (SD)	166.89(8.53)	166.03(9.70)	**<0.548**
BMI	Mean (SD)	4.60(29.38)	2.22(21.05)	**<0.001**
TMD	Mean (SD)	6.61(1.03)	7.17(0.94)	**<0.001**
NC	Mean (SD)	39.15(4.1)	34.45(3.05)	**<0.001**
Height/TMD	Mean (SD)	25.92(4.60)	23.60(3.87)	**0.000**
NC/TMD	Mean (SD)	6.04(0.97)	4.90(0.86)	**0.000**
BMI/TMD	Mean (SD)	4.54(0.93)	2.98(0.50)	**0.000**

BMI; Body mass index, DI; Difficult intubation, TMD; Thyromental distance, NC; Neck circumference

Among patients with difficult intubation, 26(42.6%) were obese, while no obese patients had easy intubation (P<0.001). The mean BMI in patients with difficult intubation (29.38 ±4.6) was higher than that in patients with easy intubation (21.05 ± 2.22) (P = 0.000). Patients experiencing difficult intubation showed lower mean value of TMD than those with easy intubation (6.61 vs. 7.17; P<0.001). However, patients with difficult intubation had higher mean values of NC as compared to those with easy intubation (39.15 vs. 34.45; P<0.001) (Table 2). Table 2 also shows the crude and adjusted odd rations of TMD (0.55; P=0.001 and 0.11; P=0.007, respectively), NC (1.48; P=0.001 and 1.09; P=0.7, respectively), NC/TMD (3.64; P<0.001 and 6.80; P<0.001, respectively) and BMI/TMD (42.76; P<0.001 and 127.66; P<0.001, respectively).

Table 2: The relation between difficult intubation with the crude and adjusted ORs (age, gender and BMI) of TMD, NC, BMI/TMD, and NC/TMD

	Crude ORs	P value	Adjusted ORs	P value
TMD	0.55	<0.001	0.11	0.007
NC	1.48	<0.001	1.09	0.7
BMI/TMD	42.76	<0.001	127.66	<0.001
NC/TMD	3.64	<0.001	6.80	<0.001

TMD; Thyromental distance, ORs; Odd ratios, BMI; Body mass index, NC; Neck circumference.

The values of area under the ROC curve for TMD, NC, NC/TMD and BMI/TMD were 0.33, 0.82, 0.82 and 0.95, respectively (Fig. 1). The optimum cut-points (sensitivity/ specificity) for these indicators to predict the difficult intubation were 6.75(5%/27%), 36.50(72%/76%), 6.75 (56%/27%) and 3.53(90%/ 87%), respectively.

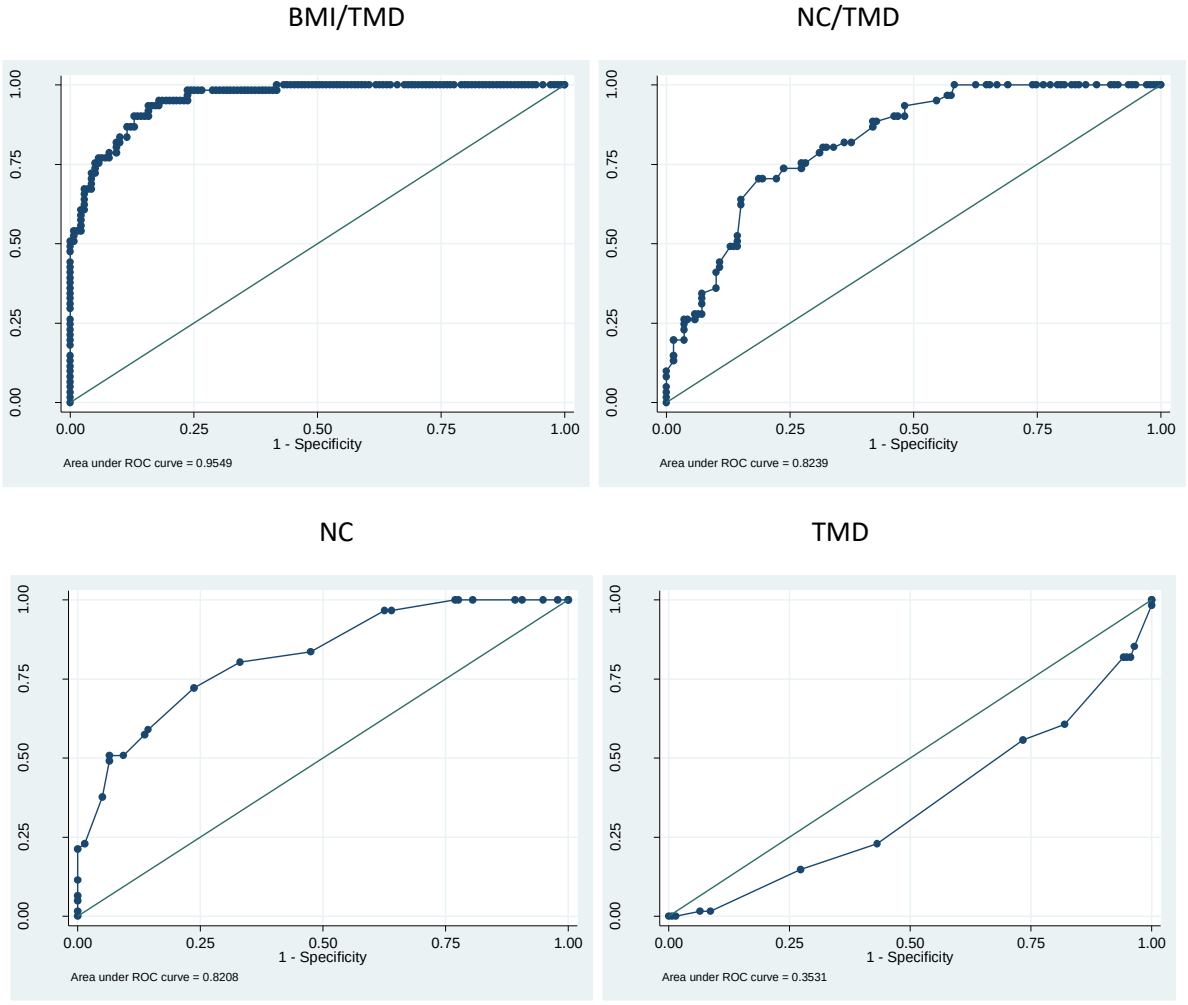

Fig. 1: ROC curves analysis for different indicators of difficult endotracheal intubation.

ROC curve; Receiver Operating Characteristic curve, TMD; Thyromental distance, ORs; Odd ratios, BMI; Body mass index, NC; Neck circumference

Discussion

Our study showed that the odd values of difficult endotracheal intubation were increased by increasing the ratio values of NC/TMD and BMI/TMD. We also observed that any increase in the NC can lead to approximately 90% reduction in the odds of difficult intubation. Furthermore, lowest and largest areas under the ROC curve belonged to TMD and BMI/TMD, respectively. Although each centimeter increase in TMD increased the odd values of difficult intubation about 48%, controlling for potential confounders showed that this indicator was not potentially associated with difficulty. That was in contrast to the results of previous studies that has pointed TMD as a predictor of difficult intubation. Our findings also showed that other anatomical and anthropometric measurements including NC, NC/TMD and BMI/TMD were significantly associated with difficult intubation. Although many studies have only reported TMD or NC/TMD as the most accurate predictors for difficult intubation, the current study showed that the

BMI/TMD not only was the strongest associated factor for difficult intubation, but also had the greatest area under the ROC curve, indicating the most accurate prediction of the difficult laryngoscopic intubation.

In a study by Ezir et al., they have suggested that in obese male patients (BMI> 35 kg/m^2), the risk of difficult intubation is increased with aging (6,7). In another study by Roh and Lee, they have indicated there is a significant relationship between BMI and NC with difficult intubation (8). Furthermore, in a study by Hassani et al., they have found that the mean weight of participants was 67.7± 3.2 kg, indicating a significant relationship between weight gain and difficult intubation (9). Similarly, our findings showed a significant relationship between increased values of some indicators, like BMI and NC, with difficult intubation. In a study by Savva (1994), they have compared four predictor tests for difficult airway in a population of 350 patients. They have subsequently reported a sensitivity and specificity of 64.7 and 81.4% for TMD, respectively (10). In a study by Bilgin et al. (1998) on 500 patients, they have demonstrated that TMD had the highest positive predictive value (11). In the study by Dr. Hematabadi et al., they have showed that degree of mouth opening was 96.3%, considered as the most specific criterion. In the same study, the sensitivity values of atlanto-axial joint mobility and TDM were 89 and 87%, respectively (12). Similarly, in our study, TMD value was lower in patients with difficult intubation. In a study by Kim et al. (2011), the risk of difficult intubation in obese patients (n=123) was 27.5% as compared with non-obese patients (n=125). They have also indicated the following factors as predictor test of difficult intubation in obese patients: high BMI, Mallampati classification, Wilson's criteria, NC, degree of mouth opening, sternomental distance, TMD, and history of difficult intubation. Furthermore, they have mentioned that the three variables, including Mallampati classification, Wilson's criteria, and NC/TMD, were directly associated with difficult intubation in obese patients, among which NC/TMD showed the highest sensitivity, the negative predictive value as well as largest area under ROC curve (13). Similarly, in our study, NC/TMD was higher in patients with difficult intubation; however, BMI/TMD showed to be more accurate in predicting the intubation difficulty using 3.53 as the most optimal cut-point with the most sensitivity (90%) and specificity (87%). There is a certain limitation in this study. This study was carried out in Southeast of Iran, so the anatomy and race of population living in this area is different from the rest of Iranian people and the world populations. We suggest conducting new studies in different cities of Iran or the world with larger sample sizes to observe more generalizable results.

Conclusion

Our study provided evidences that BMI/TMD can be applied as the most reliable indicator for predicting the difficult endotracheal intubation. However, the vast experience and skills of anesthesiologists and the use of alternative methods may play an important role in this regard. It is recommended to conduct longitudinal studies with larger sample sizes to prove the exactrelationship between these indicators and difficult intubation.

Acknowledgments

There is no conflict of interest in this study.

REFERENCES

Miller RD, Eriksson LI, Fleisher LA, Wiener-Kronish JP, Cohen NH, Young WL. Miller's anesthesia: Elsevier Health Sciences; 2014.

Jabalameli M, Saghaei M, Jaberzadeansari M. Evaluation of Airway Anatomical Characteristics after Elective Surgery with Difficult Intubation. ZJRMS. 2008; 10(2): 0-0

Hosein Khan Z, Arbabi Sh, Ebrahim Soltani A. Airway: Historical background, preoperactive assessment and management of elective and emergency airway problems (review article). Tehran Univ Med J. 2008; 65 (1): 1-12

Swamy M, Mallikarjun D. Applied aspects of anatomy and physiology of relevance. Indian J Anesth. 2004;48:333-9

Rajagopal M, Paul J. Applied anatomy and physiology of the airway and breathing. Indian J Anaesth. 2005;49(4):251-6.

Ezri T, Medalion B, Weisenberg M, Szmuk P, Warters RD, Charuzi I. Increased body mass indexper se is not a predictor of difficult laryngoscopy. Can J Anaesth 2003;50(2):179-83.

Ezri T, Gewürtz G, Sessler D, Medalion B, Szmuk P, Hagberg C, et al. Prediction of difficult laryngoscopy in obese patients by ultrasound quantification of anterior neck soft tissue. Anaesthesia. 2003;58(11):1111-4.

Roh J-L, Lee Y-W. Prediction of difficult laryngeal exposure in patients undergoing microlaryngosurgery. Ann OtolRhinolLaryngol. 2005;114(8):614-20.

Hassani F, Faritoos Z. Sensitivity. mallampati score and thyromental distance for Predicting difficult endotracheal intubation. J of Research in medical sciences 2001; 5(1):99-100.

Savva D. Prediction of difficult tracheal intubation. Br J Anaesth. 1994;73(2):149-53.

Bilgin H, Ozyurt O. Screening tests for predicting difficult intubation. A clinical assessment in Turkish patients. Anaesth Intensive Care 1998;26(4):382.

Hemmatabadi A, Jalali A, Heidarpoor E, et al. Evaluation of specificity and sensitivity of diagnostic charachteristics of difficult endotracheal intubation. J of Research in medical sciences 2001; 5(1): 97-98.

Kim W, Ahn H, Lee C, Shin B, Ko J, Choi S, et al. Neck circumference to thyromental distance ratio: a new predictor of difficult intubation in obese patients. Br J Anaesth. 2011:aer024.