Original Article

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TANAFFOS

Assessment of Ratio of Height to Rhinion-Mentum Distance as a Predictive Tool for Difficult Tracheal Intubation

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Background: Difficult Intubation (DI) is a constant concern for anesthesiologists and being able to predict it will improve patient safety. Different tests have been presented in anesthesiology practice to increase the accuracy of the DI prediction. Since there is no single sensitive and specific test, most of the practitioners use a combination of them. Here we report a new and novel index of ratio of height to rhinion-mentum distance (RHRMD) to improve the prediction.

Materials and Methods: Four hundred adult patients' candidate for elective surgery were enrolled into the study. Initially, patients' data such as weight, height and rhinion-mentum distance (RMD) were recorded by the first anesthesiologist. After anesthesia induction, the second anesthesiologist performed laryngoscopy and recorded the Cormack-Lehane (CL) score. CL score III or higher was considered as DI. Finally, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) for RHRMD was calculated.

Results: DI was reported in 7.75% of patients. RHRMD is related with CL grade: as the former increased, the latter decreased. RHRMD with cut-off point 25.4 has 90.6% sensitivity, 29.9% specificity, 10.1% PPV and 97.3% NPV in predicting DI.

Conclusion: RHRMD with 90.6% sensitivity and 97.3% NPV could be a valuable tool for prediction of DI.

Key words: Airway assessment; Difficult intubation (DI); Rhinion-mentum distance (RMD)

INTRODUCTION

Airway management is the cornerstone of every anesthesia care and failed airway is an all-time concern to anesthesiologists (1). Incidence of failed intubation varies depending on elective or emergent setting and is as frequent as 1 in 2000 among elective intubations, 1 in 300 when rapid sequence induction is applied and as high as 1 in 50-100 in emergency department, intensive care unit and pre-hospital setting (2). Prediction of difficult intubation (DI) would be invaluable for anesthesiologists but there is no single test to predict it with high sensitivity, specificity and predictive values (3, 4); therefore, combination of these tests is being used to accurately predict difficult airway (3, 5). New tests have been represented in recent years with different levels of accuracy and efficacy such as upper lip bite test (ULBT) (6), modified Mallampati test (MMT) (7), ratio of height to thyromental distance (RHTMD) (8), intubation difficulty scale (IDS) (9) or facial angles (FA) (10). Recently, ultrasound, X-ray and CT-scan, although cumbersome, have been used for prediction of DI and

found to be quiet useful (11). Here we represent a new simple and novel index, height to rhinion-mentum distance (RHRMD), which could fortify our arsenal in battling the difficult airway. Rhinion is the lower end of suture between the nasal bones or the junction between upper lip and base of nose. Mentum is the protruding part of the chin which is well known for the anesthesiologists as they measure thyromental distance in preoperative airway assessment (Figure 1).

Figure 1 A and B. Rhinion (black arrow), mentum (white arrow) and rhinion-mentum distance (red line)

MATERIALS AND METHODS

The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the last update of Helsinki Declaration.

After ethical committee approval (IR. SBMU. RETECH. REC. 1399.1246), in this prospective observational study, 400 adult patients with American Society of Anesthesiologist (ASA) classification I and II were enrolled. Informed written consent was obtained from each patient. Airway parameters were evaluated by the same single anesthesiologist who induced anesthesia to avoid inter-observer variability. We recorded patients' data (age, sex, weight, height) and measured RMD in centimeters while mouth closed. After induction of anesthesia, during direct laryngoscopy using properly sized Macintosh blade, Cormack-Lehane (CL) grading was recorded by the second anesthesiologist, with grade I and II considered as non-difficult intubation and higher grades considered as difficult ones (2). Since some of the known indices such as thyromental distance are modified by patient's height we decided to add a modification to our measurement. We divided patients' height in cm by RMD in cm and recorded it as RHRMD.

Statistical analysis

Quantitative variables were expressed as mean (SD) and categorical data expressed as number (%). To compare quantitative variables between groups, ANOVA and following tests (post hoc analysis) with Games-Howell method and for qualitative variables, Chi-square test was used. P value less than 0.05 was considered as statistically significant. SPSS software v. 22 was used. Sensitivity, specificity, PPV and NPV were calculated by using ROC (Receiver Operating Characteristic) curve.

RESULTS

Of 400 patients, 202 patients (50.5%) were in CL grade I, 167 (41.75%) in CL grade II and 31 (7.75%) in CL grade III whom were considered as DI. None of the patients were graded as CL grade IV. Relation of demographic and anatomic findings and their relevance to CL grade has been assessed and depicted (Table 1). As shown (Table 1) there is no association between age and sex with CL grading (P value>0.05). There was significant difference between 3 groups in BMI (P<0.001), RMD (P<0.007) and RHRMD (P<0.004).

Rhinion-mentum distance was related positively with CL grading, the larger RMD related with higher grade of CL was statistically meaningful (Table 1). Since CL grade I and II were considered as non-difficult intubation and CL grade III and IV as difficult intubation, RMD with cut-off point of 6.8 cm had 78.1% sensitivity, 35.01% specificity, 9.5% PPV and 94.8% NPV in predicting DI (Table 2).

The new and novel index (RHRMD) correlated with CL grade; as the former increased, the latter decreased. RHRMD with cut-off point 25.4 has 90.6% sensitivity, 29.9% specificity, 10.1% PPV and 97.3% NPV in predicting DI (Table 2).

Table 1. Demographic variables, anatomic findings and their relevance to CL grade

Variable	CL			P Value
	I	II	III	
Mean of age [year]	44.70	45.74	47.32	0.546
(SD)	(15.36)	(12.40)	(9.91)	
Sex [Female/Male]	95/108	92/74	15/16	0.45
(%)	(46.8%/53.2%)	(55.4%/44.6%)	(48.4%/51.6%)	
BMI [kg/m²]	25.98	27.99	28.66	<0.001
(SD)	(4.16)	(4.30)	(4.70)	
Mean of RMD [cm]	6.86	6.95	7.31	0.007
(SD)	(0.83)	(0.62)	(0.69)	
Mean of RHRMD (SD)	24.69 (2.94)	24.20 (2.40)	23.06 (2.00)	0.004

BMI: body mass index, RMD: Rhinion-mentum distance, RHRMD: ratio of height to rhinion-mentum distance, CL: Cormack-Lehane score

Table 2. Cut off points of recorded variables and their relation with difficult intubation.

Variable	Cutoff	Sensitivity	Specificity	PPV	NPV	Accuracy	Area	P value
RHRMD	25.4	90.6	29.9	10.1	97.3	34.8	0.64	0.01
RMD	6.8	78.1	35.01	9.5	94.8	38.5	0.63	0.012

RHRMD: ratio of height to rhinion-mentum distance, RMD: Rhinion-mentum distance

DISCUSSION

Encountering DI is an all-time concern and its prediction will be invaluable in anesthesia practice. Desired assessment method might have at least high sensitivity to be able to predict as much difficult airways as possible which usually is achieved at the cost of low specificity. Different single methods have been proposed for airway evaluation such as Mallampati test (12), thyromental distance (13), neck height and circumference (14). Most of these indices have relatively low sensitivity and acceptable specificity (3). An acceptable approach is to use different assessment methods to increase the sensitivity, specificity and predictive values. As the number of methods increase, the more accurate our prediction would be. ULBT was considered as the most sensitive single bedside assessment method to predict DI (2, 3, 5); however, it is not hundred percent sensitive and specific so its combination with other indices would be more accurate (13). Combination of indices augments the prediction ability but some of these combinations are subjective and cumbersome (15). Presenting a new and novel method for airway evaluation will augment the arsenal and increase the accuracy of DI prediction.

This study was designed to represent a new and novel index (RHRMD) and identify its sensitivity, specificity, negative predictive value (NPV) and positive predictive value (PPV) for difficult airway.

The incidence of DI in our study was 7.75% (CL III) which is in concordance with other studies (2, 16). Selvi et al. reported 43.5 mm as the cut-off point for thyromental height (TMH) and 82.06 mm for thyromental distance (TMD). They also reported combination of TMH less than 43.5 mm with MMT which resulted in 78.38% Se, 75.36% Sp and 97.50% NPV. TMH alone showed 91.89% sensitivity and 52.17% specificity with 50 mm cut-off point (17).

RHRMD is an anatomical index which is less subjective in comparison with other measurements such as TMD or MMT. As mentioned earlier, RHRMD has acceptable sensitivity (90.6%) and NPV (97.3%) at cut-off point of 25.4. When compared with the work of Selvi et al., our

technique is not dependent on patients head flexion or extension and our finding have almost the same sensitivity and specificity. RMD is an anatomical index that is easy to measure and is not as much operator dependent as the other indices such as Mallampati test or TMH and TMD. Our finding showed that RMD is related to difficult airway with 78.1% sensitivity and 94.8% NPV at the cut-off point of 6.8 cm (Table 2). Since the modification of RMD as RHRMD has a better correlation with DI, we put the spotlight on RHRMD. Since this is the first study that has introduced this index, it could be considered as a novelty.

There has always been a debate over the relation between Body mass index (BMI) and DI (18), while some authorities consider BMI > 30 kg/m^2 as an independent risk factor for DI (19) others believe that BMI alone is not DI predictor in obese patients (20-22). Moreover, intubation setting is a better predictor of DI in obese patients as DI in ICU is twice more prevalent than in operating theatre (23). Although we found BMI being positively related to CL grade, as BMI increased, CL grade increased as well but we could not find a particular BMI to be established as cut-off point and like the aforementioned studies, we believe BMI is not an independent predictor for DI.

CONCLUSION

Tests with low sensitivity may miss DI during airway evaluation. It seems that RHRMD with its acceptable sensitivity could be used to predict DI. Overall, we recommend RHRMD as an adjunct technique to increase the accuracy of DI prediction and improve patient safety.

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REFERENCES

1. Nørskov AK. Preoperative airway assessment - experience gained from a multicentre cluster randomised trial and the Danish Anaesthesia Database. ***Dan Med J*** 2016;63(5):B5241.
2. Shobha D, Adiga M, Rani DD, Kannan S, Nethra SS. Comparison of Upper Lip Bite Test and Ratio of Height to Thyromental Distance with Other Airway Assessment Tests for Predicting Difficult Endotracheal Intubation. ***Anesth Essays Res*** 2018;12(1):124-9.
3. Roth D, Pace NL, Lee A, Hovhannisyan K, Warenits AM, Arrich J, et al. Bedside tests for predicting difficult airways: an abridged Cochrane diagnostic test accuracy systematic review. ***Anaesthesia*** 2019;74(7):915-28.
4. Torres K, Błoński M, Pietrzyk Ł, Piasecka-Twaróg M, Maciejewski R, Torres A. Usefulness and diagnostic value of the NEMA parameter combined with other selected bedside tests for prediction of difficult intubation. ***J Clin Anesth*** 2017;37:132-5.
5. Roth D, Pace NL, Lee A, Hovhannisyan K, Warenits AM, Arrich J, et al. Airway physical examination tests for detection of difficult airway management in apparently normal adult patients. ***Cochrane Database Syst Rev*** 2018;5(5):CD008874.
6. Khan ZH, Arbabi S. Diagnostic value of the upper lip bite test in predicting difficulty in intubation with head and neck landmarks obtained from lateral neck X-ray. ***Indian J Anaesth*** 2013;57(4):381-6.
7. Samsoon GL, Young JR. Difficult tracheal intubation: a retrospective study. ***Anaesthesia*** 1987;42(5):487-90.
8. Krobbuaban B, Diregpoke S, Kumkeaw S, Tanomsat M. The predictive value of the height ratio and thyromental distance: four predictive tests for difficult laryngoscopy. ***Anesth Analg*** 2005;101(5):1542-5.
9. Siriussawakul A, Limpawattana P. A validation study of the intubation difficulty scale for obese patients. ***J Clin Anesth*** 2016;33:86-91.
10. Mahmoodpoor A, Soleimanpour H, Golzari SE, Nejabatian A, Pourlak T, Amani M, et al. Determination of the diagnostic value of the Modified Mallampati Score, Upper Lip Bite Test and Facial Angle in predicting difficult intubation: A prospective descriptive study. ***J Clin Anesth*** 2017;37:99-102.
11. Ji C, Ni Q, Chen W. Diagnostic accuracy of radiology (CT, X-ray, US) for predicting difficult intubation in adults: A meta-analysis. ***J Clin Anesth*** 2018;45:79-87.

12. Mallampati SR, Gatt SP, Gugino LD, Desai SP, Waraksa B, Freiberger D, et al. A clinical sign to predict difficult tracheal intubation: a prospective study. ***Can Anaesth Soc J*** 1985;32(4):429-34.
13. Badheka JP, Doshi PM, Vyas AM, Kacha NJ, Parmar VS. Comparison of upper lip bite test and ratio of height to thyromental distance with other airway assessment tests for predicting difficult endotracheal intubation. ***Indian J Crit Care Med*** 2016;20(1):3-8.
14. Gonzalez H, Minville V, Delanoue K, Mazerolles M, Concina D, Fourcade O. The importance of increased neck circumference to intubation difficulties in obese patients. ***Anesth Analg*** 2008;106(4):1132-6.
15. Wilson ME, Spiegelhalter D, Robertson JA, Lesser P. Predicting difficult intubation. ***Br J Anaesth*** 1988;61(2):211-6.
16. Khan ZH, Mohammadi M, Rasouli MR, Farrokhnia F, Khan RH. The diagnostic value of the upper lip bite test combined with sternomental distance, thyromental distance, and interincisor distance for prediction of easy laryngoscopy and intubation: a prospective study. ***Anesth Analg*** 2009;109(3):822-4.
17. Selvi O, Kahraman T, Senturk O, Tulgar S, Serifsoy E, Ozer Z. Evaluation of the reliability of preoperative descriptive airway assessment tests in prediction of the Cormack-Lehane score: A prospective randomized clinical study. ***J Clin Anesth*** 2017;36:21-6.
18. Abdullah HR, Chung F. Perioperative management for the obese outpatient. ***Curr Opin Anaesthesiol*** 2014;27(6):576-82.
19. Kheterpal S, Healy D, Aziz MF, Shanks AM, Freundlich RE, Linton F, et al. Incidence, predictors, and outcome of difficult mask ventilation combined with difficult laryngoscopy: a report from the multicenter perioperative outcomes group. ***Anesthesiology*** 2013;119(6):1360-9.
20. Aceto P, Perilli V, Modesti C, Ciocchetti P, Vitale F, Sollazzi L. Airway management in obese patients. ***Surg Obes Relat Dis*** 2013;9(5):809-15.
21. Neligan PJ, Porter S, Max B, Malhotra G, Greenblatt EP, Ochroch EA. Obstructive sleep apnea is not a risk factor for difficult intubation in morbidly obese patients. ***Anesth Analg*** 2009;109(4):1182-6.
22. Wojcikiewicz T, Cousins J, Margarson M. The bariatric airway. ***Br J Hosp Med (Lond)*** 2018;79(11):612-9.
23. De Jong A, Molinari N, Pouzeratte Y, Verzilli D, Chanques G, Jung B, et al. Difficult intubation in obese patients: incidence, risk factors, and complications in the operating theatre and in intensive care units. ***Br J Anaesth*** 2015;114(2):297-306.