ORIGINAL ARTICLE

Best Predictors of Difficult Laryngoscopy in Somali Patients: A Prospective Observational Study

Özlem Deligöz[1)], Betül Kozanhan[2)]

ABSTRACT

Background: **Difficult airway causes unexpected and mortal complications in anesthesia practice. Various screening tests are performed to predict difficult intubation preoperatively. These screening tests are affected by many factors and one of them is ethnic differences.**

Aims: **This study aimed to find the test or tests that best predict difficult laryngoscopy (DVL) in Somalia, one of the East African countries.**

Study Design: **Prospective cross - sectional study**

Methods: **This study including 277 patients over 18 years of age, who were ASA I-II and operated under general anesthesia in elective conditions. All patients were examined with Modified Mallampati (MMP), Mouth opening (MO), Sternomental Distance (SMD), Thyromental Distance (TMD), and Upper lip bite (ULBT) tests preoperatively; and the power of these tests to predict DVL was evaluated.**

Results: **Among the screening tests used, it was determined that the MMP screening test was having the highest rate in predicting DVL when used alone, with -2Log likelihood = 148.045 and Nagelkerke R squared = 0.352 values. Then, all screening tests were analyzed together using the Forward LR method to find the model that could best predict DVL and in the logistic regression analysis, it was found that the model created with ULBT, MO, MMP, and SMD was the model that best predicted DVL.**

Conclusion: **In this study; it was concluded that DVL was best predicted by the ULBT + MMP + MO + SMD model in East Africa.**

KEY WORDS

Cormack-Lehane classification, difficult airway, difficult laryngoscopy, modified mallampati test

INTRODUCTION

Difficult airway management is an important cause of morbidity and mortality in anesthesia practice. The identifying patients at risk for difficult tracheal intubation is particularly important in patients with normal appearance of airways. Preoperative evaluation of various anatomical and clinical features aids to identify a potentially difficult airway. However, the diagnostic accuracy of these screening tests varies between different studies due to the difference in the incidence of difficult laryngoscopy (DVL), insufficient statistical power, different test thresholds, and variations in patient characteristics[1)].

If the data regarding the normal range for a particular population is sufficient, the clinicians can more easily identify potentially difficult patients since they are outside the range. Race or ethnicity is one of the patient characteristics that may affect the incidence of DVL and difficult intubation (DI In literature, this issue was studied extensively on different populations, leading to the foundation of different models aimed at predicting DVL and DI[2-8)]. But in the literature review, adequate data could not be achieved regarding DVL and/or DI in the East African race. In this study, we aimed to find the incidence of DVL in Somalia, one of the East African countries, and to find out the best screening tests model in predicting DVL.

MATERIAL AND METHODS

This is prospective and observational study. ASA I-II, > 18 years patients who planned for elective surgery with general anaesthesia and tracheal intubation from 1 September 2019 to 30 November 2019. Patients were excluded if they were < 18 years, obese (BMI > 30 kg/m^2), have a goiter, facial anomalies, temporomandibular joint disorder, restricted mouth opening and cervical spine mobility, tumours of oropharynx, facial burn and anomalies, underwent obstetric, oromaxillary and mandibular surgeries (Figure 1).

In the pre-operative waiting room, a comprehensive airway assessment was utilized, including Modified Mallampati, Mouth opening, Thyromental distance, Sternomental Distance, Upper lip bite test in all patients by the chief researcher. Mouth opening (MO) was measured the distance between the incisors with the patient in sitting position and the mouth open widely. Modified Mallampati (MMP) was evaluated with the patient in sitting position and the examiner sited in front of the patient at the same level too. Asked the patient to open the mouth widely and protrude the tongue maximally without phonating and head in neutral position. Thyromental distance (TMD) was measured from mentum of mandible to the thyroid notch with the patient in sitting position, head in full extension and mouth closed. Sternomental Distance (SMD) was measured from suprasternal notch to tip of mentum with the patient

Received on May 29, 2022 and accepted on June 1, 2022
1) University of Health Sciences,
Haydarpaşa Numune Training and Research Hospital
Istanbul, Turkey
2) University of Health Sciences, Konya City Hospital
Turkey
Correspondence to: Özlem Deligöz
(e-mail: ozlem.deligoz@gmail.com)

ORCID ID:
Özlem Deligöz: 0000-0002-5651-9827

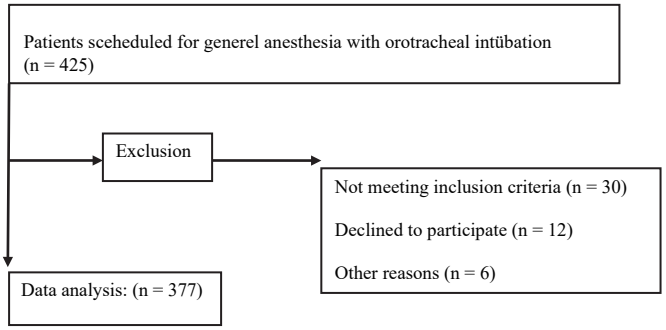

Figure 1: Study and data analysis flowchart

Table 1: Grading of airway.

Airway parameters	Easy	Difficult
MO	> 3 cms	< 3 cms
MMP	Grade I and II	Grade III and IV
TMD	> 6 cms	< 6 cms
SMD	> 12.5 cms	< 12.5 cms
ULBT	Class A and B	Class C

MO: Mouth opening, MMP: Modified Mallampati, TMD: Thyromental distance, SMD: Sternomental Distance, ULBT: Upper lip bite test

Table 2: Demographic data based on Cormack and Lehane's laryngoscopy grading

Variables	Laryngoscopic view		
	Easy (CL 1 and 2)	Difficult (CL 3 and 4)	p
Age (year)	39,46 ± 14,78	45,16 ± 11,80	**,030**
Weight (kg)	69,11 ± 10,38	73,16 ± 10,21	**,039**
Height (cm)	171,93 ± 8,72	175,37 ± 7,71	**,026**
BMI (kg/m²)	23,16 ± 2,33	23,70 ± 2,61	,259
Sex (female/male)	176/169	15/15	**,011**

BMI: Body mass index, CL: Cormack Lehane's

in sitting position, head in full extension and mouth closed. Upper lip bite test (ULBT): The examiner demonstrated to the patient how to do the upper lip bite test. It was divided into three classes as Class A, Class B and Class C[9] .

All patients underwent standard monitorisation in the operating room. Difficult airway materials were always reserved ready. The height of the operating table was adjusted so that the patient's facial plane was at the level of the laryngoscopy and the sternum of the intubating anesthetist. Anesthesia induction was achieved with 2 µg/kg fentanyl and 2-2.5 mg/kg propofol. To facilitate tracheal intubation, 0.6 mg/kg rocuronium was applied. The anesthesiologist who has more than five years of experience in anesthesia did the intubation using a Macintosh 3D blade with the patient's head in the sniffing position. The anesthesiologist was blind for the airway measurements. The laryngoscopic appearance without external laryngeal compression was graded by the Cormack and Lehane (CL) grading. CL Grade I/II was easy, and III/IV was difficult laryngoscopy and potentially difficult intubation.

This study was approved by the Ethics Committee of Mogadishu Somali T kiye Recep Tayyip Erdoğan Training and Research Hospital (no: 158, number:MSTH/2618, dated: 25.11.2019). Written informed consent was obtained from all patients. Data analysis was performed with SPSS (Statistical Package for Social Science) 25.0 program. For the descriptive statistics, continuous variables were expressed with mean ± standard deviation values and nominal variables with frequency and percentage. Binary Logistic regression analysis was used to model the variables. Model compatibility was analyzed with Hosmer-Lemeshow goodness-of-fit statistics. Analyzes were performed using a 95% confidence level and significance was set at $p < 0.05$.

Table 3: Comparison of different airway assesment tests with Logistic regression

DVL	Exp(β)	Sig	95% Cl	-2 log likehood	Nagelkerke R Square
MMP	31,536	**,000**	10,48 - 94,81	148,045	,352
SMD	3,725	,142	,64 - 21,54	194,253	,092
TMD	,922	,924	,17 - 4, 85	186,275	,140
ULBT	5,725	**,010**	1,52 - 21,44	193,918	,094
MO	5,634	**,010**	1,50 - 21,09	174,151	,209

MO: Mouth opening, MMP: Modified Mallampati, TMD: Thyromental distance, SMD: Sternomental Distance, ULBT: Upper lip bite test

Table 4: Stepwise Logistic Regression (Forwad LR)

	Cormack Lehane	Exp(β)	Sig	95% Cl	-2 log likehood	Nagelkerke R Square
Step 1	MMP	35,679	,000	14,43 - 88,21	148,045	,352
	MO	11,399	,000	3,44 - 37,68		
Step 2	MMP	25,649	,000	9,62 - 68,37	133,030	,430
	ULBT	6,320	,005	1,76 - 22,57		
Step 3	MO	9,553	,000	2,69 - 33,88	125,884	,466
	MMP	27,416	,000	9,76 - 76,97		
	ULBT	5,657	,009	1,54 - 20,76		
Step 4	MO	5,578	,010	1,51 - 20,59	122,037	,485
	MMP	31,143	,000	10,68 - 90,77		
	SMD	3,502	,043	1,03 - 11,80		

MO: Mouth opening, MMP: Modified Mallampati, TMD: Thyromental distance, SMD: Sternomental Distance, ULBT: Upper lip bite test

RESULTS

A total of 377 patients were included in the study. Of these, 51% were female (n = 192) and 49% were male (n = 185). 255 (68%) patients were ASA I and 122 (32%) patients were ASA II. DVL was observed in 30 (7.95%) patients. Comparison of the DVL and EVL patients according to age, weight, height, BMI, and gender are shown in Table 2. There were statistically significant differences between the easy and difficult groups in terms of age, weight, and height ($p < 0.05$). A statistically significant dependence was found between gender and CL measurements in groups ($p < 0.05$) (Table 2).

The screening tests used were analyzed with logistic regression in Table 3, and it was determined that TMD and SMD tests were not sufficient to predict DVL ($p < 0.05$). It was found that the MMP screening test was having the highest rate to predict DVL with the values of -2Log likelihood = 148.045 and Nagelkerke R squared = 0.352. To find the model that can best predict DVL, all the screening tests used were analyzed together and the results are summarized in Table 4.

In the logistic regression analysis performed using the Forward LR method in Table 4; other tests were included to the MMP step by step. In Step 4, it was determined that the model created with ULBT, MO, MMP, and SMD was the best predictor of DVL. Hosmer-Lemeshow test of the created model, -2Log = 122.037, and Nagelkerke R Squared = 0.485 were found significant ($p < 0.05$). It was seen that MMP was the strongest

predictor in the model (OR: 31.143; 95% CI:10.68 -90.77; $p < 0.05$). Although SMD was found to be insignificant in table 2, it was included in the analysis, and the model was examined again for its significance. It was found that SMD was significant in the created model, but it was the weakest predictor (OR:3.502; 95% CI: 1.03-11.80; $p < .05$).

DISCUSSION

An anesthetist never wants to face complications of difficult intubation such as severe hypoxia, brain damage, and death. For this reason, accurately predicting the difficult airway has been a priority in anesthesia practice. There are different ways to predict difficult intubation. In most studies, staging of the glottic opening as CL 3 or 4 by direct laryngoscopy has been shown as the gold standard for estimating DI[10,11]. We also used CL staging as the evaluation criterion for difficult intubation and found the incidence of DVL to be 7.95%.

The incidence of DVL was reported in different ranges in previous studies (0.05-18%)[12,13]. This wide variation can be explained by the fact that the laryngeal appearance may be affected by factors such as head position, level of muscle relaxation, cricoid compression, the type, and number of blades used in laryngoscopy. In addition, studies with different populations may also be a factor that needs to be emphasized. This research is the first in this field in Somalia, one of the East African countries.

The ideal screening test should be simple to administer and provide reliable results. It should also be reproducible, and its staging should be based on objective data. MMP is a scoring system used worldwide to predict difficult intubation. Despite some controversy regarding its predictive ability, it remains a clinical assessment method for many anesthetists. In a study conducted in Ireland, they noted that the validity of the positive predictive value of MMP increased from 27% to 100% after combining other predictors[14]. We also found MMP to be the best predictor of DVL alone. Similar results were found in previous studies[4,5,15].

TMD and SMD are accepted as screening tests that are widely used to predict difficult intubation[16]. However, the diagnostic accuracy of these screening tests varied across studies, possibly due to differences in the incidence of difficult intubation, insufficient statistical power, different test thresholds, or differences in patient characteristics. In this study, we also did not find that TMD or SMD as stand-alone DI indicators. When we looked at the step model in estimating DVL, we saw that SMD was also significant, but it was the weakest predictor (OR: 3.502; 95% Cl: 1.03-11.80; $p < 0.05$). This difference may be due to the diversity of the anthropometric characteristics of the populations participating in the study.

Current screening tests for DI have only weak to moderate discriminatory power when used alone. Therefore, test combinations add some incremental diagnostic value compared to the value of each test alone[2]. In the Thai population, the combination of MMT and TMD has been reported to be good predictors of difficult laryngoscopy[3]. In a study conducted with West Africans, it was found that the MMP + TMD + IIG model predicted the DVL best[4], and in another study, the combination of MMP and ULBT gave better results[5]. Again, in two separate studies conducted in India, it was found that the MMP + SMD + NM + NC model[6] and the MMT + ULBT + TMD model[7] in the other predicted DVL better.

We also tried to find a model that better predicts difficult laryngoscopy by including the MO, ULBT, SMD, and TMD tests step by step in the MMP test. When only MMP is used in step 1, Nagelkerke R Squared = 0.352, in step 2 MO + MMP with Nagelkerke R Squared = 0.430, in step 3 ULBT + MO + MMP with Nagelkerke R Squared = 0.466, in step 4 ULBT + MO + MMP + SMD Nagelkerke R Squared = 0.485. In the logistic regression analysis using the Forward LR method, when the other tests were added step by step to the MMP, it was determined that the model formed by ULBT, MO, MMP, and SMD in the 4th step was the model that best predicted DVL.

LIMITATIONS

When we look at the demographic data of easy and difficult laryngoscopy groups, variables such as age, weight, and height contributed significantly to DVL. Similar findings were also confirmed in previous studies[4,6,12,17-19]. In our study, gender difference was statistically significant in DVL. However, the small sample size is one of the main limitations of our study. We think that this finding can be estimated more accurately with larger studies.

CONCLUSIONS

Every anesthesiologist aims to start anesthesia with confidence. Unfortunately, there is still no test or tests that can predict DVL with 100% accuracy. According to our study, ULBT-MMP-MO-SMD appears to be the best combination to predict DVL in East Africa. We believe that more experience and studies are warranted to find models that can better predict DVL in East Africa.

CONFLICT OF INTEREST

None

REFERENCES

1. Shiga T, Wajima Z, Inoue T, Sakamoto A. Predicting difficult intubation in apparently normal patients: a meta-analysis of bedside screening test performance. The Journal of the American Society of Anesthesiologists. 2005; 103(2): 429-37.
2. Kurtipek O, Isik B, Arslan M, Unal Y, Kizil Y, Kemaloglu Y. A study to investigate the relationship between difficult intubation and prediction criterion of difficult intubation in patients with obstructive sleep apnea syndrome. Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences. 2012; 17(7): 615.
3. Ittichaikulthol W, Chanpradub S, Amnoundetchakorn S, Arayajarernwong N, Pawaropart N, Wongkum W. Modified Mallampati test and thyromental distance as a predictor of difficult laryngoscopy in Thai patients. Medical journal of the Medical Association of Thailand. 2010; 93(1): 84.
4. Merah NA, Wong DT, Ffoulkes-Crabbe DJ, Kushimo OT, Bode CO. Modified Mallampati test, thyromental distance and inter-incisor gap are the best predictors of difficult laryngoscopy in West Africans. Canadian journal of anaesthesia= Journal canadien d'anesthesie. 2005; 52(3): 291-6.
5. Sudhamala P, Dhanalakshmi SKS, Ramachandran G. Anticipating difficult tracheal intubation by observing Modified Mallampati Grade, Thyromental Distance and Upper Lip Bite Test. A prospective observational study.
6. Chhina AK, Jain R, Gautam PL, Garg J, Singh N, Grewal A. Formulation of a multivariate predictive model for difficult intubation: A double blinded prospective study. Journal of anaesthesiology, clinical pharmacology. 2018; 34(1): 62.
7. Wajekar AS, Chellam S, Toal PV. Prediction of ease of laryngoscopy and intubation-role of upper lip bite test, modified mallampati classification, and thyromental distance in various combination. Journal of family medicine and primary care. 2015; 4(1): 101.
8. Kim JH, Choi JW, Kwon YS, Kang SS. Predictive model for difficult laryngoscopy using machine learning: retrospective cohort study. Brazilian Journal of Anesthesiology (English Edition). 2021;
9. 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. Anesthesia & Analgesia. 2009; 109(3): 822-4.
10. Haq MIU, Ullah H. Comparison of Mallampati test with lower jaw protrusion maneuver in predicting difficult laryngoscopy and intubation. Journal of anaesthesiology, clinical pharmacology. 2013; 29(3): 313.
11. Balakrishnan KP, Chockalingam PA. Ethnicity and upper airway measurements: A study in South Indian population. Indian journal of anaesthesia. 2017; 61(8): 622.
12. Lakhe G, Poudel H, Adhikari KM. Assessment of Airway Parameters for Predicting Difficult Laryngoscopy and Intubation in a Tertiary Center in Western Nepal. Journal of Nepal Health Research Council. 2019; 17(4): 516-20.
13. Kaniyil S, Krishnadas Anandan ST. Ratio of height to thyromental distance as a predictor of difficult laryngoscopy: a prospective observational study. Journal of anaesthesiology, clinical pharmacology. 2018; 34(4): 485.
14. Patel B, Khandekar R, Diwan R, Shah A. Validation of modified Mallampati test with addition of thyromental distance and sternomental distance to predict difficult endotracheal intubation in adults. Indian journal of anaesthesia. 2014; 58(2): 171.
15. Khatiwada S, Bhattarai B, Pokharel K, Acharya R. Prediction of difficult airway among patients requiring endotracheal intubation in a tertiary care hospital in Eastern Nepal. Age (yr). 2017; 38: 14-5.
16. Janssens M, Hartstein G. Management of difficult intubation. European journal of anaesthesiology. 2001; 18(1): 3-12.
17. Basunia SR, Ghosh S, Bhattacharya S, Saha I, Biswas A, Prasad A. Comparison between different tests and their combination for prediction of difficult intubation: An analytical study. Anesthesia, essays and researches. 2013; 7(1): 105.
18. Gonzalez H, Minville V, Delanoue K, Mazerolles M, Concina D, Fourcade O. The importance of increased neck circumference to intubation difficulties in obese patients. Anesthesia & Analgesia. 2008; 106(4): 1132-6.
19. Kim JC, Ki Y, Kim J, Ahn SW. Ethnic considerations in the upper lip bite test: the reliability and validity of the upper lip bite test in predicting difficult laryngoscopy in Koreans. BMC anesthesiology. 2019; 19(1): 1-6.