Original Research Article

Indian Journal of Anesthesia and Analgesia
2018; 5 (2): 289-293
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.5218.23

Efficacy of Airway Assessment Variables as Predictors of Difficult Intubation among Northeastern Population in India: A Hospital Based Prospective Study

Tridip J. Borah[1], Md Yunus[2], Habib Md R Karim[3], Laltanpuii Sailo[4], Samarjit Dey[5]

[1]Senior Resident [2]Addl. Professor, [4,5]Assistant Professor, Department of Anaesthesiology and Critical Care, North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences, Shillong, Meghalaya 793012, India. [3]Assistant Professor, Department of Anaesthesiology and Critical Care, Andaman and Nicobar Islands Institute of Health and Medical Sciences, Port Blair, Andaman and Nicobar Islands 744104, India.

Abstract

Background and aim: Difficult intubation is an important cause of mortality in surgical patients; even more so when it is unanticipated. Predicting difficult intubation with the help of different airway parameters has been the endeavor of all anesthesiologists. However, there are variations in the accuracy of these airway parameters due to differences in race and ethnicity. The present study was aimed to assess the efficacy of various airway parameters in predicting difficult intubation in the northeast Indian population. *Methods:* Four hundred adult American Society of Anesthesiologists physical status I and II patients scheduled for elective surgery under general anaesthesia requiring tracheal intubation were assessed preoperatively for different predicting factors of difficult laryngoscopy and intubation. Intubation difficulty was assessed by the Intubation Difficulty Scale. Sensitivity, specificity, positive predictive value and negative predictive value were calculated. The association between different variables and difficult intubation was evaluated using Fishers exact test; p-value < 0.05 was considered significant. *Results:* The mean age of the patients was 43.40±12.49 years; 60% patients were male. 23 (5.75%) patients were having difficult intubation. While all the parameters were strongly able to predict difficulty, thyromental distance < 6 cm and Cormack Lehane grade ≥ 3 were having the most strong relative risk (8 and 100.22 respectively; $p < 0.0001$ for both). Only Cormack Lehane grade ≥ 3 was having both good sensitivity and specificity (95.65% and 86.74% respectively). *Conclusion:* Difficult intubation rate is not different in northeastern Indian population. Thyromental distance , Modified Mallampati score and Cormack Lehane view were the strongest predictors of difficult intubation in the study population.

Keywords: Laryngoscopy; Airway Management; Intubation; Prediction.

Introduction

A difficult airway has been defined as the clinical situation in which a conventionally trained anesthesiologist experiences difficulty with facemask ventilation of the upper airway, difficulty with tracheal intubation, or both [1]. Difficult of failed endotracheal intubation under general anaesthesia (GA) may bring on fatal outcomes. Up to 30% of anesthetic deaths were being attributed to a compromised airway [2]. The importance of prior airway assessment as a means to decrease complications in anesthesia has been well recognized. Several clinical systems were developed a few decades ago for predicting difficult intubation [3,4,5] .

The majority of studies of difficult laryngoscopy and intubation have been performed in western population [3,4,6]. Anthropometrically, Indians, especially the north east Indians are different compared to them. Adequate data of values in a given population may help the clinician to identify patients who are outside the range and therefore potentially challenging. Investigators have henceforth attempted to predict difficult intubation by using simple bedside tests (airway assessment parameters) like Modified Mallampati score (MMS), thyromental distance (TMD), sternomental distance

Corresponding Author: Md Yunus, Sub dean (Research) and Addl. Prof., Department of Anaesthesiology and Critical Care, North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences, Shillong, Meghalaya 793012, India.
E- mail: drmdyunus@hotmail.com

Received on 14.10.2017, **Accepted on** 30.10.2017

(SMD), neck circumference, receding mandible etc. Nevertheless, the diagnostic accuracy of these screening tests has varied from trial to trial which is probably because of differences in the incidence of difficult intubation, inadequate statistical power, different test thresholds, or differences in patient characteristics [7,8]. The objective of the present study was to assess the efficacy of various bedside airway parameters including Cormack and Lehane grade in predicting difficult intubation in patients of northeast India.

Methods

After the approval from the institutional ethics committee, the present prospective observational study was conducted in a tertiary care teaching hospital during (May, 2015 to February, 2017). The incidence of difficult intubation is around 8% [9]. The present study was planned with an absolute precision of 3% for an indefinite population which gave us the required sample size 315. A design effect of 1.25 was taken based on the non randomized nature of sampling which gave a total required participant as 393. Four hundred adult American Society of Anaesthesiologists (ASA) physical status I and II patients scheduled for elective surgery under GA requiring endotracheal intubation were included after obtaining written informed consent from the participants (patients). Patients with obvious anatomical and pathological abnormality of the airway, those at increased risk of aspiration, inter-incisor distance < 2 cm and unstable cervical spine were excluded from the study. The age, sex and body mass index (BMI) etc. were noted. All patients were assessed in the evening day before surgery by a single observer for collecting data of airway assessment variables. The modified Mallampati class (MMC), inter-incisor distance (IID) < or ≥ 3.5 cm, thyromental distance (TMD) < or ≥ 6 cm, sternomental distance (SMD) < or ≥12.5 cm, range of head and neck movements (Grade I ≥ 90°, II = 80° - 90° and III < 80°), ability to prognoth (Class I- lower incisors can bite the upper lip above the vermilion line, II- can bite the upper lip below the vermilion line and III- cannot bite the upper lip), protruding incisors etc. were noted.

All intubations were facilitated with and attempted after 3 minutes of injecting vecuronium 0.1 mg/kg intravenously after standard GA induction. Intubation was performed using appropriate sized Macintosh blade with the patient's head in sniffing position by anaesthesiologists with more than five years experience in anaesthesia. Laryngoscopic glottis view was graded by Cormack and Lehane grading [3]. Intubation difficulty was assessed by using the scores from Intubation Difficulty Scale (IDS). IDS score = 0 represented easy intubation, 1-5 represented slight difficulty and IDS score ≥ 6 represented major difficulty in intubation [10]. Alternative techniques included patient repositioning, change of blade or tracheal tube, use of stylet, laryngeal mask airway (LMA), intubating LMA, fibreoptic intubation or intubation through LMA. The study ended after successful tracheal intubation was confirmed by assessment of chest movement, auscultation and capnography. If tracheal intubation was not possible by any means, it was noted as impossible.

Data was calculated in absolute numbers and presented in percentage scale. The measures of central tendencies were also calculated for metric data. Sensitivity, Specificity, positive and negative predictive value and accuracy for each airway predictor was calculated using standard formula. The association between different airway assessment variables and difficulty in intubation was evaluated using the Fishers exact test and $p < 0.5$ was considered as significant. INSTAT software (Graphpad prism software, Inc,. La Zolla, CA. USA) was used for statistical analysis.

Results

All the 400 participants completed the study and were included in the study. Majority (60%) of the participants were male. The participants were in the range of 18 to 76 years of age with median ASA physical class I. The demographic parameters of the study participants are presented in Table 1.

Twenty three (5.75%) patients were having MMS 3 or more while 6.5% of the patients were having TMD less than 6 cm. The numbers of patients and respective percentage scale for different airway parameters assessed are presented in Table 2. 318 (79.5%) of the patients had easy intubation, 59 (14.75%) had slight difficulty and 23 (5.75%) patients were having moderate to major difficulty in intubation. No intubation was found to be impossible.

The MMS 3 and more, TMD < 6 cm, SMD < 12.5 cm, restricted neck extension, inability prognath up to vermilion line, higher Cormack and Lehane class showed a strong relation with difficult intubation ($p \leq 0.001$) in univariate analysis (Table 3). Thyromental distance < 6 cm followed by MMS 3

Tables 1: Demographic measures of the participants (SD- standard deviation, BMI – Body mass Index, ASA – American Society of Anaesthesiologists, (q3 – q1) – third and first quartile range)

Patient characteristics	Mean ± SD or n (%) or median (q3 – q1)
Male	240 (60.0)
Female	160 (40.0)
Age (years)	43.40 ± 12.49
Age groups	
18 – 40	118 (29.50)
40 – 65	223 (55.75)
>65	59 (14.75)
Weight (kg)	66.26 ± 17.71
Height(centimeters)	158.44 ± 6.19
BMI(kg/m2)	23.93 ± 3.79
ASA physical class	1 (2 – 1)
ASA I	239 (59.75)
ASA II	161 (40.25)

Table 2: Distribution of the participants with regard to the different airway variable assessed. (IQR – inter quartile range)

Airway Parameters	n (%) / Median (q3 – q1)
Modified Mallampati Score	1 (2 – 1)
Class I	231 (57.75)
Class II	146 (36.5)
Class III	13 (3.25)
Class IV	10 (2.50)
Inter incisor distance	
Class I > 3.5 cm	384 (96)
Class II< 3.5 cm	16 (4)
Thyromental distance	
Class I > 6 cm	374 (93.5)
Class II< 6 cm	26 (6.5)
Sternomental distance	
Class I > 12.5 cm	376 (94)
Class II< 12.5 cm	24 (6)
Head & Neck movements	
Class I > 90 degree	352 (88)
Class II > 80 – 90 degree	48 (12)
Class III < 80 degree	0
Protruding incisors	
Yes	12 (3)
No	388 (97)
Ability to prognath	
Yes (class I & II)	388 (97)
No (class III)	12 (3)
Cormack and Lehane grade	1 (2 – 1)
Grade I & II	328 (82.0)
Grade III & IV	72 (18.0)

Table 3: Relationship of airway assessment variables with intubation difficulty analyzed using Fishers exact test. (IDS – intubation difficulty scale, RR – relative risk, CI – confidence interval)

Airway assessment Variables	Intubation as per IDS		RR (95% CI)	Two tailed p
	Difficult [N= 23]	Easy + slight difficult [N = 377]		
Modified Mallampati			8.742	<0.0001
Class III & IV	8(2%)	15(4%)	(4.13-18.46)	
Class I & II	15(4%)	362(91%)		
Inter incisor distance			5.053	0.0096
Class II< 3.5 cm	4(1%)	12(3%)	(1.943-13.136)	
Class I > 3.5 cm	19(5%)	365(91%)		
Thyromental distance			8	<0.0001
Class II< 6 cm	8(2%)	17(4%)	(3.754-17.051)	
Class I > 6 cm	15(4%)	360(90%)		

Sterno mental distance			5.529	0.0012
Class II < 12.5 cm	6(2%)	18(5%)	2.400-12.737	
Class I > 12.5 cm	17(4%)	359(90%)		
Head & Neck movements Class II &			9.533	<0.0001
III	13(3%)	35(9%)	(4.425-20.537)	
Class I	10(3%)	342(86%)		
Protruding incisors			4.850	<0.0260
No	20(5%)	368(92%)	(1.665-14.128)	
Yes	3(1%)	9(2%)		
Ability to prognath			8.981	0.0002
No (class III)	18(5%)	370(93%)	4.006-20.13	
Yes (class I & II)	5(1%)	7(2%)		
Cormack & Lehane			100.22	< 0.0001
3 & 4	22(6%)	50(12%)	13.725-731.86	
1 & 2	1	327(82%)		

Table 4: Accuracies of different airway assessment parameters assessed in predicting difficult intubation. (PPV – positive predictive value, NPV- negative predictive value)

Variable Assessed	Sensitivity	Specificity	PPV	NPV
Modified Mallampati	34.78	96.02	34.78	96.02
Inter incisor distance	17.39	96.82	25	95.05
Thyromental distance	34.78	95.49	32	96
Sterno mental distance	26.09	95.23	25	95.48
Head & Neck movements	56.52	90.72	27.08	97.16
Protruding incisors	13.04	97.61	25	94.85
Ability to prognath	21.74	98.14	41.67	95.36
Cormack & Lehane view	95.65	86.74	30.56	99.70

and above was found to be the highest predictor among the external airway parameters assessed.

All the external parameters assessed had very well (> 90%) in terms of specificity, only Cormack and Lehane showed very good sensitivity and negative predictive value too to predict difficult intubation (Table 4). Inter incisor distance had the lowest sensitivity while inability to prognath was having the highest specificity. The sensitivity, specificity, positive and negative predictive values of individual variables is presented in Table 4.

Discussion

Difficult laryngoscopy and intubation in the operation theatre can lead to major morbidity and mortality. Unanticipated difficult intubation is an even greater risk. The ASA has defined difficult tracheal intubation as when "proper insertion of the endotracheal tube with conventional laryngoscopy requires more than three attempts, or more than ten minutes."[11]. However this definition is not much objective. The IDS has a scoring system for different components and parameters related to tracheal intubation which gives objectivity.

The incidence of moderate to major difficult intubation in the present study was 5.75%. The incidence of difficult intubation in our study was nearly similar to the findings of other similar studies [8,12,13]. No intubation was impossible in our study. It was found that despite having good glottis view (i.e. Cormack & Lehane grade 1 or 2) tracheal intubation was having major difficulty in two cases which state that glottis exposure alone is an incomplete reflection of intubation difficulty. Similar findings were found in the study conducted by Adnet et al too [13].

The different airway assessment parameters assessed as predictors showed significant association with the outcome i.e difficult intubation as measured by IDS. However the sensitivity, specificity, positive predictive value, negative predictive values indicate that most of the external airway parameters are having average to poor sensitivity except TMD. Although Cormack & Lehane grade 1 or 2 glottic view does not completely exclude difficult intubation; Cormack & Lehane grade ≥ 3 do have a very good accuracy in terms of sensitivity and specificity in predicting difficult intubation.

The MMS showed sensitivity of only 34.78% which was nearly similar to the result of El-Ganzouri et al. (44.7%) [14]. The specificity of MMS was also comparable to that study of El-Ganzouri et al and Merah et al [14,15]. This indicates that the MMS ≥ 3 has poor capacity to correctly predict difficult

intubation but MMS ≤ 2 is better in correctly predicting easy intubation. Among the external bedside airway assessment parameters, we found the TMD and MMS had the highest sensitivity however, all the predictors had high specificity (>90%). These findings were similar to the other studies conducted in different populations [16,17, 18]. Our findings also concur indirectly with the meta analysis of Shiga et al who inferred that a combination of the Mallampati classification and thyromental distance had the highest discriminative power among currently available tests for predicting difficult intubation [7].

The present study is however limited with the fact that this is a single centre study. Although the study was planned with 80% power and was conducted in a tertiary care referral hospital, only 400 participants do not represent the huge diverse population very well too.

Conclusion

The MMS ≥ 3, TMD ≤ 6 cm, SMD ≤ 12.5 cm, restricted neck extension, inability prognath up to vermilion line are having significant relation with difficult intubation as measured by IDS in northeastern Indian population; MMS ≥ 3 and TMD ≤ 6 cm were having the highest discriminative power. Cormack and Lehane ≥ 3 view is the best the predictor of difficult intubation having very good sensitivity, specificity and relative risk.

References

1. Apfelbaum JL, Hagberg CA, Caplan RA, Blitt CD, Connis RT , Nickinovich DG, et al. Practice guidelines for management of the difficult airway: An updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Anesthesiology 2013;118:251–70.
2. Salimi A, Farzanegan B, Rastegarpour A, Kolahi AA. Comparison of the upper lip bite test with measurement of thyromental distance for prediction of difficult intubations. Acta Anaesthesiol Taiwan 2008;46:61-65.
3. Cormack RS, Lehane J. Difficult tracheal intubation in obstetrics. Anaesthesia 1984;39:1105-11.
4. 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;32:429–34.
5. Samsoon GL, Young JR. Difficult tracheal intubation: a retrospective study. Anaesthesia 1987;42:487–90.
6. Wilson ME, Spiegelhalter D, Robertson JA, Lesser P. Predicting difficult intubation. Br J Anaesth.1988; 61:211–6.
7. Randell T. Prediction of difficult intubation. Acta Anaesthesiol Scand 1996;40:1016–23.
8. Shiga T, Wajima Z, Inoue T, Sakamoto A. Predicting difficult intubation in apparently normal patients. Anesthesiology 2005;103:429-37.
9. Langeron O, Masso E, Huraux C, Guggiari M, Bianchi A, Coriat P, et al. Prediction of difficult mask ventilation. Anesthesiology 2000;92:1229-36.
10. L'Hermite J, Nouvellona E, Cuvillona P, Fabbro-Peray P, Langerond O, Ripart J. The Simplified Predictive Intubation Difficulty Score: a new weighted score for difficult airway assessment . European J Anaesthesiol 2009;26:1003–9.
11. American Society of Anesthesiologists: Practice guidelines for management of the difficult airway. A report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Anesthesiology 1993;78:597-602.
12. Crosby ET, Cooper RM, Douglas MJ, Doyle DJ, Hung OR, Labrecque P, et al. The unanticipated difficult airway with recommendations for management. Can J Anaesth 1998;45:757-76.
13. Adnet F, Borron SW, Racine SX, Clemessy J, Fournier, Plaisance P, et al. The Intubation Difficulty Scale (IDS): Proposal and evaluation of a new score characterizing the complexity of endotracheal intubation. Anesthesiology 1997;87:1290-7.
14. el-Ganzouri AR, McCarthy RJ, Tuman KJ, Tanck EN, Ivankovich AD. Preoperative airway assessment: Predictive value of a multivariate risk index. Anesth Analg 1996;82:1197-204.
15. 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. Can J Anaesth 2005;52:291-6.
16. Iohom G, Ronayne M, Cunningham AJ: Prediction of difficult tracheal intubation. Eur J Anaesthesiol 2003;20:31–6.
17. Ayoub C, Baraka A, el-Khatib M, Muallem M, Kawkabani N, Soueide A. A new cut-off point of thyromental distance for prediction of difficult airway. Middle East J Anesthesiol 2000;15:619–33.
18. Wong SH, Hung CT: Prevalence and prediction of difficult intubation in Chinese women. Anaesth Intensive Care 1999;27:49–52.