Research Article

Predictive value of upper lip bite test and ratio of height to thryromental distance for predicting difficult laryngoscopy in apparently normal Guajarati patients

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Abstract

Background: Maintaining a patent airway in anesthetized patients is the important responsibility of an anesthesiologist.

Objective: Study conducted with the objectives to evaluate sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), relative risk (RR), odd ratio (OR) and LR for various screening tests like upper lip bite test (ULBT), ratio of height to thyromental distance (RHTMD), interincisor gap (IIG), modified Mallampatti Test (MMT), thyromental distance (TMD) and head and neck movement (HNM) in isolation.

Materials and Methods: In this prospective, single blinded observational study, 480 adult patients of either sex, ASA grade I and II were assessed and graded for ULBT, RHTMD, TMD, MMT, IIG, and HNM according to standard methods and association with the Cormack and Lehane grade.

Results: TMD, ULBT and RHTMD had highest sensitivity, specificity, positive predictive value, negative predictive value, likelihood ratio which was 46.67%, 95.45%, 63.64%, 91.3%, 4.94 and 46.67%, 92.05%, 50.0%, 91.01%, 5.13 and 40%, 90.91%, 42.85%, 89.89%, 4.45, respectively.

Conclusion: Out of all the 6 predictive tests evaluated, TMD, ULBT and RHTDM are the best predictive test for difficult laryngoscopy.

KEYWORDS: Difficult laryngoscope, upper lip bite test (ULBT), thyromental distance (RHTMD), interincisor gap (IIG), thyromental distance (TMD)

Introduction

Endotracheal intubation remains the gold standard for emergency airway management. In emergency, medicine, anesthesiology, and critical care airway management required broader skill.[1] An anesthesiologist have important responsibility to maintain a patent airway.[2] Because of difficult intubation, almost 50–75% cardiac arrest during general anesthesia that causes inadequate ventilation, which about most of them cause death or brain death.[3–5]. In difficult laryngoscopy, there are some chances of difficult intubation in most of the patients. According to data reported, 1.5–13% difficult intubation observes in the patients undergoing surgery.[6] Preoperative airway assessment tests mouth opening or inter-incisor gap (IIG), head and neck movement (HNM), modified Mallampatti Test (MMT), Wilson risk score (WS), horizontal length of mandible (HLM), sternomental distance (SMD), thyromental distance (TMD) used to predict difficult intubations.[7-11]

Study conducted with the objectives to evaluate sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), relative risk (RR), odd ratio (OR) and LR for various screening tests like upper lip bite test (ULBT), ratio of height to thyromental distance (RHTMD),IIG,MMT, TMD and, HNM in isolation, with an attempt to determine a more comprehensive and accurate as well as simple and clinically applicable to day to day basis parameter for predicting difficult laryngoscopy.

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Materials and Methods

After institutional ethical committee approval, this prospective observational study was done among 103 patients admitted during March 2014 to October 2015 at sola civil hospital, Ahmedabad. More than 18 years, of both sex, of American Society of Anesthesiologists grade I and II, undergoing elective surgeries under general anesthesia were the inclusion criteria for selection of patients. Following routine pre anesthetic check up by the attending anesthesiologist, informed written consent was taken from each patient. The airway was assessed preoperatively in the pre induction room on the day of surgery by the same anesthesiologist in all studied patients to avoid inter observer error.

IIG was measured by asking each patient to open the mouth as wide as possible. The distance between upper and lower incisor at the midline was measured and graded (Table 1).[12] Maximum range of HNM movement was noted and graded (Table 1).[12] The patient was first asked to extend the head and neck fully, while a pencil was placed vertically on the forehead and then while the pencil was held firmly in position, the head and neck was flexed. The oropharyngeal view was assessed using a MMT.[13] and measured by asking the patient to open his or her mouth maximally and to protrude the tongue without phonation, while seated (Table 1). TMD was measured from the bony point of the mentum while the nearest 0.5 cm. (Table 1)[8]

Study has also assessed height, body weight, and body mass index (BMI). Height of the patient was measured in centimetres from vertex to heel with the patient standing and was rounded to the nearest 1 cm. RHTMD) was calculated as follows and graded[14] (Table 1). RHTMD = Height (in cms)/TMD (in cms). ULBT was done to assess the range of freedom of the mandibular movement and the architecture of the teeth concurrently.[14] Each patient was asked to bite their upper lip with lower incisor and categorized as (Table 1): Class I: lower incisor can hide mucosa of upper lip. Class II: lower incisor can partially hide mucosa of upper lip. Class III: lower incisor unable to touch mucosa of upper lip.

In all the patients, standardized anesthetic protocol was followed. After establishing venous access and standard monitoring all the patients was administered intravenous (IV) Ranitidine 1 mg/kg, Ondansetron 0.15 mg/kg, Glycopyrrolate 0.004 mg/kg, Midazolam 0.03 mg/kg and Fentanyl 1–2 mcg/kg. Following preoxygenation, anesthesia was induced with Propofol 2–2.5 mg/kg IV and Succinylcholine 2 mg/kg was given to facilitate endotracheal intubation. The lungs had been ventilated with 100% oxygen with help of a facemask. Laryngoscopy was performed after the loss of the fasciculations in the lower limb. With patient's head in the sniffing position, laryngoscopy was performed with a Macintosh # 3/4 numbered laryngoscope blade by an anesthesiologist (of at least two year experience) who was blinded to the results of preoperative airway assessment and recorded the Cormack and Lehane score (without giving backward upward rightward pressure [BURP]) maneuver from 1–4, defining the difficult laryngoscopic view as Cormack grade 3–4.[8] All collected data was entered in an excel worksheet. Statistical tools in excel sheet were used.

Result

Table 2 shows that 88 (85.5%) participants belonged to class I and II and 15 (14.5%) belonged to class III and IV. Mean age, weight, and BMI was higher in class I and II than class III and IV but statistically not significant. There was a statistically significant association of sex and grading distribution.

Table 3 shows that 15 patients had IIG grade II (≤4 cm), 15 patients had HNM grade II (≤800), 22 patients had MMT class III and IV, 11 patients had TMD (≤6 cm), 14 patients had RHTMD (≥23.5 cm), 14 patients had ULBT class III.

Table 4 and 5 shows that TMD, ULBT, MMT has higher specificity, positive predictive value, odds ratio, relative risk, positive likenhood ratio and accuracy. Sensitivity was highest to IIG.

Discussion

This study found statistically not significant association ($p > 0.05$) between demographic data (age, weight, height and body mass index) and the incidence of difficult laryngoscopy. This findings are consistent with studies done by Krobbuaban et al.[15] (study of 550 patients). Safavi et al.[16]

Table 1: Grading of various predictive tests

Predictive Tests	Grade 1	Grade 2	Grade 3
Inter-Incisor Gap (IIG)	>4 cm	≤4 cm	
Head And Neck Movement (HNM)	$>80^0$	$\leq 80^0$	
Thyromental Distance (TMD)	>6.5 cm	6.0-6.5 cm	≤6.0 cm
Oropharyngeal View (MMT)	Class I (Easy)	Class II (Easy)	Class III & IV (Difficult)
Upper Lip Bite Test (ULBT)	Class I (Easy)	Class II (Easy)	Class III (Difficult)
Ratio of Height to Thyromental Distance	<23.5	≥23.5	

IIG=Inter-Incisor Gap; TMD=ThyroMental Distance; MMT=Modified Mallampatti Test; ULBT = Upper Lip Bite Test

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

Variable	Laryngoscope assessment (mean ± sd)		*p* value
	Easy (class I and II) (*n* = 88)	Difficult (class III and IV) (*n* = 15)	
Age (In Years)	37.70 ± 12.55	36.97 ± 12.32	0.84*
Weight (kg)	54.95 ± 13.43	54.62 ± 14.24	0.93*
Height (cm)	156.23 ± 9.18	156.71 ± 9.57	0.85*
BMI (kg/m^2)	22.57 ± 5.49	22.27 ± 5.71	0.85*
Sex			
Male	16	10	0.0001**
Female	72	5	

*- t-test, **- Chi-square test

Table 3: Distribution of various predictive tests based on Cormack and Lehane's laryngoscope grading

Factors	Grade	Total case	Class I (61)	Class II (27)	Class III (14)	Class IV (1)
IIG	I	47	34	8	4	1
	II	56	27	19	10	0
HNM	I	88	53	23	12	0
	II	15	8	4	2	1
MMT	CL I	49	40	9	0	0
	CL II	32	18	8	6	0
	CL III	19	3	8	7	1
	CL IV	3	0	2	1	0
TMD	>6.5 cm	85	58	21	9	0
	6-6.5 cm	7	1	4	2	0
	≤6.5 cm	11	2	2	6	1
RHTDM	<23.5 cm	89	59	21	9	0
	≥23.5 cm	14	2	6	5	1
ULBT	CL I	71	54	15	1	1
	CL II	18	6	6	6	0
	CL III	14	1	6	7	0

(study of 603 patients) found significant association between old age, obesity, high BMI with the incidence of difficult intubation in contrast to present study. The incidence of difficult intubation is 15, 1.8, 7, and 13%,[17–19,9] respectively, depending on the criteria used to define it. The incidence of failure to intubate the trachea is 0.05– 0.35%. [9] This study found that 15 patients (14.6%) had difficult intubation out of 103 patients.

The present study found IIG has the sensitivity, specificity, PPV, NPV of inter-incisor gap is 66.67, 47.73, 17.86, 89.36%, respectively. The sensitivity is highest which suggests that IIG can correctly predict difficult laryngoscopy than other tests. This study found that HNM has least sensitivity and NPV, and relative risk, odds ratio, likelihood ratio and accuracy are also less when compares to all the remaining 5 airway predictors used in the study. This low sensitivity is unacceptable in clinical practice. In this study – The sensitivity, specificity, PPV, NPV of Mallampati score was 60, 85.23, 40.91, 92.59%, respectively. low sensitivity and PPV, with high specificity and NPV (p<0.001) were found. The sensitivity of MMT was less than IIG but higher compared to all other tests. Patil et al.[20] has observed that TMD alone had been advocated as a screening test for predicting difficult laryngoscopy. A number of studies defined TMD < 7 cm to predict difficult intubation.[10] In spite of higher cut-off, these studies observed low sensitivity, specificity and PPV of TMD ($p < 0.0001$). Present study observed TMD have specificity with low sensitivity which is not acceptable. This findings are consistent with study done by Domi et al.[11], Cattano et al.[21], Krobbuaban et al.[15] and Khan et al.[22] This findings are not consistent with study done by Orozco-Diaz et al.[23], Basunia et al.[24], Shah et al.[25]

Khan et al.[22] introduced ULBT as a simple and effective method for predicting difficult intubations in 2003. In present study, ULBT has high specificity and PPV and NPV ($p < 0.0001$), which is best in identifying laryngoscopy and easy tracheal intubation. Lower sensitivity of ULBT can be explained due to low incidence of ULBT class III in this study. The results were consistent with findings of studies by Khan et al.[22] and Eberhart et al.[26]. The sensitivity of ULBT was

Table 4: Comparison of various predictive tests in predicting difficult laryngoscopy

Factors	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	OR	RR	PLR	Accuracy	*p* value
IIG	66.67	47.73	17.86	89.36	1.02	1.68	1.43	50.49	0.3
HNM	20	86.36	20	86.36	3.29	1.47	2.34	76.7	0.45
MMT	60	85.23	40.91	92.59	4.42	5.52	7.12	81.55	<0.001
TMD	46.67	95.45	63.64	91.3	7.58	7	4.94	88.35	<0.001
RHTDM	40	90.91	42.85	89.89	5.06	4.24	4.45	83.5	<0.001
ULBT	46.67	92.05	50	91.01	5.87	5.56	5.13	85.44	<0.001

PLR: positive likelihood ratio

Table 5: Comparison of various predictive tests

Criteria	Order of various airway assessment tests
Sensitivity	IIG>MMT>TMD>ULBT> RHTMD>HNM
Specificity	TMD>ULBT>RHTMD>HNM >MMT>IIG
PPV	TMD>ULBT> RHTMD>MMT>HNM>IIG
NPV	MMT>TMD>ULBT> RHTMD>IIG >HNM
OR	TMD>ULBT>RHTMD>MMT>HNM>IIG
RR	TMD>ULBT>MMT>RHTMD>IIG>HNM
PLR	MMT>ULBT>TMD>RHTMD>HNM>IIG
Accuracy	TMD>ULBT>RHTMD>MMT>HNM>IIG

higher, but specificity and NPV was lesser than the observations of other authors.[27,28] The second best test in present study was RHTMD with higher specificity, PPV, OR and accuracy (p<0.0001) (Table 5 and 6). Schmitt et al.[14] introduced RHTMD, has good predictive value for predicting difficult laryngoscopy than TMD. This findings are not consistent with study done by Krobbuaban et al.[15], Shah et al.[25], Safavi et al.[16] and Krishna et al.[29]

Conclusion

To conclude, present study demonstrates that the TMD is the best predictive test for difficult laryngoscopy out of all the six predictive tests evaluated. ULBT can be used as an acceptable alternative with a decent predictability. Since the etiology of difficult airway is multifactorial, integration of ULBT and RHTMD with other commonly used predictive test would be helpful to improve prediction of difficult airway.

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