



## Comparison of four methods for predicting difficult intubation

Javaher Foroosh Zadeh F\* and Safaii Sara

Pain Research Center, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran

Received for publication: November 27, 2015; Accepted: December 22, 2015.

**Abstract:** Confirmation of endotracheal tube appointment is of critical importance, since unrecognized esophageal intubation can be rapidly lethal (death, brain damage). The aim of our study was to compare four different methods for prediction of difficult intubation: Mallampati, Thyro-mental distance, ULBT (Upper Lip Bite Test), and Inter incisor gap. In a prospective study, 448 patients with a mean age of 53.5 who were scheduled for elective surgery were selected randomly and enrolled. Before induction of anesthesia, the airways were assessed by Mallampati test, Thyro mental distance, Upper lip bit test (ULBT) and Inter incisor gap. Laryngoscopic view according to the Cormack and Lehane grading system was determined after induction of anesthesia and Grades 3 and 4 defined as “difficult intubation.” Degree of observed difficulty of intubation was compared to predicted values. Sensitivity, specificity, positive and negative predictive values and accuracy of these tests and their combinations with the ULBT were calculated. Statistical analysis was performed using SPSS version 16. Data were analysis by using Fishers exact and McNemar's test, and a Pvalue. <0.05 was considered statistically significant. The prevalence of difficult intubation Cormack-Lehane in this study was 8.4%, Mallampati test had the highest sensitivity (47.3%) and Thyro-mental distance was most specific (96%). The ULBT (upper lip bite tests) had most positive and negative predictive value (37.9% & 93.5%). Data also showed that power of these tests in predicting easy intubation is more than their ability in assessing the likelihood of difficult intubation. There was no significant difference regarding difficult intubation based on gender ( $P < 0.05$ ), whereas there were significant differences between the older tests and laryngeal view ( $P < 0.05$ , Mc-Nemar test). Despite the validity of MMP, TMD, ULBT and IIG in predicting easy intubation is much greater than the value in prediction of difficult intubation; however, the simplicity of performing these tests and results of the four tests in evaluating patients before surgery by combination of tests in predicting difficult intubation will likely safe. It seems that best results are from applying combined test than a single one.

**Key words** Difficult intubation; Mallampati; Thyro-mental Distance; Inter incisor gap; Upper Lip Bite Test.

### Introduction

The fundamental responsibility of an anesthesiologist is to maintain adequate gas exchange through a patent airway. Failure to maintain a patent airway for more than a few minutes' results in brain damage or death.<sup>1</sup> Anesthesia in a patient with a difficult airway can lead to both direct airway trauma and morbidity from hypoxia and hypercarbia. Direct airway trauma occurs because the management of the difficult airway often involves the application of more physical force to the patient's airway than is normally used. Much of the morbidity specifically attributable to managing a difficult airway comes from an interruption of gas exchange (hypoxia and hypercapnia), which may then cause brain damage and cardiovascular activation or depression.<sup>2</sup>

Though endotracheal intubation is a routine procedure for all anesthesiologists, occasions may arise when even an experienced anesthesiologist might have great difficulty in the technique of intubation for successful control of the airway. As difficult intubation occurs infrequently and is not easy to define, research has been directed at predicting difficult laryngoscopy, i.e. when is not possible to visualize any portion of the vocal cords after multiple attempts at conventional laryngoscopy. It is argued that if difficult laryngoscopy has been predicted and intubation is essential, skilled assistance and specialist equipment should be provided. Although the incidence of difficult or failed tracheal intubation is comparatively low, unexpected difficulties and poorly managed situations may result in a life threatening condition or even death.<sup>3,4</sup>

The paucity of fool proof tests in predicting difficult intubation commonly results in unanticipated difficult scenarios and their attendant repercussions. The reported incidence of difficult intubation ranges from 0.5 to 18%.<sup>3-5</sup> It is obvious that preoperative identification of difficult intubation in patients would decrease the rate of anesthesia related complications. Although many advances have been made and many methods have been used to overcome the conundrum of an unanticipated difficult intubation, most tests are not reliable. All preoperative airway assessment tests are low sensitivity and specificity except ULBT.<sup>6,7</sup> The aim of our study was to compare four different methods for prediction of difficult intubation: Mallampati, Thyro-mental distance, ULBT (Upper Lip Bite Test), and Inter incisor gap and we evaluated sensitivity, specificity, positive predictive value, and negative predictive value of these tests.

### Materials and Methods

In a prospective study, 448 patient's American society of anesthesia class I or II older than 18 years and BMI<30 who were scheduled for elective surgery under general anesthesia were selected randomly and enrolled. Excluding criteria included: patients with airway malformation, inability to cooperate, pregnancy, edentulous patients, those unable to open the mouth and limitation in mobility of temporo-mandibular and atlanto-axial joints. After approval of the ethics committee of the Ahvaz Jundishapur University, an informed consent was obtained from all patients.

#### \*Corresponding Author:

Fatemeh Javaherforoosh,  
Ahvaz Jundishapur University of Medical Sciences,  
Imam Khomeni Hospital,  
Anesthesia Department, Ahvaz, Iran.

Before induction of anesthesia, the airways were assessed by Mallampati test, Thyromental distance, Upper lip bite test (ULBT) and Inter incisor gap (Table 1).

**Table 1:** Methods of assessment of airway

- Grade 1:** Most of glottis visible,
- Grade 2:** only the posterior extremity the glottis and the epiglottis seen
- Grade 3:** no part of the glottis visible, only the epiglottis seen,
- Grade 4:** not even the epiglottis seen.

Mallampati class 3 and 4, inter incisor gap ≤ 4cm, thyromental distance ≤ 6 and ULBT class 3 were considered as markers of a potentially difficult intubation based on receiver operating characteristic (ROC) analysis.

Laryngoscopic view according to the Cormack and Lehane grading system<sup>8</sup> was determined after induction of anesthesia and Grade 1 and 2 were considered as easy and grade 3 and 4 as “difficult intubation.” (Table 2).

**Table 2:** Cormack – Lehane classification (8)

Airway parameter	Group	No	Frequency %
Modified mallampati scoring	Class 1&2	292	65.2
	Class 3&4	156	34.8
Inter incisor gap	Class 1 ≥ 4 cm	372	83.1
	Class 2 ≤ 4cm	76	16.9
Thyromental distance	Class 1 ≥ 6 cm	428	95.5
	Class 2 ≤ 6cm	20	4.5
ULBT	Class 1&2	419	93.5
	Class 3	29	6.5

Statistical analysis was performed using SPSS software version 16/0. Data were analyzed by using Fisher's exact and Mc-Nemar tests, and a P value < 0.05 was considered statistically significant and calculation of sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy with their 95% confidence interval (95% CI).

### Results

The prevalence of difficult intubation Cormack-Lehane in this study was 8.4%. Mallampati test had the highest sensitivity (47.3%) and Thyromental distance was most specific (96%). The ULBT (upper lip bite tests) had most positive and negative predictive value (37.9% & 93.5%). Data also showed that power of these tests in predicting easy intubation is more than their ability in assessing the likelihood of difficult intubation. There was no significant difference regarding difficult intubation based on gender ( $P < 0.05$ ), whereas there were significant differences between the older tests and laryngeal view ( $P < 0.05$ , Mc-Nemar test). (Table 3, 4)

**Table 3:** the frequency analysis of predictor parameters

Various scoring system	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Modified mallampati scoring	47.3	66.3	11.5	93.1
Inter incisor gap	31.5	84.3	15.7	93
Thyromental distance	10.5	96	20	92
ULBT	28.9	95.6	37.9	93.5

**Table 4:** comparative analysis of various scoring systems

	class 1: faucial pillars, soft palate and uvula visible. Class 2: soft palate and base of uvula seen Class 3: only soft palate visible Class 4: soft palate not seen
Tyromental distance	Distance between tip of thyroid cartilage and tip of chin, with fully extended
Inter incisors gap	Distance between the incisors with mouth fully open (Cm) Class 1 lower incisor can bite the upper lip above the vermilion Class 2 lower incisor can bite the upper lip below the vermilion Class 3 lower incisor cannot bite the upper lip
ULBT	

Four hundred forty-eight (448) patients were included in our study (235 women & 213 men) The mean age was 53.5 yr. Intubation was difficult in 38 patients (8.4%). From four preoperative tests

### Discussion

Difficulty in endotracheal intubation is a major cause of morbidity and mortality, especially when it is not anticipated preoperatively. This unexpected difficulty in intubation is the result of a lack of accurate predictive tests and inadequate preoperative assessment of the airway. Since no anatomical factor can correctly forecast difficult intubation with 100% accuracy, we might expect predictive tests to be unreliable. Only few published articles regarding the use of Thyromental distance or Tyromental distance or Modified Mallampaty as screening tests to detect difficulty in intubation. This study was designed to evaluate the efficacy of Modified mallampaty, inter incisor gap, Thyromental distance and Upper Lip bite test in detection of difficult intubation, and to draw a possible correlation between the tests and Cormack – Lehane grades.

The prevalence of difficult intubation in our study was 8.4% that is comparatively with previous studies (0.5-18%).<sup>3, 4</sup> Wilson *et al.*, suggested five risk factors in predicting difficult intubation, including weight ( $p=0.05$ ), head and neck movement ( $p=0.001$ ), jaw movement ( $p=0.001$ ), receding mandible ( $p=0.001$ ), and protruding upper incisor ( $p=0.001$ ).<sup>9</sup>

ULBT when tested initially had the potential to evaluate both jaw movement and buck teeth simultaneously, providing additional support for its use as an airway evaluation test.

Sensitivity, specificity, PPV and NPV of the ULBT (28.9%, 95.6%, 37.9%, 93.5%) in our study were similar to those reported in Khan *et al.*, The ULBT has high specificity

and NPV, making it superior in identifying easy intubation. The high sensitivity and specificity of MMP and TM suggests these tests to be a valuable adjuvant when combination with ULBT providing additional support for air way assessment.

Our study has similar results to Kashan hospital. In this study PPV & NPV of MMP was 12% and 93% and for TM 9.8% & 92.7%. This group have concluded the low sensitivity and PPV of TM and MMP, they are of limited value for detection of difficult intubation.<sup>10</sup>

In Khan *et al.*, study in 2006 specificity and accuracy of ULBT was significantly higher than inter incisor and TMD similar to our study and was more accurate in airway assessment.<sup>11</sup> In Jimson and *et al.*, study in 1995, they concluded that MMP & TMD had a little value for prediction of difficult intubation, although the likelihood of an easy intubation is high when they yield negative results.<sup>12</sup> In 2003 Khan *et al.*, concluded that the ULBT significantly higher specificity and accuracy than the MMT ( $p < 0.001$ ).<sup>13</sup> Our results similar to those.

In 2009 Khan *et al.*, had similar results and they concluded that the specificity and accuracy of the ULBT is significantly higher than other tests and is more accurate in airway assessment.<sup>6</sup> Also In 2011 Khan and *et al.*, concluded an agreement between laryngoscopic grading and HMD and MMP, but was comparatively weaker.<sup>7</sup> The high accuracy of ULBT specificity, NPV, PPV as revealed a good rationale for its application in the prediction of difficulty or easiness in intubation that these were similar to our results too.

## Conclusion

Despite the validity of MMP, TMD, ULBT and IIG in predicting easy intubation is much greater than the value in prediction of difficult intubation, however the simplicity of performing these tests and results of the four tests in evaluating patients before surgery by combination of tests in predicting difficult intubation will likely safe. It seems that best results are from applying combined test than a single one.

## References

- Rose D. K., Cohen M. M. The airway: problem and predictors in 18500 patients. *Can J Anesthesia* 1994; 41:372-83.
- Benumof J. L. Management of the difficult airway: With special emphasis on awake tracheal intubation. *Anesthesiology* 1991; 75:1087-1110.
- Wilson M. E, Spiegelhalter D, Robertson J. A, Lesser P. Predicting difficult intubation. *Br. J Anesthesia* 1988; 61(2): 211-6.
- Arun K.R, Gupta, Mohamad Omid, Showkat Nengroo, Imtiyaz Naqash: Predictors of difficult intubation. *British J of M* 2010; 3(1): 307-311.
- Turkan S, Ates Y, Cuhruk H, Tekdemir I. should we reevaluate the variables for predicting the difficult airway in anesthesiology? *Anesth Analg* .2002; 94:1340-4 (Pub Med).
- Zahid Hussain Khan, M. D, Mostafa Mohammadi, M. D, Mohammad R. Rasouli, M. D, Fahimeh Farrokhnia, MD, Razmeh Hussain Khan: The diagnostic value of the upper lip bite test combined with sternomental distance, thyromental distance for prediction of easy laryngoscopy and intubation. *Anesth Analog*, 2009; 109:822-824.
- Zahid Hussain Khan, MD, Anahid Maleki, Jalil Makarem, Mostafa Mohammadi, MD, Ramooz Hussin Khan, Ali Zandieh: A comparison of the upper lip bite test with thyromental/thyrosternal distance and mandible length in predicting difficulty in intubation. *Indian JAnesthesia*2011; 55(1):43-46.
- Cormack R. S, Lehane J. Difficult intubation in obstetrics. *Anesthesia*1984; 39(11): 1105-11.
- Wilson M. E, Spiegelhalter D, Robertson JA, Lesser P. Predicting difficult intubation. *Br J Anesthesia* 1988; 61:211-6.
- Nurizad S, Mahdian M, Sayyedi H R, Mallampati and thyromental tests to predict difficult intubation, *J of KUMS*, 2002;6(3):16-21.
- Zahid Hussain Khan, M. D, Mohammady M.M. D, Eghtesadi P. Upper lip bite test with thyromental, sternomental and interincisor distance in predicting difficult intubation: a comparative study. *Tehran university of medical J*.2006; 64(5):102-110.
- Jimson C. Tse, Eric B. Rimm, Sat, and Ayyaz Hussain, FFARCS: Predicting Difficult Endotracheal Intubation in Surgical Patients Scheduled for General Anesthesia: A Prospective Blind Study. *Anesth Analg* 1995; 81:254-8.
- Zahid Hussain Khan, M.D., Arash Kashfi, M.D., and Elham Ebrahimkhani, MD: A Comparison of the Upper Lip Bite Test (a Simple New Technique) with Modified Mallampati Classification in Predicting Difficulty in Endotracheal Intubation. *Anesth Analg* 2003; 96:595-9.

### CITE THIS ARTICLE AS:

Javaher Foroosh Zadeh F Safaii Sara. Comparison of four methods for predicting difficult intubation. *International Journal of Bioassays* 5.1 (2016): 4720-4722.

**Source of support:** Nil  
**Conflict of interest:** None Declared