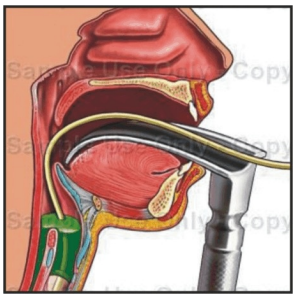
ORIGINAL PROF-914

THE UPPER LIP BITE TEST;
PREDICTION OF DIFFICULT ENDOTRACHEAL INTUBATION



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ABSTRACT... hameedchohedri@yahoo.com **Objective:** We conducted a prospective, double-blind study to determine whether a difficult endotracheal intubation could be predicted preoperatively by a simple new technique, the upper lip bite test and compared it with three other tests used for prediction of difficult intubation: Modified Mallampati criteria (MMC), Thyromental distance (TM) and Mouth opening (MO). **Materials and Methods**: Five hundred patients, aged above 16 years, and presenting for elective surgery were subjected to the following assessments: (1) Upper lip bite test (ULBT), class I: lower incisors can bite the upper lip above the vermilion line; class II: lower incisors can bite the upper lip below the vermilion line; class III: lower incisors cannot bite the upper lip; (2) Oropharyngeal class according to the MMC. (3) The distance between the chin and thyroid cartilage (thyromental distance). (4) Extend of maximum mouth opening test. **Results**: ULBT had significantly higher accuracy (96%) and specificity (98.3%) and the lowest rate of false positive ($p< 0.001$). The most sensitive test was the TM test (42%). **Conclusion:** We concluded that comparison of the three tests, UPBT has sufficient value in predicting difficult intubation in adults

Key words: Upper lip bite test; Endotracheal intubation; Difficult intubation; Mallampati classification; Thyromental distance; Mouth opening

INTRODUCTION

The incidence of difficult intubation in surgical patients undergoing general anesthesia is estimated to be approximately 1.5-13%[1]. Failure to intubation is detected in 0.05- 0.35% of the patients[2].

According to Cormack and Lehane's grading, grades III and IV of laryngoscopy, correspond to difficult intubation[3].

Several tests have been used in order to determine the degree of difficulty of intubation. The most common of

these tests are the Mallampati criteria, the thyromental distance test and maximum mouth opening test[4,8].

The range of freedom of the mandibular movement and the architecture of the teeth has pivotal roles in facilitating laryngoscopic intubation[9]. Due to these facts Khan ZH and co-workers once hypothesized that the upper lip bite test may be a good predictor for difficult laryngoscopic intubation[9]. In this study we tested the validity of ULBT and compared its sensitivity, specificity, accuracy and predictive values in predicting difficult intubation with other commonly performed tests.

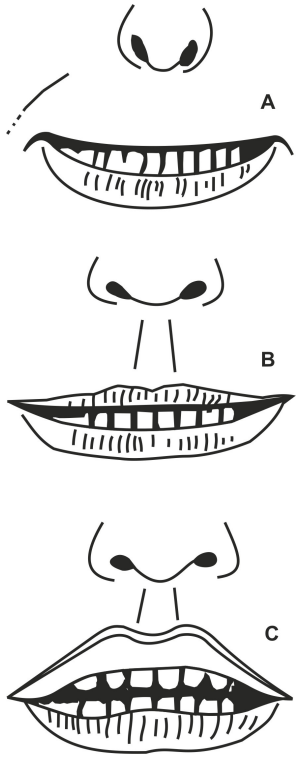

Figure-1. Schematic frontal view of the upper lip bite test. A, class I; lower incisors biting the upper lip, making the mucosa of the upper lip totally invisible. B, class II; the same biting meneuver revealing a partially visible mucosa. C, class III; the lower incisors fail to bite the upper lip.

MATERIALS AND METHODS

In a prospective randomized double-blind study, from June 2003 to December 2004, 500 surgical patients who

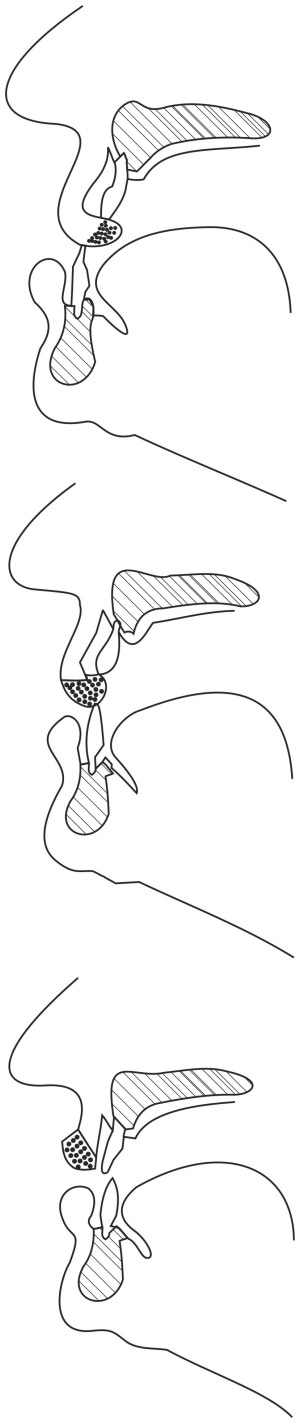

Figure-2. Schematic lateral view of the upper lip bite test. The dotted area depicts the mucosa of the upper lip. A, Class I; lower incisors reflecting a bite of the upper lip, making its mucosa entirely invisible. B. Class II; lower incisors half-biting the upper lip, making the mucosa partially visible. C, Class III; lower incisors attempting a bite but totally failing to catch the upper lip.

had referred for operation to educational hospitals of Shiraz University of Medical Sciences were studied. A written informed consent was obtained from each patient. Approval was also granted by research committee of Shiraz University of Medical Sciences. The patients' age ranged from 16 to 60 years and they were scheduled for general surgical operations. Patients with abnormal head and neck anatomy, pregnant women (due to upper air way edema), edentulous patients, those with laryngeal or pharyngeal mass, with mass in the mouth, those unable to open the mouth, or with limitation of cervical movement were excluded from the study. Additionally, mentally retarded patients or those patients whom awake endotracheal intubation was performed were also excluded. Demographic characteristics, type of operation and drug consumption history were recorded.

Preoperatively, an anaesthesiologist not involved in intubating the airways of the patients evaluated the measurements obtained by using four different methods:

1. Modified Mallampati test

The patients' oropharyngeal views were classified according to the Mallampati score[4]. In this classification, patients were instructed to sit upright with the head in the neutral position. The observer sat in front of the patient and inspected the pharynx. Next they were asked to open their mouth fully and maximally protrude their tongue. The examination was done with the aid of a flashlight. They were *not* asked to say "ah". The classification is based on the structures seen and patient with class 3 and 4 were classified as "predicted difficult". Classifications are as follows: Class 1, soft palate, fauces pillar, uvula and pillars are seen; Class 2, soft palate, fauces pillar and only part of the uvula are visualized; Class 3, soft palate and the base of the uvula in visualized, but the posterior wall is not visible; Class 4, soft palate is not visible.

2. Upper lip bite test (ULBT)

The patients were asked to bite their upper lip and scoring was performed according to the following criteria: class I: lower incisors can bite the upper lip above the vermilion line; class II: lower incisors can bite the upper lip below the vermilion line; class III: lower incisors cannot bite the upper lip. Classes I and II were classified as easy and class III as difficult intubation. (Fig 1 & 2)

Table I. Definitions of statistical terms

Sensitivity (True positive fraction)	Number of correctly predicted intubations as a proportion of all intubations that were truly difficult, i.e., true positive/(true positives + false negatives)
Specificity	Number of correctly predicted easy intubations as a proportion of all intubations that were truly easy, i.e., true negative (true negatives + false positives)
Positive predictive value	Number of correctly predicted difficult intubations as a proportion of all predicted difficult intubations, i.e., true positive/(true positives + false positives)
Negative predictive value	Number of correctly predicted easy intubations as a proportion of all predicted easy intubations, i.e., true negative (true negatives + false negatives)
Accuracy	The percentage of correctly predicted easy or difficult intubations as proportion of all intubations, i.e., (true positives + true negatives/true positives + true negatives + false negatives + false negatives)

3. Thyromental distance

The patients were asked to sit and extend their heads. Afterwards, the distance between the thyroid cartilage and the chin was measured in centimeter. Distances less than 6 cm were classified as difficult intubation[10].

4. Mouth opening test

The patients were asked to open the mouth as wide as possible. Then, the distance between the upper and lower incisors were measured. Distances less than 4 cm were classified as difficult intubation[5]

After this initial assessment, the patient was anesthetized and fully relaxed patient was place in the sniffing position. Afterwards, an anesthesiologist not informed of the preoperative MMC, ULBT, TM or MO, assessed the difficulty of laryngoscopy at intubation as described by Cormack and Lehane[3] using a Macintosh blade (Welch Allyn Inc. Skaneatills Falls, NY).

The laryngeal classified view was as follows: grade I = most of the glottis visible; grade II = only the posterior extremity of the glottis visible; grade III = no part of the glottis visible, only the epiglottis; grade IV = epiglottis not visible. Grades I and II were classified as easy intubation and grade III and IV as difficult intubation.

Sensitivity, specificity, accuracy, and positive and negative predictive values were calculated for each test. The definition of the statistical terms is shown in Table I.

STATISTICAL ANALYSIS

Patient data are expressed as mean±standard deviation (SD) and 95% confidence interval (CI) are also given when essential. Statistical analysis was accomplished using SPSS (Version 10.07, SPSS, Inc., Chicago, IL) and Microsoft EXCEL (Microsoft, Redmond, WA) software.

Minimum sample size was estimated using an *a priori* power analysis based on a confidence level of 0.95 and a power of 0.90. The Students *t*-test, Fisher's exact, χ^2 test, McNemar and Mann-Whitney U tests (when appropriate) were used to identify statistical differences between the patients' demographic characteristics, age, gender, body surface area and difficult intubation. *p* values less than 0.05 were considered as statistically significant.

Table II. Relationship between the results of the three predicting tests and laryngoscopy grades in 500 patients

Predicting test	Laryngoscopic view	
	I & II	III & IV
Upper lip bite test		
Classes I & II	478(98.4%)	12(85.6%)
Classes III	8(1.6%)	2(4.4%)
Modified Mallampati		
Classes I & II	466(95.6%)	11(78.6%)
Classes III & IV	3(21.4%)	23(4.6%)
Mouth Opening (MO)		
MO > 4cm	473(97.3%)	12(85.6%)
MO ≤ 4 cm	13(2.7%)	2(14.4%)
Thyromental distance (TM)		
TM > 6 cm	378(79.6%)	99(20.4%)
TM ≤ 6 cm	8(57.1%)	6(42.9%)

Table III. Statistical terms used for upper lip bite test, Modified Mallampati, Mouth Opening and Thyromental distance as difficult intubation predicting tests

Test	Acc% (95% CI)	Sp% (95% CI)	Se% (95% CI)	FN	FP
Upper lip bite test	96%	98.3%	14.2%	85.8%	1.7%
Mallampati	93.8%	95.8%	21.4%	78.4%	2%
Thyromental distance	78%	97%	42%	58%	21%
Mouth opening	95%	97.3%	14.2%	85.8%	2.7%

Acc = accuracy or total correct prediction; Sp = specificity; Se = sensitivity; FN = false negative; FP = false positive; CI = confidence interval

RESULTS

For the whole population of 500 patients (256 women and 244 men) enrolled in the study, in 14(2.8%) tracheal intubation was difficult. No intubation failed. 387(77.4%) patients had grade I of laryngoscopy, 99(19.8%) grade II and 14 grade III (2.8%). There were no statistical differences in weight and height between patients with difficult intubation and those without difficult intubation.

Relationship between the tests and grading of laryngoscopy are shown in table II. Accuracy, specificity, sensitivity, false positive and false negative are shown in table III. ULBT had significantly higher accuracy (96%) and specificity (98.3%) and the lowest rate of false positive ($p < 0.001$). The most sensitive test was the TM test (42%). Significant difference between ULBT and other tests in accuracy and specificity existed ($p < 0.05$).

DISCUSSION

Depending on the criteria used to define difficult intubation, the incidence ranges from 1.5 to 13%[1-10]. The incidence of difficult intubation in our study was 2.8% and there were no failure to intubate the trachea. This rate is categorized as low rate of difficult intubation when compared to previous studies. This may be due to special anthropomorphic features of our patients. It may be also due to that some patients in which pressure was applied to the larynx were excluded from the "difficult intubation" group.

Wilson et al described five quantitative tests for predicting difficult intubation including: Mouth opening test, Mallampati, Thyromental; Hyomental and Head and neck movement[11]. They also described five qualitative tests in predicting difficult intubation including. Thickness and length of the neck, Length of incisors and buck teeth and mandibular over bite or receding mandible. The ULBT which has been first suggested by Khan et al assesses a combination of jaw sublaxation and the presence of buck teeth simultaneously, obviously enhancing its predictive value and reliability[9]. There is an undoubtedly strong correlation between the ULBT and the airway anatomical architecture, reinforcing ULBT's strength and efficacy of not only predicting the airway class and the structures behind the closed curtain, but also its extraordinary potential of not having causing even a single case of lip injury in thousands of patients being tested by anesthesiologists, proves this test to be a safe test.

In our study, we observed the best specificity and accuracy of the ULBT compared to MMC, MO and TM. Our study was similar Khan et al study. However, in contrast to their study, we simultaneously evaluated three tests and compared the accuracy, sensitivity and specificity of ULBT with these tests. The rates observed in our study were similar to the study of Khan[9]. Although, the most important difference was the very low sensitivity rate of MMC in our study compared to Khan[9].

The sensitivity of MMC in our study was 21.4%. This rate is very low compared to previous studies[6-10]. The reason for such a low rate may be due to inter-observer variations and technicalities involved in the demonstration.

The three classes of ULBT are clearly demarcated and delineated, making this test a simple test with the least rate of inter-observer variations. This is unlikely the Mallampati test in which a large number of inter observer variations exits.

The principle author and innovator (ZHK) of ULBT had off objections and acceptance by different research peoples from differents parts of the world. Her schmana from NY confessed that ULBT is a new way of evaluating a patients airway in co-operative patients. It is a help to both clinician and researcher. He does not believe that it can replace the MMC (Mallampati Classification). We and the author agree with his thoughts[12].

Dr Tevari from India reluctantly accepts ULBT and writes about the chance of injuring the lips with teeth. We and author had not any case of lip injury[13].

In conclusion, the ULBT has high level of accuracy and specificity compared to other tests. It could easily predict 98.3% of easy intubations has the inherent quality to unveil and unravel he hidden airway anatomy and the

potential laryngoscopic difficulties while the mouth remains closed. Therefore, we conclude that ULBT is an acceptable option for predicting difficult intubation.

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