A Comparison of Upper Lip Bite Test with Modified Mallampati Classification in Predicting Difficult Laryngoscopic Intubation

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บทคัดย่อ: การประเมินทางเดินหายใจด้วยวิธี Upper Lip Bite Test ปรับเติมเต็มกับ Modified Mallampati Classification ในการทำนายภาวะใส่ท่อช่วยหายใจยาก ผู้ป่วย 400 ราย ที่มารับการผ่าตัดแบบไม่ฉุกเฉินในโรงพยาบาลสงขลานครินทร์ ได้รับการระบายความรู้สึกแบบ general anesthesia และมีการใส่ท่อช่วยหายใจ ประเมิน upper lip bite test กับ modified Mallampati ในช่วงก่อนผ่าตัดโดยวิสัญญีแพทย์ และประเมิน laryngoscopic view ผลการศึกษา: ผู้ป่วย 55 ราย (13.75%) ที่มี laryngoscopic view grade III หรือ IV แสดงว่า
Maintenance of a patent airway is a primary responsibility of anesthesiologist. Interruption of gas exchange, for even a few minutes, can result in catastrophic outcome such as brain damage or death.\textsuperscript{1}

The difficulty of achieving a patent airway varies with anatomic and other individual patient factors, and identification of the patient with difficult airway is important in planning anesthetic management so that endotracheal intubation can be achieved safely. Several clinical criteria can be routinely assessed on patients prior to anesthesia.\textsuperscript{1}

Mallampati\textsuperscript{SR^2} proposed a grading system (class 1 to 3) which was later modified by Samsoon and Young to four classes, assessed the size of the tongue in relation to the oropharynx and the ability to open the mouth. The classification was based on observation of the pharyngeal structures with the mouth fully open and tongue maximally protrude. Several literatures indicate that the modified Mallampati classification has relatively high specificity but low sensitivity and a high number of false positive results.\textsuperscript{3-6} Other tests, such as thyromental distance, interincisor gap, subluxation of mandible, length of mandibular rami, chin protusion and atlanto-occipital extension are not totally reliable because of little value in predicting a difficult intubation.\textsuperscript{3-8}

Ideally, any preoperative assessment of difficult tracheal intubation should have high sensitivity and specificity to result in minimal false positive or negative values.

Recently, a new technique to evaluate for difficult intubation was reported. The upper lip bite test (ULBT) was developed by Khan et al\textsuperscript{7} in an effort to produce a simple, single test that could be used preoperatively to evaluate for difficult airway. The test is classified according to the ability to bite the upper lip with the lower teeth. The researchers state the anatomical distinction between the ULBT and the other preoperative airway evaluation methods lies in the range and freedom of movement of the mandible and the architecture of the teeth. In a sample of 300, the ULBT was found to have an accuracy of 88% and specificity was 88.7% for predicting difficult intubation.\textsuperscript{7} Other literatures reported that the upper lip bite test is a useful predictor of difficult intubation.\textsuperscript{7,13}

The purpose of this study was to compare the preoperative airway evaluation methods of upper lip bite test and modified Mallampati classification สามารถทำนายภาวะใส่ท่อช่วยหายใจยากได้ แต่ modified Mallampati classification สามารถทำนายได้ดีกว่า.

คำสำคัญ: upper lip bite test, modified Mallampati classification,ภาวะใส่ท่อช่วยหายใจยาก

\textit{Thai J Anesthesiology 2010 : 36(1) : 1-8.}
classification with the direct laryngoscopic views obtained during tracheal intubation. We hypothesized that the upper lip bite test could serve as a good predictor for difficult laryngoscopic intubation.

**Materials and Methods**

After approval and written consent, a prospective observational study in 400 patients, aged ≥ 18 yr, scheduled for elective surgery under general anesthesia requiring intubation in Songklanagarind hospital during October 2008 to June 2009, were considered for enrollment. Edentulous patients, those unable to open the mouth, with laryngeal mass, with limitation of cervical movement, or requiring rapid sequence induction were excluded from the study.

Preoperatively, two nurse anesthetists not involved in intubating the airways of the patients, evaluated the ULBT or MMT.

**Upper lip bite test (ULBT)**

Upper lip bite test was assessed with patient sitting, head in neutral position. Ability of the patient to bite his/her upper lip was assessed and graded. (Figure 1)

- **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 can not bite the upper lip

**Modified Mallampati classification (MMT)**

The patients were in sitting position, head in neutral position, the mouth fully opened and tongue maximally protruded without phonation, while the observer looked at pharyngeal structures, the view was graded as follows:

- **Class I** = soft palate, fauces, uvula and pillars seen
- **Class II** = soft palate, fauces, and uvula seen
- **Class III** = soft palate and base of uvula seen
- **Class IV** = soft palate not visible

ULBT class III and MMT class III and IV was considered a potentially difficult intubation.

Anesthesiologists who had at least 1 year experience and were not informed of the preoperative airway evaluation, assessed difficult of laryngoscopy at intubation, which was performed with the patient adequately anesthetized and fully relaxed. The head was placed in sniffing position, and laryngoscopy was performed with a Macintosh blade No.3 or 4, without applying external laryngeal pressure while reporting the laryngeal view.

The laryngeal view was graded according to the method described by Cormack and Lehane as grade I = full view of glottis, grade II = glottis partly exposed with anterior commissure not seen, grade III = only epiglottis seen, and grade IV = epiglottis not seen. A grade of I or II was considered to represent easy intubation and grade of III or IV to represent difficult intubation. The complete data sheets were analyzed by SPSS version 11. The
sensitivity, specificity, positive and negative predictive values, accuracy, true positive, true negative, false positive and false negative were calculated for each test. Fisher’s exact test was used for comparison for significant differences (p < 0.05).

Figure 1  Schematics 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 maneuver revealing a partially visible mucosa. C, Class III; the lower incisors fail to bite the upper lip.

Results

Four hundred patients were enrolled in the study. None of the patients had failed endotracheal intubation. Fifty five of them (13.75%) had a laryngoscopic view of grade III or IV by the Cormack and Lehane classification and were considered to have difficult intubation.

In this study, we found that 391 patients had upper lip bite test class I or II and 9 patients had class III, whereas 352 patients were assessed to have modified Mallampati class I or II and 48 patients have class III or IV (Table 1).

Table 2 demonstrates the predictive indices of the ULBT and MMT. Sensitivity, specificity, positive and negative predictive values and accuracy as calculated were 7.1%, 98.5%, 44.4%, 86.7% and 85.8%, respectively for the ULBT, and 33.9%, 91.6%, 39.6%, 89.5% and 83.5%, respectively for the MMP. The specificity was found to be significantly higher for the ULBT than for the MMT (p < 0.05), whereas the sensitivity was found to be very low and significantly lower than MMT. Other parameters were not significantly different between the two methods.

Discussion

Unanticipated difficult tracheal intubation is a significant source of morbidity and mortality in anesthetic practice. The incidence of difficult intubation in the operating room has been reported to range from 1% to 18%4. Because of the potential serious consequences of failed tracheal intubation such as hypoxemia, cardiopulmonary arrest, considerable attention has been focused on attempts to predict, preoperatively, patients in whom laryngoscopy and intubation will be difficult. A screening test for the prediction of difficult laryngoscopy must be urgent, providing reliable results. A test to predict difficult laryngoscopy should a high positive predictive value to detect most susceptible cases. The
Table 1  Relationship between the results of two predicting test and laryngoscopy Grades in 400 patients.

<table>
<thead>
<tr>
<th>Predicting test</th>
<th>Laryngoscopic view</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I and II</td>
</tr>
<tr>
<td>Upper lip bite test</td>
<td></td>
</tr>
<tr>
<td>classes I and II</td>
<td>339 (84.75%)</td>
</tr>
<tr>
<td>class III</td>
<td>5 (1.25%)</td>
</tr>
<tr>
<td>Modified Mallampati</td>
<td></td>
</tr>
<tr>
<td>classes I and II</td>
<td>315 (78.75%)</td>
</tr>
<tr>
<td>classes III and IV</td>
<td>29 (7.25%)</td>
</tr>
</tbody>
</table>

Table 2  Predictive indices of the upper lip bite test (ULBT) and modified Mallampati classification (MMT) with the Cormack and Lehane laryngoscopic view classification as gold standard.

<table>
<thead>
<tr>
<th>Test</th>
<th>TP</th>
<th>FP</th>
<th>TN</th>
<th>FN</th>
<th>Se (%)</th>
<th>Sp (%)</th>
<th>PPV (%)</th>
<th>NPV (%)</th>
<th>Acc (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULBT</td>
<td>4</td>
<td>5</td>
<td>339</td>
<td>52</td>
<td>7.14</td>
<td>98.54</td>
<td>44.44</td>
<td>86.70</td>
<td>85.75</td>
</tr>
<tr>
<td>MMT</td>
<td>192</td>
<td>9</td>
<td>315</td>
<td>37</td>
<td>33.93</td>
<td>91.57</td>
<td>39.58</td>
<td>89.48</td>
<td>83.50</td>
</tr>
<tr>
<td>P</td>
<td>&lt; 0.05</td>
<td>&lt; 0.05</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

TP = true positive, FP = false positive, TN = true negative, FN = false negative, Se = sensitivity, Sp = specificity, PPV = positive predictive value, NPV = negative predictive value, Acc = accuracy, NS = not significant

The upper lip bite test, a new simple bedside test was introduced by Khan et al. This test is easy to perform within seconds as a bedside test because it can be determined without the use of any equipment. Furthermore, there is less probability of misinterpretation while performing the test compared with the Mallampati test.

The original study by Khan et al compared the upper lip bite test with the Modified Mallampati classification in prediction of difficult endotracheal intubation. Sensitivity, specificity, positive and negative predictive values and accuracy were 76.5%, 88.7%, 28.9%, 93.4% and 88.0%, respectively for the ULBT, and 82.4%, 66.8%, 13%, 98.4% and 67.7%, respectively for the MMT. This study was concluded that the ULBT had an inherently larger level of accuracy compared with the MMT. The ULBT could easily predict of difficult intubation.7

In the present study, the sensitivity, specificity, positive and negative predictive values and accuracy were demonstrated to be 7.1%,
98.5%, 44.4%, 86.7% and 85.8%, respectively for the ULBT. The most striking difference is the considerably lower sensitivity of the ULBT. This was only 7.1% compared to 76.5% in the original trial by Khan et al. This means that several patients who will present with difficult laryngoscopy will not be identified by the ULBT.

Our study supported the finding of Khan et al that the specificity of the ULBT is significantly higher than the MMT, signifying that a negative ULBT is more predictive of an easy intubation than is a negative MMT.

Other studies measured the upper lip bite test with the modified Mallampati classification as a comparison. Hester et al presented a study that determine a sensitivity of 55%, specificity of 97%, a positive predictive value of 83%, a negative predictive value of 90% and an accuracy of 90% for the ULBT, and a sensitivity of 11%, specificity of 75%, a positive predictive value of 9%, a negative predictive value of 79% and an accuracy of 64% for the MMT. A conclusion could be drawn that the ULBT was superior to the modified Mallampati classification in almost every aspect for difficult airway prediction.

Eberhart et al re-evaluated the ULBT in their study published in 2005; the sensitivity, specificity, positive and negative predictive values and accuracy were 28.2%, 92.5%, 33.6%, 90.6% and 84.9%, respectively for the ULBT, and the sensitivity, specificity, positive and negative predictive values and accuracy were 70.2%, 61.0%, 19.5%, 93.8% and 62.1%, respectively for the MMT. The authors concluded that both tests were poor predictors for difficult intubation when used as single preoperative test.

Bhat et al showed a low sensitivity (20.5%) but with a high specificity (99.1%) and positive predictive value of 66.7% for the ULBT, and a sensitivity of 59%, specificity of 83.5% and positive predictive value of 23.2% for the MMT. A summary could be drawn that the ULBT and the MMT were good predictors of possible easy intubation rather than difficult intubation.

Limitation of this study, we found that the larger in the percentage exhibiting the ULBT of class I or II was found 97.8% (391/400), whereas the number of patients who had the ULBT class III were small (only 2.2%). Because we conducted only with elective surgical patients, while emergency patients and patients who were recognized to be difficult airway were excluded. It may not be applicable to all subgroups of the general population. Furthermore, we did not evaluate the interobserver reliability and would be effect our result.

**Conclusion**

We study the comparison between the upper lip bite test and modified Mallampati classification in prediction for difficult intubation. We found that the upper lip bite test was a poor predictor for difficult intubation when compare with the modified Mallampati classification. Further research on the ULBT should be carried out in large samples without exclusion criteria such as patients with higher ASA classification, morbidly obese patients, pregnancy or edentulous patients.
References


A Comparison of Upper Lip Bite Test with Modified Mallampati Classification in Predicting Difficult Laryngoscopic Intubation

Abstract

**Background:** The upper lip bite test (ULBT) introduced in 2003 is a simple method for predicting difficult intubation. The ULBT evaluated the patient’s ability to reach or completely cover the upper lip with the lower incisors. If patient can not bite the upper lip, signify that the higher risk of difficult intubation. **Objective:** To compare the preoperative airway evaluation methods of the upper lip bite test with the modified Mallampati classification (MMT) for difficult intubation prediction. **Methods:** In this prospective, observational study, 400 patients who required general anesthesia with endotracheal intubation for elective surgery in Songklanagarind hospital were enrolled. Preoperatively, two nurse anesthetists not involved in intubating the airways of the patients, evaluated ULBT or MMT. After induction of anesthesia with a standard protocol, anesthesiologists who had at least 1 year experience and were not informed of the preoperative airway evaluation, assessed difficulty of laryngoscopic intubation and laryngoscopic views were graded on the Cormack and Lehane scale. **Results:** Only 55 (13.75%) of the patients had laryngoscopic view grade III or IV and were considered to have difficult intubations. Sensitivity, specificity, positive and negative predictive values and accuracy as calculated were 7.1%, 98.5%, 44.4%, 86.7 and 85.8%, respectively for the ULBT, and 33.9%, 91.6%, 39.6%, 89.5% and 83.5%, respectively for the MMT. The specificity was found to be significantly higher for the ULBT than for the MMT (p < 0.05), whereas the sensitivity was found to be very low and significantly lower than MMT. Other parameters were not significantly different between the two methods. **Conclusion:** The finding suggested that either the ULBT or the MMT can predict difficult intubation. Nevertheless the MMT is better.

**Keywords:** Upper lip bite test, modified Mallampati classification, difficult intubation