The Effect of Position on Mallampati Airway Assessment Test in the Prediction of Difficult Mask Ventilation

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Abstract

Background: The responsibility of the anesthesiologist is to maintain airway patency for better oxygenation. Perhaps the most dangerous incident for the anesthesiologist, are encountering the scenario in which intubation and ventilation in a patient are impossible. The study of mask ventilation is far more limited. The first significant manuscript focused on mask ventilation was published in 2000. In this study we studied the effect of position on the Mallampati class, and its accuracy in the prediction of difficult mask ventilation.

Methods: After ethics committee approval; Three hundred thirty patients were examined, in both supine and upright positions for the assessment of the Mallampati airway class. The results of the two different situations were evaluated for the prediction of difficult mask ventilation. The sensitivity, specificity, positive and negative predictive values were obtained.

Results: In this study, 88 (26.66%) patients had difficult mask ventilation. (21.21%) with grade 2. Evaluation of the Mallampati classification in different positions. The sensitivity did not show a significant difference but the specificity was found to be the highest in the supine position. The negative predictive value was observed to be 85% in the supine position versus 65% in an upright position, and the positive predictive value 49% versus 46% in supine versus upright respectively.

Conclusions: The highest correlation was detected in the supine position and Mallampati airway assessment test in the prediction of difficult mask ventilation.

Key Words: Mallampati test — Upright — Supine — difficult mask ventilation.

Introduction

The worst scenario and perhaps the most dangerous incident for the anesthesiologists is facing the airway manger in which both intubation and mask ventilation (MV) should be our top most priority. Ability to ventilate the patient with a mask is extremely important in the unfortunate scenario of inability to intubate. There is limited data on difficult mask ventilation (DMV). Unfortunately, the study of mask ventilation is limited by the absence of a standardized, validated definition. Mask ventilation gives the anesthesiologist an opportunity to intervene and perform resuscitative maneuvers when needed. Many studies have been performed in predicting difficult airway [2-4] but very few have focused on the issue of the DMV and the factors that could possibly herald its presence in a patient before being subjected to general anesthesia. The practice guidelines for the management of the difficult airway [1,2] also do not mention the factors predicting DMV. Of late, some studies [5-8] have been performed aiming of finding factors that could predict DMV. The original Mallampati [9] test and the modified Mallampati test introduced by Samson and Young [10] are the tests commonly used for pre-anesthetic evaluation and prediction of DMV. The accuracy of the Mallampati test is different considering race, gender and even pregnancy. Although different figures have been reported in relation to accuracy and precision in previous studies but the traditional Mallampati test identifies difficult ventilation with acceptable precision and an accuracy as 26% sensitivity (Se) and 89% specificity (Sp) have been reported. But many studies have shown moderate accuracy and precision using the traditional and the modified Mallampati test.

Mallampati test shows the proportion of the tongue's size in the mouth space [12]. In clinical situations, there are instances in which the evaluation of the patient's airway is not possible in the upright position such as situations in which the patient has a traumatic injury of the cervical vertebrae or else has a fractured vertebra in the thoracic, lumbar or the sacral regions. In these circumstances, the Mallampati test is proposed in the
supine position. In one study, no difference was found between the Mallampati tests conducted in the supine position or else in the upright position [13]. But in another study, it was shown that the patient's position real a meaningful effect on the width of mouth opening and the Mallampati score was found to be higher in the supine position than in the upright position [14]. As no study exists to have evaluated the effect of position on the Mallampati class for the prediction of DMV, we studied the effect of patient's position on the Mallampati class and their importance in the prediction of DMV.

Material and Methods

An official approval from the Ethics Committee, This research was a study of a test. This study was conducted in a teaching hospital during 2011-2012 on patient's aged 16-60 years undergoing general anesthesia for surgery. Inclusion criteria included non traumatized patients undergoing general anesthesia and having consented to enter the study protocol. Exclusion standards included patients with American Society of Anesthesiologists (ASA) class higher than II, the incapability of the patient in opening the mouth, abnormalities of the face, mouth, pharynx and airway, pregnancy, urgency and a wake intubation.

The Mallampati class was assessed before prescribing any drugs. According to the definition of the Mallampati test, the patient has his mouth wide open in upright position, his tongue completely extruded and without foundation to reveal the oropharyngeal structures. After induction of anesthesia the Laryngoscope view was evaluated by a person blinded to the patient's Mallampati or pharyngeal view.

1- Mallampati class in upright position: In this group, the patient was upright, mouth wide open, his tongue completely out, without making any sound or exhaling the oropharyngeal view was assessed by the observer, who was exactly in front of the patient.

2- Mallampati class in supine position: In this group, the patient was in the supine position, in sniffing position, mouth wide open, his tongue completely out, and without making any sound or exhaling, the oropharyngeal view was evaluated by the observer, who was watching vertically.

3- Mask ventilation: After inducing anesthesia, the difficult of mask ventilation as outlined in the protocol.

Anesthetic protocol: Pre-medication by 0.05mg/kg of Midazolam and 2µg/kg of Fenfanyl. For anesthetic induction, 5mg/kg Sodium thiopental was given followed by 0.5mg of Atracurium for skeletal muscle relaxation.

Modified Mallampati test with the addition of class zero [15] was evaluated as under:

- Class 0: Ability to see any part of the epiglottis on mouth opening and tongue protrusion.
- Class 1: Soft palate, fauces, uvula, pillars seen.
- Class 2: Soft palate, fauces and uvula has been seen.
- Class 3: Soft palate, base of the uvula is seen.
- Class 4: Soft palate not visible.

Mask ventilation scoring [8] was assessed as under:

- Inadequate mask seal. (In one person ventilation). Yes 0 No 0
- Inability to obtain chest excursion (in one person ventilation). Yes 0 No 0
- Spot <90% (in one person ventilation). Yes ☐ No ☐
- Necessity of oral airway (in one person ventilation). Yes ☐ No ☐
- Necessity of two person ventilation. Yes ☐ No ☐
- Necessities of 02 flush on how many times. Ye ☐ No ☐
- Necessity of jaw thrust. Yes ☐ No ☐

The existence of any of the above seven instances was labeled as the DMV. Also class 3 and 4 of the Mallampati test are taken as predictors of DMV, and the lower classes as easy mask ventilation. The operator was asked to report any clinically relevant danger before determining that it is a case of DMV and to rate mask ventilation as impossible when it is completely failed.

Han's Mask Ventilation Classification was used for grading. Grade 1: Ventilated without oral airway.
Grade 2: Ventilated by mask with oral airway/ adjuvant with or without muscle relaxant.
Grade 3: Difficult ventilation (inadequate, unstable, or requiring two providers) with or without muscle relaxant.
Grade 4: Unable to mask ventilate with or without muscle relaxant or Multiple providers.

Data and information were collected separately for each person.

Statistical software SPSS version 16 for data analysis. In addition to descriptive indices, the agreement results for Mallampati test in different positions were studied using the kappa agreement test. Also, sensitivity, specificity, positive and
negative predictive values, and diagnostic accuracy of the Mallampati test in different positions were appointed in laryngoscopy and DMV prediction. CI 95% was calculated for each scale. A p-value of <0.05 was significant.

Results

A total of 330 patients was evaluated in this study. The average age of the patients was 34.57± 12.7 years, and the average BMI was 25.06±3.6 kg/m². In this study 88 (26.66%) had DMV and the rest had easy mask ventilation according to the definition. 70 patients with grade 2 (21.21%) and 18 in group 3 and 4 (5.45%). In the Mallampati test, supine position had the highest Se, while upright position had the lowest (Table 1, Fig. 1). The highest negative predictive value (NPV) among two positions were observed in supine (85.8%), (Fig. 2). The kappa agreement for Se, Sp, positive predictive value and NPV was reported insignificant and slightly low in relation to mask ventilation in all of the Mallampati test positions. The test of agreement's analysis has shown that the vast amount of kappa was observed in upright than supine position. Among all the Mallampati tests conducted in different positions, the highest kappa amount was in supine in the prediction of mask ventilation and intubation state, however this difference was not of importance among the two groups.

Kappa agreement as regards Se, Sp, PPV and NPV in all the Mallampati test positions in relation to mask ventilation has not shown meaningful differences considering age, sex, ASA class, BMI, diabetes mellitus and rheumatoid arthritis. In our research, the results show that the Mallampati class has gone higher in supine position.

Table (1): Sensitivity, specificity, positive predictive value, negative predictive value, Kappa and agreement of Mallampati test in different positions.

<table>
<thead>
<tr>
<th>Mask ventilation</th>
<th>Upright</th>
<th>Supine</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean CI 95%</td>
<td>Mean CI 95%</td>
</tr>
<tr>
<td></td>
<td>Lower Upper</td>
<td>Lower Upper</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>25.61 20.12 31.1</td>
<td>38.62 32.49 44.74</td>
</tr>
<tr>
<td>Specificity</td>
<td>82.65 78.99 86.31</td>
<td>76.63 72.54 80.72</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>46.67 38.14 55.19</td>
<td>49.48 42.34 56.61</td>
</tr>
<tr>
<td>Negative predictive value</td>
<td>65.21 61.13 69.29</td>
<td>85.87 83.78 87.97</td>
</tr>
<tr>
<td>Kappa</td>
<td>0.09 0.16</td>
<td></td>
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<tr>
<td>Agreement</td>
<td>61.42 62.48</td>
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Fig. (1): Sensitivity of the Mallampati test in different positions in relation with mask ventilation status.

Fig. (2): Negative predictive value of the Mallampati test in different positions in relation with mask ventilation status.
Discussion

The reported incidence of DMV varies widely (from 0.08% to 15%) depending on the criteria used for its definition. Lower rates of DMV have been reported in studies by Langeron et al. [16] (5%), Asai et al. [17] (1.4%), Rose and Cohen [18] (0.9%), Kheterpal 2006, [8] observed a 1.4% incidence of grade 3 mask ventilation and a 0.16% incidence of grade 4 mask ventilation. El-Ganzouri [4] (0.07%), 24% [8] and 28% [6]. In a retrospective study of 2000 incident reports during anesthesia, DMV incidence reached 15% when DI occurred. SpO2 was not recorded in the study by El-Ganzouri et al. [4]. Different predictive factors and non-standardized definitions were the reasons for this incidence difference. In its original report in 1993, the American Society of Anesthesiologists (ASA) Task Force on Management of the Difficult Airway define DMV which was modified in the Task in 2003.

Langeron et al., [16] investigated factors predictive of difficult mask They rated DMV as difficult when the clinician considered it clinically relevant and could have led to potential problems if mask ventilation had to be maintained for a longer time.

Using a grading scale (Grade 1: Ventilated without oral airway, Grade 2: Requiring an oral airway or other adjunct, Grade 3: Requiring 2-person ventilation, Grade 4: Unable to mask ventilate), Han et al., [19] found a prevalence of 20% of Grade 2 DMV in a population of 1854 DMV. For the purpose of risk stratification, the scale helps to segregate two groups of patients. Although Grade 1 and 2 patients usually do not raise significant clinical concern, Grade 3 and 4 patients are likely to be at increased risk of inadequate ventilation after anesthesia induction. (Grade 2 or higher), even in the absence of difficult intubation or non-reassuring airway exam, was a strong predictor of obstructive sleep apnea (OSA). There are several limitations to Han's scale that should be considered. First, the scale has not yet been validated. It may be useful for clinical description, but may not be reproducible or sensitive enough when used for data comparisons and/or research purposes. A second, similar to grading the laryngeal view, the interpretation of DMV grade is partly subjective and operator dependent. However, this should not discourage the scale's future use.

Yildiz et al., [8] defined DMV develops when there are signs of inadequate ventilation evidenced by no perceptible chest movement, oxygen denaturation and perception of severe gas flow leak around the mask. The authors classified the degree of difficulty based on the maneuvers used to establish adequate ventilation.

Kheterpal, [5] define DMV as mask ventilation that is inadequate to maintain oxygenation, unstable MV, or MV requiring two providers. Impossible mask ventilation is denoted by absence of end-tidal carbon dioxide measurement and the lack of perceptible chest wall movement during positive pressure ventilation attempts despite airway adjuvants and additional personnel.

All the above definitions were subjective, operator dependant and not validated. There is a need for a standard definition based on an objective grading scale determined the predictors of the DMV.

Obesity, age older than 55 yr, history of snoring, lack of teeth, the presence of a beard, Mallampati Class III or IV, and abnormal mandibular protrusion test are all independent predictors of DMV. When facing it unexpectedly, it clearly causes morbidity and mortality in clinical situations. Khan et al. [6] Suggested that a combination of the upper lip bite test, a past history of snoring, and neck circumference be utilized in the prediction of DMV as these composite variables yielded the best results. Kheterpal et al. [8] Considered snoring and a thyromental distance <6cm predicting very DMV Yildiz et al. [8] Considered a Mallampati class, [20] male gender, age and an increase in weight as difficult mask ventilation's risk factors. Likewise, a short sternomental distance [20] and the presence of a beard [16] have been documented to be related to DMV.

Mallampati et al. [9] suggested that using a simple scaling which is based on the ability to see the oropharyngeal statures, difficult airways could be predicted. In their scaling, three classes were described. Later a fourth class was added to this scaling by Samsoon and Young [10]. In both the scaling, the patient was evaluated in the upright position [10,13].

A change in position has little effect, and changing position from upright to supine has not much of an effect on the Mallampati class. Amadasun et al. [21] evaluated the effects of phonation and various head and body positions in oropharyngeal view (Mallampati score), and the correlation of these with laryngoscopic view, using the Cormack and Lehane score. They concluded that the best position to conduct the Mallampati test is sitting, head maximally extended, without phonation. This correlated best with a laryngoscopic view score in...
their study [21]. Also Lewis et al. [22] reported the same findings.

In our study where the Mallampati test was evaluated in two different situations for the prediction of DMV, we could observe that supine position had the highest Se, and the upright position had the least Se. The largest NPV among all the Mallampati test positions considering the mask ventilation status was observed in supine plus phonation situation and was found to be above 85.8%.

Previous studies have not shown any difference between supine and upright positions in the assessment of Mallampati classifications [13]. However, in Singhal et al. [14] research, it is stated that a change in position has a meaningful effect on mouth opening, and the Mallampati score was higher in the supine position than in the upright position.

At least, it should be noted that the kappa agreement above Se, Sp, PPV and NPV in all the Mallampati test positions related to DMV status was found to be slightly poorer. In our study, the results showed that the Mallampati score in supine position has increased the Mallampati score, and finally the Mallampati score improvement was found to be higher in the supine position rather than the upright position.

Similarly, in our study, the test of agreement's analysis has shown that the best amount of kappa was observed in upright and supine position. Among all the Mallampati tests conducted in different situations, the highest kappa was seen in the supine position in the prediction of DMV and intubation states, however, this difference was not of importance among the two groups.

Conclusion: According to our results, it can be claimed that the Mallampati test in supine position has better compatibility in predicting DMV. The results of the study can be used as a tool along with other existing methods in timely and correct prediction of DMV which has been found to be a major and an important cause of morbidity and mortality in clinical situations.

Source of Support: Nil. Conflict of Interest: None declared.

References


