Internal Medicine: Open Access

Research Article   **Open Access**

Mallampati Airway Assessment Test in Upright and Supine Positions with and without Noisy Exhalation in the Prediction of Difficult Mask Ventilation

Zahid Hussain Khan[1]*, Ali Mohammad Khorasani[1] and Mir Saeed Yekaninejad[3]

[1]*Department of Anesthesiology and Intensive Care, Imam Khomeini Medical Center, Tehran University of Medical Sciences, Tehran, Iran*
[2]*Department of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran*

Abstract

Background: Difficult mask ventilation is an emergency situation. In this study we pursued the effect of phonation and that of patient's position on the Mallampati class, and its accuracy in the prediction of difficult mask ventilation.

Methods: Six hundred sixty one patients with or without phonation were examined, in both supine and upright positions. The results of the four different situations were evaluated for the prediction of difficult mask ventilation. For each of the four situations, sensitivity, specificity, positive and negative predictive values were obtained.

Results: In this study, 246 (37.2%) patients had difficult mask ventilation. The sensitivity of the Mallampati classification in four positions did not show a significant difference but the specificity was found to be the highest in the supine position with phonation. The negative predictive value was observed to be 95% in the supine position plus phonation, and the positive predictive value also had the highest percentage in the same situation.

Conclusions: The highest correlation was seen in the supine position without phonation and difficult mask ventilation. Phonation improved the Mallampati class better in the supine position than in the upright position.

Introduction

The worst scenario and perhaps the most dangerous incident for the anesthesiologists are facing the predicament in which both intubation and mask ventilation (DMV) should be our top most priority. Although tracheal intubation is still considered the safest way to ensure the patency of the airway and to protect the respiratory tract from possible episodes of aspiration, nevertheless, mask ventilation gives the anesthesiologist an opportunity to intervene and perform resuscitative maneuvers when needed [1]. Many studies have been performed in predicting difficult airway [2-4] but very few have focused on the issue of DMV and the factors that could possibly herald its presence in a patient before being subjected to general anesthesia. The practice guidelines for management of the difficult airway [1,2] also do not mention the factors predicting DMV. Of late, some Studies [5-8] have been performed with the explicit aim of finding factors that could predict DMV. In the study of Khertepal et al. [5] snoring and a thyromental distance <6 cm are considered to be of considerable importance in predicting DMV. Khan et al. [6] in their study noted that upper lip bite test class 2 and 3, a history of snoring and a large neck circumference positively correlated with and could predict DMV. The original Mallampati [9] test and the modified Mallampati test introduced by Samsoon 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 a accuracy as 26% sensitively (Se)

and 89% specifically (Sp) have been reported [11], but many studies have shown moderate accuracy and precision using the traditional and the modified Mallampati test.

According to the definition of the Mallampati test, the patient has his mouth wide open in upright position, his tongue completely extruded and without phonation to reveal the oropharyngeal structures. This test shows the proportion of the tongue's size to the mouth space [12]. In clinical situations, there are instances in which the evaluation on 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 supping 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 had 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 phonation and position on the Mallampati class for the prediction of DMV, we pursued the phonation effect and patient's position on the Mallampati class and their importance in the prediction of DMV in our study.

Methods and Materials

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 patients 16-60 years old undergoing general anesthesia and having consented to enter the study protocol. Exclusion standards included patients with ASA class higher than II, incapability of the patient in opening the mouth, abnormalities of the face, mouth, pharynx and airway, pregnancy, urgency and a wake intubation. All patients with the above mentioned criteria were enrolled in this study by convenience sampling method. The Mallampati class was assessed as under before prescribing any drugs, and 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 without exhalation: 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 upright position with exhalation: In this group, the patient was upright, mouth wide open and his tongue completely out and while exhaling, the orpharyngeal view was assessed by the observer positioned exactly in front of the patient.

3. Mallampati class in supine position without exhalation: In this group, the patient was in the supine position (lying on back) and his read 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.

4. Mallampati class in supine position we it exhalation : In this group, the patient was in the supine position (lying on back) and his head in sniffing position, mouth wide open, his tongue completely out, and while exhaling the or pharyngeal view was evaluated by the observer who was watching vertically.

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

Anesthetic protocol: In all patients, 0.05 mg of midazolam per kg body weight and 2 μg per kg body weight of fenfanyl was prescribed as premedication. For anesthetic induction, 5 mg per kg body weight of sodium thiopental was given followed by 0.5 mg 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

Calss1: soft palate, fauces, uvula, pillars seen

Calss2: soft plate, fauces and uvula seen

Class3: soft palate, base of uvula seen

Class 4: soft palate not visible.

Mask ventilation scoring [8] was assessed as under:

a) Inadequate mask seal. (in one person ventilation) : yes □ no □

b) Inability to obtain chest excursion (in one person ventilation): yes □ no □

c) $Spo_2 < 90\%$ (in one person ventilation): yes □ no □

d) Necessity of oral airway (in one person ventilation): yes □ no □

e) Necessity of two person ventilation: yes □ no □

f) Necessities of O2 flush: yes □ no □ how many times.

g) Necessity of jaw thrust: yes □ no □

The existence of any of the above seven instances is labeled as 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 data gathering tools comprising of survey forms including data collection sheets. The data and information were collected separately for each person. An official approval from the Ethics Committee, TUMS was obtained to carry out the research. Executers announce their commitment to the declaration of Helsinki regarding patient's confidentiality, consent and ethical considerations.

For the date analysis, acquired information is entered into statistical software SPSS version 16 as code sheets, and master sheets, and finally analyzed using the same software. In addition to descriptive indexes, the agreement results for Mallampati test in different positions are studied using the kappa agreement test. Also, sensitivity, specificity, positive and negative predictive values, and diagnostic accuracy of the Mallampati test in different positions are appointed in laryngoscopy and DMV prediction. CI 95% was calculated for each scale. A p value of <0.05 was considered to be meaningful.

Results

A total of 661 patients were 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 246 (37%) had DMV and the rest had easy mask ventilation according to the definition. The incidence of a beard in our patients was 3.2% (21/661). DMV was observed in 28.6% of the patients having beard whereas the DMV was observed in 37.5% of the patients with no beard (P=0.40)

Out of 246 (37.2%) patients who had DMV, inadequate mask seal was found to be observed in 75 (30.5%), inability to obtain chest excursion in 55 (22.4%), an $SPO_2 < 90\%$ in 31 (12.6%), necessity of an oral airway in 123 (50.0%), necessity of two person ventilation in 37 (15.0%) and necessity of O2 flush in 86 (35.0%) of the patients.

In patients where it was difficult to maintain an $SPO_2 > 90\%$,

alternative measures such as glydescope or a flexible fiberoptic was used.

In the Mallampati test in the studied positions, supine plus no phonation had the highest Se, and upright + phonation had the lowest (Table 1). The highest Negative Predictive Value (NPV) among all positions was observed in supine plus phonation (95.4%), The kappa agreement for Se, Sp, PPV and NPV was reported slightly low in relation to mask ventilation in all of the Mallampati test positions (Figures 1-4). The test of agreement's analysis has shown that the best amount of kappa was observed in upright plus phonation and supine plus phonation. Among all the Mallampati tests conducted in different positions, the highest kappa amount was in supine plus no phonation in the prediction of mask ventilation and intubation state; however this difference was not of importance among the four 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, and it has decreased while exhaling.

Discussion

The incidence of DMV varies considerably in different studies and has been reported to be 5% [16], 24% [8] and 28% [6]. 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. [5] considered snoring and a thyromental distance <6 cm predicting very DMV Yildiz et al. [8] considered a Mallampati class [17], male gender, age and an increase in weight as difficult mask ventilation's risk factors. Likewise, a short sternomental distance [17] and the presence of a beard [16] have been document to be related to DMV.

Mallampati et al. [9] suggested that using a simple scaling which is based on the ability to see the orogharyngeal 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].

Phonation in the Mallampati test has a known effect and improves the Mallampati class compared to that scored prior to phonation. On the other hand, a change in position has little effect, and changing position from upright to supine has not much of an effect on the Mallampati class. Since some of the patients perform phonation during the Mallampati test by default, a change is observed in viewing the oropharyngeal structures [13].

In our study where the Mallampati test was evaluated in four different situations for the prediction of DMV, we could observe that supine position without any phonation had the highest Se, and the upright position with patients phonating 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 95%.

Previous studies have not shown any difference between supine and upright positions in the assessment of Mallampati

Ventilation	Upright + no phonation			Supine + no phonation			Upright + Phonation			Supine + Phonation		
	Mean	CI 95%		Mean	CI 95%		Mean	CI 95%		Mean	CI 95%	
		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper
Sen	25.61	20.12	31.1	38.62	32.49	44.74	8.94	5.35	12.53	10.98	7.04	14.91
Sp	82.65	78.99	86.31	76.63	72.54	80.72	96.14	94.28	98	95.42	93.4	97.44
PPV	46.67	38.14	55.19	49.48	42.34	56.61	57.89	41.45	74.34	58.7	43.91	73.48
NPV	65.21	61.13	69.29	85.87	83.78	87.97	64.04	60.27	67.82	95.42	93.4	97.44
Kappa	0.09			0.16			0.06			0.07		
Agreement	61.42			62.48			63.69			63.99		

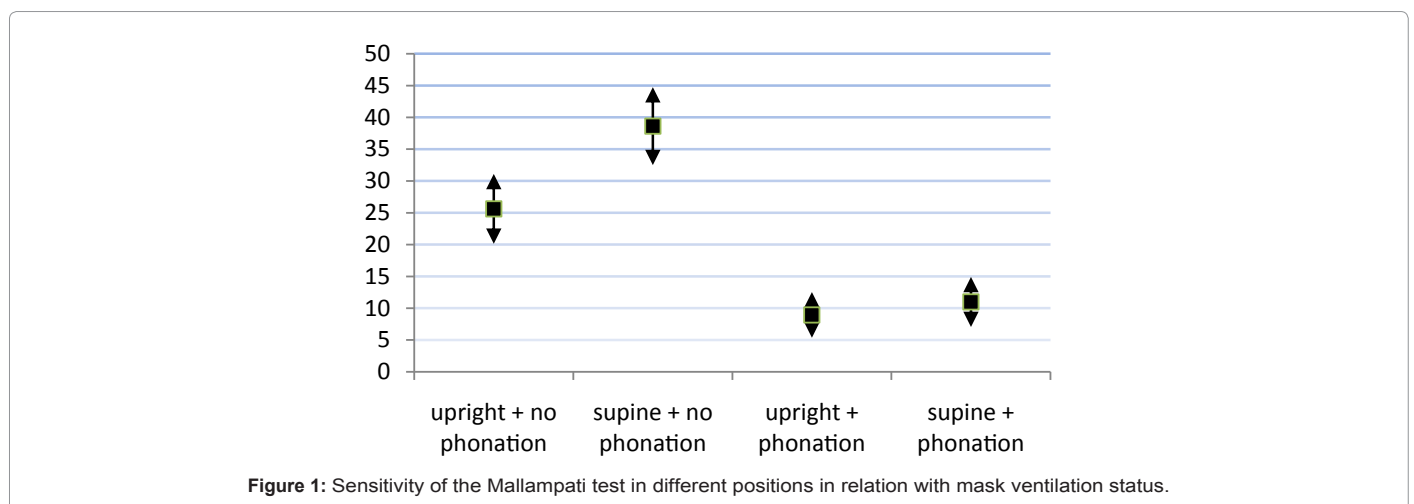**Table 1:** Se, Sp, PPV, NPV, Kappa and agreement in different positions.

Figure 1: Sensitivity of the Mallampati test in different positions in relation with mask ventilation status.
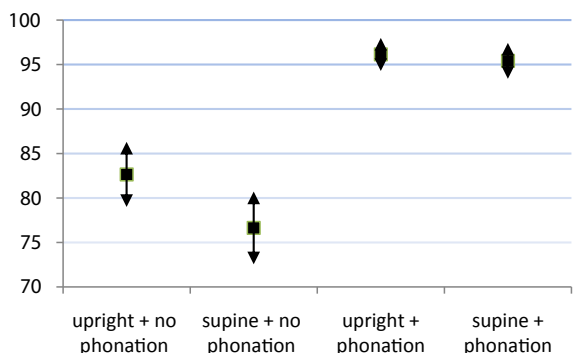
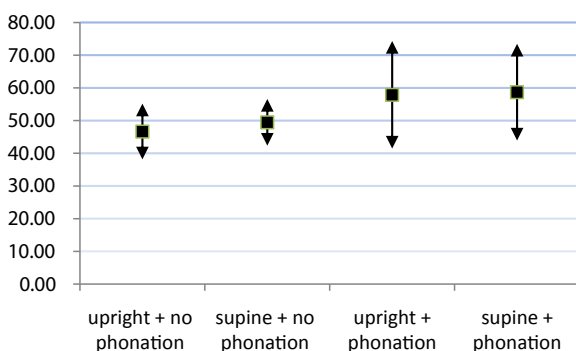**Figure 2:** Specifity of the Mallampati test in different positions in relation with mask ventilation status.

Figure 3: Positive predictive value of the Mallampati test in different positions in relation with mask ventilation status.
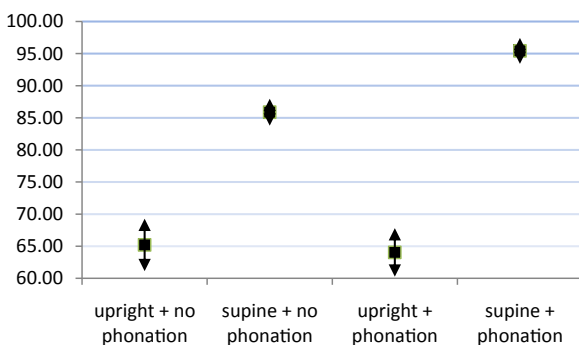

Figure 4: Negative predictive value of the Mallampati test in different positions in relation with mask ventilation status.

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 last, 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 poor. In our study, the results showed that the Mallampati score in supine position has increased, and moreover phonation has improved the Mallampati score, and finally the Mallampati score improvement was found to be higher in the supping position plus phonation rather than the upright position plus phonation.

Similarly, in our study, the test of agreement's analysis has shown that the best amount of kappa was observed in upright plus phonation and supine plus phonation satiations. Among all the Mallampati tests conducted in different situations, the highest kappa was seen in the supine position without any phonation in the prediction of DMV and intubation states; however, this difference was not of importance among the four groups.

Conclusions

The Mallampati test by itself is a weak method for the prediction of DMV, because the test has a low Se and high false positive results [18]. According to our results, it can be claimed that the Mallampati test in supine position without phonation 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.

References

1. Apfelbaum JL, Hagberg CA, Caplan RA, Blitt CD, Connis RT, et al. (2013) Practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Anesthesiology 118: 251-270.

2. Boisson-Bertrand D, Bourgain JL, Camboulives J, Crinquette V, Cros AM, et al. (1996) [Difficult intubation. French Society of Anesthesia and Intensive Care. A collective expertise]. Ann Fr Anesth Reanim 15: 207-214.

3. Benumof JL (1991) Management of the difficult adult airway. With special emphasis on awake tracheal intubation. Anesthesiology 75: 1087-1110.

4. el-Ganzouri AR, McCarthy RJ, Tuman KJ, Tanck EN, Ivankovich AD (1996) Preoperative airway assessment: predictive value of a multivariate risk index. Anesth Analg 82: 1197-1204.

5. Kheterpal S, Han R, Tremper KK, Shanks A, Tait AR, et al. (2006) Incidence and predictors of difficult and impossible mask ventilation. Anesthesiology 105: 885-891.

6. Khan ZH, Mofrad MK, Arbabi S, Javid MJ, Makarem J (2009) Upper lip bite test as a predictor of difficult mask ventilation: a prospective study. Middle East J Anesthesiol 20: 377-382.

7. Adnet F (2000) Difficult mask ventilation: an underestimated aspect of the problem of the difficult airway? Anesthesiology 92: 1217-1218.

8. Yildiz TS, Solak M, Toker K (2005) The incidence and risk factors of difficult mask ventilation. J Anesth 19: 7-11.

9. Mallampati SR, Gatt SP, Gugino LD, Desai SP, Waraksa B, et al. (1985) A clinical sign to predict difficult tracheal intubation: a prospective study. Can Anaesth Soc J 32: 429-434.

10. Samsoon GL, Young JR (1987) Difficult tracheal intubation: a retrospective study. Anaesthesia 42: 487-490.

11. Lee A, Fan LT, Gin T, Karmakar MK, Ngan Kee WD (2006) A systematic review (meta-analysis) of the accuracy of the Mallampati tests to predict the difficult airway. Anesth Analg 102: 1867-1878.

12. Gal TJ (2005) Airway management. In: Miller RD (Ed.), Miller's Anesthesia (6thedn), New York Churehill Livingston Inc: 1617-1652.

13. Tham EJ, Gildersleve CD, Sanders LD, Mapleson WW, Vaughan RS (1992) Effects of posture, phonation and observer on Mallampati classification. Br J Anaesth 68: 32-38.

14. Singhal V, Sharma M, Prabhakar H, Ali Z, Singh GP (2009) Effect of posture on mouth opening and modified Mallampati classification for airway assessment. J Anesth 23: 463-465.

15. Ezri T, Warters RD, Szmuk P, Saad-Eddin H, Geva D, et al. (2001) The incidence of class "zero" airway and the impact of Mallampati score, age, sex, and body mass index on prediction of laryngoscopy grade. Anesth Analg 93: 1073-1075.

16. Langeron O, Masso E, Huraux C, Guggiari M, Bianchi A, et al. (2000) Prediction of difficult mask ventilation. Anesthesiology 92: 1229-1236.

17. Al Ramadhani S, Mohamed LA, Rocke DA, Gouws E (1996) Sternomental distance as the sole predictor of difficult laryngoscopy in obstetric anaesthesia. Br J Anaesth 77: 312-316.

18. Savva D (1994) Prediction of difficult tracheal intubation. Br J Anaesth 73: 149-153.