J Anesth (2010) 24:482–485
DOI 10.1007/s00540-010-0905-6

SHORT COMMUNICATION

Is the modified Mallampati test performed in supine position a reliable predictor of difficult tracheal intubation?

Ashish Bindra · Hemanshu Prabhakar · Gyaninder Pal Singh · Zulfiqar Ali · Vasudha Singhal

Received: 28 September 2009 / Accepted: 14 January 2010 / Published online: 10 March 2010
© Japanese Society of Anesthesiologists 2010

Abstract Management of the airway is central to the practice of anesthesia. Several bedside airway assessment methods have been proposed for preoperative identification of patients who are difficult to intubate. The modified Mallampati test (MMT) remains a time-tested technique to date for recognizing an anticipated difficult tracheal intubation as assessed by Cormack–Lehane grade. Both Mallampati and its further modification by Samsoon and Young evaluate patients in the seated position. Recently a study mentioned a change in MMT score from sitting to supine position toward the higher side. However, there is a lack of data regarding the relationship of positional change in MMT with Cormack–Lehane grade. The aim of this prospective study was to assess if MMT score observed in sitting or supine position is a better predictor of difficult tracheal intubation. One hundred and twenty-three patients of ASA physical status I and II, aged 18–60 years, who were scheduled to undergo various neurosurgical procedures were enrolled for the study. We found that the MMT in supine position has a higher positive predictive value and is associated with more true positives as compared to MMT in the sitting position.

Keywords Mallampati test · Position · Supine · Sitting · Difficult intubation

A. Bindra · H. Prabhakar (✉) · G. P. Singh · V. Singhal
Department of Neuroanesthesiology, Neurosciences Centre, All India Institute of Medical Sciences, New Delhi 110029, India
e-mail: prabhakarhemanshu@rediffmail.com

Z. Ali
Department of Anesthesiology, Sher-i-Kashmir Institute of Medical Sciences, Srinagar, India

Good assessment of the airway is key to the safe practice of anesthesia. In the general population, difficult intubation accounts for 17% of the respiratory-related injuries with resultant morbidity and mortality. Up to 28% of all anesthetic deaths are attributed to inability to mask-ventilate or intubate [1]. The majority of difficult airways (98%) can be detected by careful evaluation of the airway. Unexpected difficulty with tracheal intubation is a significant contributor to morbidity and mortality in clinical practice [2–4]. The modified Mallampati test (MMT) is a routinely used technique for difficult airway assessment [5, 6]. Samsoon and Young later modified the Mallampati classification, and it is the most commonly applied bedside test for airway evaluation to date [7]. The literature indicates that MMT has relatively high specificity but low sensitivity and a high number of false-positive results [8–10]. However, both Mallampati and its Samsoon and Young modification tests are applied in the sitting position. During clinical practice, situations may arise where it may not be feasible for the patient to sit up for airway assessment, e.g., cervical spine injuries, disc prolapse. A previously conducted study at our center has revealed a difference in MMT in supine and sitting position [11]. However, a study conducted by Tham et al. [12] observed no clinically significant difference in the two positions. There is a paucity of literature regarding the relationship of positional change in MMT with Cormack–Lehane grade. The aim of this prospective study is to determine which position for MMT, sitting or supine, may be a better predictor of difficult tracheal intubation as assessed by using the Cormack–Lehane grade.

After local ethics committee approval and written informed consent from the patient, 123 patients of ASA physical status I and II, aged 18–60 years, who were scheduled to undergo various neurosurgical procedures over a period of 6 months were enrolled for the study.

Patients with anticipated difficult airway because of upper airway pathology, restricted neck movement (procedures on upper cervical spine, Arnold Chiari malformations, craniovertebral junction anomalies, etc.), uncooperative patients, patients with Glasgow Coma Score (GCS) less than 15, obese patients, diabetics, and pregnant females were excluded from the study. In this prospective and double-blinded study we evaluated two positions—sitting and supine—for preoperative airway assessment and glottic exposure obtained during orotracheal intubation. The interrater reliability was single blinded, that is, the observer who was assessing the glottic exposure was blinded to preoperative airway assessment. The demographic data of the patients, such as age, weight, height, gender, and body mass index (BMI), were noted. The airway was assessed at the time of the preoperative visit according to the MMT [6]. MMT is a scale indicating the amount of posterior pharynx that can be visualized on mouth opening. Accordingly, grade I is visualization of soft palate, fauces, uvula, and pillars; grade II is visualization of soft palate, fauces, and uvula; grade III is visualization of soft palate and base of uvula; grade IV is soft palate not visible. A standard airway assessment protocol was followed for all patients. First, the observation was made in the sitting position. In the sitting position, the patient sat upright with the head in the neutral position, the mouth opened maximally and the tongue protruded maximally. The observer was seated opposite the patient at eye level. The patient was then turned supine. In the supine position, the patient's head was placed on a 10-cm-high pillow, and the observer assessed the airway by looking vertically downward. In the operation room, general anesthesia was induced with fentanyl 2 μg kg^{-1} and thiopentone 4–5 mg kg^{-1}. After confirming adequate bag and mask ventilation based on the capnography, rocuronium 1 mg kg^{-1} was administered to provide muscle relaxation. Ninety seconds later, laryngoscopy was tried by an experienced anesthesiologist who was blinded to the MMT grade. The Cormack–Lehane grade was noted. Cormack–Lehane grade is indication of the glottic view upon direct laryngoscopy: grade I, full view of the glottis; grade II, glottis not fully exposed, anterior commissure not visible; grade III, only epiglottis seen; grade IV, epiglottis not seen.

We defined MMT grades I and II as easy airways and III and IV as difficult; similarly, Cormack–Lehane grades I and II were considered easy intubations and III and IV as difficult intubations. The preoperative assessment data were used to determine the accuracy of the two tests in predicting difficult intubation.

Several statistical measures that have been frequently used were calculated and are provided in the Appendix. Statistical analysis was done using software STATA 9.1 (College Station, TX, USA). Most of these measures could be easily calculated using the 2 × 2 table. Relative risk (RR) [95% confidence interval (CI)] was estimated for the MMT in two positions. P less than 0.05 was considered significant. Data are presented as mean (standard deviation, SD), number, or percentage.

A total of 123 patients participated in the study and none was excluded from final analysis. Of these, 71 (58%) were males and 52 (42%) were females. The mean age, weight, and height of the patients were 38 (14.7) years, 63.5 (11.2) kg, and 165 (9.7) cm, respectively. MMT and CL grade of the patients are shown in Table 1. A total of 16 patients had a difficult airway manifesting as grade III and IV on laryngoscopy without external laryngeal manipulations. However, external laryngeal manipulation improved the Cormack–Lehane grade by one class. Bougie was used for intubation in patients with difficult Cormack–Lehane grades. There were no failed intubations.

Our study evaluated the effect of posture on preoperative MMT for predicting difficult airway. Both supine and sitting positions were found to correlate well for anticipation of airway except for a few findings (Table 2). We compared the MMT in the two positions, sitting and supine, and further assessed their RR of predicting difficult CL grade (see Table 1). The sensitivity of the two tests was comparable and was found to be 23% and 21% for sitting and supine position, respectively. Similarly, the specificity of these positions was comparable (98% for sitting and 93% for supine). We observed that MMT (supine) was associated with a higher predictive value (69%) as compared to MMT sitting (31%); this indicates a higher percentage of correctly predicted difficult intubations as a proportion of all intubations being judged by MMT supine [RR (95% CI), 2.9 (1.1, 7.9)] ($P = 0.02$). The latter is better than sitting MMT in terms of predicting fewer false positives (5 of 124). False positives reported with MMT (sitting) were 11 of 124. At the same time, sitting posture is associated with a higher percentage (84%) of easy intubations as a proportion of all intubations as compared to

Table 1 Relationship between modified Mallampati test (MMT) in sitting and supine positions and Cormack–Lehane grading of laryngoscopic view in patients

	CL I, II ($n = 107$)	CL III, IV ($n = 16$)	RR (95% CI)	P value
MMT (sitting)				
I, II	90	11	2.1 (0.8, 5.4)	0.13
III, IV	17	5		
MMT (supine)				
I, II	65	5	2.9 (1.1, 7.9)	0.02
III, IV	42	11		

MMT modified Mallampati test, *CL* Cormack–Lehane grade, *n* number of patients, *RR* relative risk, *CI* confidence interval

Table 2 Statistical terms used for modified Mallampati test (MMT) performed in sitting and supine positions as predicting tests for difficult laryngoscopy (number or %)

Test	TP	FP	TN	FN	Se (%)	Sp (%)	PPV (%)	NPV (%)
MMT-sitting	5	11	90	17	23	98	31	84
MMT-supine	11	5	65	42	21	93	69	79

MMT modified Mallampati test, *TP* true positive, *FP* false positive, *TN* true negative, *FN* false negative, *Se* sensitivity, *Sp* specificity, *PPV* positive predictive value, *NPV* negative predictive value

supine posture (79%). We assessed patients for MMT in the seated position and then in the supine position followed by observation for Cormack–Lehane grade by a blinded observer. It was observed that MMT grade in supine position is a better predictor of difficult intubation, explained by the high positive predictive value of 69% for this position (PPV is 31% for sitting MMT). An easy intubation as predicted by MMT in sitting position is usually an easy one as the negative predictive value of MMT in this position is 84% (NPV is 79% for supine MMT). Patients assigned a higher grade in supine position are more likely to have difficult intubation whereas lower grade assignment by sitting MP grade rules out difficult intubation.

The sensitivity of MMT has been described as varying from 11% to 84% by different authors [10, 13, 14]. Khan et al. [12] reported a 66.8% specificity of sitting MMT whereas Evan et al. [14] found it to be 75%. Larger percentages of about 82 have been noticed by others [9]. The literature indicates that MMT has relatively low sensitivity, high specificity, and high number of false-positive results [8–10]. The difference between various authors may be the result of the high dependency of this test on individual observation and the possibility of involuntary phonation during the test. A systematic review of the accuracy of the Mallampati tests to predict the difficult airway by Lee et al. [15] revealed substantial variability in the reported sensitivity and specificity among the studies and in definitions of the reference tests. The possibility of racial variation cannot be ruled out. Tham et al. [12] described a small, insignificant change in the Mallampati score of ASA I–II patients when assessed in the sitting and supine position. They concluded that performing the Mallampati test with the patient supine is unlikely to make much difference to the class assigned but that the supine position does not worsen the predictive power of the Mallampati test. However, a study by Singhal et al. [11] reported a difference in MMT in sitting and supine position toward a higher grade. Patients with a higher grade had a tendency for worse grade assignment when placed supine. The authors, however, failed to comment on the clinical implications of their findings in terms of predictions on tracheal intubation. Cormack–Lehane grading was not assessed by the authors, which was a limitation of the study. According to our study, the difficult airway can be better predicted by assessing MMT grade in supine position as it assesses a number of true positives, that is, actual difficult intubations, better than MMT in sitting position. We recommend examination in both sitting and supine position for those airways being assigned a higher grade in sitting position to judge the situation more precisely. This procedure will help in gaining experience with grading in this posture and its correlation to the difficult airway, which may aid practitioners in the long run, especially in evaluating bedridden patients. However, we could have randomized the order of positioning, which may be considered a limitation of our study. In conclusion, we suggest that inability to perform MMT in sitting posture should not raise concern as the test performed in the supine position gives comparable predictive results for difficult intubation.

Appendix: Statistical terminology

True positive (TP):	Difficult intubation that had been predicted to be difficult
False positive (FP):	Easy intubation that had been predicted to be difficult
True negative (TN):	Easy intubation that had been predicted to be easy
False negative (FN):	Difficult intubation that had been predicted to be easy
Sensitivity:	Percentage of correctly predicted difficult intubations as a proportion of all intubations that were truly difficult, i.e., TP/(TP + FN)
Specificity:	Percentage of correctly predicted easy intubations as a proportion of all intubations that were truly easy, i.e., TN/(TN + FP)
Positive predictive value:	Percentage of correctly predicted difficult intubations as a proportion of all predicted difficult intubations, i.e., TP/(TP + FP)
Negative predicted value:	Percentage of correctly predicted easy intubations as a proportion of all predicted easy intubations, i.e., TN/(TN + FN)

References

1. Benumof JL. Definition and incidence of difficult airway. In: Benumof JL, editor. Airway management: principles and practice. St. Louis: Mosby; 1996. p. 121–5.
2. Keenan RL, Boyan CP. Cardiac arrest due to anesthesia: a study of incidence and causes. JAMA. 1985;253:2373–7.
3. Caplan RA, Posner KL, Ward RJ, Cheney FW. Adverse respiratory events in anesthesia: a closed claims analysis. Anesthesiology. 1990;72:828–33.
4. Cheney FW, Posner KL, Caplan RA. Adverse respiratory events infrequently leading to malpractice suits: a closed claims analysis. Anesthesiology. 1991;75:932–9.
5. Mallampati SR. Clinical sign to predict difficult tracheal intubation (hypothesis). Can Anaesth Soc J. 1983;30:316–7.
6. Mallampati SR, Gatt SP, Gugino LD, Desai SP, Waraksa B, Freiberger D. A clinical sign to predict difficult tracheal intubation: a prospective study. Can Anaesth Soc J. 1985;32:429–34.
7. Samsoon GL, Young JR. Difficult tracheal intubation: a retrospective study. Anaesthesia. 1987;42:487–90.
8. Oates JD, Macleod AD, Oates PD, Pearsall FJ, Howie JC, Murray GD. Comparison of two methods for predicting difficult intubation. Br J Anaesth. 1991;66:305–9.
9. Frerk CM. Predicting difficult intubation. Anaesthesia. 1991;6:1005–8.
10. Savva D. Prediction of difficult tracheal intubation. Br J Anaesth. 1994;73:149–53.
11. Singhal V, Sharma M, Prabhakar H, Ali Z, Singh GP. Effect of posture on mouth opening and modified Mallampati classification for airway assessment. J Anesth. 2009;23:463–5.
12. Tham EJ, Glidersleve CD, Sanders LD, Mapleson WW, Vaughan RS. Effects of posture, phonation, observer and Mallampati class. Br J Anaesth. 1992;68:32–8.
13. Khan Z, Kashfi A. A comparison of the upper lip bite test (a simple new technique) with modified Mallampati classification in predicting difficulty in endotracheal intubation: a prospective blinded study. Anesth Analg. 2003;96:595–9.
14. Hester CE, Dietrich SA, White SW, Secrest JA, Smith TA. A comparison of preoperative airway assessment techniques: the modified Mallampati and the upper lip bite test. AANA J. 2007;75:177–82.
15. Lee A, Fan L, Gin T, Karmakar MK, Kee WD. A systemic review (meta-analysis) of the accuracy of Mallampati tests to predict the difficult airway. Anesth Analg. 2006;102:1867–78.