

A Comparison of The Mallampati Test in Both Sitting and Supine Positions to Predict Difficult Intubation in Adults Undergoing Surgery Under General Anesthesia

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ABSTRACT:

Background: Difficult airway is a major concern for all anesthesiologists since failure to secure airway could lead to devastating complications and increase morbidity and mortality. Therefore airway assessment prior to induction could help us in avoidance of life-threatening complications. There are various tests to assess the airway, out of which, modified Mallampati test (MMT) is one of the common, easy and reliable methods to predict difficult airway. Usually is done with patient in sitting position. However, in certain patients in whom sitting position is not possible (suspected cervical spine injury, pelvic injury, patients in shock, etc.), the MMT can be done in supine position, therefore, we wanted to address this and to find out whether Mallampati test in supine position could offer better diagnostic accuracy or not. **Objectives:** to assess the Mallampati test in sitting and supine position among adult patients undergoing emergency operation to predict difficult laryngoscopy and difficult intubation. **Method:** This single center double blinded cross-sectional study involved 200 adult patients who underwent surgeries requiring endotracheal intubation from May 2024 to 11 2024 in the emergency operation department of Shar Teaching Hospital. The preoperative MMT was performed in both sitting and supine positions and compared with the Cormack-Lehane grading system using Chi-square test and the Statistical Package for Social Sciences (IBM SPSS Statistics 26, Chicago, IL), positive predictive value, negative predictive value, and diagnostic accuracy were calculated in the sitting and supine positions. Significance was considered when the P-value ≤ 0.05 . **Results:** Among 200 patients, 79% had easy intubation, and 21% experienced difficult intubation based on the Cormack-Lehane grading, with both groups showing similar demographic profiles in age, gender ($P>0.05$). Indeed, 57.1% ($n=24$) of the difficult endotracheal intubation was ASA I, and only 42.8% ($n=18$) were ASA II, with a significant difference ($P<0.001$). MMT III and IV increased from 12.5% in the sitting position to 30.5% in the supine position, indicating an 18.5% rise. The sitting position was superior, with higher MMT accuracy (90.0% vs. 84.5% in supine), greater sensitivity (99.4% vs. 84.2%), and lower specificity (54.8% vs. 85.7%). **Conclusion:** MMT performed in the sitting position was

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possibly a superior predictor of difficult tracheal intubation in adult patients compared with MMT in the supine position.

Keywords: Mallampati test ; Difficult intubation; Siting position, Supine position.

1. Introduction

Proficiency in airway management plays a pivotal role that contributing to morbidity and mortality among patients undergoing anaesthesia (Markos, Melese, Getachew, & Haddis, 2022). The prevalence of difficult intubation stands at 2,2 – 6% among surgical patients (Markos et al., 2022), The predominant claims according to ASA was because of respiratory events, and difficult intubation being the cause in 50% of these cases

Airway assessment is a fundamental component of preoperative evaluation in patients undergoing general anesthesia, accurate prediction of difficult laryngoscopy and difficult intubation is essential to reduce anesthesia related complications, including hypoxia, airway trauma and failed airway management, despite advances in airway devices and techniques unanticipated difficult airways

contribute to pose a major challenge to anesthesiologists . Difficult intubation is considered as the need for more than three tries to insert the endotracheal tube using conventional laryngoscopy, or for over ten minutes (Khan et al., 2020). Whereas difficult laryngoscopy is the inability to view the glottis opening using a conventional curved blade laryngoscope, corresponding to Cormack Lehane grade III or IV.

MMT is simple screening test for airway assessment, it was first described by the Indian anesthesiologist Dr. Sishagiri Mallampati in the 1975 (Goodreau, 2022), then re-defined in its most modified form in 1987 by Samsoon and Young which describe it of 4 classes (Samsoon & Young, 1987).



Figure 1: Mallampati classification (Narang, Ashahiya, Panwar, & Mahendra, 2016)

MMT relies on the visual appraisal of pharyngeal anatomy observed in patients positioned seated, with the head in a neutral alignment, the mouth maximally opened, and the tongue fully extended without vocalization (Priya, Jahangeerbasha, Ekambaram, & Ajith, 2026). Nevertheless, the physical examination is not always feasible in the seated position. In emergencies, where discomfort may inhibit mobility, or when stabilization in a supine orientation is necessary due to potential cervical injury, the MMT frequently has to be conducted while the patient is in a supine position

There are several factors affecting MMT, limitation of mouth opening (maxillofacial operation, facial bone injury, rheumatoid arthritis), obesity, tongue size, pregnancy, uncooperative patients (Wang et al., 2022). The Cormack-Lehane classification is a four-grade scale introduced by R.S. Cormack and J. Lehane in 1984 (Cormack & Lehane, 1984) to describe the quality of the laryngeal view during direct laryngoscopy, ever since become the reference standard for airway classification, in this study after assessment of airway by MMT in 2 different position, after induction we compare MMT to CL in predicting difficult airway.

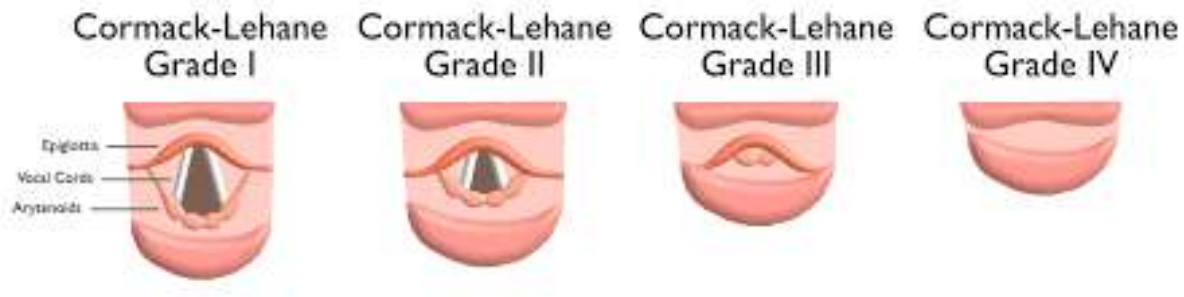


Figure 2. The Cormack-Lehane classification system for grading laryngeal view during direct laryngoscopy (Narang et al., 2016)

The study aimed to use the MMT in 2 different position to predict difficult intubation in patients undergoing emergency operations under general anesthesia, then comparing the result to laryngeal view in Cormack-Lehane classification, which helps anesthetists to better manage any undesired condition which may be faced during difficult intubation and better outcomes regarding the airway.

2. Methodology

Design

This single-center prospective observational cross-sectional study was done between May 2024 to November 2024 in the emergency operation department of Shar Teaching Hospital, The protocol of this study was approved by the Kurdistan Higher Council for Medical Specialists (KHCMS), Sulaimani, Iraq.

Participants/Sample

The sampling method was convenience, and 200 patients of both genders were enrolled. The inclusion criteria included all consenting adult patients of either gender, aged 18-60 years, ASA I, II, scheduled for surgery requiring general anesthesia with ETT insertion, who were included in the study. The exclusion criteria included patients unwilling to participate in the study, those patients with upper airway pathology, restricted neck, craniovertebral junction anomalies, artificial dentures, and limitation of mouth opening, hemodynamically/mentally unstable patients, and pregnant women.

Instruments

Airway assessment was performed using two standard clinical classification systems. First, the modified Mallampati test (MMT) was used to visually examine the oropharyngeal structures (Samsoon & Young, 1987). This assessment was performed in two distinct body positions, including sitting and supine. In the sitting position, patients were positioned upright in a chair, with the head in a neutral position, the mouth wide open, and the tongue extended as far as possible without producing sound. For the supine assessment, patients were placed on the operating room table without pillows and repeated the same maneuvers while maintaining a neutral neck position. MMT scores were divided into four classes based on the Samsoon and Young modification; classes I and II indicated an easy airway and classes III and IV indicated a possible difficulty in intubation. Second, the Cormack-Lehane (CL) classification system (Cormack & Lehane, 1984) was used as the gold standard to determine the actual degree of difficulty of laryngoscopy and intubation. After induction of anesthesia, an independent anesthesiologist blinded to the patient's preoperative MMT scores assessed the glottis during direct laryngoscopy with a Macintosh blade (number 3 or 4). CL scores were divided into two categories for statistical analysis: grades I and II were defined as easy intubation and grades III and IV as difficult intubation.

Procedure

First in sitting position while both patient and observer were sitting on a chair on the same level, with the patient's head in neutral position, mouth being open wide, and the tongue protruding without phonation. Later in the supine position, on the

operating room bed, the MMT was performed with the head on a flat surface, neutral neck, and tongue protruding without phonation and without a pillow.

The induction drugs for all patients were the same, consisting of Fentanyl, Propofol, and Rocuronium bromide. All doses adjusted according to the patient's weight and hemodynamical state. Then, a second anesthesiologist whose anesthetic experience were more than 2 years were not informed about the MMT score of the patient, graded the laryngoscopic view during intubation with Macintosh blade 3 or 4 and grading the laryngeal view using the CL score, CL classes I and II were defined as easy intubations, and III and IV as difficult intubations. In those cases that we expected to be difficult airways, the emergency trolley and all other equipment (such as stylet, Bougi, video laryngoscope) were prepared for the safety of the patients.

Data Analysis

The statistical analysis has been conducted using the Statistical Package for Social Sciences (IBM SPSS Statistics 26, Chicago, IL). Quantitative data was expressed as Mean $\pm$ SD. While Categorical data are presented as numbers (%). Mann Whitney U test and Chi-square test were used for numerical and categorical data respectively. Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy were calculated in the sitting and supine positions. Significance was considered when the P-value $\leq$ 0.05.

3. Results

The results showed that the mean age of the participants was 32.66 ± 12.25 and most of them were in the age range of 18 to 25 years. 62.5% were male and 37.5% were female. In terms of the ASA Physical Status variable, 79.5% were in ASA I and 20.5% were in ASA II (Table 1).

Table 1: demographic data

Variable	Category	n (%) / Mean $\pm$ SD	P-value*
Age (years)	18–25	80 (40.0%)	<0.001
	26–35	60 (30.0%)	
	36–45	35 (17.5%)	
	46–60	25 (12.5%)	
	Mean $\pm$ SD	32.66 $\pm$ 12.25	
Gender	Male	125 (62.5%)	0.0004
	Female	75 (37.5%)	
ASA Physical Status	ASA I	159 (79.5%)	<0.01
	ASA II	41 (20.5%)	

Two categories were established: easy intubation corresponding to Mallampati classifications 1 and 2, and difficult intubation encompassing Mallampati classifications 3 and 4. Also Cormack-Lehane grade has the same classification of MMT. Table 2, shows how Modified Mallampati Test (MMT) scores in sitting and supine positions relate to intubation difficulty according to Cormack–Lehane classification.

Table 2 :Distribution of tracheal intubation difficulty among study participants (n = 200) according to CL, class 1 and 2 considered as easy , class 3 and 4 considered as difficult intubation

Difficulty of intubation	Number (%)
Easy	158(79%)
Difficult	42(21%)
Total	200 (100%)

Results were shown Age was not significantly associated with difficulty of intubation. Higher ASA status (ASA II) was significantly associated with difficult intubation. Higher Mallampati class (III and IV) were strongly associated with difficult intubation with supine position rather than sitting (Table 3).

Table 3: Relationship of age and ASA with difficulty of tracheal intubation according to Mallampati score in sitting and supine positions

Position	Mallampati Class	Total	Easy Intubation (CL I–II)	Difficult Intubation (CL III–IV)	P-value
Sitting	Class I–II	176	157	19	<0.001
	Class III–IV	24	1	23	
	Total	200	158	42	
Supine	Class I–II	145	141	4	<0.001
	Class III–IV	55	17	38	
	Total	200	158	42	

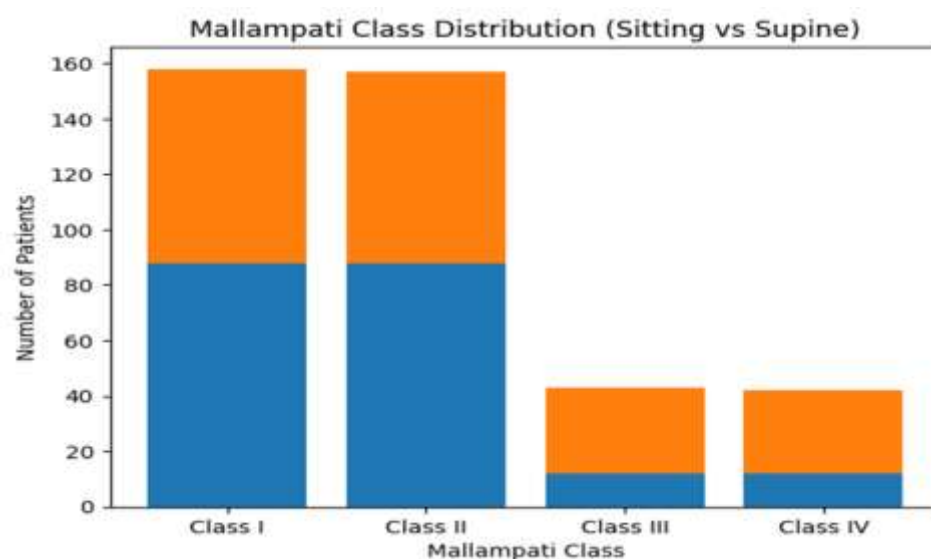


Figure 3: Distribution of Modified Mallampati Test (MMT) classes in sitting versus supine positions.

Figure 3 showed Lower Mallampati classes (I–II) are more common overall, while higher classes (III–IV) increase in the supine position, indicating a shift toward more difficult airway assessment.” Blue bars indicating sitting position, orange position indicating supine position.

Regarding the diagnostic characteristics of the MMT in sitting and supine positions for predicting difficult. The accuracy for the MMT in setting position (90.0 (85.0 – 93.8) was significantly greater than that for the

Table 4: Sensitivity, specificity, positive predictive value, negative predictive value, prevalence and accuracy of Mallampati in the sitting and supine position.

Variables	Mallampati Classification	
	Sitting Position	Supine Position
Sensitivity	99.4 (96.5 - 99.9)	84.2 (75.5 - 89.5)
Specificity	54.8 (38.7 - 70.2)	85.7 (71.5 - 94.6)
PPV	89.2 (85.6 - 92.0)	95.7 (91.3 - 97.9)
NPV	95.8 (76.2 - 99.4)	59.0 (49.6 - 67.8)
Prevalence	79.0 (72.7 - 84.4)	79.0 (72.7 - 84.4)
Accuracy	90.0 (85.0 - 93.8)	84.5 (78.7 - 89.2)

Abbreviations: NPV, negative predictive value; PPV, positive predictive value.

4. Discussion

An essential objective of preanesthetic airway evaluation is to anticipate the ease or difficulty of airway management concerning mask ventilation, laryngoscopy, and/or tracheal intubation. Anatomical variables and attributes (such as oral aperture, tongue dimensions concerning oropharyngeal structures, dental arrangement, etc.) play a significant role in forecasting intubation challenges; however, their predictive utility is constrained due to interindividual variability and fluctuations within the same individual over different stages of life

The study conducted by Wang et al (Wang et al., 2022) and the modification proposed by Samsoon and Young elucidated the Mallampati test, which is administered with the patient in a seated position, with the head positioned in either the sniffing or neutral orientation, and performed without phonation. For the majority of patients, the Mallampati classification, when executed as delineated, effectively anticipates complications associated with airway management, particularly when utilized in conjunction with supplementary assessments.

In this study, the Mallampati test prediction for difficult intubation and laryngoscopy in sitting and supine was investigated. In this prospective observational study, we longitudinally compared airway assessments using MMT in both sitting and supine positions, examining their correlation in predicting a difficult airway.

Our study revealed that the prevalence of difficult intubation was estimated at 21% of the patients who underwent general anaesthesia. Our result was close to 22.2%, conducted by de Carvalho et al., 2022 (de Carvalho, da Silva, Leite, & de Orange, 2022). While it is lower than the results of Harjai et al (2021) (Harjai, Alam, Bhaskar, HARJAI, & Alam Sr, 2021) and Amaha et al. (2021), who conducted 47.0% and 50.0%, respectively (Amaha, Haddis, Aweke, & Fenta, 2021).

In our findings, both groups exhibited comparable demographic profiles (age, gender, and ASA ($P>0.05$)). This finding is in line with the study by Karaca et al. (2020), which reported similar results

(Karaca & Kuzucu, 2020). Moreover, the study of Hanouz et al. (2018) showed a difference in age and gender between the groups (Hanouz et al., 2018). In addition, Tamire et al. (2019) documented that there was no significant difference regarding difficult intubation based on age and gender (Tamire, Demelash, & Admasu, 2019).

There is a significant association between Cormack-Lehane grades of the patients and MMT classes in the sitting position 99.4% of patients who had Cormack-Lehane (CL1) had MMT class 1. But 54.8% of those who had CL 1 had MMT class 2.

In our findings we observed MMT III and IV in 12.5% (sitting) and 30.5% of patients (supine) respectively, meaning that class 3 and class 4 were increased by the measurement of 18.5% when they shifted from sitting to supine posture. To be more precise, shifting from a sitting to a supine position significantly deteriorated the Mallampati grade (i.e., Grade I/ II became Grade III/IV on supine), and our findings align with those of most other studies. Ahirwar et al., 2025. (Ahirwar, Kumar, & Kumar, 2025), Singhal et al. (2009) (Singhal, Sharma, Prabhakar, Ali, & Singh, 2009) and Kotwani et al. (2024) (Kotwani, Kawale, Nam, & Kotwani, 2024) found that the MMT increased to a higher grade when the patient transitioned from a sitting to a supine position. Kotwani et al (2024) noted that 37.7% of the patients who class 1 and 2 of MMT were shifted to class 3 and 4 when changed from sitting to the supine position.12 On the contrary, Markos et al.,2022 (Markos et al., 2022) reported an improvement in Mallampati grades when transitioning from the sitting to the supine position.

We observed that the setting position was superior to the supine, in setting posture the accuracy for the MMT (90.0 (85.0 – 93.8) was significantly greater than that for the MMT in the supine position (84.5 (78.7 – 89.2), In addition in setting position, the sensitivity was higher 99.4 (96.5 - 99.9) and specificity was lower 54.8 (38.7- 70.2) comparison to supine position, in a way, the sensitivity and specificity were 84.2 (75.5 - 89.5) and 85.7 (71.5 - 94.6) respectively. Kotwani et al. (2024) (Kotwani et al., 2024) observed that the sitting posture exhibited higher accuracy than the supine posture (76.7% vs. 72.7%)

A study by Ismael et al., 2019. Involving 42 acromegaly patients, MMT III and IV were found in 36% of patients in the sitting position and 48% in the supine position. These findings are comparable to our study, where we observed MMT III and IV in 28.6% of patients in the sitting position and 48.5% in the supine position (Ismael & Mughamis, 2019).

A Prospective Observational Cohort Study conducted by Hanouz et al., 2018 provides a summary of his predecessor's research (Hanouz et al., 2018) they noted that six studies have analyzed the MMT in both sitting and supine positions, two studies demonstrated that the MMT shifted to a higher class when the patient's position changed from sitting to supine. Four studies have presented conflicting findings regarding the effectiveness of the MMT in sitting and supine positions for

predicting difficult laryngoscopy, ie, Cormack and Lehane grade).

This disparity in their results may be attributed to their MMT technique, which involved head extension and phonation.

5. Conclusion

This research highlights the superiority of the sitting position over the supine position in performing the Mallampati test to predict difficult intubation in adults undergoing surgery under general anaesthesia. The sitting position provided more reliable and consistent results, while the supine position often resulted in higher Mallampati grades, potentially compromising its predictive accuracy. These findings underscore the importance of patient positioning during airway assessment.

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