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Original Research Article

AN OBSERVATIONAL STUDY OF THE EFFECT ON THE RESPIRATION, PHONATION, POSITION AND TONGUE PROTRUSION ON THE MODIFIED MALLAMPATI SCORING

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ABSTRACT

Background: The Modified Mallampati (MM) Grading is a widely used, non-invasive bedside assessment tool to predict the ease of endotracheal intubation. While traditionally performed in a sitting position during quiet respiration without phonation or tongue protrusion, recent research suggests that dynamic factors such as respiration phase, tongue posture, phonation, and patient position may influence the Mallampati score. The aim of our study to evaluate the variations in Modified Mallampati grading associated with changes in respiratory phase (inspiration and expiration), tongue protrusion, phonation and position (sitting vs. supine).

Material and Methods: This observational study was conducted on 500 adult patients of either sex undergoing pre-anaesthetic airway assessment for patients scheduled for elective surgery. MM scores were recorded during quiet breathing, deep inspiration/expiration; with and without tongue protrusion and phonation and in sitting and supine positions. MM scores were analysed using Chi-square test. P value 0.05 considered statistically significant.

Results: Significant variations in MM scores were observed with changes in all the evaluated parameters. Tongue protrusion and phonation generally improved visibility of oropharyngeal structures, resulting in lower (better) MM scores. Negative changes (worsening) were more prevalent during inspiration and supine positioning often led to higher (worse) MM grades. These findings were statistically significant ($p < 0.05$).

Conclusion: We concluded that Mallampati scoring improved in sitting position and positive changes were more commonly seen after expiration. Phonation and tongue protrusion also improve the Mallampati grading score. Hence a standardized dynamic MM grading protocol incorporating these variables be considered for future airway assessments in pre-anaesthetic evaluations.

Keywords: Modified Mallampati Score, Oropharyngeal View, Phonation, Position, Respiration.

INTRODUCTION

Airway assessment is a critical component of pre-anaesthetic evaluation, as unanticipated difficult intubation remains a major cause of morbidity and mortality in anaesthesia practice. Incidence of unanticipated difficult tracheal intubation has been reported from 1% to 18% worldwide.[1] Among various bedside tests, the Modified Mallampati (MM) grading is a simple, non-invasive, and widely

used method to predict difficult laryngoscopy by assessing the visibility of oropharyngeal structures. Traditionally, the MM grading is performed in a sitting position, with the patient opening the mouth and protruding the tongue,[2] without phonation or active respiratory efforts. However, this standard technique may not account for the dynamic nature of the airway, which can change based on several factors, including respiration, phonation, tongue movement, and body position.[2,3,4,5] For example, supine positioning, often required during actual airway management, may worsen Mallampati scores due to posterior displacement of the tongue and soft tissues.[4] Inspiration may enlarge the pharyngeal airway due to upper airway muscle activation and through negative intrathoracic pressure, while expiration could reduce it.[6] Similarly, tongue protrusion and phonation may stretch or elevate surrounding structures, improving visibility. Despite the clinical relevance, there is limited comprehensive data analysing the combined effects of these variables on MM grading. Understanding these influences is essential not only for standardizing assessment techniques but also for improving the predictive accuracy of Modified Mallampati grading in identifying potentially difficult airways in day-to-day practice.

Hence this study aimed to evaluate how positioning (sitting vs. supine), presence or absence of tongue protrusion, respiratory phases (inspiration and expiration), phonation affect the MM grading in patients scheduled for elective surgery.

MATERIALS AND METHODS

This was a prospective observational study conducted in the pre-anaesthesia clinic at P.D.U. Medical College and Hospital, Rajkot. The study included 500 adult surgical patients aged 10-80 years, either gender scheduled for elective surgeries during the year March 2024 to June 2025. Ethical approval was obtained from the Institutional Ethics Committee (PDUMCR/IEC/212/2024). As there was no intervention with patient safety involved, and written informed consent was taken from all participants. Patient with known or suspected difficult airway (e.g., facial anomalies, trauma, tumour, limited mouth opening (<3 cm), neck immobility or cervical spine injury), pregnancy, uncooperative or cognitively impaired patients.

Each patient underwent standardized airway assessment in a well-light room, performed by a single observer to reduce interobserver variability. Modified mallampati grades were assessed with neutral head position, wide open mouth with tongue protruded in the upright position without phonation.

The Modified Mallampati Grade was assessed with the following characteristics

1. Sitting position, quiet breathing, with tongue protrusion, no phonation
2. Supine position, quiet breathing, with tongue protrusion, no phonation
3. Sitting position, with tongue protrusion deep expiration and no phonation
4. Sitting position, deep inspiration with tongue protrusion and no phonation
5. Sitting position, quiet breathing with tongue protrusion, no phonation
6. Sitting position, quiet breathing without tongue protrusion, no phonation
7. Sitting position, with phonation (‘ah’) and tongue protrusion.
8. 8.. Sitting position, breathing, no tongue protrusion or phonation

The MM Grade was classified as, Class 1 –soft palate, fauces, uvula, pillars seen, Class 2 – soft palate, uvula are visible, but fauces and pillars may be partially obscured Class 3- soft palate and base of uvula seen, Class 4 – only hard palate seen (Figure 1).

Each observation was made after ensuring proper patient posture, with the head in a neutral or sniffing position where appropriate. Patients were instructed and time was allowed to understand each step before performing. The baseline modified mallampati score was used as a reference. Score deviations from the reference were considered positive when clinically more reassuring and closer to a score of 1, or negative when less reassuring and closer to score of 4.

Sample size was determined by using by using systematic random sampling technique and single population proportion formula by assuming a prevalence of 0.5% and 5% margin of error at 95% confidence interval using the formula: n=(za/2)2p(1-p)/d2, where n=sample size, z=1.96, p=0.5,d=0.05,, n=(1.96)20.5(1-0.5)/(0.05)2=384, nf=n/(1+n/N), where N=600 was calculated. By selecting every second case for patients scheduled for elective surgery until the sample size of 500 was achieved.

All data were compiled in Microsoft Excel and analysed using Epi info version 7. Descriptive statistics were used for demographic data. Chi-square test was used to assess the significance of changes in MM scores across different conditions. A p-value of <0.05 was considered statistically significant.

RESULTS

Table 1: Demographic data represented as total number of patients (N) and percentage (%)

Age categories	N	%
10-20	28	5.60%
20-30	86	17.20%

30-40	130	26%
40-50	110	22%
50-60	94	18.80%
60-70	40	8%
70-80	12	2.40%
GENDER		
FEMALE	250	50%
MALE	250	50%
BMI		
<30	450	90%
>30	50	10%

Table 2: Summary of variables that affect Modified Mallampati score

PARAMETERS	VARIABLES OF EACH PARAMETER	CHANGE IN MALLAMPATI SCORE	NO OF PTS.	%	P VALUE	CHI SQUARE TEST
POSITION	SITTING	NO CHANGE	325	65%	0.0001	13.92
	SUPINE	NEGATIVE CHANGE	255			
TONGUE PROTRUSION	WITHOUT TONGUE PROTRUSION	NO CHANGE	192	38.40%	P<0.001	52.9
		NEGATIVE CHANGE	308	61.60%		
RESPIRATION	INSPIRATION	NEGATIVE CHANGE	130	26%	P<0.001	148.8
		NO CHANGE	160	29%		
	EXPIRATION	POSITIVE CHANGE	90	18%		
PHONATION	WITH PHONATION	POSITIVE CHANGE	296	59%	P<0.001	390
		NEGATIVE CHANGE	40	8%		
		NEUTRAL	164	32%		

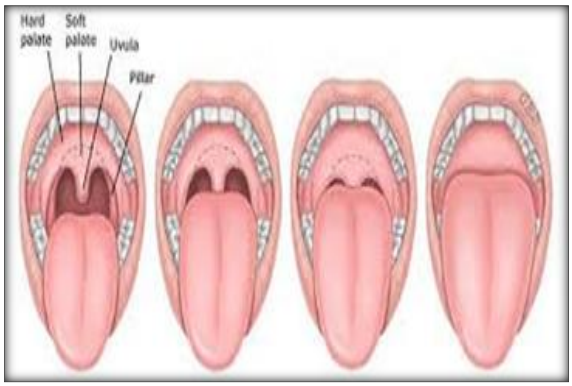

Figure 1: Modified Mallampatti Score

A total 500 patients were examined and middle aged (30-40 years old) were in majority, equally distributed with 50 % (250) male and 50% (250) females.46.5 % had a BMI of < 30 (90%) and >30 (10%). The demographic data are shown in Table 1.

A review of the Mallampati score classes are shown, the change from each patient variables according to parameters affecting the Mallampati scores were shown in the table 2. Supine position worsens Mallampati score in 51% of patients and 65% of patients show no change in Mallampati score in sitting position. (P-0.001). A highly statistically significant difference in Mallampati score distributions between sitting and supine position.

Mallampati score in inspiration is worsened in 26% of patients and 18% of patients show improvement in score in expiration However 29% of patients show no change in score in respiration(P<0.001.) This indicates a significant difference in Mallampati score changes between inspiration and expiration.

59% of patients show improvement in score with phonation,32% patients show no change in score also 8% show negative change(P<0.001) The extremely low p-value confirms a highly statistically significant difference in Mallampati score distributions between phonation and non-phonation conditions. With phonation, the majority of patients demonstrated positive changes in Mallampati score. Without phonation, the distribution reverses with the majority experiencing negative changes. The neutral category remains constant proving a clear difference in directional change. The results strongly suggest that phonation contributes positively to Mallampati score improvement, potentially enhancing airway dynamics and 61% patients show worsening in score without tongue protrusion and 39% of no change in score without tongue protrusion. (P value<0.001). A highly statistically significant difference in the distribution of Mallampati score changes between the two groups (with vs without tongue protrusion) Without tongue protrusion, more patients had negative changes in Mallampati score.

DISCUSSION

The MM class system is the most commonly used bedside airway evaluation test used by anaesthesiologists in today's practice. The present study was aimed to assess the need for standardisation of modified Mallampati system by adding various factors which affect the MM grading like position, respiration, phonation and tongue protrusion.

In our study, the impact of patient positioning—supine versus sitting—on MM Grading was evaluated. The statistical analysis revealed a significant difference in Mallampati score distribution between the two positions indicating that body position meaningfully influences the visibility of pharyngeal structures during airway evaluation The findings demonstrated a trend toward worsening of Mallampati scores in the supine position,

This is consistent with the gravitational effects and soft tissue dynamics of the upper airway.

In the supine position, the tongue, soft palate, and pharyngeal walls are more likely to fall posteriorly, thereby narrowing the oropharyngeal space and obscuring the view of key anatomical landmarks. On the contrary, the sitting position allows gravity to pull these structures downward and away from the airway, improving visibility and often yielding better Mallampati scores. In contrast to our study, Bindra et al,[9] in their study showed that there was improvement in the supine position with phonation and higher class change into a lower class.

This significant positional variation has direct clinical implications. Patients graded as Mallampati class I or II in the sitting position may actually demonstrate more challenging airway features when lying down for surgery.[10] Therefore, an over-reliance on sitting position scoring without accounting for supine variation may underestimate intubation difficulty, especially in high-risk populations such as those with obesity, obstructive sleep apnoea or decreased pharyngeal muscle tone.

This study demonstrates that the respiratory phase—inspiration versus expiration—has a statistically significant impact on MM Grading. Negative changes were more prevalent during inspiration. Conversely, positive changes were more commonly seen after expiration.[11,12] Neutral grades remained the most frequent in both phases, reflecting baseline airway status in a majority of patients. These findings provide valuable insight into the dynamic behaviour of the upper airway during different phases of breathing and reinforce the need for standardized techniques in pre-anaesthetic airway assessment.

Our study demonstrated a positive change in MM score, 296 out of 500 patients in phonation group compared to the non-phonation group had statistically significant impact on Mallampati Grading. These results are consistent with prior studies,[13,14] that suggest phonation causes improvement in Mallampati visualization. Our study suggests that integrating phonation as part of dynamic airway assessment may enhance the predictive value of MPG, especially in borderline or intermediate grades. In contrast Lewis et al,[15] found that phonation did not influence the overall accuracy of Mallampati test. In contrast other studies reported that phonation results in unpredictable motion of pharynx and should be avoided as it may obstruct the view.[16,17] However, the results also raise the question of reproducibility and standardization: phonation may vary between individuals, depending on vocal effort, pitch, or breath control. Thus, further studies using controlled phonation techniques or video documentation may help in developing standard phonation-assisted airway assessment. Phonation significantly improves MM grading in a majority of patients, demonstrating that dynamic airway assessment can yield better predictive insights.

Our study highlights the significant influence of tongue protrusion on MM Grading in surgical patients undergoing pre-anaesthetic airway assessment. The analysis of 500 patients revealed that absence of tongue protrusion was associated with a higher proportion of negative changes in Mallampati scores, while tongue protrusion resulted in more stable or unchanged scores, a statistically highly significant shift. This result correlate with Ouchi k et al,[2] that tongue protrusion also improve the MM grading. Also Yozo Manabe et al,[18] in their study proved that without tongue protrusion can predict difficult tracheal intubation more accurately than the traditional Mallampati classification. Moreover, our data signifies that standardize tongue protrusion as a mandatory step in all MM grading assessments. Our findings suggest that failure to include it leads to a significant underestimation of airway adequacy.

In our study, a single observer conducted the procedure and hence problem associated with the test including observer and subjective variability is excluded. Also large sample size was the strength of our study.

Also our study has few limitations, some geriatric patients who could not understand the directions may lead to erroneous results. The degree of type of phonation was not standardized due to individual variation. We could not predict intubation difficulty score along with other predictors.

CONCLUSION

In our study reveal that Modified Mallampati scoring improved in sitting position and worsening in supine position, positive changes were more commonly seen after expiration a however negative in inspiration. On other hand phonation and tongue protrusion also improve the Mallampati grading score. We propose that a standardized dynamic MM

grading protocol incorporating these variables be considered for future airway assessments, especially in pre-anaesthetic evaluations and enhance patient safety.

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