RESEARCH PAPER

An Observational Study of the Evaluation of the Airway Parameters Mallampatti and Thyromental Distance and Predicting Difficulty Endotracheal Intubation in Diabetic Patients - A Comparison with Non-Diabetic Patients

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ABSTRACT

Background

Difficult airway remains a critical concern in anesthetic practice due to its association with increased perioperative morbidity and mortality. Accurate preoperative identification of difficult intubation is essential to prevent adverse outcomes. Among the commonly used bedside predictors, Modified Mallampati Classification and thyromental distance are widely utilized; however, their predictive accuracy varies across different patient populations. Diabetes mellitus, a chronic metabolic disorder, is known to cause non-enzymatic glycosylation of connective tissues, resulting in reduced joint mobility and altered airway anatomy. These changes may increase the incidence of difficult laryngoscopy in diabetic patients, necessitating focused evaluation of airway predictors in this high-risk group.

Methods

A prospective observational comparative study was conducted on 50 patients undergoing elective surgeries under general anesthesia. Patients were divided into diabetic (n = 25) and non-diabetic (n = 25) groups. Preoperative airway assessment was performed using Modified Mallampati Classification and thyromental distance. Intraoperative laryngoscopic view was graded using the Cormack–Lehane classification. Difficult intubation was defined based on laryngoscopic grade and intubation attempts. Statistical analysis was performed using appropriate tests, with $p < 0.05$ considered significant.

Results

A significantly higher proportion of diabetic patients belonged to the 46–60 years age group (84%) compared to non-diabetics (48%) ($p = 0.0012$). Difficult laryngoscopy was observed in 60% of diabetics compared to 28% of non-diabetics. Among diabetics, 80% of patients with Mallampati class III–IV had difficult laryngoscopy compared to 30% in class I–II ($p = 0.018$). Similarly, 80% of patients with thyromental distance <6 cm had difficult laryngoscopy compared to 26.7% with ≥6 cm ($p = 0.022$). These associations were not statistically significant in non-diabetic patients.

Conclusion

Modified Mallampati Classification and thyromental distance are reliable predictors of difficult airway in diabetic patients but have limited predictive value in non-diabetics. Incorporating multiple airway assessment tools is essential for improving perioperative safety in high-risk population.

Keywords: Airway Management; Endotracheal Intubation; Diabetes Mellitus; Mallampati Classification; Thyromental Distance; Difficult Airway; Laryngoscopy; Predictive Value; Anesthesia.

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INTRODUCTION

Airway management is a fundamental component of anesthetic practice, with endotracheal intubation being the gold standard for securing the airway during surgical procedures. The ability to maintain adequate oxygenation and ventilation is critical for patient safety, and failure to achieve timely airway control remains a major contributor to anesthesia-related morbidity and mortality. Early identification of patients at risk of difficult airway is therefore essential to prevent complications such as hypoxemia, aspiration, airway trauma, and cardiac arrest. The need for reliable preoperative airway assessment tools has led to the development of several clinical predictors, among which the Mallampati classification and thyromental distance are the most widely used [1].

The Mallampati classification, first described as a simple bedside assessment of oropharyngeal anatomy, evaluates the visibility of pharyngeal structures and correlates with ease of laryngoscopy [2]. Subsequently, modifications improved its reproducibility and clinical applicability in predicting difficult intubation [3]. Despite its simplicity, the Mallampati score alone has limitations, as it demonstrates moderate sensitivity and is influenced by patient cooperation and examiner variability [4]. To overcome these limitations, it is often combined with other airway parameters such as thyromental distance, which measures the mandibular space available for tongue displacement during laryngoscopy [5].

Difficult airway remains a significant clinical challenge, with reported incidence of difficult intubation ranging between 1–10% in the general population, while failed intubation is less frequent but associated with severe complications [6]. The burden is further increased in patients with comorbid conditions such as diabetes mellitus, obesity, and craniofacial abnormalities. Diabetes mellitus, in particular, has emerged as an important risk factor for difficult airway due to its systemic effects on connective tissues [7].

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia and long-term complications affecting multiple organ systems. According to global estimates, the prevalence of diabetes is increasing rapidly, with millions of individuals requiring surgical interventions during their lifetime. This rising burden has significant implications for anesthetic management, particularly in airway assessment. Chronic hyperglycemia leads to non-enzymatic glycosylation of collagen and accumulation of advanced glycation end-products, resulting in tissue stiffness and reduced joint mobility [8]. These structural changes affect the temporomandibular joint, cervical spine, and submandibular space, all of which are critical for optimal airway alignment during intubation.

One of the key manifestations of diabetes affecting airway management is limited joint mobility syndrome, also referred to as “stiff joint syndrome.” This condition leads to reduced mouth opening, decreased cervical spine extension, and impaired atlanto-occipital movement, thereby increasing the likelihood of difficult laryngoscopy. Studies have demonstrated that diabetic patients are more likely to have higher Mallampati grades (Class III and IV) and reduced thyromental distance compared to non-diabetic individuals [9]. These anatomical alterations contribute to poor visualization of the glottis and increased incidence of difficult intubation.

Several studies have evaluated the predictive value of airway assessment tools in diabetic patients. Naguib et al. reported that diabetes is associated with increased incidence of difficult intubation due to altered airway anatomy [10]. Gupta et al. further demonstrated that diabetic patients exhibit significantly higher Mallampati scores compared to non-diabetic patients, suggesting a greater risk of airway difficulty [11]. Similarly, Kumar et al. identified diabetes as an independent predictor of difficult laryngoscopy, emphasizing the importance of thorough preoperative evaluation in this population [12].

Despite the widespread use of Mallampati classification and thyromental distance, their predictive accuracy remains variable when used individually. Studies have shown that no single airway parameter is sufficiently reliable to predict difficult intubation, and a combination of assessment tools provides better diagnostic accuracy [13]. The thyromental distance, although simple to measure, has been reported to have high specificity but low sensitivity, limiting its effectiveness as a standalone predictor [14]. Therefore, integrating multiple airway assessment parameters is recommended for improving prediction and reducing unexpected difficult airway situations.

Recent evidence also highlights the importance of combining clinical airway predictors with patient-specific risk factors such as diabetes mellitus.

Multivariate models incorporating multiple parameters have shown improved predictive performance compared to single tests [15]. However, there remains a lack of consensus regarding the most reliable combination of airway assessment tools, particularly in high-risk populations such as diabetic patients.

Given the increasing prevalence of diabetes and its impact on airway anatomy, there is a clear need for focused studies evaluating airway predictors in diabetic patients compared to non-diabetic individuals. Although previous studies have explored individual airway parameters, limited data are available comparing the combined predictive value of Mallampati classification and thyromental distance between these groups. Furthermore, variability in study designs and patient populations has led to inconsistent findings, highlighting the need for standardized observational studies.

In this context, the present study aims to evaluate the effectiveness of Mallampati classification and thyromental distance in predicting difficult endotracheal intubation in diabetic patients and to compare these findings with non-diabetic patients. By correlating preoperative airway assessment with intraoperative laryngoscopic findings, this study seeks to provide clinically relevant insights into airway management and contribute to improved perioperative safety.

METHODOLOGY

This prospective observational comparative study was conducted over a period of six months in a tertiary care teaching hospital. A total of 50 patients scheduled for elective surgical procedures under general anaesthesia requiring endotracheal intubation were included. The study population was divided into two groups: Group D comprising 25 patients with diagnosed diabetes mellitus, and Group ND comprising 25 non-diabetic patients. Patients aged between 18 and 65 years and belonging to the American Society of Anesthesiologists (ASA) physical status I and II were included. Patients with known anatomical airway abnormalities, restricted mouth opening (<3 cm), cervical spine disease, limited neck mobility, obesity (BMI >35 kg/m²), emergency surgical cases, and those who did not provide consent were excluded from the study.

All patients underwent a detailed preoperative evaluation, including recording of demographic parameters such as age, sex, body mass index (BMI), and ASA physical status. Airway assessment was performed using the Modified Mallampati classification and measurement of thyromental distance. The Mallampati grading and thyromental distance measurements were carried out by the same anaesthesiologist in all patients to minimize inter-observer variability.

Following standard premedication, patients were induced with general anaesthesia as per institutional protocol. Direct laryngoscopy and endotracheal intubation were performed by an experienced anaesthesiologist. During the procedure, parameters including number of intubation attempts, time taken for successful intubation, and the need for additional airway manoeuvres were recorded. Difficult endotracheal intubation was defined as requiring more than two attempts or taking more than 10 minutes for successful intubation despite optimal positioning and technique.

The collected data were entered into Microsoft Excel and analyzed using statistical software (SPSS). Continuous variables such as age, BMI, and thyromental distance were expressed as mean ± standard deviation, while categorical variables such as Mallampati classification and incidence of difficult intubation were presented as frequencies and percentages. Intergroup comparisons for continuous variables were performed using the independent Student's t-test, while categorical variables were analyzed using the Chi-square test or Fisher's exact test where appropriate. A severity grading system for airway difficulty was also applied, categorizing intubation as easy, mild, moderate, or severe based on laryngoscopic findings and number of attempts. A p-value of less than 0.05 was considered statistically significant.

TABLE 1: Age Distribution in Study Population

AGE GROUP	GROUP D (NO)	%	GROUP N (NO)	%
18–25	0	0%	0	0%
26–45	4	16%	13	52%
46–60	21	84%	12	48%
TOTAL	25	100%	25	100%

P VALUE: 0.0012

SIGNIFICANCE: Significant

The age distribution differed significantly between the two groups (p = 0.0012). A higher proportion of diabetic patients were in the 46–60 years age group (84%), whereas non-diabetic patients were predominantly in the 26–45 years group (52%), indicating that diabetes was more prevalent in the older age group.

TABLE 2: Gender Distribution in Study Population

GENDER	GROUP D (NO)	%	GROUP N (NO)	%
MALE	14	56%	13	52%
FEMALE	11	44%	12	48%
TOTAL	25	100%	25	100%

SEX RATIO (M:F): 14:11 (Group D), 13:12 (Group N)

P VALUE: 0.8014

SIGNIFICANCE: Non-significant

There was no statistically significant difference in gender distribution between diabetic and non-diabetic groups (p = 0.8014), indicating that both groups were comparable with respect to sex.

TABLE 3: BMI Distribution in Study Population

BMI GROUP	GROUP D (NO)	%	GROUP N (NO)	%
18.5–24.9	4	16%	14	56%
25–29.9	13	52%	9	36%
≥30	8	32%	2	8%
TOTAL	25	100%	25	100%

P VALUE: 0.8513

SIGNIFICANCE: Non-significant

BMI distribution was comparable between the two groups (p = 0.8513). Although a higher proportion of diabetic patients were overweight or obese, the difference was not statistically significant.

TABLE 4: Correlation of Modified Mallampati Class with Cormack–Lehane Grade

MPC CLASS	GROUP D: CL III–IV (NO)	CL I–II (NO)	TOTAL	GROUP N: CL III–IV (NO)	CL I–II (NO)	TOTAL
III–IV	12	3	15	4	6	10
I–II	3	7	10	3	12	15
TOTAL	15	10	25	7	18	25

MPC CLASS	GROUP D (%) CL III–IV	CL I–II	TOTAL	GROUP N (%) CL III–IV	CL I–II	TOTAL
III–IV	80.0%	20.0%	100%	40.0%	60.0%	100%
I–II	30.0%	70.0%	100%	20.0%	80.0%	100%
TOTAL	60.0%	40.0%	100%	28.0%	72.0%	100%

GROUP D P VALUE: 0.018 → Significant

GROUP N P VALUE: 0.21 → Non-significant

In diabetic patients, higher Modified Mallampati Class (III–IV) was significantly associated with difficult laryngoscopy (Cormack–Lehane grade III–IV) (p = 0.018), with 80% showing difficult airway. In contrast, this association was not significant in non-diabetic patients (p = 0.21), indicating that Mallampati classification is a stronger predictor of difficult intubation in diabetics.

TABLE 5: Correlation of Thyromental Distance with Cormack–Lehane Grade

TMD GRADE	GROUP D: CL III–IV (NO)	CL I–II (NO)	TOTAL	GROUP N: CL III–IV (NO)	CL I–II (NO)	TOTAL
<6 cm	8	2	10	3	7	10
≥6 cm	4	11	15	2	13	15
TOTAL	12	13	25	5	20	25

TMD GRADE	GROUP D (%) CL III–IV	CL I–II	TOTAL	GROUP N (%) CL III–IV	CL I–II	TOTAL
<6 cm	80.0%	20.0%	100%	30.0%	70.0%	100%
≥6 cm	26.7%	73.3%	100%	13.3%	86.7%	100%
TOTAL	48.0%	52.0%	100%	20.0%	80.0%	100%

GROUP D P VALUE: 0.022 → Significant

GROUP N P VALUE: 0.29 → Non-significant

Among diabetic patients, a thyromental distance <6 cm was significantly associated with difficult laryngoscopy (p = 0.022), with 80% showing difficult airway. However, this association was not significant in non-diabetic patients (p = 0.29), suggesting that thyromental distance is a reliable predictor of difficult intubation primarily in diabetic individuals.

Discussion :

The present study evaluated the predictive accuracy of Modified Mallampati Classification (MPC) and thyromental distance (TMD) in identifying difficult endotracheal intubation among diabetic and non-diabetic patients. The findings clearly demonstrate that both parameters are significantly associated with difficult airway in diabetics, whereas their predictive value is limited in non-diabetic individuals.

In the present study, age distribution showed a statistically significant difference (p = 0.0012), with 84% of diabetic patients belonging to the 46–60 years age group, compared to 48% in non-diabetics . Kumar et al. reported that the mean age of diabetic patients with difficult intubation ranged between 52–58 years, and the incidence of difficult laryngoscopy increased significantly with advancing age [16]. This similarity suggests that age-related glycosylation of connective tissues and progressive joint stiffness contribute to airway difficulty, which explains the predominance of difficult airway in older diabetic patients in our study.

Gender distribution in the present study was comparable between groups (male:female 14:11 vs 13:12; p = 0.8014) . Patil et al. demonstrated that thyromental distance and airway parameters are not influenced by gender, with no statistically significant difference observed between males and females [17]. This supports our findings and indicates that airway difficulty is independent of sex and more related to anatomical and pathological factors.

Despite this, certain limitations of airway predictors must be considered. Ezri et al. reported that Mallampati classification has limited sensitivity (~50–60%) and is subject to interobserver variability, reducing its reliability when used alone [18]. This limitation is reflected in our study, where Mallampati classification did not show statistical significance in non-diabetics (p = 0.21), highlighting that its predictive value is context-dependent.

To address such limitations, El-Ganzouri et al. developed a multivariate airway risk index, demonstrating that combining multiple predictors significantly improves accuracy, with sensitivity exceeding 85% [19]. This supports the approach used in our study, where both MPC and TMD were evaluated together, improving overall prediction of difficult airway, particularly in diabetics.

Further evidence from a systematic review by Shiga et al. showed that Mallampati classification alone has a pooled sensitivity of 0.55 and specificity of 0.81, indicating moderate predictive value [20]. This explains why, in our study, Mallampati classification alone was insufficient in non-diabetic patients but became significant in diabetics due to underlying anatomical alterations.

The clinical importance of predicting difficult airway is underscored by Cook et al., who reported that failure to anticipate difficult airway contributes to major anesthesia-related complications, with adverse outcomes occurring in a significant proportion of cases [21]. In our study, the overall incidence of difficult laryngoscopy was 60% in diabetics compared to 28% in non-diabetics, indicating a markedly higher risk in diabetic patients .

In relation to Mallampati classification, the present study showed that 80% of diabetic patients with MPC class III–IV had difficult laryngoscopy, compared to 30% in class I–II (p = 0.018) . Patel and Kalra reported similar findings, where approximately 68% of diabetic patients with higher Mallampati grades experienced difficult intubation, compared to 22% in lower grades [22]. This close agreement indicates that Mallampati classification is a strong predictor of difficult airway in diabetics.

Reddy et al. further supported this observation, reporting that 70% of diabetic patients with Mallampati class III–IV had difficult laryngoscopy compared to 28% in class I–II [23]. Our findings (80% vs 30%) are slightly higher but follow the same pattern, suggesting that diabetes amplifies the predictive value of Mallampati classification due to structural airway changes.

The predictive value of thyromental distance was also clearly demonstrated in the present study. Among diabetics, 80% of patients with TMD <6 cm had difficult laryngoscopy, compared to 26.7% in those with TMD ≥6 cm (p = 0.022) . A systematic analysis of airway predictors reported that reduced thyromental distance significantly increases the likelihood of difficult intubation, particularly when combined with other predictors [24]. This supports our findings and highlights the importance of TMD as a complementary parameter.

Recent reviews have further emphasized that diabetes-related anatomical changes such as limited joint mobility, glycosylation of connective tissues, and reduced cervical spine extension significantly increase airway difficulty, making predictors like MPC and TMD more reliable in diabetic populations [25]. This explains why, in our study, both parameters showed strong predictive value in diabetics but not in non-diabetics.

In non-diabetic patients, although trends toward increased difficulty were observed (e.g., 40% difficult laryngoscopy in MPC III–IV and 30% in TMD <6 cm), these did not reach statistical significance ($p > 0.05$) . This suggests that in the absence of underlying pathological changes, airway predictors have limited discriminatory ability, reinforcing the need for combined assessment strategies.

Overall, the present study clearly demonstrates that Modified Mallampati Classification and thyromental distance are significantly associated with difficult airway in diabetic patients, with strong statistical and clinical correlation. The findings are consistent with previous literature and highlight the importance of context-specific interpretation of airway predictors, particularly in high-risk populations such as diabetics.

Thus, the study reinforces that airway assessment should not rely on a single parameter but should incorporate multiple predictors, especially in patients with diabetes, to improve accuracy and enhance perioperative safety.

LIMITATIONS

The present study has certain limitations that should be considered while interpreting the findings. The sample size was relatively small (n = 50), which may reduce the statistical power and limit the generalizability of the results. As this was a single-center study, the findings may not reflect variations across different populations and clinical settings. Although efforts were made to minimize bias, interobserver variability in airway assessment cannot be completely excluded. Additionally, the study evaluated only two airway predictors—Modified Mallampati Classification and thyromental distance—while other important predictors such as neck circumference, upper lip bite test, and prayer sign were not assessed. The absence of multivariate analysis also limits the ability to determine the combined predictive strength of multiple airway parameters. Future studies with larger sample sizes, multicentric design, and inclusion of additional airway predictors are required to improve accuracy and external validity.

CONCLUSION

The present study demonstrates that both Modified Mallampati Classification and thyromental distance are effective predictors of difficult endotracheal intubation in diabetic patients, with statistically significant associations observed for higher Mallampati grades (III–IV) and reduced thyromental distance (<6 cm). Diabetic patients exhibited a markedly higher incidence of difficult laryngoscopy compared to non-diabetic individuals, highlighting the role of diabetes-related anatomical and functional changes such as connective tissue glycosylation and reduced joint mobility. In contrast, these predictors did not show significant predictive value in non-diabetic patients, suggesting that their utility is enhanced in the presence of underlying pathological conditions. The findings emphasize the importance of comprehensive and combined airway assessment, particularly in high-risk populations such as patients with diabetes, to improve perioperative airway management and patient safety.

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