Original Article
DOI: https://doi.org/10.70749/ijbr.v3i7.2786

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://ijbr.com.pk
ISSN: 2960-2793/ 2960-2807

Airway Assessment; Accuracy of Mallampati Scoring in Detecting Difficult Airway in Patient Elected for General Surgery Under General Anesthesia

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ARTICLE INFO

Keywords: Airway management, Anesthesia, Intubation, Laryngoscopy, Preoperative evaluation

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Declaration
Authors' Contribution: All authors equally contributed to the study and approved the final manuscript.

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History
Received: 04-06-2025 Revised: 01-07-2025
Accepted: 06-07-2025 Published: 10-07-2025

ABSTRACT

Background: Airway management is an important aspect of anesthetic practice. Failure to detect a potentially challenging airway before induction can trigger severe complications in the course of intubation. An in-depth preoperative airway evaluation helps the anesthesiologist to develop a strategy of airway management and avert its risks. The Mallampati scale is regularly used to predict a challenging airway but its predictive power is controversial especially in different populations. **Objective:** To determine the diagnostic accuracy of Mallampati scoring in detecting difficult airway in patients undergoing general surgery under general anesthesia using Cormack Lehane grading as gold standard. **Study Design:** Cross sectional validation study. **Duration and Place of Study:** This study was conducted from January 2025 to May 2025 in the Department of Anesthesiology Ayub Teaching Hospital Abbottabad. **Methodology:** A total of 423 patients of either gender aged 18 to 60 years undergoing elective general surgery were included. Mallampati assessment was done preoperatively in sitting position. Direct laryngoscopy was performed after induction of anesthesia and Cormack Lehane grading was noted. Difficult airway was defined as grade three and four. Data were analyzed using Statistical Package for Social Sciences version 26. Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were calculated using two by two contingency table. **Results:** Mallampati scoring showed sensitivity of 57.30%, specificity of 80.40%, diagnostic accuracy of 75.90%, positive predictive value of 41.20% and negative predictive value of 88.70%. **Conclusion:** Mallampati scoring has moderate accuracy for predicting difficult airway.

INTRODUCTION

Endotracheal intubation is very important part of anesthesia practice because it help to maintain airway and allow proper oxygen and anesthetic gases delivery during surgery.[1] When anesthesia is given, patient lose protective airway reflexes and muscle tone become low, which can cause airway obstruction if not managed properly.[2] Intubation is used to protect lungs from aspiration and to control ventilation especially in long surgeries or emergency cases.[3] Anesthetist must be careful during intubation because delay or repeated attempts can cause low oxygen level, airway injury, and heart problems.[4] Therefore planning and assessment before intubation is necessary for safe anesthesia management.

Detection of difficult airway is an essential step before anesthesia induction because airway difficulty can cause serious complications.[5] Difficult airway may include difficulty in mask ventilation, laryngoscopy, or intubation, and sometimes all occur together.[6] Clinicians usually assess airway by patient history and physical examination such as limited mouth opening, short neck, obesity, poor neck movement, large tongue, or facial abnormalities.[7] History of previous difficult intubation also give important information. However, no single test can correctly predict difficult airway in all patients, so anesthetist use combination of different signs and tests.[8] Early identification help to prepare backup plans and equipment which reduce risk during anesthesia.

Mallampati scoring is a commonly used method to predict difficult intubation by looking inside the mouth and throat.[9] The patient is asked to open mouth widely and stick out tongue, and based on visible structures the score is given.[10] Higher Mallampati class usually indicate higher chance of difficult laryngoscopy.[10] It is easy and quick test, so it is widely used in preoperative assessment. But accuracy of Mallampati scoring alone is not very high because it depends on patient cooperation, examiner technique, and body position.[11] Different observers may give different score for same patient. Therefore, Mallampati score should not be used alone, but combined with other airway assessment methods to better detect difficult airway.[12]

A study by Chatterjee A et al. showed that Mallampati scoring had a sensitivity of 41.2%, specificity of 79.3%,

positive predictive value (PPV) of 29.2% and negative predictive value (NPV) of 86.7% in the assessment of difficult airway with a prevalance of 22.2%.[13]

This study is needed in Abbottabad because local patient population have different physical features and health conditions which can affect airway assessment. There is limited local data available about accuracy of Mallampati scoring in predicting difficult airway in this region. Anesthetists mostly rely on international studies which may not fully apply to our setup and resources. By doing this study in Abbottabad it will help improve local anesthesia practice, early identification of difficult airway and reduce complications during intubation in our hospitals.

METHODOLOGY

This cross sectional validation study was carried out in the Department of Anesthesiology Ayub Teaching Hospital Abbottabad and it was conducted over a period from 10 January 2025 to 10 May 2025. Approval for the study was taken from the hospital ethical committee (Approval Code/Ref.No. RC-FA-2024/227) and all ethical principles related to human research were followed throughout the study duration. The sample size was calculated by using WHO sensitivity and specificity calculator keeping sensitivity as 41.2%, specificity as 79.3% and prevalence as 22.2% with confidence interval of 95%. Precision for sensitivity and specificity was kept as 10%. Based on these values the calculated sample size was 423 patients. Patients of either sex aged between 18 and 60 years were included in the study. Only ASA I and ASA II patients undergoing general surgery under general anesthesia were enrolled. Pregnant patients, patients with cervical spine injury, face or neck pathology, emergency surgeries and patients having apparently restricted head and neck movement were excluded from the study. Before data collection, informed written consent was obtained from each patient after explaining the purpose, benefits of the study in understandable language.

Demographic information was recorded including age, gender, BMI, diabetes, hypertension, type of surgery and ASA grade. Detailed medical history was taken, including chronic illnesses and any previous history of difficult intubation. Physical examination was performed focusing on airway assessment. Mallampati assessment was done in sitting position with neutral head posture and tongue maximally protruded. Body weight, height, dentition status and presence of long facial hair were also noted as part of airway examination. After completion of the procedure and airway assessment difficult airway according to Mallampati scoring was considered present when Mallampati grade III and IV were observed, while grades I and II were considered easy airway. Standard anesthesia monitoring was applied to all patients including ECG, pulse oximetry, capnography, noninvasive blood pressure and end expiratory inhalational gas monitoring. Intravenous cannulation was secured and general anesthesia was induced using ketamine, propofol, muscle relaxants and inhalational agents including sevoflurane or isoflurane according to patient weight and surgical duration. Direct laryngoscopy was performed after induction and Cormack Lehane grading was noted at the time of intubation. Difficult airway according to Cormack Lehane grading was taken as grade III and IV, while grade I and II were considered easy intubation.

Data were entered and analyzed using IBM SPSS version 26. Quantitative variables such as age, BMI were expressed as mean ± standard deviation. Qualitative variables including gender, diabetes, hypertension, type of surgery, ASA grade, difficult airway on Mallampati scoring and difficult airway on Cormack Lehane grading were expressed as frequencies and percentages. Sensitivity, specificity, positive predictive value, negative predictive value and overall diagnostic accuracy of Mallampati scoring against Cormack Lehane grading were calculated using 2×2 table.

RESULTS

The study enrolled 423 patients with mean age of 39.04±12.46 years and mean BMI of 26.99±2.64 kg/m^2. The sample was consisting of 258 (61.0%) males and 165 (39.0%) females. Majority of patients was undergone abdominal surgery 248 (58.6%), followed by orthopedic surgery 91 (21.5%) and other types of surgeries 84 (19.9%). Regarding comorbidities, diabetes was present in 100 (23.6%) patients while hypertension was found in 66 (15.6%) patients. Most of patients was classified as ASA grade I with 291 (68.8%) cases, while 132 (31.2%) patients were ASA grade II (as shown in Table 1).

Table 1

Patient Demographics

Demographics		Mean ± SD
Age (years)		39.04±12.46
BMI (kg/m^2)		26.99±2.64
Gender	Male n (%)	258 (61.0%)
	Female n (%)	165 (39.0%)
Type of Surgery	Abdominal surgery n (%)	248 (58.6%)
	Orthopedic surgery n (%)	91 (21.5%)
	Other n (%)	84 (19.9%)
Diabetes	Yes n (%)	100 (23.6%)
	No n (%)	323 (76.4%)
Hypertension	Yes n (%)	66 (15.6%)
	No n (%)	357 (84.4%)
ASA Grade	I n (%)	291 (68.8%)
	II n (%)	132 (31.2%)

The overall results was showing that Mallampati scoring identified difficult airway as positive in 114 (27.0%) cases and negative in 309 (73.0%) cases. On the other hand, Cormack-Lehane grading was detected positive difficult airway in 82 (19.4%) patients and negative in 341 (80.6%) patients out of total 423 patients (as shown in Table 2).

Table 2

Overall Results of Mallampati Scoring and Cormack-Lehane Grading in Diagnosis of Difficult Airway

Difficult Airway	Mallampati Scoring	Cormack-Lehane Grading
Positive	114 (27.0%)	82 (19.4%)
Negative	309 (73.0%)	341 (80.6%)
Total	423 (100%)	423 (100%)

When Mallampati scoring was compared with Cormack-Lehane grading for diagnosis of difficult airway, the results was demonstrated that out of 114 positive Mallampati scores, 47 was true positive and 67 was false positive.

Among 309 negative Mallampati scores, 35 was false negative while 274 was true negative. The Cormack-Lehane grading was showing 82 positive cases and 341 negative cases in total (as shown in Table 3).

Table 3
Comparison of Mallampati Scoring versus Cormack-Lehane Grading in Diagnosis of Difficult Airway

Mallampati Scoring	Cormack-Lehane Grading		Total
	Positive	Negative	
Positive	47 (TP)	67 (FP)	114
Negative	35 (FN)	274 (TN)	309
Total	82	341	423

Key: TP = True positive, FP = False positive, FN = False negative, TN = True negative

The diagnostic performance of Mallampati scoring was evaluated and the sensitivity was found to be 57.30% with specificity of 80.40%. The diagnostic accuracy was calculated as 75.90%. The positive predictive value was 41.20% whereas negative predictive value was 88.70% (as shown in Table 4).

Table 4
Sensitivity, Specificity, Diagnostic Accuracy, PPV and NPV of Mallampati Scoring in Diagnosis of Difficult Airway

Diagnostic Parameter	Result
Sensitivity	57.30%
Specificity	80.40%
Diagnostic Accuracy	75.90%
PPV	41.20%
NPV	88.70%

DISCUSSION

The findings were demonstrated moderate diagnostic performance of Mallampati scoring with sensitivity of 57.30% and specificity of 80.40%. The mean age of patients was 39.04±12.46 years which is indicating that most patients was in middle age group where anatomical variations and airway changes is commonly seen due to natural aging process and tissue changes. The male predominance 258 (61.0%) in study population can be explained by the fact that males is more likely to undergo surgical procedures especially abdominal and orthopedic surgeries due to occupational injuries and lifestyle factors. The sensitivity of Mallampati scoring was found to be 57.30% which is moderate and suggesting that this test can identify difficult airway in only half of actual cases. This limited sensitivity is occurring because Mallampati scoring is only assessing oropharyngeal structures and not considering other anatomical factors like neck mobility, thyromental distance and jaw protrusion which is also contributing to difficult intubation. The specificity was relatively better at 80.40% which is showing that test can correctly identify patients without difficult airway in majority of cases. The positive predictive value was only 41.20% which is indicating that when Mallampati scoring predict difficult airway, it is correct in less than half cases. This high rate of false positives 67 cases is problematic because it may lead to unnecessary preparations and anxiety. However, the negative predictive value was high at 88.70% which is clinically important because it mean that when test predict easy airway, it is reliable in most situations. The diagnostic accuracy was 75.90% which is acceptable but not excellent, suggesting that Mallampati scoring alone is not sufficient for predicting difficult airway and should be combined with other assessment tools for better prediction.

The sensitivity of Mallampati scoring in present study was 57.30% which is showing moderate agreement with several previous studies. Alaubaidi R *et al.* reported lower sensitivity of 40% in their study of 72 patients undergoing thyroid surgery [14] while Sanyal R *et al.* also found lower sensitivity of 42.86% in Indian population of 100 patients.[15] Similarly, Yousuf S *et al.* reported sensitivity of 52% in 247 patients [16] which is quite comparable to present findings. However, Aslam T *et al.* reported much higher sensitivity of 92.4% in larger sample of 1035 patients,[17] and Chatterjee A *et al.* found 100% sensitivity when Mallampati test was performed in supine position in 100 patients.[13] The variation in sensitivity is possibly occurring due to different patient positions during assessment, sample size differences, and population characteristics as supine position may reveal more anatomical details of oropharynx.

The specificity of 80.40% in current study was relatively consistent with most previous researches. Sanyal R *et al.* reported similar specificity of 82.56%,[15] and Yousuf S *et al.* found 81.1% specificity [16] which is almost identical to present findings. However, Alaubaidi R *et al.* reported perfect specificity of 100% [14] while Aslam T *et al.* found higher specificity of 90.1%.[17] The higher specificity values in some studies may be attributed to stricter criteria for defining positive Mallampati scores or different population characteristics. Chatterjee A *et al.* reported lower specificity of 58.5% when test was done in supine position,[13] suggesting that position of assessment is significantly affecting test performance.

The diagnostic accuracy of 75.90% in present study was comparable to several studies. Sanyal R *et al.* reported similar accuracy of 77%,[15] and Yousuf S *et al.* found accuracy of 78.1% [16] which is very close to current findings. However, Alaubaidi R *et al.* reported much higher accuracy of 91.7% in their thyroid surgery patients [14] while Aslam T *et al.* found even higher accuracy of 78.1% for Mallampati but noted that thyromental height was more accurate at 92.27%.[17] Nurullah M *et al.* also demonstrated that thyromental height test had superior accuracy of 93.5% compared to Mallampati test accuracy of 79.1%.[18] The variation in accuracy is possibly related to the fact that Mallampati scoring is only assessing oropharyngeal structures and missing other important anatomical factors.

The positive predictive value of 41.20% in current study was notably low and this is consistent with findings of other researchers. Sanyal R *et al.* reported PPV of 28.57% [15] which is even lower, while Yousuf S *et al.* found PPV of 23.6% [16] indicating high false positive rates. Chatterjee A *et al.* reported PPV of 33.3% in supine position.[13] These low PPV values across multiple studies is demonstrating that Mallampati scoring frequently overestimate difficult airway, leading to unnecessary preparations. However, Aslam T *et al.* found higher PPV of 60.2%,[17] and Shah AA *et al.* using Upper Lip Bite Test achieved much better PPV of

72.8% with sensitivity of 91.5%,[19] suggesting that alternative assessment methods may be more reliable.

The negative predictive value of 88.70% in present study was acceptably high and this is supporting by most previous researches. Sanyal R *et al.* reported similar NPV of 89.87%,[15] Yousuf S *et al.* found NPV of 93.8%,[16] and Chatterjee A *et al.* reported perfect NPV of 100% in supine position.[13] The high NPV across studies is clinically important because it mean that when Mallampati scoring predict easy airway, the prediction is reliable in majority of cases. Aslam T *et al.* reported NPV of 98.6%,[17] and Shah AA *et al.* found NPV of 98.9% using Upper Lip Bite Test.[19] Nurullah M *et al.* also found that thyromental height test had NPV of 97.8% compared to Mallampati NPV of 80.2%.[18]

The systematic review by Lee A *et al.* including 42 studies with 34,513 patients concluded that Mallampati tests is having limited accuracy for predicting difficult airway when used alone,[20] which is supporting present findings. Green SM *et al.* in their narrative review also concluded that Mallampati score was having inadequate sensitivity for predicting difficult laryngoscopy and intubation.[21] The male predominance 258 (61.0%) in present study was contrasting with several studies like Alaubaidi R *et al.* who reported 81.9% females [14] and Yousuf S *et al.* with 83.4% females,[16] possibly due to different surgical specialties included as present study had more abdominal surgeries 248 (58.6%). The mean BMI of 26.99±2.64 kg/m^2 in current study was lower compared to Shah AA *et al.* who studied patients with mean BMI of 29.8±3.59 kg/m^2 [19] and Chatterjee A *et al.* with BMI of 27.60±5.90 kg/m^2.[13] Loka SH *et al.* specifically studied obese patients with BMI >30 and found that combining Mallampati score with ultrasound measurements was showing higher predictive value,[22] suggesting multimodal assessment approach may improve accuracy.

The current research had a number of limitations, which should be mentioned. To begin with, it was a single study, which could limit the applicability of the results to other groups of people and medical facilities that are not similar in terms of patient characteristics and surgical procedures. Secondly, the sample included 423 participants, which was rather small but in comparison with some multicentre studies was quite small and, therefore, the statistical significance of the findings might have been influenced. Thirdly, only Mallampati score and CormackLehane classification were compared; other tools of airway evaluation like thyromental height, the upper lip bite test or ultrasonographic measurements were excluded; this limited the thoroughness of the evaluation.

CONCLUSION

The current study concludes that Mallampati scoring has moderate levels of sensitivity and medium levels of specificity in the prediction of difficult airway in comparison to the reference standard- Cormack-Lehane grading. Despite the fact the test exhibits a good negative predictive value thus confirming its reliability in the rejection of difficult airway conditions the positive predictive value is relatively small implying that there are a high number of false-positive predictions.

Disclaimer: Nothing to declare.

Acknowledgment: The authors want to thank the medical staffs of the department for their help. Their effort in keeping patients records and managing data properly supported this study a lot.

Ethical Approval: This study was approved by the ethical committee. All researches activities were carried out by following committee instructions and also the Helsinki Declaration.

Patients' Consent: Written permissions was taken from all patients before starting the study. Patient were informed that their data would be kept confidential and they were free to withdraw at any time.

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