



Original Article

The palm print and prayer sign as a predictor for difficult laryngoscopy in diabetic patients and comparison with non-diabetic patients

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Received: 08 November 2025

Accepted: 26 December 2025

Published: 04 February 2026

DOI

10.25259/BJKines_4_2025

Quick Response Code:



ABSTRACT

Introduction: In diabetic patients, due to “stiff joint syndrome,” the incidence of difficult laryngoscopy is higher. It can be predicted by the ‘palm print sign’ and the ‘prayer sign’. These tasks, per journal policies, can be valuable in predicting difficult laryngoscopy in non-diabetic patients as well.

Material and Methods: 116 adult patients, operated under general anesthesia with endotracheal intubation, were enrolled into GROUP-D, patients with diabetes mellitus ≥ 5 years, and GROUP-N, patients without diabetes. Preoperatively, modified Mallampati class, thyromental distance, mouth opening, neck extension, dentition, palm print grade, and prayer sign were recorded. Cormack Lehane grade was recorded at the time of laryngoscopy. Statistical analysis was performed using Fisher's exact test.

Results: Incidences of difficult laryngoscopy were 44.9% and 15.5%, in diabetics and non-diabetics, respectively. In the diabetic group, palm print grade, prayer sign, and dentition had 100% sensitivity, and thyromental distance had 98.2% specificity in predicting difficult laryngoscopy. In the nondiabetic group, the palm print sign, degree of head extension, and dentition had 100% sensitivity, and the prayer sign had 100% specificity. HbA1c levels were associated with higher palm print score and difficult laryngoscopy.

Conclusion: Palm print grade and Prayer sign assessment are valuable tools to predict difficult laryngoscopy in diabetic patients, as well as equally useful in non-diabetic patients.

Keywords: Optic nerve sheath diameter, Palm print test, Prayer sign

INTRODUCTION

Endotracheal intubation is one of the most common methods of airway management in anesthesia practice. However, establishing airway management with conventional techniques of endotracheal intubation can pose difficulty in certain groups of patients. Pre-procedure assessment and prediction of a difficult airway by use of various clinical indices is crucial to anesthetic practice. Inability to successfully secure the airway in adult patients has led to 30% estimated deaths attributable to anesthesia.¹

Diabetes mellitus is the commonest endocrine disorder that we encounter in patients posted both for elective and emergency surgery under general anesthesia. In diabetic patients, it is seen that the incidence of difficult intubation is higher than in the normal population, estimated at 27-31%.^{2,3} Some patients with long-standing diabetes have limited joint mobility syndrome

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(LJM), also called “stiff joint syndrome,” which occurs due to the non-enzymatic glycosylation and increased crosslinking in collagen fibrils in chronic hyperglycemia states.^{4,5} These collagen fibrils become abnormally stable and relatively insoluble to enzymatic degradation. Beginning in the interphalangeal joints of the fourth and fifth digits, it can involve the cervical spine and atlantooccipital joint, making head extension and laryngoscopy difficult in patients with diabetes. The degree of small joint involvement of the hand can be assessed by the “prayer sign” and the “palm print sign”, which in turn can be an indirect predictor of cervical spine and atlantooccipital joint involvement and difficult laryngoscopy.²⁻⁴

In our prospective observational study, we have primarily aimed to compare the sensitivity and specificity of the palm print test and prayer sign with other airway evaluation indices like modified Mallampati score, thyromental distance, Head extension, and mouth opening in the prediction of difficult laryngoscopy in diabetic and non-diabetic patients. We have also assessed for any correlation of duration of diabetes and glycemic control in the prediction of difficult laryngoscopy.

MATERIAL AND METHODS

After the approval of the Institutional Ethics Committee (Ref No. EC/37/2023/26/06/2023) and CTRI registration (CTRI/2023/10/058969), this prospective observational study was conducted in B. J. Medical College and Civil Hospital, Ahmedabad, from December 2023 - April 2024. Written and informed consent from all the participating patients was obtained before enrolling. A total of 116 patients aged 18-70 years, of either sex, undergoing elective (74) and emergency surgery (42) under general anesthesia requiring endotracheal intubation were included in the study. A study was conducted with two groups: patients with diabetes mellitus (Group D) having diabetes for ≥ 5 years and patients without diabetes (Group N), each having 58 patients [Chart 1]. Patients with evident anatomical variation of face, neck, palate, mouth opening < 2.5 cm, faciomaxillary/mandibular injuries, cervical spine injuries, rheumatoid arthritis, trismus, syndromes associated with difficult intubation, history of difficult intubation/tracheostomy in the past, edentulous, morbidly obese body mass index (BMI) ≥ 40 and patients with congenital deformity of hands, injury/amputee of dominant hand were excluded from our study. After informed and written consent, on the day before surgery, demographic data were collected, BMI was recorded, and American Society of Anesthesiologists (ASA) risk grading was done. Patients were examined in a sitting position for airway indices, modified Mallampati class (MMC), mouth opening, thyromental distance (TMD), degree of head extension, palm print sign, and prayer sign.

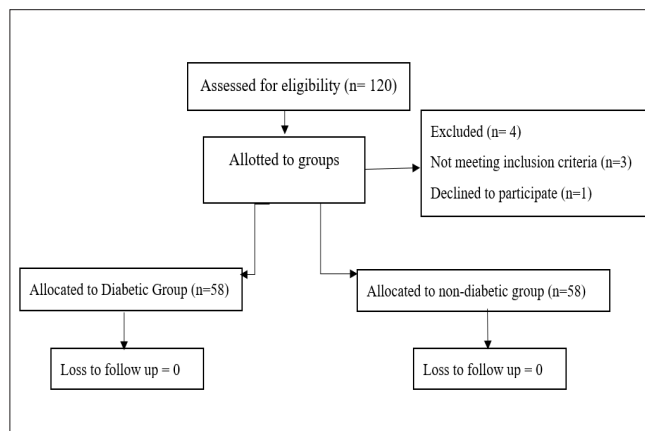


Chart 1: Consort flow diagram of study participant recruitment and follow up.

Interpretation of airway assessment

MMC: The patient was asked to open the mouth fully and protrude the tongue as far as possible without phonation. oropharyngeal structures were inspected and viewed as-

Class I: Soft palate, uvula, fauces, and pillars visible, Class II - Soft palate, uvula, fauces visible but pillars obscured, Class III - Soft palate only visible, Class IV - Soft palate not visible, only hard palate visualized.

Thyromental distance: The patient was asked to fully extend the neck from the neutral position. The distance from the mentum to the thyroid notch was measured with a measuring scale and graded as: Grade 0- distance ≥ 6 cm, Grade 1- distance < 6 cm.

Head extension: In the sitting position, a horizontal line joining the mentum to the angle of the mandible parallel to the floor is established with a scale, and the patient was then asked to maximally extend the head backwards. The angle traversed from the horizontal by the mento-mandibular line was measured. Grade 0 - Head extension > 35 degrees, Grade 1 - head extension < 35 degrees.

Mouth opening: Measured in terms of the number of fingers that can be placed vertically between the upper and lower jaw on maximal mouth opening by the patient.

Palm print sign: The palm and fingers of the dominant hand were painted using blue/black ink. Palm print was recorded on plain white paper by its own weight without applying extra pressure. Scoring will be done as follows: Score 0: All phalangeal areas visible, Score 1: Deficiency in the interphalangeal areas of the 4th and/or 5th digit, Score 2: Deficiency in the interphalangeal areas of the 2nd to 5th digit, Score 3: Only the tips of the digits seen [Figure 1].



Figure 1: Palm print grade

Prayer sign: The patient was asked to bring both palms together as making a “namaste” and categorized as positive: when there is a visible gap between the fingers and palm, negative: there is no gap between the palms, and fingers of both hands can be approximated [Figure 2].



Figure 2: Prayer sign: Positive

Cormack Lehane (CL) grade of laryngoscopy: Grade I - Vocal cords visible, Grade II - Only posterior commissure or arytenoids visible, Grade III - Only epiglottis visible, Grade IV - No glottic structure visible [Figure 3].

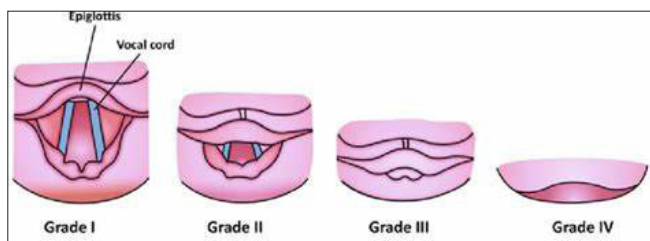


Figure 3: Cormack Lehane laryngoscopy grade

Dentition: Regular/irregular/edentulous.

As per preoperative advices, Nil by mouth for 6 hours for solids and 2 hours for clear liquids was confirmed on the day of surgery. The dose of the antidiabetic agent was withheld on the morning of surgery, and morning fasting blood sugar was recorded for diabetic patients; intravenous access was secured using an 18/20G cannula. In the operating room, patients were positioned supine on an operating table in sniffing position, and monitors like electrocardiography, pulse oximetry, non-invasive blood pressure, and end tidal carbon dioxide (EtCO₂) were attached. Patients were pre-medicated with inj. glycopyrrolate (4µg/kg), inj. ondansetron (0.16mg/kg), inj. fentanyl (2µg/kg). After pre-oxygenation for 3-5 min, induction of anesthesia was done with inj. propofol (2-3mg/kg) and neuromuscular blockade achieved with inj. succinyl choline (2mg/kg) intravenously. Laryngoscopy was performed 60 s later using a Macintosh blade (size 3/4), and the laryngoscopic view was graded as per Cormack and Lehane grading.

The number of attempts for successful intubation, time taken, and use of stylet/bougie/external laryngeal manipulation were also recorded. Anesthesia was maintained with O₂ (50%), air (50%), sevoflurane (1.5-3%), inj. atracurium (0.5mg/kg) IV loading dose and (0.1 mg/kg) incremental dose. Palm print grades 0 and 1 were considered as predictors of easy intubation, and grades 2 and 3 were considered as predictors of difficult intubation. Cormack Lehane grades 3 and 4 were considered as difficult intubation.

Study design

Prospective, single-blinded, observational study involving 116 patients who consented to participate in the study. Single blinding was done such that the anesthesiologist performing laryngoscopy was unaware of the diabetic status of the patient, as well as unaware of the results of preoperative airway assessment, prayer sign, and palm print grade. The laryngoscopies in all the patients in both groups were performed by a single anesthesiologist.

Statistical analysis

The Data collected was entered into an Excel sheet 2021 version, and analysis was done using Statistical Package for Social Sciences version 26.0 (SPSS). The comparison of qualitative variables between groups, such as sex, duration of diabetes, HbA_{1c} levels, prayer sign, use of stylet, and external laryngeal manipulation, was done using the ‘Chi-square test’. Whereas the comparison of age, BMI, ASA grade, mouth opening, thyromental distance, head extension, dentition, palm print score, and number of supplementary attempts between groups was done using Fisher's exact test. Comparison between palm print score and duration

of diabetes and HbA1c levels was done using Fisher's Exact test. A '*p*-value' <0.05 was accepted as statistically significant. The sensitivity, specificity, positive and negative predictive values for each test were calculated according to the standard formulas.

RESULTS

In our study, we evaluated the various parameters of airway assessment and their ability to predict difficult laryngoscopy and intubation in patients with (58) and without (58) diabetes. The demographic characteristics of the patients are represented in Supplementary material. There was a significant difference between groups in terms of mean age and ASA grade, and they were comparable in terms of sex and mean BMI.

The mean time taken for intubation in seconds was higher for the diabetic group, 20.12 ± 12.58 s, as compared to the non-diabetic group, 13.66 ± 8.23 s, and this difference was statistically significant ($p < 0.001$). The number of supplementary attempts taken, external laryngeal manipulation, and the use of a stylet for aiding endotracheal intubation were more in the diabetic group, and it was statistically significant. The percentage of patients in whom a bougie was used for endotracheal intubation was higher in the diabetic group, but it was not statistically significant. There were no patients in either group in whom an alternative airway management technique was required. Duration of diabetes had no correlation with laryngoscopic grade in our study. Whereas, poor glycemic control (HbA1c >7%) was significantly associated with higher Cormack Lehane grade ($p = 0.044$).

The parameters calculated for each airway evaluation index in both groups were sensitivity, specificity, positive predictive value, and negative predictive value. In the diabetic group, palm print grade, prayer sign, and dentition had the highest sensitivity (100%), and thyromental distance had the highest specificity (98.2%) in predicting difficult laryngoscopy. The diagnostic accuracy was maximum for palm print grade and thyromental distance (94.8%). In the non-diabetic group, the palm print sign, degree of head extension, and dentition had the highest sensitivity (100%), and the prayer sign was highly specific (100%), followed by Head Extension. The highest diagnostic accuracy to predict difficult laryngoscopy was of the prayer sign (98.3%).

DISCUSSION

Difficult laryngoscopy and higher Cormack Lehane grade have been found in patients with Diabetes Mellitus in our study, as well as in a few previous studies. The mean intubation time, incidence of Cormack Lehane grade II/III,

use of external laryngeal manipulation, stylet, and bougie were significantly higher in the diabetic group. Hogan *et al.*¹ described that diabetes was associated with a significant increase in the proportion of patients having difficult laryngoscopies. Sachdeva *et al.*⁶ diabetic patients had 11-fold more incidence of difficult laryngoscopy as compared to non-diabetics.

In our study, a significant positive association was found with CL Grades II & III with irregular dentition, TMD ≤ 6 cm, neck extension Grades III and IV, palm print Grades II, III, and the positive prayer sign was noted in both groups. In the diabetic group, the highest sensitivity of dentition, prayer sign, and palm print score was noted, and the specificity of the thyromental distance followed by the palm print score. In the non-DM group, head extension was a highly sensitive and specific indicator for predicting difficult laryngoscopy, dentition, and palm print score had the highest sensitivity, and the prayer sign was highly specific.

Palm print sign (PPT) showed a significant association with difficult intubation in the study by Hashim and Thomas.⁷ The incidence of difficult laryngoscopy was 21.7%, with palm print showing the highest sensitivity (76.9%) and specificity (89.3%). Mahmoodpoor *et al.*⁸ did a study in a mixed population of patients with and without diabetes. They compared the modified Mallampati score, the 3-3-2 rule, and the palm print and found that the palm print had the highest specificity (96.46%) but lower sensitivity (13.64%). The modified Mallampati had the highest sensitivity (98.4%). Higher palm print grade was significantly associated with difficult laryngoscopy in long-term diabetic patients, with an average age of 24 years. A study by Reissell *et al.*⁴ reported that the palm print test was 100% sensitive. Highest sensitivity of MMC and specificity of PPT (Kute *et al.*)⁹ Highest specificity of MMC and sensitivity of PPT (Rao *et al.*)¹⁰ K.P. Sachdeva *et al.*⁶ found that the palm print had a sensitivity of 95.56% and a specificity of 73.3%, and the interphalangeal gap had a sensitivity of 86.36% and a specificity of 75%. They found both of the tests to be reliable predictors of difficult laryngoscopy in patients with diabetes.

Prayer's sign had the highest specificity in non-DM (100%) in our study, but the least sensitivity in the non-DM group. However, in the DM group, the prayer sign had high sensitivity (100%) and specificity (80%) with a negative predictive value of 100%. The accuracy of predicting difficult laryngoscopy (81%) was found to be less than the palm print sign (94.8%) and thyromental distance (94.8%) in the diabetic group. Similarly, a statistically significant association of a positive prayer sign with difficult laryngoscopy in DM patients was found in a study by Erden *et al.*⁵

TMD had high specificity in the non-diabetic group (98.2%)

with a high negative predictive value, and comparable specificity (96.5%) in the Diabetic group in our study. Hashim and Thomas⁷ found lower sensitivity of TMD as compared to the Palm print sign in diabetic patients included in their study. Kute *et al.*⁹ compared airway indices in diabetic and non-diabetic patients and found TMD to have lesser specificity and sensitivity than the Palm print sign in the diabetic group, but higher specificity and sensitivity in the non-diabetic group. Distinct results were also noted in some studies. Rao *et al.*¹⁰ found the highest specificity of MMC, TMD in the Diabetic group as well as the Non-diabetic group, which may be attributed to variations in duration of diabetes and glycemic control.

Irregular dentition or edentulousness was associated with difficult Cormack Lehane grades in both groups in our study, so it was a highly sensitive indicator in both groups with limited specificity and accuracy.

In the study by Nadal *et al.*³, difficult laryngoscopy was significantly associated with the duration of diabetes of more than ten years. Vani *et al.*¹¹, in a similar study, found that the mean duration of diabetes and incidence of difficult intubation were 5.3 years and 16%, respectively. Significant correlation between duration of diabetes (10.4 years) & difficult laryngoscopy (CL III, IV) Singh *et al.*¹²

In our study, however, we found no correlation between difficult laryngoscopy and duration of diabetes; the glycemic control (HbA1c >7%) was associated with a higher Cormack Lehane grade ($p = 0.044$).

LIMITATIONS

The limitation in our study is that we have excluded patients with mouth opening of <2.5 finger breadths and modified Mallampati class 3,4 patients. So, comparison of mouth opening and MMC with other airway indices is of limited value. The proportion of patients having irregular dentition or edentulous in diabetic and non-diabetic groups was not the same, and both groups were different in terms of age and dentition, which might have independently affected the grade of laryngoscopy.

CONCLUSION

Incidence of difficult laryngoscopy (Cormack Lehane grade II and III) was significantly higher in Group D with poor glycemic control, rather than increased duration of diabetes. Palm print and prayer sign, known to be useful in predicting difficult laryngoscopy in patients with diabetes, can be effectively used in non-diabetic patients for preoperative airway evaluation. However, a combination of tests best predicts difficult laryngoscopy and intubation in all patients.

In patients with diabetes, the palm print was the best single predictor of a difficult intubation, followed by TMD. In non-DM patients, the prayer sign, TMD, and palm print were the best predictors of airway difficulty. Even though we have multiple tests to predict airway difficulty, no single test is a foolproof armamentarium for an anesthesiologist. All have poor-to-moderate discriminative power when used alone. A combination of tests may add some incremental diagnostic value.

Author contributions: SE: Conceived the topic of the study, drafted results and discussion, and critical revision of the manuscript; CB: Data collection, analysis and interpretation, and drafted the manuscript. Both authors designed the manuscript. Both authors approved the final version of the manuscript.

Acknowledgements: The authors would like to mention special thanks to the patients who cooperated in the study. Thankful to the B.J. Medical College Ethical Committee for approval of the study and the Department of Anesthesiology. Operating room staff for their aid in the study.

Ethical Approval: The research/study was approved by the Institutional Review Board at B J Medical College and Civil Hospital, Ahmedabad, number EC/37/2023/26/06/2023, dated 26/06/2023.

Declaration of patient consent: Patient's consent not required as patient's identity is not disclosed or compromised.

Financial support and sponsorship: Nil

Conflicts of interest: There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation: the authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript, and no images were manipulated using AI.

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How to cite this article: Bora C, Engineer SR. The palm print and prayer sign as a predictor for difficult laryngoscopy in diabetic patients and comparison with non-diabetic patients. *BJKines - Natl J Basic Appl Sci.* 2025;17:64-9. doi: 10.25259/BJKines_4_2025