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EVALUATION OF AIRWAY AND PREDICTING DIFFICULT ENDOTRACHEAL INTUBATION IN DIABETIC PATIENT-A COMPARISON WITH NON DIABETIC PATIENTS

DR RATHNA A
PROFESSOR, SAVEETHA MEDICAL COLLEGE, SIMATS, CHENNAI

DR NIVEDITA
POST GRADUATE SAVEETHA MEDICAL COLLEGE, SIMATS, CHENNAI

ABSTRACT:
Background: The term "difficult intubation" denotes the failure to accomplish intubation through all accessible methodologies. The necessity to anticipate potentially challenging tracheal intubation has garnered heightened significance, albeit with constrained success. The current investigation was undertaken to evaluate diverse airway assessment indices employed to foresee difficult airway scenarios in Indian patients suffering from diabetes mellitus.
Methods: This prospective, observational investigation was conducted involving 60 patients at a tertiary care facility within a private medical college and hospital located in Kanchipuram, South India. The study comprised two cohorts of participants, one consisting of individuals diagnosed with diabetes and the other comprising individuals without diabetes. All participants underwent a comprehensive evaluation of their airway utilizing the modified Mallampati test, thyromental distance measurement, head extension assessment, palm print analysis, prayer sign evaluation, and body mass index calculation. Preoperative data pertaining to various airway indices were systematically compared with the incidence of difficult intubation as determined by the Cochrane Lahane grading system..
Results: More than fifty percent of the study participants were male. Nearly two-fifths (38%) of the study cohort were classified as overweight or obese. The proportion of diabetic individuals identified as having difficult airways, according to the modified Mallampati test, thyromental distance, head extension, palm print, and prayer sign, were 57%, 43%, 57%, 37%, and 23% respectively. According to the Cochrane Lahane grading system, the occurrence of difficult intubation was determined to be 30%. Significant differences were observed in predicted difficult airways as well as in the incidence of difficult intubation between the diabetic and non-diabetic groups. The predicted percentages of difficult airways from the palm print test and prayer sign were found to be closely aligned with the gold standard, Cochrane Lahane grading.. **Conclusion:** Although all airway indices hold significance within the repertoire of an anesthesiologist, the palm print and the prayer sign demonstrated similar finding of routinely accepted Cochrane lahane grading among patients with diabetes mellitus.

Keywords: Airway , difficult intubation, diabetes,

INTRODUCTION

The predominant concern of the anesthetist pertains to an unforeseen challenging intubation. Challenging intubation necessitates the manipulation of external laryngeal structures. The characterization of challenging intubation entails the necessity for more than three attempts at intubation. Challenging intubation signifies the incapacity to achieve intubation utilizing all available methodologies. The risk associated with repeated unsuccessful intubation contributes to a heightened incidence of mortality and morbidity. When a particular method appears ineffective, specialists tend to revert to the algorithmic approach rather than expending time on unproductive attempts.(1,2) According to the American Society of Anesthesiologists (ASA), challenging intubation is defined as the situation in which three attempts at endotracheal intubation are necessary during an average laryngoscopy or when the duration of endotracheal intubation exceeds 10 minutes. (3) Difficult tracheal intubation accounts for 17% of respiratory-related injuries and results in considerable morbidity. It is estimated that the inability to effectively manage a challenging airway has been

responsible for 30% of fatalities attributed to anesthesia. The occurrence of challenging and unsuccessful intubation is documented to range between 1% and 3.6% and between 0.05% and 0.3%, respectively.(4)

Diabetes mellitus (DM) constitutes the most prevalent endocrine disorder encountered in clinical practice, with nearly 50% of individuals diagnosed with DM undergoing surgical procedures for various medical indications throughout their lifetime. (5.6) The phenomenon known as 'stiff joint syndrome,' or 'restricted joint mobility,' is a recognized chronic complication among individuals afflicted with diabetes mellitus, thereby exacerbating the challenges associated with ventilation in such patients. Consequently, when contrasted with the general populace, individuals with diabetes appear to be at an elevated risk for experiencing a difficult airway. (7) In cases of diabetes, the limited mobility of the atlanto-occipital joint is frequently observed due to the glycosylation of collagen in the cervical vertebrae and surrounding tissues, which progressively restricts head and neck extension during the process of laryngoscopy. The glycosylation of collagen is typically first identified in the fourth and fifth interphalangeal joints, leading to an inability to achieve palm-to-finger approximation, despite maximal effort. Additionally, challenges in intubation may arise as a result of the stiffening of pharyngeal soft tissues, particularly affecting the epiglottis.(8)

The prediction of challenging intubation utilizing specific clinical findings remains a subject of contention among researchers. While numerous individual physical examination findings have been documented as predictive, none possess the singular reliability necessary to exclude the likelihood of a difficult intubation. The necessity to anticipate potentially challenging tracheal intubation has garnered increased significance, albeit with limited success. A variety of anatomical and pathological variables have been identified and proposed as instrumental in forecasting a difficult airway. However, these factors are constrained due to considerable fluctuations in the incidence of difficult intubation, inter-observer variability, and insufficient statistical power of the currently assessed variables. This investigation was undertaken to evaluate the diverse airway assessment indices employed to predict challenging airway scenarios in Indian patients with diabetes mellitus and to examine their positive predictive value in forecasting difficulties associated with endotracheal intubation.

METHODS

An observational comparative study was conducted in the department of Anesthesia which is belonging to a private medical college and hospital situated in Kancheepuram, South India. The study was conducted between September 2023 and August 2024. A total of 60 study subjects were selected in which they are divided into two groups with one group being a known case of diabetes and other group without the diabetes. Only those patients giving valid consent and with age of 35 years and above of either sex, with or without diabetes mellitus posted for surgery under general anesthesia requiring endotracheal intubation were included into the study. The exclusion criteria framed for the study is as follows: 1 .obvious anatomical deformity (congenital, traumatic, post surgical origin) of neck, neck, palate and hands. 2. Coexisting factors like rheumatoid arthritis, large thyroid, airway trauma. 3. emergencies surgeries.

A written informed consent form was obtained from all patient. On the day prior to surgery, the airways of all participants were assessed by the same investigator by using different assessment indices while the patients were sitting on a chair. The airway indices such as mallampati score, thyromental distance, head extension, prayers sign, palm print index were assessed and prediction of difficult intubation was made among the both two groups of study subjects. The procedure of each of the airway indices have been furnished below:

Modified Mallampati Test (MMT) (9):

The patient is asked to open his/her mouth fully and protrude the tongue as far as possible while keeping the head in neutral position. The pharyngeal structures are inspected with a torch at the patient's eye level without the patient phonating. There are four grades of MMT:

Grade I: Soft palate, faucial, uvula, pillars are visible

Grade II: Soft palate, faucial and uvula are visible, however, pillars are obscured.

Grade III: Only soft palate is visible.

Grade IV: Even the soft palate is not visible.

Grade III and Grade IV are accepted to predict difficult intubation.

Thyromental Distance (TMD): (10)

The TMD is the distance between the midpoint of the tip of the jaw and the overhang of the thyroid cartilage. The TMD should be measured while the patient's head is in full extension, and the mouth is closed. If the measured distance is less than 6 cm, a difficult intubation is expected.

Degree of Head Extension (HE): (11)

When the head is in neutral position and the line between the mentum and the angle of the mandible is parallel to the floor, the patient maximally extends the head on the neck. A protractor compass is used to measure the angle traversed by the mentomandibular line. If head extension is > 35 degree, it is called Grade 1 and it predicts easy intubation. If head extension is less than 35 degree, it is called Grade 1 and it predicts difficult intubation.

Palm Print Test (PPT): (12)

A black writing ink is used to paint the palm and fingers of the dominant hand of the patient. Then the patient is asked to press his/her hand firmly against a white sheet of paper. The painting on the sheet is classified with 4 grades:
If all phalangeal areas are visible, it is Grade 0. Grade I- If there is a deficiency in the inter-phalangeal areas of 4th and/or 5th digit, it is Grade I. If there are deficiencies in the inter-phalangeal areas of 2nd to 5th digit, it is Grade II.If only the tips of digits are seen, it is Grade III. Grade 0 to I predicts as easy intubation and Grade II-III predicts difficult intubation.

Prayer Sign (PS): (12)

The patient is asked to bring both his palms together as doing “namaste” and if a gap is seen between the palms, prayer sign is categorised as positive.

Criteria of Cormack and Lehane: (13)

Cormack Lehane (CL) classification is the laryngoscope view of the airway.
When any part of the vocal cords is seen directly, laryngoscopy is evaluated as easy (Grade 1). When laryngoscopy becomes difficult due to a stiff neck but the larynx can be visualized, laryngoscopy is evaluated as relatively easy (Grade 2).
When limited mouth opening, a stiff neck or a hanging epiglottis make larynx not be visualized, laryngoscopy is evaluated as relatively difficult (Grade 3)
When an anesthesiologist needs several attempts for endotracheal intubation due a hanging epiglottis and the aid of an introducer is needed for a successful tracheal intubation, laryngoscopy is evaluated as difficult (Grade 4).
Grade 3 and Grade 4 were accepted as signs of difficult intubation. In the current study, CL classification was used to evaluate the success of each test in predicting difficult laryngoscopy.

Patients were kept nil per orally, 6 hrs for solids & 2 hrs for clear fluids. On the day of surgery, dose of antidiabetic agents was withheld. Morning fasting blood sugar was done, and an intravenous (IV) line was secured. Intubation was performed by an anesthesiologist with at least 6 months of experience. After shifting the patient to the operating room monitors like electrocardiogram (ECG), pulse oximetry (SpO2), non-invasive blood pressure (NIBP) was connected. All patients were preoxygenated with 100% of O2 for three minutes. A stylet, bougie, long Macintosh curve blade, LMA, IGEL are kept ready in case of its emergencies.

Information on gender, height , weight, grading of different airway indices and its corresponding predicted difficult intubation were noted and entered in MS Excel sheet. The collected data was analyzed using SPSS software version of 26. Descriptive statistics such as frequency and proportions was used. Chi square test was performed to find the difference in the proportions of predicted difficult airways of different airway indices/ screening tools.

RESULTS

Fig 1- Gender distribution of the study subjects (N=60)

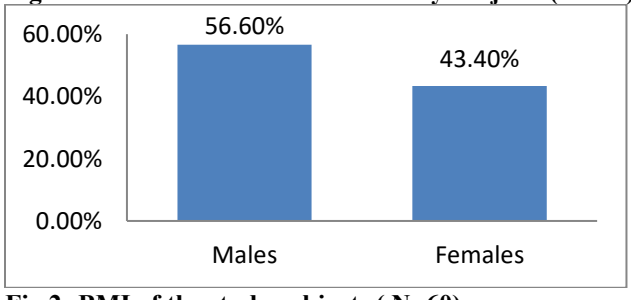
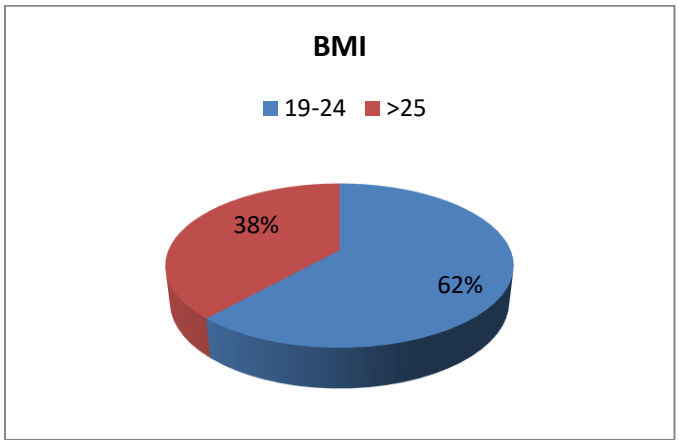


Fig 2- BMI of the study subjects (N=60)



A total of 60 study subjects among which the two groups were made, with one group of diabetes and the other group of non-diabetes. Fig 1 shows that the more than half of the study subjects were males and in fig 2 , it was found that almost 2/5th of the (38%) of the study participants were overweight & obese.

Table 1- Differences between two group of study subjects as per gender and BMI(N=60)

S.No	Category	Diabetic group	Non Diabetic group	Total	P value
1	**Gender** Male Female	 17 13	 17 13	 34 26	 >0.05
2.	**BMI** 19-25 >25	 18 12	 19 11	 37 23	>0.05
Total		30	30	60	

The above table shows that the there is so no statistical differences between diabetic and non-diabetic groups in terms of gender and BMI. This means that the two groups are almost similar in characteristics of gender and BMI.

Fig 3- Prediction of Difficult airway by different methods among the two groups of study subjects in percentages (N=60)

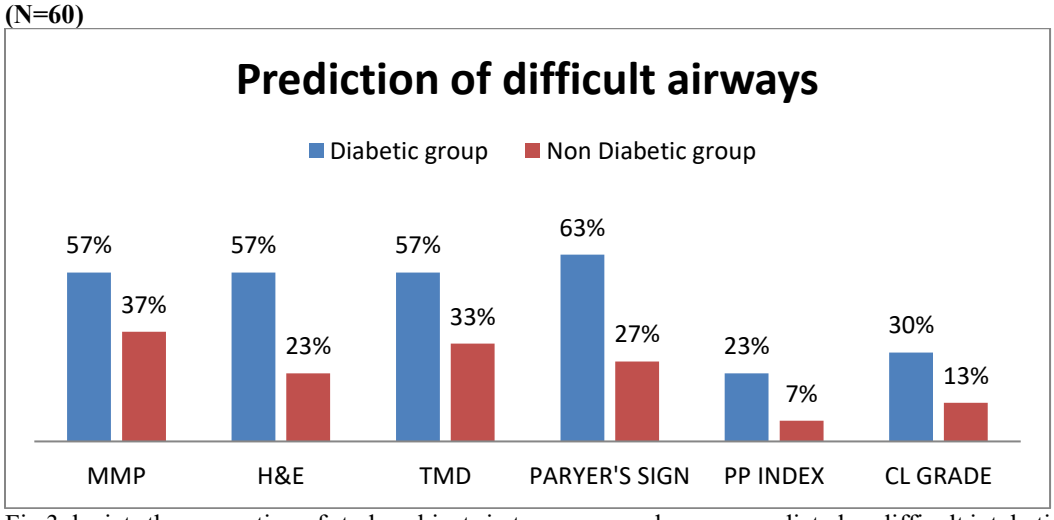


Fig 3 depicts the proportion of study subjects in two groups who were predicted as difficult intubation. The percentage of difficult airways are higher for diabetic group than non-diabetic group in each of the assessed airway indices, in which highest was shown for prayer's sign.

Table 2- Association between the status of diabetes with difficult airways predicted by different methods (N=60)

S.No	MMP CLASS	Diabetic group (n=30)	Non diabetic group (n=30)	P value
1.	**MMP CLASS** CLASS 1&2 CLASS 3&4	 13(43%) 17(57%)	 19(63%) 11(37%)	0.01*
2.	**H&E** CLASS 1&2 CLASS 3&4	 13(43%) 17(57%)	 23(77%) 7(23%)	<0.01*
3.	**TMD** <6 >6	17(57%) 13(43%)	10(33%) 20(67%)	<0.01
4.	**PRAYERS SIGN** POSITIVE NEGATIVE	19(63%) 11(37%)	8(27%) 22(73%)	<0.01*
5	**PP INDEX** GRADE 1&2 GRADE 3&4	23(77%) 7(23%)	28(93%) 2(7%)	<0.01*
6	**CLGRADE** GRADE 1&2 GRADE 3&4	21(70%) 9(30%)	9(30%) 4(13%)	0.01*

The above chi sqaure table shows the proportion of predicted as difficult airways was found to be higher among the diabetic group than the non-diabetic group. These findings are found to statistically significant at p value of less than 0.05.

DISCUSSION

The current investigation was undertaken to appraise a range of clinical parameters pertaining to airway assessment and their efficacy in forecasting challenging laryngoscopy and intubation. Various parameters for airway evaluation, including MMP, Head Extension, TMD, palm print sign, and prayer sign, were employed. The difficulty of intubation was assessed through challenging laryngoscopy in accordance with CL grading. The present study found that the prediction of difficult airways through various tools and also the difficult intubation by CL grading was higher with diabetic patients when compared to non diabetic patients which is consistent with a study conducted by Neha tilak et al. (14)

Glycosylation of tissue proteins due chronic hyperglycaemia was blamed as the reason for this vital complication. Deposition of glycosylation in the joints causes a limitation in joint mobility. This situation is called as “limited joint mobility (LJM) syndrome”. Unfortunately, 25-45% of all long term diabetic patients are known to develop LJM syndrome. (15) According to Riesel et al., glycosylation in joints of larynx and cervical vertebras may increase incidence of difficult intubation. The duration of diabetes and age attained are said to be important variables in development of the LJM syndrome. In our study, diabetic patients were included with one year duration of diabetes, however conclusive evidence on duration of diabetes associated with LMJ syndrome was not found. (16)

Our study reported 30% of difficult intubation among the diabetic patients. Studies by Hogan et al [17], Riesel et al[16], Nodal et al [18], and Hashim [19] have reported 32%, 31%, 27%, 16% and 27.1% incidence of difficult laryngoscopy respectively in diabetic patients. This is almost equivalent to the reported incidence of difficult intubation assessed by Cormack and Lehane grading. It was found that in the present study among all the airway indices measured among the diabetic patients, it’s the prayers signs (37%) and PP index (23%) which predicted the difficult airway which is equal to that of CL grading (30%) with a difference of 7%.

The limitation in our study was that laryngoscopes’ view was used to evaluate the airway indicies such as mallampati score, tyromental distance, head and neck extension, prayers sign, palm print index, CL grade. Although, difficult laryngoscopy does not mirror difficult intubation. Laryngoscopic view is an accepted method of comparing airway evaluation indices. It provides a more objective grading of difficult laryngoscopy without any ambiguity.

CONCLUSION

It is proven that the difficult airways was predicted more among those patients with diabetes than non-diabetic patients in all airway assessment tools. The prediction of Prayers sign and Palm Print index was found to be near to the gold standard Cochrane lahane grading of difficult intubation.

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