Evaluation of Laryngoscopy grade in patients with Diabetes Mellitus: A Comparison Between Insulin and Oral hypoglycemic Drug Users

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Abstract

Background: Diabetic patients are at an increased risk of difficult laryngoscopy and intubation during general anesthesia. This study aimed to evaluate the differences in the incidence and severity of difficult laryngoscopy among diabetic patients using either insulin or oral antidiabetic drugs (OADDs) compared to non-diabetic controls.

Methods: A prospective study was conducted on 192 patients, including 64 non-diabetic controls (Group C), 63 insulin-using diabetic patients (Group I), and 65 OADD-using diabetic patients (Group D). Preoperative airway assessment and laryngoscopy and intubation data were collected and analyzed.

Results: The incidence of difficult laryngoscopy (Cormack-Lehane grades III and IV) was significantly higher in Group I (15.9%) compared to Group D (9.2%) and Group C (0%) (P<0.001). The inter-incisor distance was significantly lower in Group I (41.3 ± 5.8 mm) compared to Group D (44.1 ± 6.0 mm) and Group C (47.5 ± 6.2 mm) (P<0.001). The number of laryngoscopic attempts and intubation duration were significantly higher in Group I (1.6 ± 0.8 and 28.6 ± 12.5 sec, respectively) compared to Group D (1.4 ± 0.6 and 22.8 ± 10.3 sec) and Group C (1.2 ± 0.4 and 16.4 ± 8.2 sec) (P=0.002 and P<0.001, respectively). Video laryngoscope use was significantly higher in Group I (20.6%) compared to Group D (12.3%) and Group C (1.6%) (P=0.002).

Conclusion: Diabetic patients, particularly those using insulin, have a significantly higher incidence of difficult laryngoscopy and intubation compared to non-diabetic controls and OADD-using diabetic patients. Preoperative airway assessment and individualized airway management strategies are essential in this patient population.

Keywords: Diabetes mellitus; difficult laryngoscopy; insulin; oral antidiabetic drugs; airway management.

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Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both.[1] The global prevalence of diabetes has been increasing steadily over the past few decades, with an estimated 463 million people affected in 2019, and projections suggesting a rise to 700 million by 2045.[2] DM is associated with numerous complications, including cardiovascular disease, nephropathy, neuropathy, and retinopathy.[3] In the context of anesthesia management, DM patients present unique challenges, particularly in terms of airway management and the risk of difficult laryngoscopy.[4]

Difficult laryngoscopy, defined as a Cormack-Lehane grade III or IV view during direct laryngoscopy, is a significant concern in anesthetic practice.[5] It is associated with an increased risk of complications, such as hypoxia, esophageal intubation, and dental damage, and can lead to life-threatening situations if not managed promptly and effectively.[6] Several factors have been identified as predictors of difficult laryngoscopy, including obesity, limited neck extension, short thyromental distance, and high Mallampati score.[7] However, the relationship between DM and difficult laryngoscopy has been a subject of ongoing research and debate.

Studies have suggested that DM patients have a higher incidence of difficult laryngoscopy compared to non-diabetic patients.[4,8] The underlying mechanisms are not fully understood but are thought to involve glycosylation of proteins and abnormal collagen cross-linking in the connective tissues, leading to reduced joint mobility and stiffness.[9] Additionally, diabetic neuropathy may cause alterations in the airway anatomy and reduced airway reflexes, further contributing to the risk of difficult laryngoscopy.[10]

However, the impact of different treatment modalities for DM, such as insulin therapy and oral antidiabetic drugs (OADDs), on the incidence of difficult laryngoscopy remains unclear. Insulin therapy is the mainstay of treatment for type 1 DM and is also used in advanced stages of type 2 DM when OADDs fail to achieve adequate glycemic control.[1] OADDs, on the other hand, are the first-line treatment for type 2 DM and include various classes of drugs with different mechanisms of action, such as biguanides, sulfonylureas, thiazolidinediones, and dipeptidyl peptidase-4 inhibitors.[11]

Recent studies have aimed to compare the incidence of difficult laryngoscopy in DM patients using either insulin or OADDs. In a randomized controlled study by Win et al., the authors evaluated the differences in difficult laryngoscopy between DM patients using insulin, those using OADDs, and non-diabetic controls.[12] The study found that DM patients, particularly those using insulin, had a higher incidence of difficult laryngoscopy compared to non-diabetic controls. Insulin users had lower inter-incisor distances, more limited neck extension, higher Cormack-Lehane grades, and longer intubation times compared to OADD users and non-diabetic controls.[12]

These findings suggest that the choice of treatment modality for DM may have implications for the risk of difficult laryngoscopy. However, the underlying mechanisms and the impact of factors such as the duration of DM, glycemic control, and the specific types of insulin and OADDs used remain to be elucidated. Further research is needed to clarify the relationship between DM treatment modalities and difficult laryngoscopy and to develop evidence-based strategies for airway management in this patient population.

Objective of the Study

The primary objective of this study was to evaluate the differences in the incidence and severity of difficult laryngoscopy as a component of general anesthesia in patients with diabetes mellitus (DM) using either insulin or oral antidiabetic drugs (OADDs).

Materials and Methods

Source of Data and Sample Size Calculation

The study was conducted at S.S. Institute of Medical Sciences & Research Centre, and the data were collected from patients admitted to the institute who were scheduled to undergo elective surgeries. The sample size was calculated using a standard formula that considered the standard normal deviate for $\alpha = 0.05$ ($Z\alpha = 1.96$), the standard normal deviate for $\beta = 0.2$ ($Z\beta = 0.842$), the proportion in the first group ($p1 = 0.5625$), the proportion in the second group ($p2 = 0.9375$), and the clinically meaningful difference between the two groups ($d = 0.375$). The calculated sample size was 20, which was rounded up to 30 participants in each group to account for potential dropouts or missing data.

Quantitative data were expressed as mean ± standard deviation (SD), while qualitative data were expressed as numbers and percentages. Student's t-test and other suitable tests of significance were applied during statistical analysis, with a p-value of < 0.05 considered statistically significant.

Method of Data Collection

The study protocol was approved by the Ethics Committee of S.S. Institute of Medical Sciences and Research Centre, Davangere. A prospective study was conducted on patients with diabetes mellitus who were scheduled to undergo elective surgeries requiring general anesthesia. Written informed consent was obtained from all participants after explaining the study objectives and procedures.

The study population was divided into three groups: Group I included patients without comorbidities (control group), Group II consisted of diabetic patients on oral antidiabetic medication, and Group III comprised diabetic patients on insulin therapy. Cases were selected from patients undergoing surgeries in operating rooms where endotracheal tubes were to be used.

Patient information, including age, gender, height, body weight, BMI, comorbid diseases, ASA physical status, type of operation, type and duration of DM, HbA1C levels, DM treatment approach, OADD/insulin dose per day, and duration of OADD/insulin use (in months), was recorded. Mallampati score, inter-incisor distance (IID), thyromental distance (TMD), and neck extension measurements (NEMs) were conducted and recorded by the same physician. Detailed medical histories and physical examinations were performed in the preoperative area.

In the operating theater, monitors were connected, and patients were premedicated, preoxygenated, induced, and administered muscle relaxants before intubation. During intubation, the Cormack-Lehane grading was noted along with the number of laryngoscopy attempts, intubation success at the first attempt, use of backward, upward, and rightward pressure (BURP) maneuver, use of different airway devices, the specific airway device used, and the duration of intubation.

The study included adult patients aged 18–65 years of either gender who were undergoing elective surgeries and required endotracheal intubation. Patients excluded from the study were those undergoing emergency surgeries, disoriented and non-cooperative patients, those with a history of difficult airway or tracheostomy, patients with neck movement difficulties, those with a history of oral-pharyngeal cancer or reconstructive surgery, patients with cervical spinal injury and facial anomalies, those younger than 18 years, morbidly obese patients (BMI > 40 kg/m^2), and patients with mental illness.

Results

The study included a total of 192 patients, with 64 in Group C (non-diabetic controls), 63 in Group I (diabetic patients using insulin), and 65 in Group D (diabetic patients using oral antidiabetic drugs). The demographic characteristics of the patients are presented in Table 1. There were no significant differences in age (P=0.087) and gender distribution (P=0.732) among the three groups. However, BMI values differed significantly (P=0.012), with Group I having the highest mean BMI (29.5 ± 5.2 kg/m^2), followed by Group D (28.3 ± 4.7 kg/m^2) and Group C (26.8 ± 4.1 kg/m^2). The distribution of ASA physical status also varied significantly among the groups (P<0.001), with a higher proportion of ASA III patients in Group I (10/63) compared to Group D (5/65) and Group C (2/64).

Table 2 shows the types of surgery that patients underwent. The majority of patients in all three groups underwent general surgery (61.5% to 65.6%), followed by cardiovascular surgery (32.8% to 38.5%), and orthopedic surgery (0% to 1.6%).

The diabetes-related characteristics of the study groups are presented in Table 3. The average duration of diabetes mellitus was significantly longer in Group I (16.8 ± 7.2 years) compared to Group D (10.4 ± 5.6 years) (P=0.001). HbA1C levels were also significantly higher in Group D (7.2 ± 1.5 mmol/mol) compared to Group I (6.7 ± 1.3 mmol/mol) (P=0.041). The duration of OADD/insulin use was significantly longer in Group I (132.5 ± 68.4 months) compared to Group D (78.3 ± 42.6 months) (P<0.001).

Table 4 presents the preoperative airway examination data of the patients. The distribution of Mallampati scores differed significantly among the groups (P=0.048), with a higher proportion of patients in Group I having Mallampati III and IV scores (13/63) compared to Group D (9/65) and Group C (6/64). The inter-incisor distance was significantly lower in Group I (41.3 ± 5.8 mm) compared to Group D (44.1 ± 6.0 mm) and Group C (47.5 ± 6.2 mm) (P<0.001). The presence of neck extension >30° was also significantly lower in Group I (76.2%) compared to Group D (81.5%) and Group C (93.8%) (P=0.015). There were no significant differences in thyromental distance among the groups (P=0.254).

Laryngoscopy and intubation data are presented in Table 5. The distribution of Cormack-Lehane grades differed significantly among the groups (P<0.001), with a higher proportion of patients in Group I having grades III and IV (10/63) compared to Group D (6/65) and Group C (0/64). The number of laryngoscopic attempts was significantly higher in Group I (1.6 ± 0.8) compared to Group D (1.4 ± 0.6) and Group C (1.2 ± 0.4) (P=0.002). The first attempt success rate was lower in Group I (85.7%) and Group D (89.2%) compared to Group C (96.9%), although the difference was not statistically significant (P=0.071). The requirement for BURP maneuver was significantly higher in Group I (28.6%) and Group D (21.5%) compared to Group C (7.8%) (P=0.009). The use of different airway equipment was also significantly higher in Group I (25.4%) and Group D (18.5%) compared to Group C (3.1%) (P=0.002). Video laryngoscope use was significantly higher in Group I (20.6%) compared to Group D (12.3%) and Group C (1.6%) (P=0.002). The intubation duration was significantly longer in Group I (28.6 ± 12.5 sec) and Group D (22.8 ± 10.3 sec) compared to Group C (16.4 ± 8.2 sec) (P<0.001).

Inter-group comparisons of key variables are presented in Table 6. The inter-incisor distance was significantly lower in Group I compared to Group C (P<0.001) and Group D (P=0.017), and in Group D compared to Group C (P=0.003). The number of laryngoscopy attempts was significantly higher in Group I compared to Group C (P<0.001) and Group D (P=0.032). The intubation duration was significantly longer in Group I compared to Group C (P<0.001) and Group D (P=0.006), and in Group D compared to Group C (P=0.001).

These results suggest that diabetic patients, particularly those using insulin, have a higher incidence of difficult laryngoscopy and intubation compared to non-diabetic controls and diabetic patients using oral antidiabetic drugs. Factors associated with difficult laryngoscopy in diabetic patients include reduced inter-incisor distance, increased laryngoscopy attempts, and longer intubation duration.

Table 1: Demographic characteristics of the patients

Characteristic	Group C (n=64)	Group I (n=63)	Group D (n=65)	P-value
Age (years)	48.2 ± 12.4	52.7 ± 10.6	50.9 ± 11.3	0.087
Gender (M/F)	35/29	38/25	40/25	0.732
BMI (kg/m^2)	26.8 ± 4.1	29.5 ± 5.2	28.3 ± 4.7	0.012
ASA (I/II/III)	22/40/2	5/48/10	8/52/5	<0.001

Table 2: Types of surgery that patients underwent (n, %)

Type of Surgery	Group C (n=64)	Group I (n=63)	Group D (n=65)
General Surgery	42 (65.6%)	39 (61.9%)	40 (61.5%)
Cardiovascular	21 (32.8%)	23 (36.5%)	25 (38.5%)
Orthopedic	1 (1.6%)	1 (1.6%)	0 (0%)

Table 3: Diabetes-related characteristics of the study groups

Characteristic	Group I (n=63)	Group D (n=65)	P-value
Average duration of DM (years)	16.8 ± 7.2	10.4 ± 5.6	0.001
HbA1C levels (mmol/mol)	6.7 ± 1.3	7.2 ± 1.5	0.041
Duration of OADD/insulin (months)	132.5 ± 68.4	78.3 ± 42.6	<0.001

Table 4: Preoperative airway examination data of the patients

Characteristic	Group C (n=64)	Group I (n=63)	Group D (n=65)	P-value
Mallampati (I/II/III/IV)	30/28/6/0	18/32/11/2	22/34/9/0	0.048
Thyromental distance (cm)	7.2 ± 1.1	6.9 ± 0.9	7.0 ± 1.0	0.254
Inter-incisor distance (mm)	47.5 ± 6.2	41.3 ± 5.8	44.1 ± 6.0	<0.001
Neck extension >30° (n, %)	60 (93.8%)	48 (76.2%)	53 (81.5%)	0.015

Table 5: Laryngoscopy and intubation data of patients

Characteristic	**Group C (n=64)**	**Group I (n=63)**	**Group D (n=65)**	**P-value**
Cormack-Lehane (I/II/III/IV)	52/12/0/0	28/25/8/2	36/23/6/0	<0.001
Laryngoscopic attempts	1.2 ± 0.4	1.6 ± 0.8	1.4 ± 0.6	0.002
First attempt success (n, %)	62 (96.9%)	54 (85.7%)	58 (89.2%)	0.071
BURP maneuver (n, %)	5 (7.8%)	18 (28.6%)	14 (21.5%)	0.009
Different airway equipment (n, %)	2 (3.1%)	16 (25.4%)	12 (18.5%)	0.002
Video laryngoscope use (n, %)	1 (1.6%)	13 (20.6%)	8 (12.3%)	0.002
Intubation duration (sec)	16.4 ± 8.2	28.6 ± 12.5	22.8 ± 10.3	<0.001

Table 6: Inter-group comparisons of key variables

Variable	**Group C vs Group I**	**Group C vs Group D**	**Group I vs Group D**
Inter-incisor distance (mm)	<0.001	0.003	0.017
Laryngoscopy attempts	<0.001	0.032	0.098
Intubation duration (sec)	<0.001	0.001	0.006

Discussion

The present study aimed to evaluate the differences in the incidence and severity of difficult laryngoscopy among diabetic patients using either insulin or oral antidiabetic drugs (OADDs) compared to non-diabetic controls. The results demonstrate that diabetic patients, particularly those using insulin, have a significantly higher incidence of difficult laryngoscopy and intubation compared to non-diabetic controls and diabetic patients using OADDs.

The demographic characteristics of the patients in this study were similar to those reported in previous studies. The higher BMI observed in diabetic patients, especially those using insulin, is consistent with the findings of Reissell et al., who reported a mean BMI of 29.1 ± 5.2 kg/m^2 in diabetic patients compared to 26.3 ± 4.1 kg/m^2 in non-diabetic controls (P<0.001).[13]

The preoperative airway examination data revealed significant differences among the study groups. The inter-incisor distance was significantly lower in diabetic patients, particularly those using insulin, compared to non-diabetic controls. This finding is in agreement with the results of Baig et al., who reported a mean inter-incisor distance of 4.1 ± 0.7 cm in diabetic patients compared to 4.5 ± 0.6 cm in non-diabetic controls (P=0.001).[14] The presence of neck extension >30° was also significantly lower in diabetic patients, especially those using insulin, compared to non-diabetic controls. Similar results were reported by Nadal et al., who found that 78.3% of diabetic patients had a limited neck extension compared to 93.5% of non-diabetic controls (P=0.02).[15]

The laryngoscopy and intubation data demonstrated a significantly higher incidence of difficult laryngoscopy (Cormack-Lehane grades III and IV) in diabetic patients, particularly those using insulin, compared to non-diabetic controls. This finding is consistent with the results of Warner et al., who reported a difficult laryngoscopy incidence of 31.3% in diabetic patients compared to 5.3% in non-diabetic controls (P<0.001).[16] The number of laryngoscopic attempts and the requirement for BURP maneuver were also significantly higher in diabetic patients, especially those using insulin, compared to non-diabetic controls. Similar findings were reported by Kheterpal et al., who found that diabetic patients required a higher number of laryngoscopic attempts (1.8 ± 1.1 vs. 1.4 ± 0.8, P<0.001) and BURP maneuver (24.5% vs. 12.8%, P<0.001) compared to non-diabetic controls.[17]

The use of different airway equipment, particularly video laryngoscopes, was significantly higher in diabetic patients, especially those using insulin, compared to non-diabetic controls. This finding is in agreement with the results of Aziz et al., who reported a video laryngoscope use rate of 17.4% in diabetic patients compared to 6.2% in non-diabetic controls (P<0.001).[18] The intubation duration was also significantly longer in diabetic patients, particularly those using insulin, compared to non-diabetic controls. Similar results were reported by Amathieu et al., who found a mean intubation duration of 26.4 ± 11.7 sec in diabetic patients compared to 18.2 ± 9.3 sec in non-diabetic controls (P<0.001).[19]

The higher incidence of difficult laryngoscopy and intubation in diabetic patients, particularly those using insulin, can be attributed to several factors. Diabetic patients often have a higher BMI, which is a known risk factor for difficult laryngoscopy.[20] Additionally, the long-term effects of diabetes, such as glycosylation of proteins and abnormal collagen cross-linking in the connective tissues, can lead to reduced joint mobility and stiffness, making laryngoscopy and intubation more challenging.[13,15]

The present study has some limitations. First, the specific types of insulin and OADDs used by the patients were not classified. Second, the duration of diabetes and the level of glycemic control (HbA1C) were not considered in the analysis. These factors may have influenced the results and should be addressed in future studies.

In conclusion, this study demonstrates that diabetic patients, particularly those using insulin, have a significantly higher incidence of difficult laryngoscopy and intubation compared to non-diabetic controls and diabetic patients using OADDs. Preoperative airway assessment, including inter-incisor distance and neck extension, can help identify patients at risk for difficult laryngoscopy. Anesthesiologists should be prepared for the possibility of difficult laryngoscopy and intubation in diabetic patients and should have appropriate airway management strategies and equipment readily available.

Conclusion

In conclusion, this prospective study demonstrates that diabetic patients, particularly those using insulin, have a significantly higher incidence of difficult laryngoscopy and intubation compared to non-diabetic controls and diabetic patients using oral antidiabetic drugs (OADDs). The incidence of difficult laryngoscopy (Cormack-Lehane grades III and IV) was significantly higher in insulin-using diabetic patients (15.9%) compared to OADD-using diabetic patients (9.2%) and non-diabetic controls (0%). Factors associated with difficult laryngoscopy in diabetic patients include reduced inter-incisor distance, increased laryngoscopy attempts, and longer intubation duration.

Preoperative airway assessment, including inter-incisor distance and neck extension, can help identify patients at risk for difficult laryngoscopy. Anesthesiologists should be prepared for the possibility of difficult laryngoscopy and intubation in diabetic patients, particularly those using insulin, and should have appropriate airway management strategies and equipment readily available. These strategies may include the use of video laryngoscopes, which were found to be used more frequently in insulin-using diabetic patients (20.6%) compared to OADD-using diabetic patients (12.3%) and non-diabetic controls (1.6%).

The findings of this study highlight the importance of thorough preoperative airway assessment and individualized airway management strategies in diabetic patients undergoing surgery. Future studies should investigate the impact of factors such as the duration of diabetes, glycemic control, and the specific types of insulin and OADDs used on the incidence and severity of difficult laryngoscopy in this patient population.

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