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Comparison of palm print test with other difficult intubation prediction tests in patients with diabetes mellitus

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Abstract

Prediction of difficult intubation has critical importance in anesthesia practice. Diabetic patients usually have limited joint mobility which limits the head and neck extension during laryngoscopy. On the day prior to surgery, the patients who had diagnosis of diabetes mellitus at least for one year, were examined by an investigator by using palm print test (PPT) and other standard assessment indices. The investigator assigned a score to each evaluation indices. PPT was found to have better sensitivity (0.944), spesivity (0.692), positive predictive value (0.895) and negative predictive value (0.818) than standard assessment tests ($p < 0.01$). PPT should be kept in mind as a viable and easy-to-perform test for predicting difficult intubation of patients with Diabetes Mellitus.

Keywords: Difficult intubation, diabetes mellitus, palm print test

Introduction

Difficult intubation is one of the most important and vital issues of anesthesia practice (1). Patients with Diabetes Mellitus (DM) usually have limited joint mobility and atlanto-occipital joint motion due to glycolysis in the joints. After a while, the glycolysis in these joints results in limited head and neck extension during laryngoscopy (2).

As the glycolysis begins in interphalangeal joints first, Palm Print Test (PPT) has been described to determine the limitation in motility of the interphalangeal joints. The test is performed by coloring the palm of the dominant hand and then suppressing of the palm simply on a white paper (3).

In this prospective observational study, our primary aim is to compare the efficacy of PPT with other tests used to predict difficult intubation by determining the positivity thresholds of each test. Also our secondary aim is to evaluate the effect of regulation and complication of diabetes on palm print predictivity.

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Materials and Methods

Materials

After the approval of the Local Ethics Committee (17.05.2016 with decision number 2016/50), the study was conducted as a prospective, observational, single-center study. A written informed consent form was obtained from all pa¬tients who agreed to participate. The patients with a diagnosis of DM at least for one year and scheduled for an elective surgery under general anesthesia were included into the study. The exclusion criteria were; patients without DM or a history of DM less than a year, patients with an anatomical anomaly of face, neck, palate or hands, and a previous history of difficult airway. 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 investigator did not take part in the further steps of the study.

Cormack Lehane (CL) classification is the laringoscopic view of the airway. When any part of the vocal cords are 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.

The tests which purpose to predict difficult were as follows:

Modified Mallampati Test (MMT): 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, fauces, uvula, pillars are visible Grade II: Soft palate, fauces 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 (4) (Figure 1).

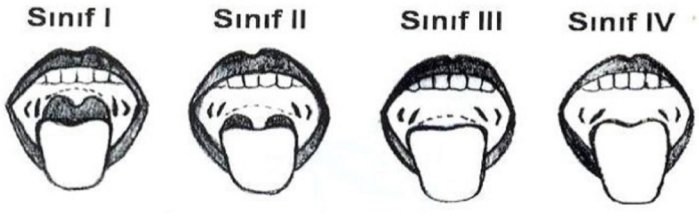

Figure 1. Modify mallampati test

Thyromental Distance (TMD): 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 [(5–7)] (Figure 2).

Figure 2. Tyromental distance

Sternomental Distance (SMD): The SMD is the distance between the midpoint of the jaw and the upper limit of the manibrium sterni. It is measured while the patient's head is in full extension,and the mouth is closed. If the measured distance is less than 12.5 cm, a difficult intubation is expected (5–7) (Figure 3).

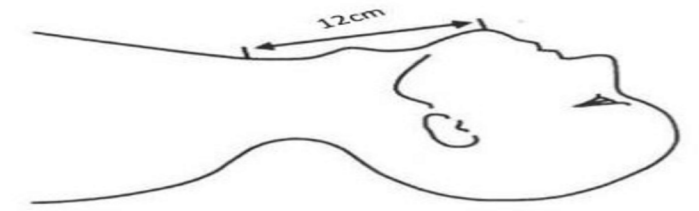

Figure 3. Sternomental distance

Degree of Head Extension (HE):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 0 and it predicts easy intubation. If head extension is less than 35 degree, it is called Grade 1 and it predicts difficult intubation [(8) (Figure 4).

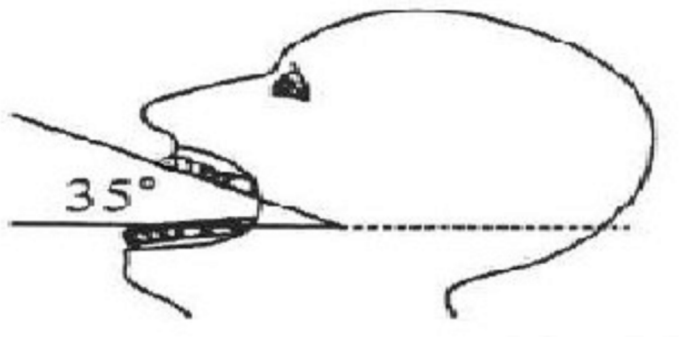

Figure 4. Degree of head extension

Upper limb bite test (ULBT): The ULBT is first described in 2003 (9). There are 3 classes in this text. If the lower incisors can bite the upper lip above the vermilion line, it is called Class 1. If the lower incisors can bite the upper lip below the vermilion line, then it is called Class 2. If the lower incisors can not bite the upper lip, it is called Class 3. Classes 1 and 2 are accepted as the signs of easy intubation, while Class 3 shows a difficult intubation (Figure 5).

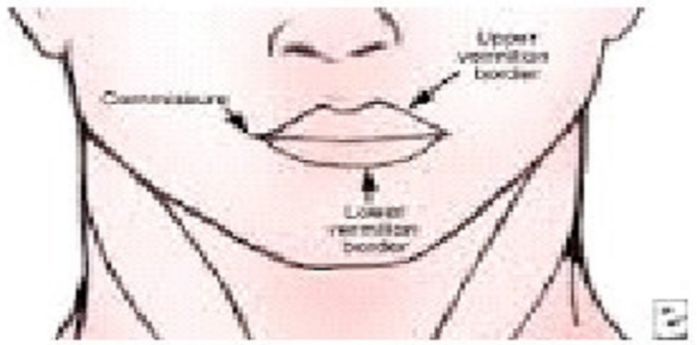

Figure 5. Upper limb bite test

Palm Print Test (PPT): 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 (Figure 6).Grade 0-I easy and Grade II-III predicts difficult intubation.

Prayer Sign (PS): 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 (10) (Figure 7).

The patients were also questioned for regulation of blood glucose level (Regulation of DM) and diabetes-related complications

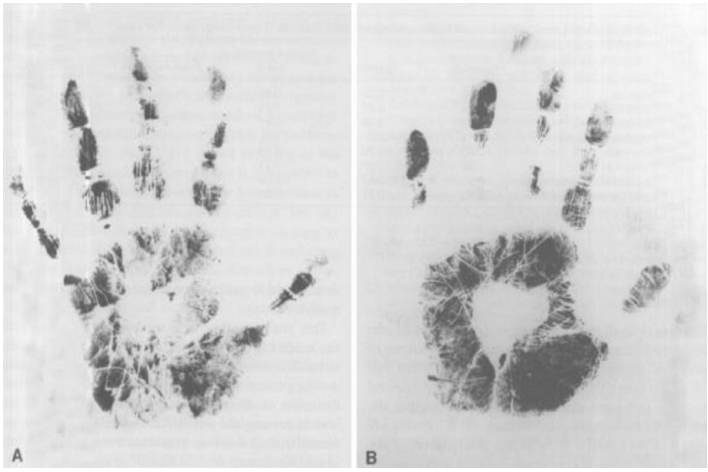

Figure 6. Palm print test A: Grade 1 B: Grade 4

Figure 7. Prayer sign

(Complications of DM) were recorded. It was recorded as "non-regulated DM" when two of followings were present: If the daily blood glucose measurement frequency was above 3 or if the hemoglobin A1C value in the last 3 months was above 7 or if the blood glucose level was above 180 gr dl-1 in the morning of that day. The presence of neuropathy, nephropathy, hepatosteatosis, retinopathy or peripheral circulatory disorders was recorded as "complication of DM" (CoD).

A stylet, gum elastic bougie, long machintos curved blade, laryngeal mask airway (LMA) and an i-gel airway were kept ready for emergency situations during the airway management of all patients.

Blood glucose regulation and diabetes-related complications were questioned and recorded. It is called non regule diabetes mellitus when the presence of 2 criteria of the daily blood glucose measurement frequency above 3, the hemoglobin A1C value in the last 3 months above 7, and the blood glucose level in the morning of the evaluated day was above 180.

The presence of neuropathy, nephropathy, hepatosteatosis, retinopathy or peripheral circulatory disorders in clinical follow-up recorded as diabetic complication.

Stylet, gum elastic bougie, long macintosh curved blade, laryngeal mask airway (LMA) and i-gel airway were kept ready for emergency.

Power analysis

We conducted a pilot study with 10 patients in our clinic. According to the pilot study, the incidence levels of prediction of palm print test 73.9% and 26.1% were recorded. Assuming $\alpha = 0.05$,and $\beta = 0.10$ with a power of 90%, at least 42 patients were needed in total. Considering a drop-out ratio of 15%, we decided to include 49 patients in total.

Statistical analysis

All measured indexes including PPT, Regulation of Diabetes (RoD), Complication of Diabetes (CoD), MMT, TMD, SMD, HE, ULBT, and PS were compared with CL classification. Sensitivity, specificity, positive predictive value, and negative predictive value of each tests were calculated for prediction of CL classification. The comparisons were analyzed by Chi-square test. Statistical analyses were performed using SPSS version 25 (made by SPSS Incorporated, located in Chicago, Illinois, USA). P values of < 0.05 were considered significant for the tests results presented.

Results

A total of 49 patients, including 22 females and 27 males, were included in the study. The mean age was 62.32 ± 8.24 years in females, and 57.22 ± 12.02 years in males. The mean body mass index (BMI) of females was 30.5 ± 4.49 kg m-2, and BMI of males was 29.26 ± 5.00 kg m-2. The average durations of diabetes were 7.68 ± 5.45 years and 7.96 ± 6.39 years for females and males respectively (Table 1).

Table 1. Descriptives of patients

Variable	Gender	N	Mean	SD
Age	Female	22	62.32	8.24
	Male	27	57.22	12.02
BMI	Female	22	30.50	4.49
	Male	27	29.26	5.00
YoD	Female	22	7.68	5.45
	Male	27	7.96	6.39

YoD: Year of Diabetes; N: sample size; SD: standard

Sensitivity, specificity, positive predictive value, and negative predictive value of each indexes for predicting the difficultness of intubation are listed in Table 2.

According to the chi-square test results, the relationship between PPT and CL assessment classification was statistically significant ($p = 0.000$). But RoD, SMD, ULBT, and PS relationships were not statistically significant with CL classification with slightly higher p values of 0.088, 0.106, 0.106, and 0.112 respectively (Table 3).

Table 2. Sensitivity, specificity, positive predictive value, and negative predictive value

Index vs Cormack	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Chi-square p value
Palm print test	0.944	0.692	0.895	0.818	0.000
Regulation of diabetes	0.583	0.692	0.840	0.375	0.088
Complication of diabetes	0.472	0.385	0.680	0.208	0.376
Modified mallampati test	0.361	0.538	0.684	0.233	0.524
Thyromental distance	0.806	0.308	0.763	0.364	0.402
Sternomental distance	0.833	0.385	0.789	0.455	0.106
Degree of head extension	0.611	0.538	0.786	0.333	0.350
Upper limb bite test	0.833	0.385	0.789	0.455	0.106
Prayer sign	0.361	0.385	0.619	0.179	0.112

$p < 0.05$ is considered as statistically significant

Table 3. Frequencies and chi-square test

Variable	Gender	N	Mean	SD
Palm print test	Easy	34	4	0.000
	Difficult	2	9	
Regulation of diabetes	Regulated	21	4	0.088
	Not Regulated	15	9	
Complication of diabetes	Presence	17	8	0.376
	Absence	19	5	
Modified mallampati test	Easy	13	6	0.524
	Difficult	23	7	
Thyromental distance	Easy	29	9	0.402
	Difficult	7	4	
Sternomental distance	Easy	30	8	0.106
	Difficult	6	5	
Degree of head extension	Easy	22	6	0.350
	Difficult	14	7	
Upper limb bite test	Easy	30	8	0.106
	Difficult	6	5	
Prayer Sign	PS Positive	13	8	0.112
	PS Negative	23	5	
Total			36	13

p value is obtained with Chi-square test, and $p < 0.05$ is considered as statistically significant

Discussion

In the current literature, the percentage of deaths related to anesthesia is about 30% and most of them are related to inability of intubation (10). "Difficult intubation" is defined as difficult tracheal intubation: Tracheal intubation requires multiple attempts, in the presence or absence of tracheal pathology (11). The difficulty of laryngoscopy/intubation was reported as high as 27-31% in diabetic patients (3,12,13). Similar to the literature, the intubation was evaluated as difficult in 13 patients (26,5%) in our study. Diabetic patients have additional risk factors, such as gastric motor dysfunction, residue contents and hyperacidity, that make the accurate evaluation of airway more important than normal population (14). As a result, anesthesiologist should prepare supplies (fiberoptic, awake tracheal intubation sets, etc) for the risk of difficult intubation in patients with DM.

The difficulty of airway management in diabetic patients was reported by Salzarulo et al.(2) first time in 1986. Glycosylation of tissue proteins due chronic hyperglycemia was blamed as the reason for this vital complication (15). 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 patient are known to develop LJM syndrome (2). According to Reissell et al., glycosylation in joints of larynx and cervical vertebraes may increase incidence of difficult intubation (13). PPT is an easily-performed test to evaluate the limitation in small joints of the hands (16). Previous studies showed that PPT was helpful to predict difficult intubation in diabetic patients (17,18).

Moreover, some studies suggested that PPT predicted difficult intubation better than other tests in patients with DM (12,16,18). Nadal et al. (12) reported the sensitivity of PPT as 85% for prediction of difficult laryngoscopy. Similar to these results, the sensitivity (0.944), specificity (0.692), positive predictive value (0.895) and negative predictive value (0.818) of PPT were found higher than other tests ($p < 0.01$) in our study.

Prayer sign is a more easily-performed test than PPT. Previous studies (12,18) showed PS as a useful test in predicting difficult laryngoscopy in diabetic patients and suggested performing PPT only after prayer sign was found positive. Contrary to above mentioned studies (12,18), PS was not an effective option for prediction of difficult intubation in our study. The sensitivity (0,361), specificity (0.385), positive prediction value (0.619) and negative prediction value (0.179) of PS were found less than PPT and the other tests.

The secondary aim of our study was to evaluate the effect of RoD and CoD on PPT predictivity. However, there were no significant relations between RoD or CoD and PPT predictivity. Similarly, the relationship between RoD and CL classification was not statistically significant ($p= 0.088$). The most possible reason for these results is the relatively small size of this study. Although the study had enough power to meet the primary aim of this study, the sample size was not large enough to detect a relation between RoD or CoD and PPT predictivity, and RoD and CL classification. Further studies with larger observations are needed for these purposes.

Limitations

As mentioned above, the main limitation of our study is the relatively sample size. Although it is enough for primary outcome the sample size can be lack of power for secondary outcome. The secondary limitation of the study is that all endotracheal intubations were not performed by a single anesthesiologist, instead, there were two different anesthesiologists. However, both of the anesthesiologists were experienced enough in airway management.

Conclusion

In the current study, PPT was more effective than other assessment indices in predicting difficult intubation. PPT may be a viable and easily-to-perform option for preoperative airway assessment of patients with DM.

Conflict of interest
The authors declare that they have no competing interest.

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Ethical approval
The 06.06.2018 date and 09/III decision number of Clinical research ethics committee of Mugal Sitki Kocman University.

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