



## Sensitivity and Specificity of Palm Print Sign in Difficult Laryngoscopy among Diabetic Patients

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### Abstract

**Background:** Early securing of the airway at the induction of anaesthesia is imperative in patients at risk, making preoperative identification of the diabetics with difficult airway decisive. Diabetic patients are susceptible for limited joint mobility syndrome. Involvement of atlantooccipital joint limits adequate extension of head and neck during laryngoscopy leading to difficult intubation. The collagen glycosylation is first noted in the fourth and fifth inter-phalangeal joints leading to inability to approximate the palms and fingers of the hand. The palmprint has been used to objectively assess the degree of inter phalangeal joint involvement. A palm print score from 0-3 based on the degree of visibility of phalangeal areas on a piece of paper is assessed as a predictor of difficult laryngoscopy. The aim of our study was to evaluate the effectiveness of palm print sign as a screening tool for predicting difficult laryngoscopy in diabetic patients.

**Methods:** Preoperatively, airway of 267 patients were assessed by the investigator, while they were sitting upright in a chair using the modified Mallampati test, thyromental distance, degree of head extension and the palm print test. Palm print is obtained by taking the ink impression of the dominant hand palm. Their corresponding Cormack- Lehane score [Gold standard] were noted at the time of intubation by the attending anaesthesiologist. He was blinded to the results of preoperative airway evaluation. Cormack lehane 3 or 4 view, Palm print grade 2, Mallampati grade 3 and 4, Thyromental distance grade 0, Head extension grade 1 were defined as predictors of difficult intubation. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of each were compared to get the results.

**Conclusion:** The PP test seems to be the most sensitive and specific tool in the prediction of difficult laryngoscopy among diabetic patients.

**Keywords:** Palm print sign, Diabetic, Difficult laryngoscopy.

### Introduction

Airway management is the key to anesthetic practice. It has been found that as many as 30% of deaths related to anaesthesia was due to inability

to manage difficult airway.<sup>[2]</sup> To manage difficult intubation, whose incidence is 1.513% and to decrease the incidence of fatal outcomes, practice guidelines have been established. These guidelines

emphasises on elective assessment and prediction of difficult intubation. Screening tests like Mallampatti test, Wilson risk score, upper lip bite test, Lemon score, Ultrasonography of neck soft tissue are already in use for predicting difficult intubation<sup>(1)</sup>. The diabetic patients are more likely to have difficult laryngoscopy and intubation, the incidence being 27-31%<sup>12,13</sup>. Nonenzymatic glycosylation of collagen and its deposition in the joints leads to 'Limited joint mobility'(LJM) syndrome, which occurs in 25-45% of patients with long standing diabetes<sup>13</sup>. Atlanto-occipital joint involvement restricts adequate head and neck extension during laryngoscopy leading to intubation difficulties. These changes begins in the fourth and fifth interphalangeal joints because of which the patient is unable to approximate the palms and fingers of the hands, the 'Prayer sign'<sup>10</sup>. Objective assessment of degree of interphalangeal joint involvement can be done by scoring the ink impression made by the palm of the dominant hand as done by Reissell et al<sup>12,13</sup>. Palm print sign has been shown to predict difficult intubation in diabetic patients<sup>(3,10)</sup> The present study compares the sensitivity and specificity of the palm print test with other used indices like Modified Mallampatti test, Thyromental distance, Head extension angle in their ability to predict difficult laryngoscopy in diabetic patients.

### Material and Methods

In our descriptive study, 267 diabetic patients above 40 years of age undergoing elective surgery under anaesthesia were included after consecutive sampling for diagnostic test evaluation. Approval of the institutional research methodology, ethical committee and written informed consent were obtained. Patients with obvious anatomical variation of their face, neck, palate or hands, patients with history of difficult intubation, patients unwilling to give consent were excluded from the study. Preoperatively, airway was assessed in each patient while they were sitting upright in a chair using the Modified Mallampatti test, thyromental distance, degree of head

extension and the palm print test. Their corresponding Cormack\_ Lehanescore [Gold standard] was noted at the time of intubation. Scores were given for each index as follows:

Modified Mallampati Test: Keeping the head in neutral position the patient was asked to open the mouth fully and protrude the tongue as far as possible. Looking from the patient's eye level the pharyngeal structures were inspected with a torch without the patient phonating and the view was graded as follows:

- \* Grade I - Soft palate, uvula, fauces and pillars visible.
- \* Grade II - Soft palate, uvula, fauces visible but pillars obscured.
- \* Grade III - Soft palate only visible
- \* Grade IV - Soft palate not visible

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

Head extension: Keeping the head in neutral position and the line joining the mentum to the angle of the mandible parallel to the floor, the patient was asked to maximally extend the head on the neck. The angle traversed by the mentomandibular line is measured using a protractor compass.

- \* Grade 0 Head extension > 35 degree which is normal.
- \* Grade 1 - Head extension < 35 degree.

Palm Print Test: The palm and fingers of the patients dominant hand is pressed firmly against a washable stamp pad and then onto a white paper on a hard surface. Scoring was done as: Grade 0 - All phalangeal areas visible.:

Grade 1 - Deficiency in the inter\_ phalangeal areas of 4<sup>TH</sup> and/or 5<sup>th</sup> digit.

Grade 2 - Deficiency in the inter\_ phalangeal areas of 2nd to 5th digit.

Grade 3 - Only the tips of digits seen.

On presentation at the operating room, the patients were positioned with a standard pillow under the head. The monitors were attached and after preoxygenation, general anaesthesia was induced with 2.5% Thiopentone sodium 5 mg/kg and Succinylcholine 2 mg/kg. After full muscle relaxation laryngoscopy was performed by a qualified anaesthetist using a standard medium sized Macintosh blade. The laryngoscopist could try up to 3 attempts to acquire the best laryngeal view without external laryngeal pressure applied to the cricoid cartilage. The laryngoscopist assigned a laryngeal view class based on the criteria of Cormack and Lehane.

Grade I \_ Vocal cords visible

Grade II \_ Only posterior commissure or arytenoids visible

Grade III \_ Only epiglottis visible:

Grade IV - No glottic structure visible

Grade III & IV laryngoscopic views were considered as difficult laryngoscopy. After grading laryngeal view, patient was intubated with appropriate sized endotracheal tube and the correct placement of the tube was confirmed. Stylet, gum elastic bougie and long Macintosh curved blade, laryngeal mask airway (LMA) and i-gel airway were kept ready for emergency .

To compare the clinical performance of the four indices: sensitivity, specificity, positive predictive value, false negative and false positive ratios were calculated by simple 2 X 2 tables. Confidentiality was ensured and maintained throughout the study. Data collection was done by measuring scale, protractorcompass, writing ink, brush and whitepaper. Outcome measurement done by anaesthesiologist in charge of table (Cormac and lehanelaryngoscopic grade). Grade1, Grade2, Grade3, Grade4 according to the visibility of laryngeal structures and data entered into Microsoft excel sheet. Data analysis were done using SPSS / EPIINFO. Sensitivity of the palmprint sign was estimated as a proportion of palmprint sign positive among patients with difficult intubation and specificity as a proportion

of palmprint sign negative among easily intubated patients. Difficult airway was confirmed by the gold standard Cormack lehane. Cormacklehane grade 3&4 considered as difficult intubation. Palmprint grade 2 and 3 considered as predictors of difficult intubation. Palmprint grade 0 and 1 considered as predictors of easy intubation.

True positive - Cormack lehane grade 3&4 +palmprint grade 2& 3

True negative - Cormack lehane 1&2 + palmprint 0 &1

False negative - Cormack lehane 1&2 + palmprint sign grad & e 2 3

False positive - Cormack lehane 3&4 + palmprint grade 0 & 1

**Results and Analysis**

Sensitivity, specificity, positive predictive value, negative predictive value, accuracy of each tests were calculated using SPSS. Out of 267 ASA II and ASA III patients recruited in the study, maximum strength was in the age group 51-60 yrs (39.5%), 52.7% females, 61% under ASA 2 .The study results were applicable equally to both males and females and diabetics with more than 10 yrs of duration were only 27%.Hence no significant association between the duration of diabetes and difficult laryngoscopy could be noted.

**Table 1:** Distribution of the sample based on the grade of PALM PRINT SIGN (PPS)

Palm Print	Count	Percent
Grade 0	87	33
Grade 1	85	32
Grade 2	95	35

PPS Grade 0 and 1 were considered as easy intubation and Grades 2 and 3 as difficult intubation. Hence there was 35 % incidence of difficult intubations predicted by this test. There were 33 % patients having Grade 0, and 32 % having Grade 1 and 35 % under Grade 2 and 0% under Grade 3.

**Table 2** Comparison of PPS with gold standard CL in prediction of difficult intubation

		CL		
		Easy intubation	Difficult intubation	Total
PPS	Easy intubation	156	16	172
	Difficult intubation	15	80	95
	Total	171	96	267

k = 0.747 p= <0.001

Out of 267 study population, difficult intubations predicted by palmprint sign were 95 and there were 96 difficult intubations as per the gold standard test, the Cormac and Lehane. There were 80 true positives and 15 false positives. There were 156 true negatives and 16 false negatives. From these values, sensitivity, specificity, positive predictive value, negative predictive value were calculated. Measure of agreement kappa is 0.747 and p value <0.001 showed substantial strength of agreement.

**Table 3** PPS validity indices

Parameter	Value
Sensitivity	83.33%
Specificity	91.2%
Positive predictive value	84.2%
Negative predictive value	90.6%
Accuracy	88.38%

The results showed 83.3% sensitivity, 91.2% specificity, 84.2% positive predictive value, 90.6% negative predictive value, and accuracy 88.38%

**Table 4** shows commonly used indices in their ability to predict difficult laryngoscopy in diabetic patients

		Cormack-Lehane Score			Kappa	p
		Difficult	Easy	Total		
Palm Print	Difficult	80	15	95	0.747**	0.000
	Easy	16	156	172		
	Total	96	171	267		
Modified Mallampati Test	Difficult	72	49	121	0.44**	0.000
	Easy	24	122	146		
	Total	96	171	267		
Head extension angle in degrees	Difficult	8	0	8	0.09**	0.000
	Easy	88	171	259		
	Total	96	171	267		
Thyromental Distance in CM	Difficult	19	9	28	0.18**	0.000
	Easy	76	163	239		
	Total	95	172	267		

**Table 5** shows predictive power of commonly used indices in their ability to predict difficult laryngoscopy in diabetic patient

	Sensitivity	Specificity	False Negative	False positive	Positive Predictive value	Negative Predictive value	Positive Likelihood ratio	Negative Likelihood ratio	Accuracy
Palm Print	83.33	91.2	84.21	15	84.21	90.69	9.5	0.6	88.38
Modified Mallampati Test:	75.8	71.3	24.2	28.7	59.5	84.1	2.6	0.3	72.9
Head extension angle in degrees	7.4	100.0	92.6	0.0	100.0	66.0		0.9	66.9
Thyromental Distance in CM	20.0	95.3	80.0	4.7	70.4	68.2	4.3	0.8	68.4

## Discussion

Preoperative identification of patients at risk of difficult laryngoscopy is crucial in planning an appropriate strategy for the induction of anaesthesia and intubation. Diabetes is the most common endocrine disorder anaesthesiologist encounters. Limited joint syndrome is a long term complication of diabetes mellitus with a incidence of 8-58%. The changes in the LJM syndrome usually starts in the metacarpophalangeal and proximal interphalangeal joints of the fifth finger and extend laterally. Patient has difficulty approximating the palm and fingers of the hands<sup>6</sup>. This study was designed to compare the sensitivity and specificity of the palm print test with the commonly used indices (Modified Mallampati test, Head extension angle, Thyromental Distance) in their ability to predict difficult laryngoscopy in diabetic patients.

A 2003 prospective study by Erdenetal showed a statistically significant increase in difficult laryngoscopy (18.75% vs 2.5%) in type 2 diabetics vs non diabetics<sup>(2)</sup>. According to Reissellet al, glycosylation of the joints of the larynx and cervical vertebral region may be responsible for the increased incidence of difficult intubation.<sup>12</sup> The joint limitation is painless and non disabling. No relationship is found between the LJM syndrome and sex, race, or control of diabetes. The duration of diabetes and age attained are found to be important variables in development of the LJM syndrome.<sup>14</sup> However in the study by K V Hashim and Mary Thomas, out of 60 patients, fifteen had PP grade 2 or 3. Out of 13 difficult laryngoscopies 10 had PP grade 2 or 3. In our study out of 96 difficult laryngoscopies, 95 had PP grade 2<sup>4</sup>. Nadal et al., found that duration of diabetes more than ten years was a sensitive indicator of difficult laryngoscopy<sup>(13)</sup> Vani et al, in a similar study put in that the mean duration of diabetes and incidence of difficult intubation was 5.3 years and 16% respectively<sup>7</sup>. However, a mere observation in our study was that there was no significant association between difficult laryngoscopy and duration of diabetes. In Nadal et

al study, PP test was found to be 100% sensitive.<sup>[13]</sup> A PP Grades 2 or 3 was assumed to predict difficult laryngoscopy (CL Grades 3 and 4). Of the total 96 difficult laryngoscopies that we encountered, 95 patients had PP Grades 2. Palmprint score is a highly sensitive tool for prediction of difficult intubation as it is quantitative in nature, and hence the classification of the test is precise with low inter observer variability. Vani et al also concluded that PP was the most sensitive test (75%) followed by head extension (52.5%), Mallampati grade (25%), TMD (90.5%),<sup>7</sup>. However TMD was the most specific (95.2%), followed by Mallampati (90.5%), PP (69%), HE (61.9%). This study may be criticized for eliminating from the subject group diabetic patients with history of difficult laryngoscopies and intubation during prior surgical anesthetics. This may have decreased the positive predictive value and increased the sensitivities of all tests if it was assumed that all 4 airway examinations in these patients would have been of a "difficult" grade. Since our objective was to compare the specificity, positive predictive value, and sensitivity of these indices, we feel, that this did not adversely affect the main findings. These patients were eliminated from the study because ethical concerns demanded that the clinician performing direct laryngoscopy be aware of the prior history. We used laryngoscopy view as a measure to reflect difficult intubation. The incidence of difficult laryngoscopy among all patients presenting for surgical anesthesia is 1-5.9%<sup>11,15</sup> though the incidence of difficult and failed intubation has been reported to be 1-3.6% and 0.05-0.3%, respectively. Although difficult laryngoscopy does not mirror difficult intubation, (ETT may be placed into the trachea without adequate visualization of the glottis), laryngoscopic view has proven to be a universally accepted method of comparing techniques of airway evaluation<sup>(11)</sup>.

In contrast to previous authors, Mallampati classification can be taken as a sensitive index for predicting difficult airway in diabetics<sup>8</sup>. The



sensitivity of the graded palm print index shows the value of applying evaluation indices to distinct populations. It is possible that the other commonly used indices of airway evaluation may have improved sensitivity and specificity when applied to distinct groups of patients as each may measure a distinct anatomical entity (or compilation of entities) which is responsible for the difficulty. Although a false positive airway evaluation test result may lead to over-preparation of personnel, supplies and equipment, with the patient undergoing unnecessary procedures, it is preferable to a false-negative prediction which may end in a disastrous consequences, especially in diabetic patients where gastric motor dysfunction, residual gastric contents, and hyperacidity raise the risk for pulmonary aspiration<sup>(9,10)</sup> False positive findings are acceptable as long as tests achieve high sensitivity and aid in reducing morbidity. This is especially applicable when equipment and personnel may be scarce (e.g., at night), and advance preparation and securing of equipment may be the only alternative in safe intubation.

### Conclusion

The study showed that palmprint sign has the highest level of Accuracy, Sensitivity, Specificity, and Positive Predictive Value (PPV) compared with other airway indices. Thus the palmprint test is highly sensitive and specific tool in the prediction of difficult laryngoscopy among diabetics. It is a useful bedside test due to its simplicity and can be used alone or in combination with other tests for prediction of difficult airway in diabetics.

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