International Journal of M edicine Research
ISSN: 2455-7404; Impact Factor: RJIF 5.42
Received: 17-05-2019; Accepted: 19-06-2019
www.medicinesjournal.com
Volume 4; Issue 3; July 2019; Page No. 104-107

Sensitivity of palm print sign in prediction of difficult laryngoscopy in diabetic patients: A comparison with other airway indices

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Abstract

Background: Patients with diabetes mellitus may have limitation in joint mobility due to non–enzymatic glycosylation of collagen and its deposition in the joints. From "Palm Print Sign", we can assess the degree of inter-phalangeal joint involvement. The purpose of this study is to compare and evaluate sensitivity & specificity of palm print sign & commonly used airway indices to predict difficult laryngoscopy and therefore difficult intubation in diabetic patients and if there is an association between duration of diabetes mellitus & difficult laryngoscopy.

Methods: Airway of 60 adult diabetic patients, undergoing elective surgery under general anaesthesia was assessed pre-operatively using Modified Mallampati test (MMT), Thyromental distance (TMD), Degree of head extension (HE) & Palm print sign (PP). Comparison of these data with Cormack-Lehane score at the time of laryngoscopy were done to decide the accuracy of these tests in predicting difficulty in intubation.

Results: In our study, Palm Print Sign was most specific among 4 indices to predict difficult laryngoscopy. It has highest positive predictive value, which is very important as it is the percentage of correctly predicted difficult intubations as a proportion of all predicted difficult intubations.

Conclusion: Though all the tests have their place in armamentarium of the anaesthesiologist, palm print is the best single predictor of a difficult laryngoscopy and intubation, with highest positive predictive value and is most specific.

Keywords: degree of head extension (HE), modified mallampati test (MMT), palm print sign (PP), thyromental distance (TMD)

Introduction

The fundamental responsibility of an anaesthesiologist is to maintain adequate gas exchange. In order to do this, airway must be secured and managed in such a way that it remains continuously patent. An intubation is defined difficult if a conventionally trained anaesthesiologist needs more than ten minutes or more than three attempts for a successful endotracheal intubation [1]. The criteria for anticipation of difficult intubation are: noting tracheal anatomy, head & neck movement, temporomandibular joint function, mouth opening etc. and various clinical indices have been used like Mallampati test, Thyromental distance, Degree of head extension, etc [2, 3, 4] to predict it pre operatively. In diabetic patients, reported incidence of difficult intubation is 27-31% due to 'Limited Joint Mobility Syndrome'(LJMS) [5, 6, 7]. LJMS occurs due to non – enzymatic glycosylation of collagen and its deposition in the joints [5, 8]. In such patients, involvement of atlanto-occipital joint hampers adequate extension of head & neck during laryngoscopy, which may cause difficult intubation [6, 8, 9]. Starting of these changes occur in interphalangeal joints of 4th & 5th fingers. Involvement of interphalangeal joint can be assessed by "Palm Print Sign". PP sign is scoring the ink impression made by the palm of dominant hand on blank white paper [5, 7]. In our study, comparison & evaluation of sensitivity & specificity of PP sign with commonly used airway indices were done to predict difficult laryngoscopy in diabetic patients.

Methods

This study comprised 60 adult diabetic patients, scheduled to undergo elective surgery under general anaesthesia. Patients with congenital syndrome related to airway anomaly, history of difficult intubation or hand deformity due to injury & ASA grade above II were excluded from our study. Preoperative airway assessment in all patients was performed by another anaesthesiologist who was not involved in the research project to avoid inter-observer variability.

Four methods were used to predict difficult intubation.

i) Modified Mallampati test

Each patient was asked to protrude the tongue by opening his/her mouth maximum. Pharyngeal structures were inspected with a torch without patient phonating while seating at patient's eye level and graded as

Grade I: soft palate, uvula, fauces & pillars visible

Grade II: pillars obscured while soft palate, uvula, fauces visible

Grade III: only soft palate and base of uvula visible

Grade IV: even soft palate not visible

ii) Thyromental distance
While fully extending the neck from neutral position, measurement of the distance from the mentum to the thyroid notch with a measuring scale was done and graded as
Grade 0: ≥6cm
Grade I: <6cm

iii) Degree of head extension
Patient was asked to keep the head in neutral position & the line joining the mentum to the angle of mandible parallel to the floor & then to maximally extend the head on the neck. The angle traversed by mento mandibular line was measured using the protractor compass and graded as
Grade 0: $\geq 35^0$ degree
Grade I: $<35^0$ degree

iv) Palm print sign
The palm & fingers of the dominant hand were painted using pad & brush soaked in blue ink. Patients were instructed to let the painted hand rest on the plain white paper by its own weight. Grades are
Grade 0: All phalanges visible
Grade I: Interphalangeal area of $4^{th}/5^{th}$ digit not visible
Grade II: interphalangeal area of 2^{nd} to 5^{th} digit not visible
Grade III: Only tips of digits visible

Informed and written consent was taken
In operation theatre, IV line was secured. Monitors like ECG, NIBP & pulse oximeter probe were applied. All necessary instruments required for intubation were kept ready before induction of anaesthesia.

In cases who were predicted as difficult airway, difficult airway cart was kept ready
After premedication with glycopyrrolate (4µg/kg), ondansetron (4mg) & fentanyl (2µg/kg), the induction was done with i.v. thiopentone sodium (6mg/kg) & succinylcholine (2mg/kg) to facilitate tracheal intubation. After obtaining complete muscle relaxation, laryngoscopy and intubation was carried out by consultant. View obtained at laryngoscopy was observed & recorded according to Cormack-Lehane score. After fixation of tube & confirming bilateral air entry, anaesthesia was maintained as required for concerned patient. Patients were observed post-operatively for any complaints regarding extubation like sore throat, hoarseness of voice or bleeding.
Using pre-operative assessment data and laryngoscopy findings, the accuracy of the tests in predicting difficult intubation was determined. True positive, false positive, true negative & false negative as well as sensitivity, specificity, positive predictive value & negative predictive value of each method of airway assessment were calculated using standard formula.
True positive = a difficult intubation that had been predicted to be difficult.
False positive = an easy intubation that had been predicted to be difficult.
True negative = an easy intubation that had been predicted to be easy.
False negative = a difficult intubation that had been predicted to be easy.
Sensitivity = the percentage of correctly predicted difficult intubations as a proportion of all intubations that were truly difficult, i.e.,

$$\frac{\text{True positives}}{\text{True positives + False negatives}}$$

Specificity = the percentage of correctly predicted easy intubations as a proportion of all intubations that were truly easy, i.e.,

$$\frac{\text{True negatives}}{\text{True negatives + False positives}}$$

Positive predictive value = the percentage of correctly predicted difficult intubations as a proportion of all predicted difficult intubations, i.e.,

$$\frac{\text{True positives}}{\text{True positives + False positives}}$$

Negative predictive value = the percentage of correctly predicted easy intubations as a proportion of all predicted easy intubations, i.e.,

$$\frac{\text{True positives}}{\text{True positives + False positives}}$$

Results
In this study, total 60 diabetic patients of either sex undergoing elective surgery under general anaesthesia with endotracheal intubation were included.

Table 1: Shows relation between duration of diabetes and laryngoscopy grading.

Duration of diabetes (years)	No. of patients & Laryngoscopy grading		Total	P value
	Easy (I & II)	Difficult (III & IV)		
<10	18 (45%)	8 (40%)	26(43.3%)	0.71
≥10	22 (55%)	12(60%)	34(56.7%)	
Total	40	20	60	

These results show that there is no significant correlation between duration of diabetes and difficult intubation in our study.

Table 2: Modified Mallampati test versus Laryngoscopy grading

Cormack-Lehane grade	Modified Mallampati grade				Total
	I	II	III	IV	
Easy (I & II)	20(95.2%)	18 (75%)	2 (15.4%)	0	40(66.7%)
Difficult (III & IV)	1 (4.8%)	6 (25%)	11 (84.6%)	2 (100%)	20(33.3%)
Total	21	24	13	2	60

Modified Mallampati test had sensitivity of 65% and specificity of 95%.
It has positive predictive value of 86.6%.

Table 3: Thyromental distance test versus Laryngoscopy grading

Cormack-Lehane grade	Thyromental distance grade		Total
	0	I	
Easy (I & II)	35 (89.7%)	5 (23.8%)	40 (66.7%)
Difficult (III & IV)	4 (10.3%)	16 (76.2%)	20 (33.3%)
Total	39	21	60

Thyromental distance test had sensitivity of 80% and specificity of 87.5%.
It has positive predictive value of 76.10%.

Table 4: Degree of head extension versus Laryngoscopy grading

Cormack-Lehane grade	Head extension grade		Total
	0	I	
Easy (I & II)	36 (85.7%)	4 (22.2%)	40 (66.7%)
Difficult (III & IV)	6 (14.3%)	14 (77.8%)	20 (33.3%)
Total	42	18	60

Degree of head extension had sensitivity of 70% and specificity of 90%.
It has positive predictive value of 77.7%.

Table 5: Palm print sign versus Laryngoscopy grading

Cormack-Lehane grade	Palm print sign				Total
	0	I	II	III	
Easy (I & II)	22(91.7%)	17(81%)	1 10%)	0	40(66.7%)
Difficult (III & IV)	2 (8.3%)	4 (19%)	9(90%)	5100%)	20(33.3%)
Total	24	21	10	5	60

Palm print sisgn had sensitivity of 70% and highest specificity of 97.5%.
It has highest positive predictive value 93.3%.

Discussion

DM is the commonest endocrine disorders, the anaesthesiologist encounters [10]. Diabetic patients are said to be difficult to intubate due to LJMS. LJMS usually start in the metacarpo-phalangeal and proximal interphalangeal joints of the fifth finger. In diabetic patients there is an abnormality of collagen metabolism. It causes increased cross-link formation. These abnormally stable collagen fibrils are relatively insoluble and resistant to enzymatic degradation [7, 11]. These changes are usually irreversible. Glycosylation of the larynx and cervical vertebral region may be responsible for the increased incidence of difficult intubation as pondered by Reissell *et al*. [7].

In our study, diabetic patients undergoing general anaesthesia with intubation, palm print test was evaluated in an effort to predict difficult laryngoscopy and compared with modified Mallampati test, thyromental distance and head extension. To determine sensitivity, specificity, positive predictive value and negative predictive value of each test, the pre-operative criteria and intubation findings at the time of laryngoscopy (grade I to IV as Cormack-Lehane) were used.

Nadal *et al*. [5] In a similar study found PP grade 2 or 3 was presumed to predict difficult laryngoscopy and thus PP test to be most sensitive among all. Hashim and Mary Thomas [12] reflected from their study that the PP test had 89.4% specificity and 76.9% sensitivity in the prediction of difficult laryngoscopy in diabetic patients. In our study of 60 patients, we encountered PP test grade 2 or 3 in 15 patients from 20 difficult laryngoscopies and 14 patients among them had difficult laryngoscopy (sensitivity of PP test is 70% and specificity is 97.5%). Thus, our study supports the study of both researchers. Vani *et al*, [10] in a similar study found that PP was the most sensitive test (75%), followed by HE (62.5%), MMT (25%) and TMD (25%). Shiga *et al*. [13] In his meta-analysis & Vani *et al*. [10] showed that specificity & sensitivity of each test in prediction of difficult intubation is not ideal, but if we use these tests together, they offer a better prediction of difficult laryngoscopy.

In our study of comparison of 4 indices with respect to their ability to predict difficult laryngoscopy, palm print sign was the most specific (97.5%) of all. MMT grade had sensitivity of 65% & specificity of 95%, which supports study of above authors. HE had sensitivity of 70% & specificity of 90%, while TMD had sensitivity of 80% & specificity of 87.5%, which is turned to be most sensitive. PP sign has highest positive predictive value (93.3%), which is very important as it is the percentage of correctly predicted difficult intubations as a proportion of all predicted difficult intubations. Pre-operative identification of difficult airway is important in diabetics as they are at risk of aspiration. Rapid securing of the airway at the induction of the anaesthesia is essential in these patients. So, use of palm print sign should aid the anaesthesiologist to anticipate difficult laryngoscopy in diabetic patient.

Conclusion

High sensitivity & specificity, high positive predictive value & have minimal false positive & false negative predictions are the ideal method for pre-operative airway assessment. In our study, palm print sign has highest specificity of 97.5% while thyromental distance test has highest sensitivity of 80%. Palm print sign has highest positive predictive value (93.5%).

Though all the tests have their place in the armamentarium of the anaesthesiologist, palm print is the best single predictor of a difficult intubation.

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