

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

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ABSTRACT

BACKGROUND

The aim of this study is to evaluate the various clinical parameters of airway assessment and their ability to predict difficult laryngoscopy and intubation in diabetic patients as compared to nondiabetic patients.

MATERIALS AND METHODS

Out of 120 patients, 60 diabetics (group-D) and 60 nondiabetics (group-N) were studied preoperatively for various airway indices such as the modified Mallampati Test (MPC), Thyromental Distance (TMD), Degree of Head Extension (HE), the Palm Print Index (PP) and the Prayer Sign (PS) and their corresponding Cormack-Lehane scores (CL) were noted. The two groups were studied using chi-square tests. $p < 0.05$ was considered statistically significant.

RESULTS

The incidence of difficult laryngoscopy as indicated by CL grade III and IV in diabetic patients was 43.33%, while that in the nondiabetic group was 20%. In diabetics group, MPC as a predictor was more sensitive (80.77%) while PP index was more specific (97.06%). PP index also had maximum positive predictive value and odds ratio.

In nondiabetic group, MPC had maximum sensitivity (75.00%) while PP index, PS and TMD were showed equal specificity (95.83%).

CONCLUSION

MPC as a predictor was more sensitive in both groups while PP index was more specific in group D.

KEYWORDS

Diabetics, Airway Indices, Difficult Laryngoscopy, Limited Joint Mobility Syndrome (LJMS).

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BACKGROUND

It has been estimated that inability to successfully manage difficult airway has been responsible for as many as 30% of deaths attributable to anaesthesia.^{1,2} The incidence of difficult and failed intubation has been reported to be 1-3.6% and 0.05-0.3%, respectively.³

To anticipate difficult airway preoperatively, many clinical indices have been devised, the commonly used ones being the MPC test, TMD and HE. Unfortunately, most of these have low sensitivity and specificity. By examining features specific to a subpopulation of patients, improved sensitivity of the test maybe achieved.

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Diabetes mellitus is the most common endocrine disorder encountered and almost 50 percent of diabetic patients undergo surgery for various reasons during their life period.⁴

The incidence of difficult intubation in diabetic patients is said to be higher than in the normal population, the reported incidence being 27 to 31%.^{4,5,6} This is due to nonenzymatic glycosylation of collagen and its deposition in joints resulting in Limited Joint Mobility Syndrome (LJMS). It occurs in 25 to 45% of patients with long-standing diabetes mellitus due to involvement of atlanto-occipital joint, which limits adequate extension of head and neck during laryngoscopy leading to difficult intubation.^{3,7}

Since, diabetic patients form a major percentage of the population and since the incidence of difficult intubation is considered as high in these patients, it is in order that a thorough airway assessment be performed in diabetic patients and its implication be studied with respect to difficulty in intubating the trachea.

Here, we undertake the study to evaluate the various clinical parameters of airway assessment and their ability to predict difficult laryngoscopy and intubation in diabetic patients as compared to nondiabetic patients.

MATERIALS AND METHODS

After the approval of Institutional Ethics Committee, this prospective observational study was conducted in two groups of patients; group D diabetic patients (n=60) and group N nondiabetic patients (n=60).

Inclusion Criteria

- Patient giving valid consent.
- Patients with age 35 years and above of either sex, with or without diabetes mellitus posted for surgery under general anaesthesia requiring endotracheal intubation.

Exclusion Criteria

- 1) Obvious anatomical deformity (congenital, traumatic, postsurgical origin) of face, neck, palate and hands.
- 2) Coexisting factors like rheumatoid arthritis, large thyroid, airway trauma.
- 3) Emergency surgeries.

A thorough airway assessment was done in sitting position and the various airway indices were MPC and mouth opening, HE, TMD, PP index and PS.

The intubation was predicted to be difficult when MPC class III and above, TMD class II, HE class III and above, PP grade III and above, PS positive or negative.

Patient's trachea was intubated with appropriate size of endotracheal tube and correct placement of tube confirmed by auscultation of chest and capnography. In case of difficulty, manoeuvres and gadgets like use of External Laryngeal Manipulations (ELM), change in position of head, use of different size and type of laryngoscope blade, intubating bougie, intubation by a more experienced anaesthesiologist was done. Following factors were noted. CL grade, need for ELM, change in position of head, use of intubation assist devices like bougie or different technique, time required for intubation, number of attempts at laryngoscopies, number of operators. Complications if any were noted as follows; desaturation, hypertension/hypotension, arrhythmias, airway injuries.

RESULTS

A total 120 patients were studied out of 60 diabetes (group-D) and 60 nondiabetics (group-N). 63.3% of the patients were male in diabetic group, which was comparable to 55% among nondiabetic group. Patients was ranging from 36-94 years with average age of 53.38 years in diabetic group, which was comparable to 50.05 years in nondiabetic group. Mean duration of diabetes was 7.24 years.

Duration of diabetes showed strong correlation with difficult laryngoscopy as measured by CL grading 18 (66.7%) diabetes patients with duration more than 10 years, had difficult intubation, whereas 25 (75.8%) patients of diabetes less than 10 years had easy laryngoscopy as per CL grading (Table 1).

Duration of Diabetic (year)		Cormack Lehane Difficult Laryngoscopy		Total
		CL III and IV	CL I and II	
≥10	No.	18	9	27
	%	66.7%	33.3%	100.0%
<10	No.	8	25	33
	%	24.2%	75.8%	100.0%
Total	No.	26	34	60
	%	43.3%	56.7%	100.0%
Pearson Chi-Square	10.884	1	0.00097	Significant

Table 1. Duration of Diabetes and CL Difficult Laryngoscopy

26 (43.3%) patients in diabetes group had CL III or IV as compared to only 12 (20.0%) in nondiabetic group (Table 2).

CL III and IV indicates difficult laryngoscopic view indicating that diabetic patients are more likely to have difficult intubation.

Cormack Lehane Difficult Laryngoscopy	Group			Total
		D	N	
CL III and IV	No.	26	12	38
	%	43.3%	20.0%	31.7%
CL I and II	No.	34	48	82
	%	56.7%	80.0%	68.3%
Total	No.	60	60	120
	%	100.0%	100.0%	100.0%
Pearson Chi-Square	7.548	1	0.00601	Significant

Table 2. Cormack Lehane Difficult Laryngoscopy Between D and N

The total number of five airway predictors were evaluated preoperatively in both groups to predict difficult laryngoscopy. The grading of laryngoscopic view on the basis of CL grading for MPC (Table 3), HE (Table 4), TMD (Table 5), PP (Table 6), PS (Table 7) were given in respective table for both groups. Statistical analysis done with chi-square test shows in group-D PP, PS and HE and in group-N MPC, TMD, PS had significant association with difficult laryngoscopy (P <0.05).

Sensitivity, specificity, the positive and negative predictive values and odds ratio (OR) in both the diabetic and nondiabetic group was calculated for each airway predictors (Table 8).

In diabetes patients, MPC had 80.77% sensitivity followed by PS, HE and PP index. Most of the tests showed high specificity, the highest specificity being for palm print (97.06%). The PPV and OR also show high value for PP index.

MPC Grade		Cormack Lehane Difficult Laryngoscopy for D		Total	Cormack Lehane Difficult Laryngoscopy For N		Total
		CL III and IV	CL I and II		CL III and IV	CL I and II	
MPC III and IV	No.	21	20	41	9	5	14
	%	51.22%	48.78%	100%	64.28%	35.72%	100.0%
MPC I and II	No.	5	14	19	3	43	46
	%	26.32%	73.68%	100%	6.52%	93.48%	100.0%
Total	No.	26	34	60	12	48	60
	%	43.33%	56.67%	100.0%	20.0%	80.0%	100.0%
Pearson Chi-Square	2.343	0.070	Not significant	Pearson Chi-Square	22.384	0.0001	Significant

Table 3. Correlation Between MPC and CL Grading Between D and N Group

Neck Movements (HE)- Grade		Cormack Lehane Difficult Laryngoscopy for D		Total	Cormack Lehane Difficult Laryngoscopy For N		Total
		CL III and IV	CL I and II		CL III and IV	CL I and II	
Neck movements (HE) III and IV	No.	15	6	21	1	3	4
	%	71.42%	28.58%	100%	25%	75%	100%
Neck movements (HE) I and II	No.	11	28	39	11	45	56
	%	28.20%	71.80%	100%	19.64%	80.36%	100%
Total	No.	26	34	60	12	48	60
	%	43.33%	56.67%	100.0%	20.0%	80.0%	100.0%
Pearson Chi-Square	10.385	0.0013	Significant	Pearson Chi-Square	0.067	0.7958	Non-Significant

Table 4. Correlation Between HE and CL Grading Between D and N Groups

TMD Grade		Cormack Lehane Difficult Laryngoscopy for D		Total	Cormack Lehane Difficult Laryngoscopy For N		Total
		CL III and IV	CL I and II		CL III and IV	CL I and II	
TMD II (<6 CM)	No.	6	4	10	3	2	5
	%	60.00%	40.00%	100%	60%	40%	100%
TMD I (>6 CM)	No.	20	30	50	9	46	55
	%	40.0%	60.0%	100%	16.36%	83.64%	100%
Total	No.	26	34	60	12	48	60
	%	43.33%	56.67%	100.0%	20%	80.0%	100.0%
Pearson Chi-Square	1.357	0.244	Not significant	Pearson Chi-Square	5.455	0.01952	Significant

Table 5. Correlation Between TMD and CL Grading Between D and N Groups

Palm Print Grade		Cormack Lehane Difficult Laryngoscopy for D		Total	Cormack Lehane Difficult Laryngoscopy For N		Total
		CL III and IV	CL I and II		CL III and IV	CL I and II	
Palm print III and IV	No.	15	1	16	2	2	4
	%	93.75%	6.25%	100%	50%	50%	100%
Palm print I and II	No.	11	33	44	10	46	56
	%	25%	75%	100%	17.86%	82.14%	100%
Total	No.	26	34	60	12	48	60
	%	43.33%	56.67%	100.0%	20.0%	80.0%	100.0%
Pearson Chi-Square	22.585	0.0001	Significant	Pearson Chi-Square	2.411	0.121	Not Significant

Table 6. Correlation Between Palm Print and CL Grading Between D and N Groups

Prayer Sign		Cormack Lehane Difficult Laryngoscopy for D		Total	Cormack Lehane Difficult Laryngoscopy For N		Total
		CL III and IV	CL I and II		CL III and IV	CL I and II	
Prayer Sign + (positive)	No.	20	4	24	4	2	6
	%	83.33%	16.67%	100.0%	66.67%	33.33%	100.0%
Prayer Sign - (negative)	No.	6	30	36	8	46	54
	%	16.67%	83.33%	100.0%	14.81%	85.19%	100.0%
Total	No.	26	34	60	12	48	60
	%	43.33%	56.67.0%	100.0%	20.0%	80.0%	100.0%
Pearson Chi-Square	26.063	0.0001	Significant	Pearson Chi-Square	9.074	0.00259	Significant

Table 7. Correlation Between Prayer Sign and CL Grading Between D and N Groups

Diabetic Patients						Nondiabetic Patients				
	SEN	SPE	PPV	NPV	OR	SEN	SPE	PPV	NPV	OR
MPC	80.77%	41.18%	51.22%	73.68%	2.940	75.00%	89.58%	64.29%	93.48%	25.800
HE	57.70%	82.35%	71.43%	71.79%	6.3636	8.33%	93.75%	25.00%	80.36%	1.3636
TMD	23.08%	88.24%	60.00%	60.00%	2.250	25.00%	95.83%	60.00%	83.64%	7.667
PP	57.70%	97.06%	93.75%	75.00%	45.000	16.67%	95.83%	50.00%	82.14%	36.668
PS	76.92%	88.24%	83.33%	83.33%	25.000	33.33%	95.83%	66.67%	85.19%	11.500

Table 8. Sensitivity, Specificity, PPV, NPV and OR between D and N

DISCUSSION

Preoperative identification of those patients at risk of difficult laryngoscopy assumes importance in order to formulate an appropriate strategy for the induction of anaesthesia and intubation.

The present prospective comparative study aims to evaluate the airway of diabetic patients requiring general anaesthesia with endotracheal intubation with respect to predictability of difficult intubation, assessment of intubation, finding incidence of difficult intubation in diabetic patients and complications if any. Similar assessment was done in nondiabetic patients also. The predictors of difficult laryngoscopy analysed were MPC, TMD, HE, PP index and PS. Both our groups were comparable demographically.

The duration of diabetes and age attained are said to be important variables in development of the LJM syndrome.⁸ In our study, duration of diabetes showed strong correlation with difficult laryngoscopy as measured by CL grading (Table 1, $P=0.00097$). The mean duration of diabetes in our study was 7.24 years. The incidence of difficult laryngoscopy in our study was 43.3%, while the incidence in nondiabetic patients was 20% (Table 2, P value 0.00601).

The results were compared with other study as follows in a study by Hashim and Thomas et al,⁹ total 60 diabetic patients were studied. The mean age of the study population was 56.3 years. The incidence of difficult laryngoscopy was 21.7%. The mean duration of diabetes was 6.7 years. In the study by Nadal et al,³ duration of diabetes more than 10 years was found to be a sensitive indicator of difficult laryngoscopy. Only two patients with duration less than 10 years had difficult laryngoscopy.

Vani et al¹⁰ in a similar study found that the mean duration of diabetes and incidence of difficult intubation was 5.3 years and 16%, respectively.

The limitation in our study was that laryngoscopic view was used to evaluate the airway indices. Although, difficult laryngoscopy does not mirror difficult intubation. Laryngoscopic view is an accepted method of comparing airway evaluation indices.¹¹ It provides a more objective grading of difficult laryngoscopy without any ambiguity.

Studies by Hogan et al,⁹ Reissell et al,⁶ Nadal et al,³ Vani et al¹⁰ and Hashim and Thomas et al⁹ have reported 32%, 31%, 27%, 16% and 27.1% incidence of difficult laryngoscopy respectively in diabetic patients.

Thus, in our study, MPC, HE, palm print and prayers sign, which are predictors of difficult intubation showed significant difference between the diabetic and nondiabetic population. The correlation between prediction and actual difficult laryngoscopy was seen with HE, palm print and prayer sign.

Similar to our study, Hashim et al⁹ also had similar results where most of the predictors of difficult intubation failed to show significant association with actual difficult intubation except the palm print index, which was highly significant ($P=0.00$).

Russel et al⁶ in 1990 concluded that the higher the palm print score, the more difficult was the laryngoscopy ($p<0.001$).

We computed sensitivity, specificity, the positive and the negative predictive value and the odds ratio (Table 8).

In our study, in diabetic group, MPC was the most sensitive test and identified 21 out of 26 patients with difficult laryngoscopy (80.77%). Prayer's sign was next sensitive test identified 20 difficult laryngoscopies out of 26 (76.92%). Palm print and head extension are equally sensitive in identifying difficult laryngoscopy (57.70). TMD was least sensitive.

In our study, PP index was the most specific test that identified 33 out of 34 non-difficult laryngoscopies

(97.06%), which means that a negative PP test will almost certainly rule out a difficult intubation. Prayer's sign was also specific (88.24%) and identified 30 out of 34 nondifficult laryngoscopies. MPC is least specific test identified in diabetic group identified 14 (34) nondifficult laryngoscopies.

In our study, PP index showed the highest PPV of (93.75%), while the least value was MPC (51.22%).

PS had highest NPV (83.33%) followed by that of PP index. PP index had the highest odds ratio (45.00) in diabetic group.

In our study, in nondiabetic group, MPC was most sensitive test that identified 9 difficult laryngoscopies out of 12 and PS could identify difficult laryngoscopy in 7 out of 12 patients and 4 out of 12 patients, respectively. Next, sensitive test is PP index, identified 2 out of 12 difficult laryngoscopies, HE is least sensitive identified 1 out of 12 difficult laryngoscopies. Most of the tests were more specific that is sensitive in case of nondiabetics. The PP index, PS and TMD have equal specificity in identifying nondifficult laryngoscopies in non-diabetics. MPC was relatively less specific.

We compared our results with other studies. Hashim and Thomas et al⁹ had found that PP index was the most significant in predicting difficult laryngoscopy ($P=0.000$) with highest sensitivity (76.9%) and specificity of (89.3%). The PS was the next most sensitive (61.5%), but not statistically significant. The MPC grade was found to have no significance in predicting difficult intubation. HE was also insensitive, but TMD was the least sensitive airway index in predicting difficult laryngoscopy.

In the study by George and Jacob,¹² it was found that the PP test was most sensitive (76.7%) and most specific (89.3%). The MMP test was the next sensitive (56%) followed by prayer sign (54.5%) and HE (50%). TMD had a sensitivity of 0. Following PP, MMP test was next specific (61.9%) followed by prayer sign (52.5%) and HE (48.8%). Body mass index was the most sensitive index in obese nondiabetics in predicting difficult airway, but PP sign was most significant in diabetics.

Vani et al¹⁰ in a similar study found that PP was the most sensitive test (75%) followed by HE (62.5%), MMP (25%) and TMD (90.5%). However, TMD was most specific (95.2%) followed by MMP (90.5%), PP (69%) and HE (61.9%).

Nadal et al³ in a similar study found the PP test to be 100% sensitive.

CONCLUSION

MPC, HE, palm print index and prayer sign strongly predicted difficult intubation in diabetic patients. HE palm print index and prayers sign showed strong correlation with difficult intubation as indicated by CL grade III and IV. MPC was the most sensitive and PP index was the most specific predictor

in diabetic group. PP index also had maximum positive predictive value and odds ratio. Incidence of difficult laryngoscopy in diabetes patients was more as compared to nondiabetic patients. The use of assisted intubation was more in diabetic patients and they also required more number of attempts. There were no complications observed in both groups.

REFERENCES

- [1] Bellhouse CP, Dore C. Criteria for estimating likelihood of difficulty of endotracheal intubation with the Macintosh laryngoscope. *Anaesth Intensive Care* 1988;16(3):329-337.
- [2] Benumof JL. Management of the difficult adult airway: with special emphasis on awake tracheal intubation. *Anesthesiology* 1991;75(6):1087-1110.
- [3] Nadal JL, Fernandez BG, Escobar IC, et al. The palm print as a sensitive predictor of difficult laryngoscopy in diabetics. *Acta Anaesthesiol Scand* 1998;42(2):199-203.
- [4] Jonasson O. Surgical aspects of diabetes mellitus. In: Sabiston CD, ed. *Sabiston textbook of surgery: the biological basis of modern surgical practice*. 13th edn. Philadelphia: WB Saunders 1997:p. 183.
- [5] Hogan K, Rusy D, Springman SR. Difficult laryngoscopy and diabetes mellitus. *Anesth Analg* 1988;67(12):1162-1165.
- [6] Reissell E, Orko R, Maunuksela EL, et al. Predictability of difficult laryngoscopy in patients with long-term diabetes mellitus. *Anaesthesia* 1990;45(12):1024-1027.
- [7] Salzarulo HH, Taylor LA. Diabetic stiff joint syndrome as a cause of difficult endotracheal intubation. *Anesthesiology* 1986;64(3):366-368.
- [8] Fitzcharles MA, Doby S, Waddell RW, et al. Limitation of joint mobility (cheiroarthropathy) in adult non-insulin dependent diabetic patients. *Ann Rheum Dis* 1984;43(2):251-254.
- [9] Hashim KV, Thomas M. Sensitivity of palm print sign in prediction of difficult laryngoscopy in diabetes: a comparison with other airway indices. *Indian J Anaesth* 2014;58(3):298-302.
- [10] Vani V, Kamath SK, Naik LD. The palm print as a sensitive predictor of difficult laryngoscopy in diabetics: a comparison with other airway evaluation indices. *J Postgrad Med* 2000;46(2):75-79.
- [11] Caplan RA, Posner KL, Ward RJ, et al. Adverse respiratory events in anesthesia: a closed claims analysis. *Anesthesiology* 1990;72(5):828-833.
- [12] George SP, Jacob R. Predictability of airway evaluation indices in diabetic patients. *Indian J Anaesth* 2003;47(6):476-478.