Section: Anesthesiology

Original Research Article

A PROSPECTIVE OBSERVATIONAL STUDY TO CORRELATE BETWEEN THE LEMON SCORE AND INTUBATION DIFFICULTY SCALE IN ELECTIVE SURGERY PATIENT UNDERGOING GENERAL ANESTHESIA

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Abstract

Background: Endotracheal intubation is an integral part of airway management under general anaesthesia. Prediction of a difficult airway can help reduce the incidence of failed or difficult intubations. This study aimed to determine the ability of the LEMON scoring system to predict difficult intubations. **Materials and Methods:** This prospective observational study was conducted on 33 patients in the Department of Anesthesiology, SRM Medical College Hospital and Research Centre, Kancheepuram for one year and six months. Patients' airways were assessed using the LEMON method. The patient's neck mobility was assessed, and general anaesthesia was administered. Tracheal intubation was performed using a direct laryngoscope and intubation difficulty scores were recorded. Patients were divided into difficult and non-difficult intubation groups based on their IDS scores. **Result:** The modified LEMON score significantly correlated with the IDS score ($p < 0.001$). The difficult intubation group had higher modified LEMON scores than the non-difficult intubation group. This difference was statistically significant, and obstruction contributed to difficult intubation. We calculated the odds ratio which was 7.5, and showed a positive correlation, suggesting that increased obstruction leads to increased difficulty in intubation. The 95% confidence interval for the odds ratio was 2.1-29.2 which shows a correlation that suggests that increased obstruction leads to an increase in the difficulty of intubation. This was the only independent predictor of difficulty in intubation. **Conclusion:** LEMON score can serve as a valuable tool for predicting intubation difficulty and assisting anaesthesiologists in planning and implementing appropriate airway management strategies.

INTRODUCTION

Predicting difficult intubation is critical for developing a strategy that best facilitates the first attempt at intubation. Complex airway management is a multi-faceted issue. The consequences of failed airway maintenance, endotracheal intubation, or both can result in morbidity or mortality and can be devastating to the patient, physician, and healthcare system. The American Society of Anesthesiologists Task Force on Management of the Difficult Airway defines this as a clinical situation in which a conventionally trained anaesthetist has difficulty with facemask ventilation of the upper airway, tracheal intubation, or both. When a trained anaesthetist is unable to intubate after two optimal attempts, this is referred to as difficult intubation.[1-3] Several serious and fatal complications are associated with difficult intubation, including airway trauma, laryngospasm, hypoxaemia, and arrhythmias/possible cardiac arrest. Therefore, preoperative evaluation and prediction of a potentially difficult airway are critical. Various tests and measurements, including the Mallampati classification and Wilson's mouth opening, have been used to assess the airway and predict difficult intubations. Other factors included a history of difficult intubation, mandibular protrusion, indirect laryngoscopy, dental morphology, and head and neck radiology. However, the accuracy of these tests is likely to vary because of the different testing thresholds and patient characteristics. It has been proposed that the LEMON score should include a combination of the Look, Evaluation, Mallampati, Obstruction, and Neck Mobility tests.[4-6]

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Aim

This study aimed to determine the ability of the LEMON scoring system to predict difficult intubations.

MATERIALS AND METHODS

This prospective observational study was conducted on 33 patients in the Department of Anesthesiology, SRM Medical College Hospital and Research Centre, Kancheepuram for one year and six months. The study was approved by the institutional ethics committee before initiation, and informed consent was obtained from all patients.

Inclusion Criteria

The age group of 20-60 years, ASA grade I or II, both sexes, elective surgery, and patients who consented to participate were included in the study.

Exclusion Criteria

Patient refusal, head injury, low GCS score requiring emergency medical care, and ASA grades III and IV were excluded.

The patient's airway was assessed at a pre-assessment clinic. According to the LEMON method, we look at the patient externally for characteristics that are known to cause difficult laryngoscopy, intubation, or ventilation in the LEMON method. The Look criteria assess the presence of four features (facial trauma, large incisors, beard or moustaches, and large tongue) and evaluate the 3-3-2 rule to assess the alignment of the pharyngeal, laryngeal, and oral axes. The distance between the patient's incisor teeth (at least three finger breadths), distance between the chin and hyoid bone (three finger breadths), and distance between the thyroid notch and floor of the mouth (two fingers). Mallampati Class I: soft palate, uvula, fauces, and pillars visible; Class II: soft palate, uvula, fauces visible; Class III: soft palate, the base of the uvula visible; Class IV, hard palate only visible.

Neck mobility assesses the presence of limited neck mobility or the use of a hard-neck collar immobiliser. The airway assessment score for each predictor was recorded and added to the standard recording sheet. General anaesthesia was administered according to the institution's routine clinical practice. Anaesthesia was induced with propofol (1–2 mg/kg) and maintained with volatile anaesthetics such as sevoflurane or desflurane. fentanyl 2mcg/kg was used as the opioid. A neuromuscular blocking agent (NMBA), vecuronium bromide 0.08 to 0.1 mg/kg was administered to facilitate tracheal intubation.

Initially, tracheal intubation was performed using a direct laryngoscope by an anaesthesia resident. The difficulty of the intubation result was recorded in a standard recorded sheet using the intubation difficulty scale: N1, the number of supplementary intubation attempts; N2, the number of supplementary operators; N3, the number of alternative intubation techniques used; N4, glottis exposure as defined by the Cormack and Lehane grade (grade 1, N4 = 0; grade 2, N4 = 1, grade 3, N4 = 2; grade4, N4 = 3); N5, the lifting force applied during laryngoscopy (N5 = 1 if a subjectively increased lifting force was required); N6, external laryngeal pressure to improve glottis exposure (N6 = 1 if external laryngeal pressure was required); N7, position of the vocal cords at intubation (N7 = 0 if vocal cords in abduction or will not visualise, N7 = 1 if vocal cords were in adduction or blocking the tube passage).

The IDS score was the sum of N1 and N7. An IDS score between 1 and 5 represents slight difficulty, while an IDS score > 5 represents moderate to major difficulty. The patients were divided into a difficult intubation group (group D) and a non-difficult intubation group (group ND) according to an IDS score > 5 or ≤ 5.

Statistical Analysis

Data are presented as mean, standard deviation, frequency, and percentage. Continuous variables were compared using Student's t-test or Mann-Whitney U test. Categorical variables were analysed using the chi-square test, and the Cochran-Armitage test was used for trend analysis. The correlation between the LEMON score and IDS was calculated using Spearman's rank correlation to determine the relationship between one dependent factor and one or more independent factors, and logistic regression analysis was performed. Data are expressed as the mean ± standard deviation, median [interquartile range], or number (%). Statistical significance was set at $P < 0.05$.

RESULTS

The non-difficulty group had 31 patients aged <50 years, 11 patients aged >50 years, 35 patients aged <50 years, and 23 patients aged >50 years. Sex distribution of 47 males and 53 females among the patients in Group ND and 24 males and 33 females in Group D (22 males and 21 females). In weight, the comparison between Group ND 57 (67-49.5) and Group D 58 (65-51). There were no significant differences in age, sex, or weight between groups [Table 1].

Facial trauma, large incisors, beards or moustaches, and large tongues between Group ND and Group D in Group ND were found in only 7, 2, 7, and 6 patients, respectively, and in Group D, 28, 30, 20, and 24. These results show the sensitivity, specificity, and positive predictive values of the four "LOOK "predictive tests. Inter-incisor distance, hyoid-to-mental distance, and thyroid-to-hyoid distance between groups ND and D. Group ND was found in only 20, 13, and 13 patients, respectively, and in Group D 57,35, And 42. These results show the sensitivity, specificity, and positive predictive value of the 3-3-2 rule "predictive tests.

Of the 58 patients (Group D), 37 were present and 21 were absent. Of the 42 patients (group ND), 18 were present and 24 were absent. Of the 42 patients with

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neck mobility (group D), 21 patients were present and 37 patients were absent. Of 42 patients (group ND), 13 were present and 29 were absent. Of the 58 patients in Mallampati (group D), 52 patients were present and 6 patients were absent. Of 42 patients (group ND), 34 were present and eight were absent [Table 2].

In the facial trauma group, 28 patients were involved in difficult intubation, and 7 were in the non-difficult intubation group. We found that the p-value was 0.0015 which means that this difference was statistically significant; thus, facial trauma contributes to difficult intubation. The 95% confidence interval for the odds ratio was 1.59 - 13.83.

In the large incisors, the distance of >4 cm was 32. Of the 32 patients, 14 had difficult intubation and 18 had non-difficult intubation, with a p-value of 0.75, which was not statistically significant. This indicates that there was no correlation between the large incisor distance and intubation difficulty scale.

In the beard or moustache (look externally) out of 27 patients, 20 had difficulty intubation and 7 had non-difficult intubation; the p-value was 0.047. This indicates that there is a slight correlation between the beard or moustache and IDS.

In the large tongue categories, the patients by IDS the intubation difficulty scale (IDS) found that 24 were included in the intubation difficulty group and 6 patients had non-difficult intubation. The p-value was 0.0049, indicating that a large tongue contributed to difficult intubation. The calculated odds ratio which was 4.05, showed a positive correlation, suggesting that an increased large tongue size leads to an increase in intubation difficulty. The 95% confidence interval for the odds ratio of 1.36- 13.5287.

For inter-incisor distance, hyoid-to-mental distance, and thyroid-to-hyoid distance out of 100 patients, 32 were, 15 were in the difficult intubation group, and 17 were in the non-difficult intubation group. The p-value was 0.9863 which was not significant; therefore, there was no correlation between inter-incisor distance and IDS. For hyoid-to-mental distance from (100) patients, 49 patients had hyoid-to-mental distance. We found 36 patients with difficulty in intubation and 13 with non-difficult intubation. We calculated a p-value of 0.0047, which indicates that the hyoid-to-mental distance contributes to difficult intubation. 55 patients had a thyroid-to-hyoid distance of 55, 42 had difficult intubation, and 13 had non-difficult intubation. We calculated the p-value to be 0.0001, which indicates that a significant thyroid hyoid distance contributes to difficult intubation. The calculated odds ratio, 5.85, showed a positive correlation, suggesting that increased thyroid-to-hyoid distance leads to increased intubation difficulty. The 95% confidence interval for the odds ratio was 2.25-15.42.

In the Mallampati scores, 75 patients had difficult intubation and 11 patients were in the non-difficult intubation group (p = 0.0008). which means statistically significant so Mallampati contributes to difficult intubation and the odds ratio which was 6.8 showing a positive correlation suggests that an increased Mallampati score >3 leads to an increase in the difficulty of intubation. 95% confidence interval for the odds ratio of 1.6-27.3.

Forty patients with intubation difficulty and 15 with non-difficult intubation were included. We calculated the p-value to be 0.0295 which means that this difference was statistically significant; thus, obstruction contributes to difficult intubation. We calculated the odds ratio which was 7.5, and showed a positive correlation, suggesting that increased obstruction leads to increased difficulty in intubation. The 95% confidence interval for the odds ratio is 2.1-29.2 which shows a correlation that suggests that increased obstruction leads to an increase in the difficulty of intubation.

Neck Mobility in a LEMON score categorising the patients by the intubation difficulty scale (IDS) found that 22 were involved in difficult intubation and 13 were in the non-difficult intubation group. We found a p-value of 0.0003, indicating that the difference was statistically significant. Limited Neck Mobility contributed to difficult intubation and calculated the odds ratio which was 7 which showed a positive correlation, suggesting that increased Limited Neck Mobility leads to increased difficulty in intubation. 95% confidence intervals for the odds ratio 2.2-25.5 [Table 3].

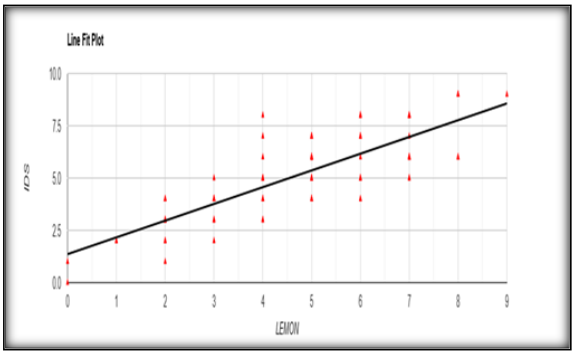

Figure 1. Comparing the correlation between LEMON score and intubation difficulty showing the odds ratio of various parameters

Pearson's correlation indicated a significantly large positive relationship between LEMON and IDS (r (98) = 0.809, p < 0.001) [Figure 1].

Table 1: Demographic data of the study

		Group ND	Group D	P value
Age (years)		37	42	0.087
Gender	Male	24	22	0.486
	Female	33	21	
Weight (kgs)		57	58	0.756

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Table 2: Comparisons of LEMON scores between the groups

			Group D	Group ND
Look externally	Facial trauma	Present	28	7
		Absent	30	35
	Large – incisors distance	Present	30	2
		Absent	28	40
	Beard or moustache	Present	20	7
		Absent	38	35
	Large tongue	Present	24	6
		Absent	34	36
	Inter-Incisor Distance	Present	57	20
Evaluate 3-3-2 rule		Absent	1	22
	Hyoid to mental distance	Present	35	13
		Absent	23	29
	Thyroid to hyoid distance	Present	42	13
		Absent	16	29
	Obstruction	Present	37	18
		Absent	21	24
Neck mobility		Present	21	13
		Absent	37	29
Mallampati score		Present	52	34
		Absent	6	8

Table 3: Distribution of Group ND indicates patients show intubation difficulty score ≤ 4 and Group D indicates patients show intubation difficulty score > 5

Variables	Group D	Group ND	95% Confidence	P value
Facial Trauma	28	7	1.59-13.83	0.0015
Large – incisor's distance	14	18	0.34-2.21	0.757
Beard or Moustache	20	7	0.91-8.22	0.047
Large tongue	24	6	1.36-13.52876	0.0049
Inter Incisor distance	15	17	0.39-2.50	0.9863
Hyoid to mental distance	36	13	1.41-9.05	0.0027
Thyroid to hyoid distance	42	13	2.25-15.42	0.0001
Mallampati score	75	11	1.6-27.3	0.0008
Obstruction	40	15	2.1-29.2	0.0291
Neck mobility	22	13	2.2-25.5	0.003

DISCUSSION

In our study, we correlated the modified LEMON score and intubation difficulty scale and compared each predictor in the LEMON score with IDS, which will help predict the difficulty in intubation attempts. Of the 100 patients, 47 were male and 53 were female, and the number of female patients was higher. Further separated into Group ND were 24 males and 33 females in group D were further separated into Group ND (22 males and 21 females.

Several studies have examined this correlation to determine the predictive value of the modified LEMON score for identifying patients who may have challenging intubation.[6-8] Mahalia et al. found that difficult intubation using the Cormack and Lehane scores had sensitivities of 99.1%, 96.6%, and 92.5% for facial trauma, large incisors, and beard or moustache, respectively, and positive predictive values of 0%. A combination of predictors in the "L E M O N" score showed that it increased, as did the difficulty of visual laryngoscopy. The study concluded that the combination of airway predictors in the "L E M O N" scoring system significantly improves the ability to predict difficult intubation, similar to our study.[9]

In our study, we found that 28 of them were involved in difficult intubation and seven were in the non-difficult intubation group. This difference was statistically significant; therefore, facial trauma contributes to difficult intubation. We calculated an odds ratio of 4.6 which shows a positive correlation, suggesting that increased facial trauma leads to increased difficulty in intubation. The 95% confidence interval for the odds ratio was 1.59 - 13.83.

In our study, we found 40 patients with intubation difficulty and 15 with non-difficult intubation, and this difference was statistically significant. Thus, obstruction contributed to the difficult intubation. We calculated the odds ratio which was 7.5, and showed a positive correlation, suggesting that increased obstruction leads to increased difficulty in intubation. The 95% confidence interval for the odds ratio is 2.1-29.2 which shows that the correlation suggests that increased obstruction leads to an increase in the difficulty of intubation. Thus, both facial trauma and obstruction have a high correlation and are independent risk factors for difficult intubation.

Morandi et al., conducted a prospective observational study in 2019 to evaluate the "Modified LEMON score compared to the Mallampati score for predicting difficult laryngoscopy. The study concluded that the modified LEMON score showed higher sensitivity and specificity than the Mallampati score for predicting difficult laryngoscopy. Compared to our study, 86 patients had >3 Mallampati scores. We found that 75 patients had

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difficult intubation, and 11 patients were in the non-difficult intubation group, which was statistically significant. Therefore, Mallampati contributed to difficult intubation. We calculated the odds ratio which was 6.8, showing a positive correlation, suggesting that an increased Mallampati score >3 leads to an increase in intubation difficulty. 95% confidence interval for the odds ratio of 1.6-27.3. Both the results were highly correlated.

Previous studies have shown that thyroid-to-hyoid distance is not an independent predictor of difficult intubation. We believe that this difference may be due to the study population, particularly the high proportion of patients with head and neck injuries.

In our study, the thyroid-to-hyoid distance was an independent predictor of intubation difficulty. This indicates that a significant thyroid hyoid distance contributes to difficult tracheal intubation. The calculated odds ratio of 5.85 shows a positive correlation, suggesting that increased thyroid-to-hyoid distance leads to an increase in the difficulty of intubation. The 95% confidence interval for the odds ratio was 2.25-15.42.

CONCLUSION

In conclusion, this thesis provides evidence of a significant correlation between the LEMON score and IDS under general anaesthesia. The LEMON score can serve as a valuable tool for predicting intubation difficulty and assisting anaesthesiologists in planning and implementing appropriate airway management strategies. Further research is needed to validate these findings and to explore additional factors that may contribute to intubation difficulty.

Limitations: The study included only (ASA - I and ASA - II); it is a single-centre trial with a smaller sample size, and all patients undergoing elective surgeries in the general anaesthesia age group within 18 -80 years not including head injury or low GCS.

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