LEMON SCORE: A TOOL TO PREDICT DIFFICULT AIRWAY IN ED IN INDIAN SETTING.

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Abstract

Background: Airway management is a critical need in many acutely ill and injured patients. Inadequate delivery of oxygen to brain and other vital structures is the quickest killer. Emergency airway management is the major key for successful resuscitation in ED. Emergency medicine is an emerging branch in India at present and no research study has been conducted to evaluate difficult airway prediction score. Hence this study aimed to find the use of LEMON score as a tool to predict difficult airway in our ED.

Methods: All the patients requiring invasive mechanical ventilation with age >12 years, not admitted outside and admitted to the emergency medicine department from July 2017 to September 2019 were included in our study. A total of 67 patients required invasive ventilation and were assessed by LEMON score for difficult intubation. This score is related to number of attempts required and Cormack lehane class of laryngoscopic view while intubation.

Results: In the "LOOK EXTERNALLY" the most common finding was edentulous mouth with occurrence of 26.87%. In 'EVALUATE' component the most common difficulty was 2-3-2. In MALLAMPATI CLASS 56.71% were class I, 39.39% were class II. In OBSTRUCTION component of LEMON, 98.51% had no obstruction. In NECK MOBILITY component we found that 85.1% subjects had mobile neck and only 15.15% subjects had restricted neck mobility. We observed that the LEMON score is 60% sensitive and 96.15% specific to predict difficult airway. The positive predictive value was 83.33%.

Conclusion: This tool can reduce the chance of unexpectedly encountering difficult airway.

Introduction

Airway management is a critical need in many acutely ill and injured patients. Inadequate delivery of oxygen to brain and other vital structures is the quickest killer. An unobstructed, protected airway and adequate ventilation are critical to prevent hypoxemia.

Emergency airway management is the major key for successful resuscitation in ED. Emergency department deals with most of the cases with threatened airway and impending respiratory failure requiring mechanical ventilation. This early period of care has significant impact on the outcomes of these patients. Emergency medicine is an emerging branch in India at present and no research study has been conducted to evaluate baseline demographic features, indications, difficult airway assessment, modes of ventilation etc for patients requiring mechanical ventilation in the ED setting.

Therefore by this observational study we try to study the baseline characteristics of patients requiring mechanical ventilation, difficult airway assessment and difficulties in airway management in ED setting. Objective signs of airway obstruction are:

1. Agitation (hypoxia) or obtundation (hypercarbia).
2. Use of accessory muscles of ventilation that predicts the airway compromise.
3. Abnormal sounds i.e. Snoring, gurgling and crowing sounds can be associated with partial occlusion of pharynx or larynx.
4. Abusive behaviour of the patient may be due to hypoxemia.
5. Involuntary motor movements.

Definitive airway is defined as tube placed in the trachea with cuff inflated below the vocal cords secured in place with tape.

INDICATIONS FOR INTUBATION

a. Inability to maintain a patent airway by other means, with impending or potential airway

compromise(e.g. following, facial fractures, retropharyngeal hematoma or inhalational injury)

b. Inability to maintain adequate oxygenation with the help of facemask oxygen supplementation, or the presence of apnea.

c. Obtundation resulting from cerebral hypoperfusion

d. Head injury with GCS less than or equal to 8, sustained seizure activity, and need to protect the airway from aspiration of blood or vomitus.

An intubation is called difficult if a trained physician needs 2 or more attempts or more than 10 min for a successful endotracheal intubation. In this study we used LEMON score to assess the difficult airway.

'LEMON' ASSESSMENT FOR DIFFICULT INTUBATION

L: LOOK EXTERNALLY
Look for signs of inhalational burn, large overbite, facial trauma, edentulous mouth,short neck or obesity etc.

E: EVALUATE 3-3-2 RULE:
To allow for the alignment of laryngeal, pharyngeal and oral axes, observe the following:

Distance between the patient's incisor teeth- atleast 3 finger breadths

Distance between the chin and hyoid bone - 3 finger breadths

Distance between thyroid notch and floor of the mouth - 2 finger breadths.

M: Mallampati score:
Class I: soft palate, fauces pillars, uvula entirely visible

Class II: soft palate, fauces, uvula partially visible.

Class III: soft palate, base of uvula visible

Class IV: only hard palate visible

O: Obstruction
Any condition that causes obstruction of the airway will make laryngoscopy difficult. Eg foreign body.

N: Neck mobility
Patients who require cervical spinal motion restriction are more difficult to intubate This is usually seen in cases of trauma, cervical stenosis, etc.

Table 1: CORMACK-LEHANE CLASSIFICATION SYSTEM FOR LARYNGOSCOPIC VIEW

Grade	Description
1	Full view of glottis
2a	Partial view of glottis
2b	Only posterior extremity of glottis seen or only arytenoid cartilages
3	None of glottis seen , only epiglottis seen
4	Neither epiglottis nor glottis seen

Cormack Lehane class 2b and more are usually considered as difficult airway.

METHODOLOGY:

STUDY DESIGN
Prospective observational study.

PLACE OF STUDY
The present study was done on the patients in the Department of Emergency Medicine at Dr. D.Y. Patil Medical College, Hospital and Research Centre, Pimpri, Pune.

ETHICAL CLEARANCE
Study was conducted only after the clearance from ethical and scientific committee of this institution.

INCLUSION CRITERIA
All the patients undergoing intubation and non-invasive ventilation in the emergency department during the period of study with age more than 12 years.

EXCLUSION CRITERIA
1. Age less than 12 years.
2. Pregnant
3. Presented to EM who had already taken treatment outside and intubated in the hospital where he / she was admitted previously.

Look externally-

Table 1: 'Look externally' distribution among study subjects

Findings	Score
Normal	0
Edentulous	1
Facial fractures	2

Evaluate 3-3-2 rule:

Finding	Score
3-3-2	0
Any other variant	1

Mallampati score:

Findings	Score
Class 1	0
Class 2	1
Class 3	2
Class 4	3

Obstruction:

Findings	Score
Nil	0
Broken tooth, foreign body,etc	1

Neck mobility:

Findings	Score
Mobile	0
Restricted due to any cause	1

LEMON score elaborated

Total score was taken as 12, and we have scored the patients accordingly.

For Cormack Lehane score, class 2b laryngoscopic view and futher were taken as difficult aiway.

OBSERVATIONS AND RESULTS:

Distribution of "LEMON" approach for difficult airway:

We have used "LEMON" approach to predict difficult airway. Its each component has been tabulated with frequency as follows:

(i)   **Look Externally**:

In 'look externally' component, the most common finding was edentulous mouth with frequency of 18 out of total 67 subjects intubated.

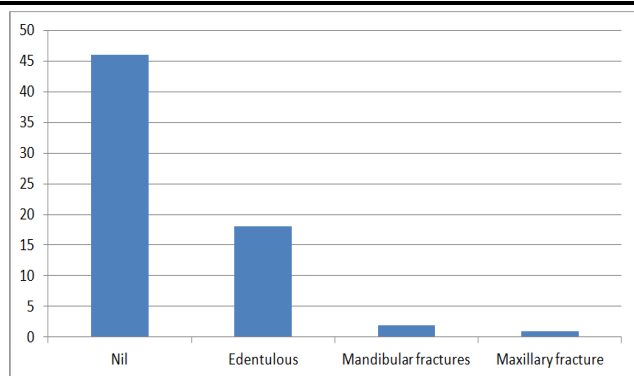| Look externally	Frequency	Percent
Edentulous	18	26.87%
Mandibular fractures	2	2.99%
Maxillary fracture	1	1.49%
Nil	46	68.66%
Total	67	100.00%

Figure 1: Distribution of 'Look externally' component among study subjects

(ii)   **Evaluate 3-3-2 rule**:

It was observed that 46 out of 67 subjects intubated maintained 3-3-2 finger breadth with respective anatomy. The most common variation was 2-3-2 , with frequency of 7 (10.45%).

Table 2: 3, 3, 2 RULE distributions among study subjects

3-3-2 RULE	Frequency	Percent
1,3,2	1	1.49%
2,2,1	1	1.49%
2,2,2	1	1.49%
2,3,1	1	1.49%
2,3,2	7	10.45%
3,2,1	5	7.46%
3,2,2	3	4.48%
3,3,1	2	2.99%
3,3,2	46	68.66%
Total	67	100.00%

(iii)   **Mallampati score**: most of the patients (56.71%) were class I, followed by class II (39.39) and class III (4.55). None of the patient had class IV score.

Table 3: Distribution of Mallampati classification.

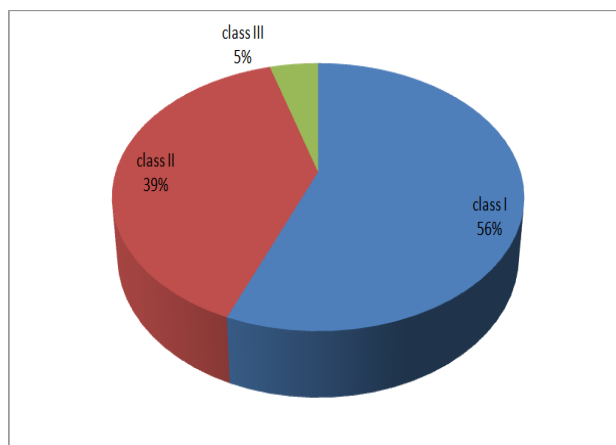| Mallampati score	Frequency	Percent
class I	38	56.71%
class II	26	39.39%
class III	3	4.55%
Total	67	100.00%

Figure 2: Mallampati score distribution among study subjects

(iv) Obstruction: no significant findings observed under this component.

Table 4: Obstruction distribution among study subjects

Obstruction	Frequency	Percent
Laryngeal tumour with Lymphadenopathy	1	1.49%
Nil	66	98.51%
Total	67	100.00%

(V) Neck mobility: it was observed that 85.1% subjects had mobile neck followed by 14.90% who had restricted neck mobility. Restriction was mainly due to head and neck injury, cervical stenosis, or cervical spine fracture.

Table 5: Neck mobility distribution among study subjects

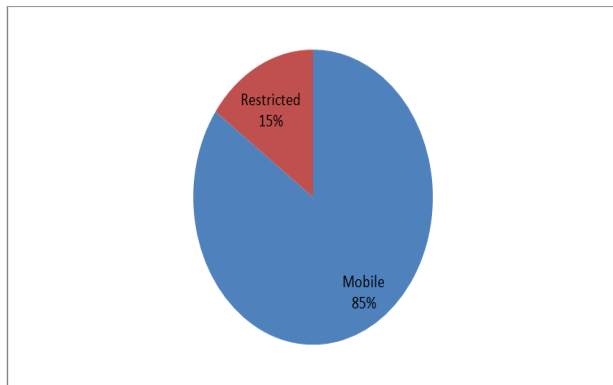| Neck mobility	Frequency	Percent
Mobile	57	85.1%
Restricted	10	14.90%
Total	67	100.00%

Figure 3: 'Neck mobility' distribution among study subjects

The cut off for lemon score is taken as equal to or more than 3. After comparing the 'lemon' score with difficult intubations, it was observed that:

The overall sensitivity of 'LEMON SCORE' to predict difficult intubation (i.e. more than or equal to 2 attempts) is 60% and specificity is 96.15%. The positive predictive value that means the probability of patients with positive test will truly have the disease is 83.33%.

Table 6: Statistics with LEMON score =/>3 as predictor of airway difficulty

Statistic	Value	95% CI
Sensitivity	60.00%	38.67% to 78.87%
Specificity	96.15 %	89.17% to 99.20%
Positive Likelihood Ratio	15.60	4.92 to 49.51
Negative Likelihood Ratio	0.42	0.26 to 0.67
Disease prevalence	24.27% (*)	16.36% to 33.71%
Positive Predictive Value	83.33% (*)	61.17% to 94.07%
Negative Predictive Value	88.24 % (*)	82.24% to 92.39%
Accuracy	87.38% (*)	79.38% to 93.11%

Distribution of Cormack lehane laryngoscopic view among study subjects:

It was observed that maximum 67.16% subjects were of class 1, 20.89% were of class 2a and 11.94% were of class 2b category. Class 3 and 4 views were not observed.

Table 7: Cormack Lehane Class distribution among study subjects

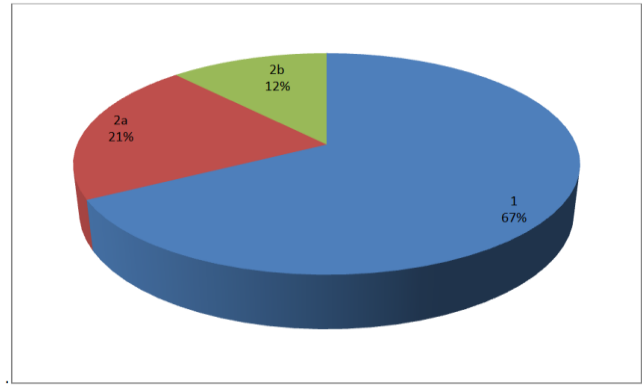| Cormack Lehane Class	Frequency	Percent
1	45	67.16%
2a	14	20.89%
2b	8	11.94%
Total	67	100.00%

Figure 4: Cormack Lehane Class distribution among study subjects

Further we tabulated the number of attempts of intubation among study subjects and related the number of attempts with Cormack lehane laryngoscopic view. We found that number of attempts of intubation increased with increase in Cormack lehane score.

Following table shows attempts of intubation among study subjects. Maximum 45(67.1%) were intubated in first attempt of intubation and 10.45% were required 3rd attempt of intubation.

Table 8: Attempts of intubation among study subjects

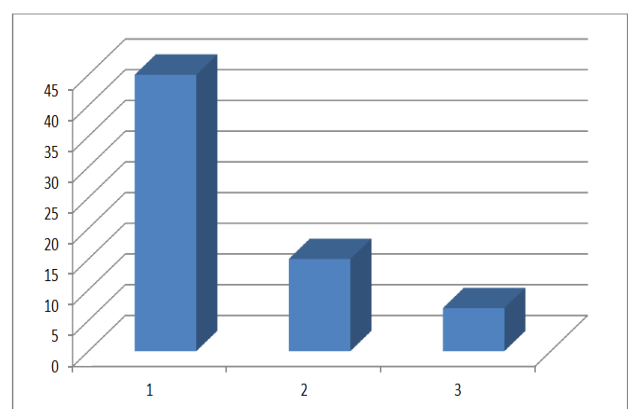| Attempts of intubation	Frequency	Percent
1	45	67.16%
2	15	22.39%
3	7	10.45%
Total	67	100.00%

Figure 5: Attempts of intubation among study subjects

Relationship between Cormack lehane class with number of attempts of intubation:

It was found that 95.5% cases of Cormack Lehane class 1 were intubated in first attempt, 78.57% cases

of Cormack Lehane class 2a were intubated in 2nd attempt and 62.5% cases of Cormack Lehane class 2b were intubated in 3rd attempt. It was concluded that as the Cormack Lehane class increases number of attempts of intubation also increases.

Table 9: Relationship of Cormack Lehane class with attempts of intubation

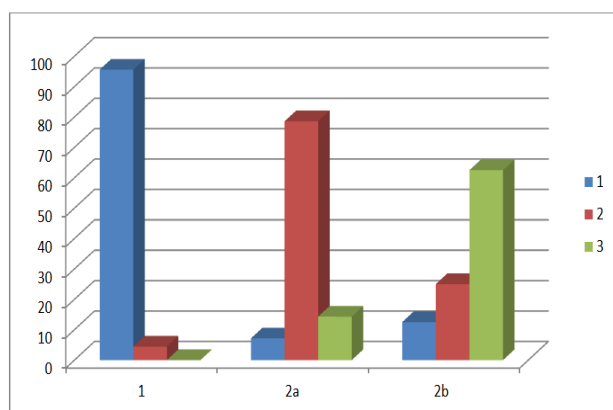| CORMACK LEHANE CLASS	Attempts of Intubation			
	1	2	3	Total
1	43(95.56%)	2(4.44%)	0	45
2a	1(7.14%)	11(78.57%)	2(14.29%)	14
2b	1(12.50%)	2(25.00%)	5(62.50%)	8
Total	45(67.16%)	15(22.39%)	7(10.45%)	67

Figure 6: Relationship of Cormack Lehane class with attempts of intubation

Statistics of Cormack- Lehane scale to predict difficult airway:

The cutoff of Cormack lehane scale for difficult airway is taken as class 2b.

The sensitivity of Cormack lehane scale is 33.33% and specificity for difficult intubation is 100%. With a positive predictive value of 100%.

Table 10: Statistics with Cormack Lehane scale >/= class 2b as predictor of difficult airway

Statistic	Value	95% CI
Sensitivity	33.33%	15.63% to 55.32%
Specificity	100.00 %	95.26% to 100.00%
Negative Likelihood Ratio	0.67	0.50 to 0.88
Disease prevalence	24.00% (*)	16.02% to 33.57%
Positive Predictive Value	100.00% (*)	
Negative Predictive Value	82.61 % (*)	78.16% to 86.31%
Accuracy	84.00% (*)	75.32% to 90.57%

Out of the total 24 difficult intubations 19 were assisted and successfully intubated with gum elastic bougie. Laryngeal mask airway was not used in any of

these subjects and surgical cricothyroidotomy was not required in any of the difficult airway.

There was no incidence of failed intubation in our study.

DISCUSSION:

'LEMON' score as a tool to predict difficult airway:

In present study we have used "LEMON" approach to predict difficult airway. In the "LOOK EXTERNALLY" we found that the most popular difficulty was edentulous mouth with occurrence of 26.87%.

In 'EVALUATE' component the most common difficulty was 2-3-2 ie. 2 finger breadth distance between incisors, 3 finger breadth between chin and hyoid bone and 2 finger breadth between thyroid notch and floor of the mouth. The occurrence was 10.45%.

In MALLAMPATI CLASS 56.71% were class I, 39.39% were class II, and 4.55% were class III.

In OBSTRUCTION component of LEMON, 98.51% had no obstruction and only one subject was found to have laryngeal tumor (1.49%).

In NECK MOBILITY component we found that 85.1% subjects had mobile neck and only 15.15% subjects had restricted neck mobility.

Although the mallampati score was assessed in our study as a part of the LEMON approach during emergency intubation, it was observed that it was not feasible as compared to the remaining components.

This conclusion was similar to the study by Reed MJ, et al[49] who studied 100 patients treated in the resuscitation room of a UK teaching hospital between June 2002 and January 2003 , on criteria based on the 'LEMON' method. He observed that all criteria of the 'Look' section of the method could be adequately assessed. Data for the 'Evaluate' section could not be obtained in 10 patients, with inter-incisor distance being the most problematical item. The 'Mallampati' score was unavailable in 43 patients, and had to be assessed in the supine position in 32 of the remaining 57 patients. Assessment for airway 'Obstruction' and 'Neck mobility' could be performed in all patients. He concluded that The 'Look', 'Obstruction' and 'Neck mobility' components of the 'LEMON' method are the easiest to assess in patients undergoing treatment in the emergency department resuscitation room. The 'Evaluate' and 'Mallampati' components were less

easily applied to the population that present to the resuscitation room, and assessment of these was more problematical and prone to inaccuracy.

In present study we have observed that the LEMON score is 60% sensitive and 96.15% specific to predict difficult airway. The positive predictive value i.e. the probability of patients with positive test will truly have the disease was 83.33%.

This is similar to the study conducted by Diane M. Birnbaumer,et al [50]who found that patients in the difficult-intubation group had significantly higher LEMON scores than did those in the easy-intubation group. They also validated that the LEMON method predicts which patients have difficult-to-manage airways.

Distribution of Cormack Lehane Scale to classify laryngoscopic view:

In our study we have used Cormack lehane scale to classify the laryngoscopic view. We found that Maximum 67.16% were of class 1, 20.89% were of class 2a and 11.94% were of class 2b category. Then we tabulated the number of attempts required for Cormack lehane class 1 , 2a and 2b(class 3 and 4 were not found in our subjects) and related it with number of attempts required for intubation. . It was found that 95.5% cases of Cormack Lehane class 1 were intubated in first attempt, 78.57% cases of Cormack Lehane class 2a were intubated in 2nd attempt and 62.5% cases of Cormack Lehane class 2b were intubated in 3rd attempt. It was concluded that higher the class of Cormack lehane, more is the number of attempts of intubation.

The sensitivity of Cormack lehane scale, in our study was 33.33% and specificity for difficult intubation was 100% with a positive predictive value of 100%.

Out of the total 24 difficult intubations 19 were assisted and successfully intubated with gum elastic bougie. Laryngeal mask airway was not used in any of these subjects and surgical cricothyroidotomy was not required in any of the difficult airway.

This was in agreement with the study done by M J Reed, M J G Dunn,D W McKeown, et al [49] in which 156 patients were intubated during the study period. There were 114 Cormack and Lehane grade 1

intubations, 29 grade 2 intubations, 11 grade 3 intubations, and 2 grade 4 intubations. they concluded that patients with a poor laryngoscopic view (grades 2, 3, or 4) were more likely to have increased attempts of intubation with difficulty.

It is also in favour with the study done by Shirgoska B , Netkovski J. et al [51]who also concluded that increasing grade of Cormack lehane classification of laryngoscopic view is associated with difficult intubation.

CONCLUSION

For assessing LEMON score, 'look externally', 'evaluate', 'obstruction' and 'neck mobility' were easiest to access while mallampati was not feasible before emergency intubation and was prone to errors. The overall sensitivity and specificity of this tool is 60% and 96.15% respectively to predict difficult airway with a positive predictive value of 83.33%. Use of this tool can reduce the chance of unexpectedly encountering a difficult airway.

The increase in Cormack-lehane classification for laryngoscopic view is related to increased number of attempts for intubation and higher LEMON score.. It is highly specific for difficult intubation.

Gum elastic bougie was used in majority of difficult intubations and has proved to be a useful tool in emergency scenario. As soon as we predict difficult airway by using 'LEMON' score or observe an airway of high Cormack lehane score, next attempt of intubation should be assisted with GEB to save time and maintain patent airway.

References:

1. Reed MJ, Dunn MJG, McKeown DW. Can an airway assessment score predict difficulty at intubation in the emergency department? Emergency Medicine Journal (2005);22:99-102.
2. Diane M. Birnbaumer.Airway Assessment Using "LEMON" Score Predicts Difficult ED Intubation. NEJM(2005).
3. Shirgoska B, Netkovski J., et al Predicting difficult airway in apparently normal adult and pediatric patients. Pril (Makedon Akad Nauk Umet Odd Med Nauki). 2013;34(1):155-9.