

## PREDICTORS OF DIFFICULT INTUBATION: STUDY IN KASHMIRI POPULATION

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### ABSTRACT

*Airway assessment is the most important aspect of Anaesthesia practice as a difficult intubation may be unanticipated. A prospective study was done to compare the efficacy of airway parameters to predict difficult intubation viz; degree of head extension, thyromental distance, inter incisor gap, grading of prognathism, obesity and modified mallampati test. Six hundred patients with ASA I & ASA II grade were enrolled in study. All patients were preoperatively assessed for airway parameters. Intra-operatively all patients were classified according to Cormack and Lehane laryngoscopic view. Clinical data of each test was collected, tabulated and analyzed to obtain the sensitivity, specificity, positive predictive value & negative predictive value. Results obtained showed incidence of difficult intubation in 3.3%. Head & neck movements had the highest sensitivity (86.36%); high arched palate had highest specificity (99.38%). Head & neck movements had highest sensitivity; high arched palate had highest specificity, however, head & neck movements strongly correlated for patients with difficult intubation.*

**Keywords:** Intubation, Anaesthesia, Laryngoscopy

### INTRODUCTION

The fundamental responsibility of an anesthesiologist is to maintain adequate gas exchange. In order to do this, the airway must be managed in such a way that it is almost continuously patent. Failure to maintain a patent airway for more than a few minutes results in brain damage or death<sup>[1]</sup>. Anaesthesia in a patient with a difficult airway can lead to both direct airway trauma and morbidity from hypoxia and hypercarbia. Direct airway trauma occurs because the management of the difficult airway often involves the application of more physical force to the patient's airway than is normally used. Much of the morbidity specifically attributable to managing a difficult airway comes from an interruption

of gas exchange (hypoxia and hypercapnia), which may then cause brain damage and cardiovascular activation or depression<sup>[2]</sup>.

Though anesthesiologist is a final authority in the technique of Endotracheal Intubation, there will be hardly any such specialist who might not be experiencing occasional difficulties in this life saving technique. As difficult Intubation occurs infrequently and is not easy to define, research has been directed at predicting difficult laryngoscopy, "this is graded as the portion of larynx seen when a Macintosh laryngoscope is used in a patient". It is argued that, if difficult laryngoscopy has been predicted and intubation is essential, skilled assistance and special equipment should be provided. Although the incidence of difficult or failed tracheal intubation is comparatively low, unexpected difficulties and poorly managed situation may produce a life threatening condition or even death<sup>[3]</sup>.

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Difficulty in intubation is usually associated with difficulty in exposing the glottis by direct laryngoscopy.

This involves a series of maneuvers like extending the head, opening the mouth, displacing and compressing the tongue into the submandibular space and lifting the mandible forward. The ease or difficulty in performing each of these maneuvers can be assessed by one or more parameters<sup>[4]</sup>.

Extension of head at the atlanto-occipital joint can be assessed by simply looking at the movements of the head, measurement of sternomental distance or by using devices to measure the angle<sup>[5]</sup>. Mouth opening can be assessed by measuring the distance between upper and lower incisors with the mouth fully open. The ease of lifting the mandible can be assessed by comparing the relative position of the lower incisors in comparison with the upper incisors after forward protrusion of the mandible<sup>[6]</sup>. The measurement of mento-hyoid distance and thyromental distance provide a rough estimate of the submandibular space<sup>[7]</sup>. The ability of the patient to move the lower incisor in front of the upper incisor tells us about jaw movement. The classification provided by Mallampati et al<sup>[8]</sup> and later modified by Samsoun and Young<sup>[9]</sup> help to assess the size of tongue relative to oropharynx. Abnormalities in one or more of these parameters may help predict difficulty in direct laryngoscopy<sup>[11]</sup>.

Initial studies tried to compare individual parameters to predict difficult intubation with mixed results<sup>[8,9]</sup>. Later studies have attempted to create a scoring system<sup>[3,10]</sup> or a complex mathematical model<sup>[11,12]</sup>. This study is an attempt to verify which of these factors are significantly associated with difficult exposure of glottis and to rank them according to the strength of association.

## MATERIALS & METHODS

The study was conducted after obtaining institutional review board approval. Six hundred ASA I & II adult patients, scheduled for various elective procedures under general anesthesia, were included in the study after obtaining informed consent. Patients with gross abnormalities of the airway were excluded from the study. All patients were assessed the evening before surgery by a single observer. The details of airway assessment are given in Table I.

Airway Parameter	Method of assessment
Modified Mallampati Scoring	Class I: Faucial pillars, soft palate and uvula visible. Class II: Soft palate and base of uvula seen Class III: Only soft palate visible. Class IV: Soft palate not seen  Class I & II : Easy Intubation Class III & IV : Difficult Intubation
Obesity	Obese BMI (= 25) Non Obese BMI (< 25)
Inter Incisor Gap	Distance between the incisors with mouth fully open(cms)
Thyromental distance	Distance between the tip of thyroid cartilage and tip of chin, with fully extended(cms)
Degree of Head Extension	Grade I = 90° Grade II = 80°-90° Grade III < 80°
Grading of Prognathism	Class A: - Lower incisor protruded anterior to the upper incisor. Class B: - Lower incisor brought edge to edge with upper incisor but not anterior to them. Class C: - Lower incisors could be brought edge to edge.

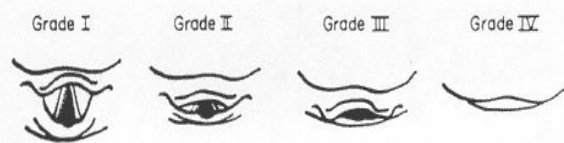
**Table I: Method of assessment of various airway parameters (predictors)**

In addition the patients were also examined for the following and if present were recorded accordingly.

- High arched palate.
- Protruding maximally incisor (Buck teeth)
- Wide & short Neck

Direct laryngoscopy with Macintosh blade was done by an anesthetist who was blinded to preoperative assessment.

Glottic exposure was graded as per Cormack-Lehane classification<sup>13</sup>(Fig 1):



**Figure 1: Cormack-Lehane grading of glottic exposure on direct laryngoscopy**

GRADE 1: Most of the glottis visible

GRADE 2: Only the posterior extremity of the glottis and the epiglottis visible

GRADE 3: No part of the glottis visible, only the epiglottis seen

GRADE 4: Not even the epiglottis seen

Grades 1 and 2 were considered as 'easy' and grades 3 and 4 as 'difficult'.

## RESULTS

Glottic exposure on direct laryngoscopy was difficult in 20 (3.3%) patients.

The frequency of patients in various categories of 'predictor' variables is given in Table-II

The association between different variables and difficulty in intubation was evaluated using the chi-square test for qualitative data and the student's test for quantitative data,  $p < 0.05$  was regarded as significant.

Airway Parameter	Group	Frequency (%)
Modified Mallampati Scoring	Class 1&2	96%
	Class 3&4	4%
Obesity	Obese BMI ( $\geq 25$ )	28.7%
	Non Obese BMI ( $< 25$ )	71.3%
Inter Incisor Gap	Class I: $> 4$ cm	93.5%
	Class II: $< 4$ cm	6.5%
Thyromental distance	Class I: $\geq 6$ cm.	94.6%
	Class II: $< 6$ cm.	5.4%
Head & Neck Movements	Difficult { class II & III ( $90^\circ$ )}	16%
	Easy { class I ( $> 90^\circ$ )}	84%
Grading of Prognathism	Difficult (class III)	96.1%
	Easy (class I + II)	3.9%
Wide and Short neck	Normal neck body ratio 1:13	86.9%
	Difficult (Ratio $\geq 1:13$ )	13.1%
High arched Palate	Yes	1.9%
	No	98.1%
Protruding Incisors	Yes	4.2%
	No	95.8%

**Table II: The frequency analysis of predictor parameters**

Clinical data of each test was collected, tabulated and analyzed to obtain the sensitivity, specificity, positive predictive value & negative predictive value.

Comparative analysis of sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of various physical factors and scoring systems are given in Table III.

Physical factors and various Scoring Systems	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Obesity	81.8	72.76	6.34	99.43
Inter incisor gap	18.8	94.14	6.6	98.1
Thyromental distance	72.7	96.5	32.0	99.4
Head and Neck movement	86.36	86.0	34.6	99.7
Prognathism	4.5	96.3	2.7	97.9
Wide and Short neck	45.5	87.9	7.8	98.6
High arched palate	40.1	99.38	60.0	98.67
Protruding incisor	4.6	95.9	2.5	97.79
Mallampati scoring system	77.3	98.2	48.57	99.5
Cormack and Lehane's scoring system	100	99.7	88	100

**Table III: Comparative analysis of various physical factors and scoring systems**

## DISCUSSION

Difficulty in endotracheal intubation constitutes an essential predisposing factor of morbidity and mortality, especially when it is not anticipated preoperatively. This unexpected difficulty in intubation is probably the result of a lack of accurate predictive tests and inadequate preoperative assessment of the airway. Risk factors if identified at the preoperative visit help to alert the anesthesiologist so that alternative methods of securing the airway can be used or additional expertise sort before hand.

Direct laryngoscopy is the gold standard for tracheal intubation. There is no single definition of difficult intubation. Difficult glottic view on direct laryngoscopy is the most common cause of difficult intubation. The incidence of difficult intubation in this study is similar to that of others.

As for as the predictors are concerned there are wide variations. Restriction of head and neck movement and decreased mandibular space has been identified as important predictors in other studies as well. Mallampati classification has been reported to be a good predictor by many but found to be of limited value by others<sup>[14]</sup>. Interincisor gap, forward movement of jaw and thyromental distance produce variable results in previous studies<sup>[7,15]</sup>. Even though thyromental distance is a measure of mandibular space, it is influenced by degree of head extension.

There have been attempts to create various scores in the past. Many of them could not be reproduced by others or of limited practical value. Complicated mathematical models based on clinical and/or radiological parameters have been proposed by few in the past<sup>[16]</sup>, but these are difficult to understand and tough to follow in clinical setting. Many of these studies consider all the parameters of equal importance.

Instead of trying to find 'ideal' predictor(s), score or model, we simply arrange them in an order based on the strength of association with difficult intubation. Restricted extension of head, decreased thyromental distance and poor Mallampati class are significantly associated with difficult intubation.

In other words patients with decreased head extension have much higher probability of having a difficult intubation compared to those with abnormality in other parameters. The type of equipments needed to manage can be chosen according to the parameter which is abnormal. For example in a patient with decreased mandibular space, it may be prudent to choose devices which do not involve displacement of the tongue like Bullard laryngoscope or Fiber-optic laryngoscope. Similarly in patients with decreased head extension devices like McCoy Larngoscope are likely to be more successful.

## CONCLUSION

This prospective study tests the efficacy of various parameters of airway assessment as predictors of difficult intubation. We have find out that head & neck

movements, high arched palate, thyromental distance & Modified Mallampatti test are the best predictors of difficult intubation.

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