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Different Methods of Airway Assessment

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ABSTRACT

Airway assessment is an essential preoperative step that allows prediction of potential difficulties during airway management, particularly tracheal intubation and ventilation. Proper evaluation helps to reduce airway-related complications and improve perioperative safety. Several bedside tests have been proposed to predict difficult intubation, yet their accuracy and reliability remain variable. Comprehensive assessment combining clinical, anatomical, and radiological predictors is therefore vital for safe anesthetic practice.

Keywords: *Airway assessment; Difficult intubation; Mallampati classification; Thyromental distance; Cormack–Lehane grade; Predictive value*

1. INTRODUCTION

Securing the airway is one of the most critical components of safe anesthesia practice, as failure to predict or manage a difficult airway can rapidly lead to hypoxia, brain injury, or death **(1).** Preoperative airway assessment plays a pivotal role in identifying patients who may present challenges during laryngoscopy or tracheal intubation. Despite advances in airway devices and algorithms, unanticipated difficult intubations still occur and contribute significantly to anesthesia-related morbidity and mortality **(2).** Hence, early recognition through structured assessment remains essential in minimizing risk and improving patient outcomes.

Various bedside tests have been developed to predict difficult airway scenarios, including the Mallampati classification, thyromental distance (TMD), sternomental distance (SMD), inter-incisor gap (IIG), and upper lip bite test (ULBT). Although these parameters are simple and widely used, their predictive reliability varies among populations and ethnic groups **(3).** Several studies have shown that no single test possesses sufficient sensitivity or specificity to accurately predict a difficult intubation **(4)**. Therefore, combinations of multiple airway predictors are recommended to enhance diagnostic accuracy and reduce false-negative results.

Recent investigations have also highlighted the role of advanced imaging modalities—such as ultrasound, computed tomography, and video laryngoscopy—in improving preoperative airway evaluation **(5).** However, these technologies are not always available in all clinical settings, particularly in resource-limited environments. Thus, comprehensive clinical assessment remains the cornerstone of airway management, providing anesthesiologists with practical, reproducible, and cost-effective tools for predicting airway difficulty. Continuous validation of these predictive methods across different patient populations remains a vital field of study in modern anesthetic practice.

Preoperative airway assessment should be performed routinely to identify factors that lead to anticipate difficulty with face-mask ventilation, a supraglottic airway device insertion and tracheal intubation. Difficult airway can be divided into difficult Supraglottic Airway (SGA) placement, difficult mask or SGA ventilation, difficult laryngoscopy, difficult or failed endotracheal intubation (6).

Conventional methods of airway assessment

Assessment of difficult airway in patients begins with a comprehensive history and physical examination. Medical, surgical or anesthetic factors may be indicative of a difficult airway (DA) (Table 1) (7).

) Table (1): Airway-compromising condition8 .(

Congenital : Pierre-Robin syndrome, Treacher-Collins syndrome, Goldenhar‟s syndrome, Down‟s syndrome, Kippel-Feil syndrome.
Acquired: Infections: Croup, Abscess (intraoral, retropharygeal), Ludwig‟s angina.
Arthritis: Rheumatoid arthritis, Ankylosing spondylitis.
Benign tumors: Cystic hygroma, lipoma, adenoma, goiter.
Malignant tumor
Trauma Edema of the airway, facial injury, hematoma, unstable fracture(s) of the cervical spine, maxillae, or mandible, and laryngeal/tracheal trauma.
Obesity: Short thick neck, redundant tissue in the oropharynx, obstructive sleep apnea.
:Acromegaly .Macroglossia, prognathism
Acute burns: Oedema of airway.

.History

General, regional and physical examination:

A global assessment should include the:

Patency of nares: Masses inside nasal cavity (e.g., polyps) or deviated nasal septum should be looked for.

Mouth opening: Mouth opening of a three finger breadths between upper and lower incisors in adults is desirable.

Teeth: Prominent upper incisors, or canines with or without overbite, can impose a limitation on alignment of oral or pharyngeal axes during laryngoscopy.

Palate: A high arched palate or a long, narrow mouth may present difficulty.

Patient‟s ability to protrude the lower jaw beyond the upper incisors (Prognathism) must be assessed.

Temporo-mandibular joint movement: It can be restricted in ankylosis, fibrosis, tumors, and rheumatoid arthritis.

Measurement of submental space: Thyromental length should ideally be > 6 cm.

Observation of patient’s neck: A short, thick neck is often associated with difficult intubation. Any masses in neck, extension of neck, neck mobility and ability to assume

„sniffing‟ position should be observed.

Presence of hoarse voice/stridor or previous tracheostomy may suggest stenosis.

Any systemic or congenital disease requiring special attention during airway management must be recognized, (e.g., respiratory failure, significant coronary artery disease, acromegaly, etc.).

Presence of infections of airway (e.g., epiglottitis, abscess, croup).

Presence of some physiologic conditions such as pregnancy.

Prescence of specific diseases such as obesity. (9).

III- Specific tests for assessment:

A) Anatomical criteria:

1. Relative to tongue/pharyngeal size:

Modified Mallampati Classification: The Modified Mallampati Classification (Figure 1) correlates the tongue size to the pharyngeal size. Classification is assigned according to the extent the base of tongue is able to mask the visibility of pharyngeal structures into four classes:

Class I: Visualization of the soft palate, fauces; uvula, anterior and the posterior pillars.

Class II: Visualization of the soft palate, fauces and uvula.

Class III: Visualization of soft palate and base of uvula.

Class IV: Only hard palate is visible. Soft palate is not visible at all. (9).

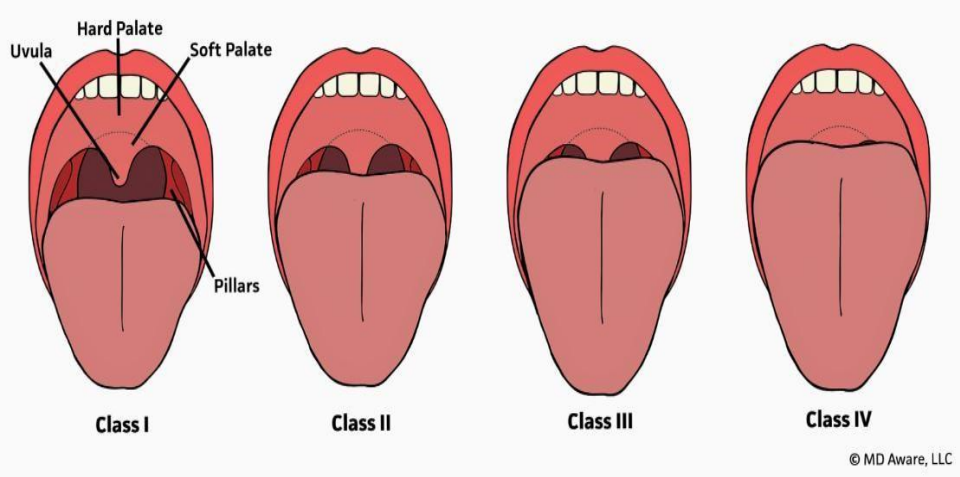

Figure (1): Modified Mallampati Classification (10).

2- Atlanto-occipital joint (AO) extension:

It assesses feasibility to make sniffing position for intubation. the angle traversed by the occlusal surface of upper teeth is estimated (Figure 2). Normal angle of extension is 35° or more. Any reduction in extension is expressed in grades:

Grade I: >35° Grade II: 22°-34°

Grade III: 12°-21° Grade IV: < 12° (9).

Figure (2): Atlanto-occipital joint angle (11).

2. Mandibular space:

Thyromental (T-M) distance (Patil's test): It is defined as the distance from the mentum to the thyroid notch while the patient‟s neck is fully extended (Figure 3) .This measurement helps in determining how readily the laryngeal axis will fall in line with the pharyngeal axis when the atlanto-occipital joint is extended. Alignment of these two axes is difficult if the T-M distance is < 3 finger (12).

Inter-incisor distance: Measured from the upper central incisors to the lower central incisors while the patient‟s mouth was fully opened. If it is less than 5 cm (approximately three finger breadths) with limited forward protrusion of the mandible, this is associated with increased risk of difficult laryngoscopy (12).

Figure (3): Thyromental distance (13).

B) Scores for airway assessment

Wilson score system

Combination of 5 variables: body weight, head and neck mobility, and jaw movements, mandibular recession (retrognathia) and presence or absence of buck teeth. A risk score was developed between 0 to 10 (14).

Table (2): The Wilson score system (15).

Score Points	Risk Factors
	Weight
0	kg 90>
1	kg 110 - 90
2	kg 110<
	Mobility of the head and neck (Angle formed between the positions of greatest extension and greatest flexion of the neck)
0	°90<
1	°90~
2	°90>
	Jaw movement IO: maximum interincisal opening SLux: Jaw subluxation and maximum forward protrusion of the lower incisors beyond the upper incisors.
0	IO > 5 cm or SLux > 0
1	IO < 5 cm or SLux = 0
2	IO < 5 cm or SLux < 0

	Retrognathia
0	Absent
1	Moderate
2	Severe
	Buck teeth
0	Absent
1	Moderate
2	Severe

Ø Scores ≥ 2 and ≤4 = a possibly difficult intubation; >4 = often difficult intubation.

LEMON airway assessment method (Figure 4):

A score with a maximum of 10 points is calculated by assigning 1 point for each of the following LEMON criteria:

L = Look externally (facial trauma, large incisors, beard or moustache, large tongue)

E = Evaluate the 3-3-2 rule (inter-incisor distance-3 finger breadths, hyoidmental distance-3 finger breadths, thyroid to floor of the mouth distance-2 finger breadths)

M = Mallampati (Mallampati score ≥ 3).

O = Obstruction (presence of any condition like epiglottitis, peritonsillar abscess, trauma).

N = Neck mobility (limited neck mobility)

Patients in the difficult intubation group have higher LEMON scores (10).

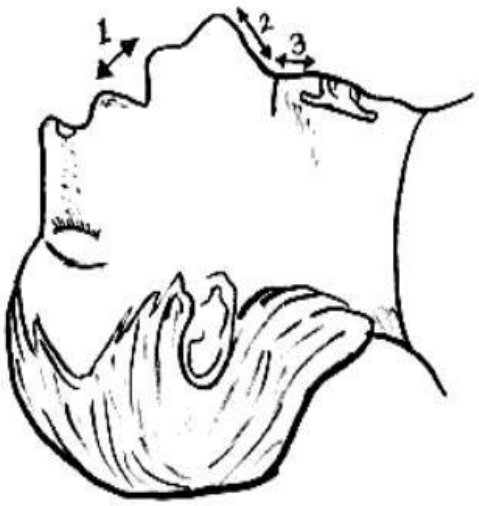

Figure (4): LEMON airway assessment method. 1 = Inter-incisor distance in fingers, 2 = Hyoid-mental distance in fingers, 3 = Thyroid-to-floor of mouth in fingers (8).

3. Cormack –lehane scoring system:

Difficulty in intubation can be classified according to the view obtained during direct laryngoscopy into 4 grades. These 4 grades of laryngoscopic views were defined by Cormack and Lehane in 1984 (Figure 5).

Grade I – Visualization of the entire laryngeal aperture.

Grade II – Visualization of only the posterior commissure of laryngeal aperture.

Grade III – Visualization of only the epiglottis. § Grade IV – Visualization of just the soft palate.

-Grades III and IV predict difficult intubation. (7).

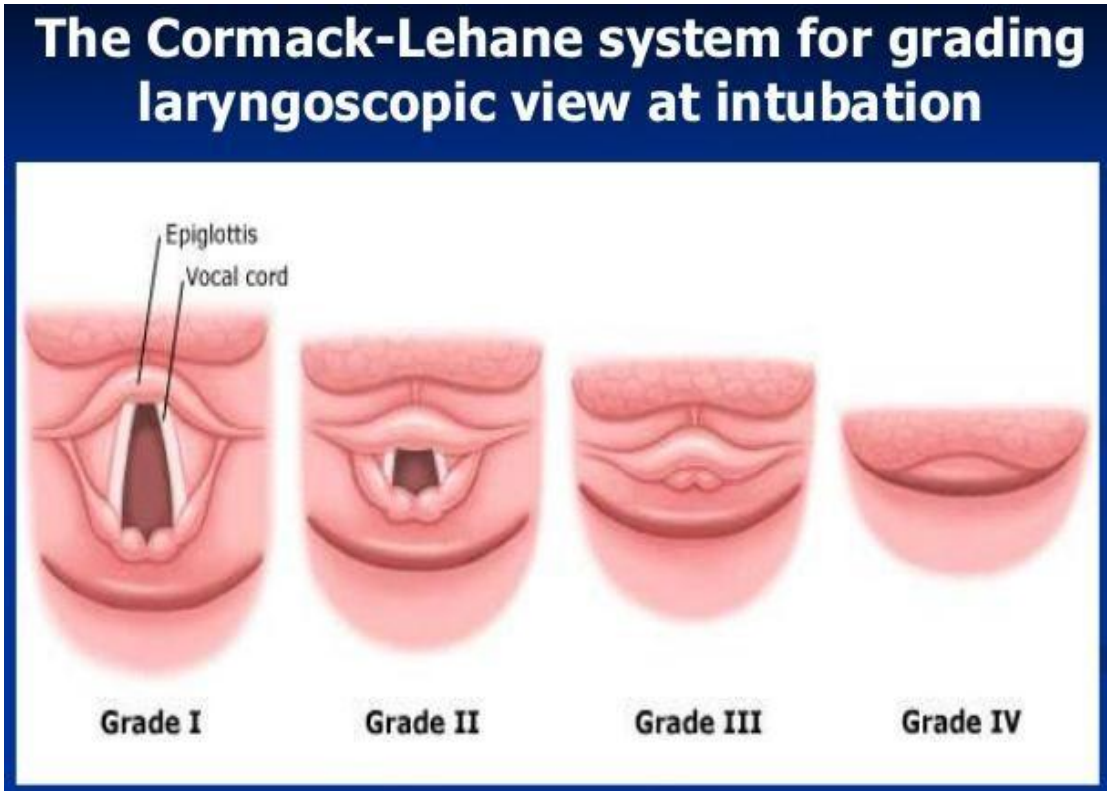

Figure (5): Grades of laryngoscopic views (11).

4. El-Ganzouri score:

Table (3): Risk index of El-Ganzouri for difficult tracheal intubation

Points	Finding	Variable
0 1	cm 4 ≤ cm 4 >	Mouth opening
0	cm 6.5 <	Thyromental distance
1	cm 6.5–6.0	
2	cm 6.0 >	
0	I	Mallampati score
1	II	
2	III	
0	°90 <	Neck movement
1	°90–80	
2	°80 >	
0	Yes	Ability to prognath

1	No	
0	kilograms 90 >	Body weight
1	kilograms 110–90	
2	kilograms 110<	
0 1 2	None Questionable Definite	History of difficult intubation

The minimum score is 0 and the maximum score is 12: (10)

Tracheal Intubation	**Index Score**
unlikely to be difficult	4 >
likely to be difficult	4 ≤

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