A SYNOPSIS OF AIRWAY ASSESSMENT: EASE OF INTUBATION

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Abstract

Airway management is a critical aspect of anaesthesia practice, with significant implications for patient safety and outcomes. This synopsis synthesizes key concepts from recent presentations on airway assessment, predictors of difficult intubation, and management strategies. Emphasizing the importance of thorough preoperative evaluations, this article aims to provide a framework for anticipating and managing difficult airways effectively.

1. INTRODUCTION

- About 30% of anaesthetic deaths are associated with problematic airway management.[1]
- The entire incidence of difficult endotracheal intubation in the surgical population is 5.8% but could be as high as 22.2% in patients with obstructive sleep apnoea (OSA).[2]
- Development of airway emergencies increases the probability of death/brain damage by 15 folds.[3]
- Poor preparation, leads to suboptimal management of patients with difficult airway resulting in most of these tragedies.

The Goals for Endotracheal Intubation

- Ensure airway patency for oxygenation and ventilation
- Protect lower airway from gastric content, blood, debris
- Tracheal intubation often requires direct laryngoscopy, otherwise could be achieved by indirect techniques/advanced equipment
- Direct laryngoscopy requires: A line of sight from upper teeth to glottis; Mouth opening, extension of the upper C-spine; Displacing of mandibular arch tissues
- The challenge of achieving tracheal intubation is a spectrum that spans relative ease to difficulty
- The effectiveness of mask ventilation during preoxygenation affects the duration of apnoea during tracheal intubation thus the ease of intubation

- Additionally, the use of airway assessment to predict difficult airway is fundamental to achieving ease of intubation

Difficult Airway (DA) is a clinical situation in which a conventionally trained anesthesiologist experiences difficulty with facemask ventilation of the upper airway, difficulty with tracheal intubation or both ~ ASA practice guidelines definition.[4]

Where "an experienced provider anticipates or encounters difficulty with any or all of face mask ventilation, direct or indirect (e.g., video) laryngoscopy, tracheal intubation, supraglottic device use or surgical airway."~ Canadian Airway Focus Group 2022.

Langenstein and Cunitz, also defined an intubation as difficult, if a practicing anesthesiologist needed more than 3 attempts or more than 10 min for a successful endotracheal intubation.[5]

DA is the most important cause of anaesthesia – related morbidity and mortality.[1]

The etiology of DA:

i. Operator based
ii. Patient based
iii. Equipment based

Airway Assessment are the processes that detect risks to airway maintenance, ventilation & oxygenation, not just difficulty in laryngoscopy/intubation.

These "processes" History, examination & investigations will produce an "airway plan" that anticipates and circumvents predicted difficult airway or alleviate their adverse effects.

Consequently, **AIRWAY ASSESSMENT = AIRWAY PLAN = EASE OF INTUBATION.**

Thus, an Airway Assessment is critical to the Ease of Intubation.

2. PREDICTING A DIFFICULT AIRWAY

Predicting a difficult airway is best done before surgery during the preanaesthetic review, taking relevant clinical history, examination and appropriate investigations.

Clerk patient, check patients' records and anaesthetic charts if any, is there a desaturation risk: e.g. paediatric patients, pregnancy, obesity, sepsis

Relevant clinical history that is predictive of difficult airway include;

- Edentulous patients; jaws slide over gum = poor facemask seal
- Bearded patients; poor facemask seal
- Neonates & Infants; large tongue to mouth ratio, obligate nasal breathers, differences in the airway anatomy
- Contractures from burns (Face/Neck)

- Congenital Anomalies: Down's, Klippel- Feil, Pierre - Robins Syndromes, Hydrocephalus, Cleft lip/palate etc
- Acquired difficulties: Pregnancy, Obesity, Diabete Mellitus, Rheumatoid Arthritis, Ankylosing Spondylitis, Osteoarthritis, Acromegaly, Snoring, OSA,, severe tetanus, Large Goitre, Oropharyngeal tumours
- Iatrogenic problems: C-spine fusion, Oral/Pharyngeal radiotherapy, wired jaw, Laryngeal/Tracheal/TMJ surgery
- Trauma: Maxillofacial, Mandible, larynx, trachea, head injury with cervical collar +/- fracture
- Emergency patients: limited time for thorough airway assessment, starvation status
- Aspiration risk: Increased in DA. May complicate any airway management situation & should be an essential part of airway assessment however does not predict DA. Patient's last oral intake, co – morbidities, medication & current surgical pathology should be considered. When indicated before surgery ensure reduction of gastric pH & volume by fasting, pharmacological means & mechanical decompression with a gastric tube.

Congenital Anomalies associated with Difficult Airway

Syndrome	**Airway features**
Apert syndrome	Midface hypoplasia; possible choanal stenosis; progressive calcification of cervical spine
Crouzon syndrome	Midface hypoplasia; maxillary hypoplasia
Pfeiffer syndrome	Midface hypoplasia
Pierre Robin sequence	Micrognathia; glossoptosis (backward displacement of tongue); Cleft palate
Goldenhar syndrome	Asymmetrical malar; maxillary and mandibulary hypoplasia; hemifacial microsomia
Treacher Collins syndrome	Bilateral malar and mandibular hypoplasia; airway obstruction at rest
Mucopolysaccaridoses (Hunter's and Hurler's syndrome)	Accumulation Of mucopolysaccharides in various tissues, including airway; short, immobile neck; cervical instability Macroglossia
Beckwith—Wiedemann syndrome	Airway features

Physical Examination: Note the following predictive of difficult airway

- Hair styles; that prevent neck extension
- Anatomical hindrances; Nasal patency, small mouth, receding chin, high arched palate, cleft palate, large tongue, bull neck, large breasts
- Acquired difficulties; head/neck burns, tumours, haematoma, restrictive scars, reduced mouth opening, Obesity (BMI > 35kg/m2)
- Poor C-spine movement; especially at the occipito-atlanto-axial
- Poor dentition; anterior gaps, buck, loose teeth

- Prayer sign; Glycosylated joint in DM
- Surgical equipment; neck collar, halo traction, dental wiring
- Palpate neck swellings; displaced larynx/trachea
- Palpate for Thyroid and Cricoid cartilages, identify the Cricothyroid membrane
- Preoperatively, an impalpable trachea & cricothyroid membrane may be located by ultrasound and marked
- Paediatrics; Difficult intubation is associated with weight < 10kg, Micrognathia

Investigations: predictive of difficult airway

- Indirect Laryngoscopy; Laryngeal view is classified
- Video Laryngoscopy; Laryngeal view is classified
- Xray; Chest, Thoracic inlet, Cervical spine - PA, lateral
- MRI/CT Chest; Complex airway, soft tissue pathology
- Nasendoscopy

3. AIRWAY ASSESMENT TOOLS

Assessment of Difficult Mask Ventilation

- Age > 60 years
- Male sex
- Full beard
- BMI> 35
- Previous difficult tracheal intubation
- Snoring
- OSA
- Edentulous Patient
- Thyromental distance < 6cm,
- Mallampati classes III & IV
- Facial abnormalities
- Neck radiotherapy
- DIFFMASK score ≥ 5
- Facemask ventilation is categorized as follows:
- Easy
- Difficult – FM vent inadequate, unstable or requiring two providers, with or without neuromuscular blocking agents (NMBA)
- Impossible – unable to facemask ventilate with or without NMBAs

DIFFMASK score by Lundstrøm et al[6]

- Uses ten predictors of difficult mask ventilation, score ranges 0 – 18

- Score ≤ 5 relative ease, 6 – 10 should be further assessed; higher scores predict increased risk & difficulty
- Sensitivity of 85% and specificity of 59%

DIFFMASK Score for Predicting Difficult Mask Ventilation		
Age	45-59 yrs	2
	≥60 yrs	3
Male gender		1
BMI	25-35	2
	>35	3
Previous difficult intubation		1
Thyromental distance	6.0-6.5 cm	1
	<6.0 cm	2
Mallampati score	3	1
	4	2
Full beard		2
Snoring		1
Sleep apnea		1
Neck radiation skin changes		2

Assessment of Difficult Direct Laryngoscopy

a. Inter Incisor Gap; Distance between the incisors/alveolar margins with the mouth opened maximally should at least 3cm

- <3cm predicts difficulty
- <2.5cm SGA insertion will also be difficult

b. Thyromental distance (Patil test); Tip of the thyroid cartilage to tip of the mandible, neck fully extended:

- Normal ≥ 6cm
- <6cm predicts ~ 75% of difficult laryngoscopies
- Combined Patil & Mallampati tests (<6cm & Class III & IV) increase specificity (97%) but decrease sensitivity (81%)

c. Sternomental distance (Savva test); sternal notch to tip of mandible, neck fully extended, mouth closed:

- < 12.5cm associated with difficulty (positive predictive value 82%)

d. Mandibular protrusion;

- ➢ Class A: can protrude lower incisors beyond upper incisors
- ➢ Class B: can protrude lower incisors to but not beyond upper incisors
- ➢ Class C: can't protrude lower incisors to upper incisors
- ✓ Classes B & C are associated with difficulty

e. Upper lip bite test; The patient attempts to bite as far up their lip as possible

- ➢ Class I: lower incisors bite upper, upper lip mucosa not visible
- ➢ Class II: lower incisors bite upper, upper lip mucosa partially visible
- ➢ Class III: lower incisors fail to bite upper lip
- ✓ Class III is a strong predictor of difficult laryngoscopy

f. Extension of the upper cervical spine; when restricted, increases the risk of difficult direct laryngoscopy. Movement may be assessed by

- ➢ Flexing the head on the neck, restraining the lower C-spine with a hand on the neck, then fully extending the head
- ➢ Placing a pointer on the vertex/forehead allows estimation of the angle of movement
- ➢ Placing one finger on the patient's chin and one finger on the occipital protuberance and extending the head maximally
- ✓ With normal spine flexibility, the finger on the chin is higher than that on the occiput
- ✓ Fingers at the same level indicate moderate limitation - difficulty
- ✓ Finger on chin lower than finger on occiput indicates severe limitation – extreme difficulty

h. Modified Mallampati Test (with Samsoon & Young's modification); Examiner is positioned opposite the patient, the oropharynx is viewed while patient opens mouth maximally, protruding tongue without phonating

- ➢ Class I: faucial pillars, soft palate and uvula visible
- ➢ Class II: faucial pillars & soft palate visible, uvula tip masked by base of tongue
- ➢ Class III: only soft palate is visible
- ➢ Class IV: soft palate not visible
- ✓ Class III & IV views are associated with difficult laryngoscopy

i. Laryngeal View;

- Cormack & Lehane's Classification of Laryngeal View
- Grade I: Full view of the glottis
- Grade II: Partial view of the glottis or arytenoids
- Grade III: Only the epiglottis is visible
- Grade IV: Neither the glottis nor epiglottis is visualized
- ➢ Grades III & IV are associated with difficulty

- Cook's Modified Classification of Laryngeal View
- Grade I: Full view of the glottis
- Grade IIa: Partial view of the glottis
- Grade IIb: Arytenoids or posterior part of the glottis only just visible
- Grade IIIa: Only the epiglottis is visible but liftable
- Grade IIIb: Only the epiglottis is visible but not liftable
- Grade IV: Neither the glottis nor epiglottis is visualized
- In Cook's classification, the 'easy' views (I & IIa) require no adjuncts, restricted views (IIb & IIIa) require a bougie, 'difficult' views (IIIb & IV) require advance techniques to facilitate intubation

j. Wilsons score

- ➢ Five factors; weight, upper C-spine mobility, jaw movement, receding mandible & protruding upper teeth
- ➢ Each factors scored 0,1 or 2 points from broadly normal to severely abnormal
- ✓ Total score ≥ 2 predicts 75% of difficult intubations, 12% false positives

Assessment of Difficult Direct Laryngoscopy in Critically Ill

▪ **MACOCHA Score**[7]; Detects critically ill patients at risk of difficult intubation ▪ Range 0 – 12 (score > 2 predicts difficult intubation)	• *Weighted variables*: ▪ **M**allampati III/IV – 5 points ▪ **A**pnoea/OSA – 2 points ▪ **C**-spine mobility – 1 point ▪ Mouth **O**pening < 3cm – 1 point ▪ **C**oma – 1 point ▪ Severe **H**ypoxaemia – 1 point ▪ Non – **A**naesthetist intubator – 1 point

Airway Assessment for difficult intubation in the emergency room – LEMON Score

EVALUATION CRITERIA	POINTS
L = Look externally	
Facial trauma	1
Large incisors	1
Beard or moustache	1
Large tongue	1
E = Evaluate the 3-3-2 rule	
Incisor distance-3 finger breadths	1
Hyoid-mental distance-3 finger breadths	1
Thyroid-to-mouth distance-2 finger breadths	1
M = Mallampati (Mallampati score > 3)	1
O = Obstruction (presence of any condition like epiglottitis, peritonsillar abscess, trauma)	1
N = Neck mobility (limited neck mobility)	1
Total	**10**

An airway assessment score based on criteria of the 'L-E-M-O-N' method is able to successfully stratify the risk of difficult intubation. When all these airway predictors are combined and used as the 'L-E-M-O-N' assessment score the ability to predict a difficult intubation is greatly improved, as there is a greater possibility of a difficult intubation in patients with a higher score on a scale of zero to ten than those with lower scores.

Assessment of Difficult Awake Tracheal Intubation (ATI)

- With an experienced operator, the complication of unexpected removal of a fibre-optic bronchoscope, Video laryngoscope or Tracheal tube during ATI is 1 – 2%
- **Predictors**:
- inadequate oxygenation

- uncooperative patient
- operator and/or assistant inexperience
- suboptimal environment
- airway blood or unmanageable secretions,
- inadequate topical anaesthesia
- Oversedation
- very narrow airway

Assessment of Difficult Front of Neck Access (FONA)

- Obesity; increased pretracheal tissue
- Anterior neck masses; Goitre
- Infection/scarring
- Tracheal deviation
- Previous radiotherapy
- Surgical collar/external fixator limiting access

Assessment of Difficult Paediatric Mask Ventilation and Intubation[8,9]

- Predictors of difficult mask ventilation
- Age (risk increases as the age decreases)
- Neck circumference
- receding chin
- Poor neck extension
- Difficult intubation is associated with
- Weight < 10kg
- Micrognathia
- >2 direct laryngoscopy attempts before an indirect technique

Practical Use of Airway Assessment

- The 4th National Audit Project looking at 'Major Complications of Airway Management in the United Kingdom' highlighted significant deficiency in airway assessment as a factor in many of the cases of airway complications. Out of 133 reports, difficulty in airway management was anticipated in 66 cases but subsequent management strategy was not always matched to the initial assessment.[10]

- Guidelines for the management of anticipated & unanticipated difficulty with mask ventilation and tracheal intubation exists (DAS, ASA).

Practical Use of Airway Assessment

- For these guidelines to be viable, they rely on the assumption that each of these options is a credible proposition in the first place.

- When problems are detected in the primary airway assessment, this should prompt the possibility of an alternative, individualized airway management plan.
- Mortality and morbidity cases of airway difficulty should be presented regularly at clinical meetings and used to test the recommendations of the established guidelines. The formulation of local guidelines may be required.

4. CONCLUSION

Effective airway assessment is vital for predicting and managing difficult intubations. By understanding the various predictors and employing appropriate assessment tools, healthcare providers can develop individualized airway management plans that enhance patient safety and improve outcomes. Regular presentation and discussion of difficult airway cases can further refine these strategies and ensure that anaesthetists are well-prepared for any challenges that may arise during airway management.

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