PREDICTORS OF DIFFICULT AIRWAY: PREOPERATIVE ASSESSMENT

Suhasini Sonavdekar¹, Mitali Nayak²

¹Associate Professor, Department of Anaesthesia, MGM Medical College & Hospital, Kamothe, Navi Mumbai, Maharashtra.

²Professor, Department of Respiratory Medicine, Terna Medical College & Hospital, Nerul, Navi Mumbai, Maharashtra.

ABSTRACT

BACKGROUND

The primary goal of an anaesthesiologist is to maintain a patent airway. Successful airway management requires a range of knowledge and skill sets. The ability to predict difficulty with airway management beforehand is very important. The management of difficult airway is different and requires skill besides the use of various equipment. It is therefore essential to assess the airway preoperatively to prevent further complications.

KEYWORDS

Difficult Airway, Preoperative Assessment.

HOW TO CITE THIS ARTICLE: Sonavdekar S, Nayak M. Predictors of difficult airway: Preoperative assessment. J. Evolution Med. Dent. Sci. 2016;5(36):2163-2168, DOI: 10.14260/jemds/2016/504

INTRODUCTION

The main role of anaesthesiologist is to maintain a patent airway in an anaesthetised patient. Patent airway is essential to maintain adequate oxygenation and ventilation. It is crucial therefore to recognise patients for whom mask ventilation or intubation is potentially difficult. Assessment of airway must be carefully done in all situations, be it elective or emergency so that preventative measures can be taken and one must be prepared to apply first-line treatment. This will avoid the stress of a surprise situation.

Definition

The 2013 ASA practice guidelines describe a “difficult Airway” as a clinical situation in which a conventionally trained Anaesthesiologist experiences difficulty with mask ventilation, tracheal intubation or both.^{1,2}

The term “Airway” refers to the upper airway and may be defined as the extra-pulmonary air passage, consisting of the nasal and oral cavities, pharynx, larynx, trachea and large bronchi.³

An “Experienced Anaesthetist/Endoscopist” is considered as experienced in airway management if he/she has performed more than 20 difficult laryngoscopies and intubations while working in a busy unit performing an average of 20 elective and emergency intubations per month over a year and is currently carrying out laryngoscopy and tracheal intubation on a regular basis.

The criteria for optimal attempt for orotracheal intubation is reasonably experienced laryngoscopist, no significant muscle tone, optimal sniff position, optimal external laryngeal pressure, change length of blade once, change type of blade once.⁴

The criteria for optimal attempt for bag mask ventilation is two persons’ additive/synergistic effort for optimal jaw thrust and mask seal, large oropharyngeal airway, large bilateral nasopharyngeal airways.⁴

Difficult tracheal intubations are said to occur if proper placement of the tracheal tube with conventional laryngoscopy requires more than 3 attempts or proper insertion of tracheal tube with conventional laryngoscopy requires more than 10 minutes.

Incidence

Management of airway in case of emergency outside the OR is challenging with incidence of difficult intubation ranging from 9% to 12%^{1,5,6,7,8} and a complication rate ranging from 4.2% to 28%.^{1,5,6,8} Difficult or impossible intubation kills an estimated 600 people a year worldwide.^{4,9} In fact, up to 28% of all anaesthesia related deaths are secondary to the inability to mask ventilate or intubate.^{3,10}

Predictive Indicators of Difficult Intubation

Assessment of difficult airway in patients begins with comprehensive history and physical examination.

A. History

History taking is an art and science. Medical, surgical and anaesthetic factors play an important role in assessment of difficult airway.

Congenital disease, rheumatic disease, local pathologies, diabetes mellitus, acromegaly^{4,11} are other common factors linked to difficult intubation.

Oedema, burns, bleeding, tracheo-oesophageal stenosis, compression or perforation, pneumothorax, aspiration of gastric contents are few anaesthetic factors which predispose to difficult intubation. History of previous anaesthesia technique, previous intubations are also a guide for difficult intubation.

Neurosurgical procedures with or without division of the temporal muscle can lead pseudoankylosis of the mandible leading to difficult intubation,^{4,12} immobility of cervical spine due to previous surgery on spine. Tongue piercing predisposes to difficult intubation.^{4,13}

Financial or Other, Competing Interest: None.

Submission 06-04-2016, Peer Review 17-04-2016,

Acceptance 20-04-2016, Published 05-04-2016.

Corresponding Author:

Dr. Suhasini Sonavdekar,

Associate Professor,

Department of Anaesthesia,

MGM Medical College & Hospital,

Kamothe, Navi Mumbai,

Maharashtra.

E-mail: suhasinee.dr@gmail.com

DOI: 10.14260/jemds/2016/504

B. General and Physical Examination

Thorough assessment of patient will give a guide to predict difficult intubation. Factors including patency of nares, mouth opening, prominent incisors and canines, missing teeth, edentulous state, high arched palate, short thick neck, neck mobility, extension and flexion of neck. Infections of the airway like croup, epiglottitis, bronchitis, abscess are contributory factors. Intubation is generally considered more difficult in pregnant women and in otolaryngology (ENT).^{4,14} and traumatology patients.

C. Regional Assessment

I. Relative Tongue- Pharyngeal Size:

i) Mallampati test.^{3,4,15}

The Mallampati classification correlates tongue size to the pharyngeal size. It also may possibly indicate whether displacement of the tongue by the laryngoscope blade would be easy or difficult and whether the mouth can be opened adequately to permit intubation, besides assessing the head and neck mobility. The test can be performed when the patient is awake, standing upright with head in neutral position, mouth fully opened, and the tongue maximally protruding. Classification is assigned according to the extent the base of tongue is able to mask the visibility of pharyngeal structures.

The problems of this test has been attributed to errors in methodology. Variations between observers are also source of false positive or false negatives which is not sufficient on its own to predict difficult laryngoscopy nor, a fortiori, difficult intubation.⁴ The insufficiency of the classification has been specifically shown for obese patients in a study conducted by Lavaut et al.^{4,16} A study conducted by Calder I et al. indicates that this classification should no longer be considered individually capable of predicting with precision what laryngoscopic view will be.^{4,17}

Recent investigations^{5,18} conducted by Calder I et al. has suggested that craniocervical extension relates to mouth opening, and limited head or neck mobility may result in a poor Mallampati score.

Fig.1

ii) Cormack and Lehane Classification.^{3,19}

Cormack and Lehane (1984) have defined 4 grades of laryngoscopic view, according to the assessment of relative tongue-pharyngeal size. Intubation is easy for grade I and slightly more difficult for grade II, but this is generally improved by external manipulation of the larynx. Grade III corresponds to severe intubation difficulties, and grade IV usually corresponds to an impossible intubation.

Fig. 2: Cormack and Lehane Classification

II. Assessment of Mandibular Movement

1. Inter incisor gap is measured between the upper and lower incisors in midline when the mouth is maximally open. It helps in assessment of space for insertion of laryngoscope blade. Normal is 4.6 cm.
2. Subluxation of the mandible: Helps to assess the amount of anterior mandibular movement.

III. Assessment of Mandibular Space

1. Thyromental Distance.^{3,20}

Besides being an indicator of mandibular space, the test also reflects whether displacement of tongue by the laryngoscope blade would be easy or difficult. It is defined as the distance between the mentum to the thyroid notch when the patient's neck is fully extended. Normal is >6.5 cm.

2. Hyomental Distance.^{3,21}

Measurement of mandibular length from mentum to hyoid should be at least 6 cm or 3 fingerbreadths. It helps in assessing the capacity of the mandibular space to accommodate the tongue on laryngoscopy. Laryngoscopy becomes difficult as the vertical distance between the mandible and hyoid bone is increased.

3. Sternomental Distance.^{3,22}

Savva estimated the sternomental distance and investigated its possible correlation with Mallampati class, jaw protrusion, inter incisor gap and thyromental distance. It is measured as distance from the suprasternal notch to the mentum. A value of less than 12 cm is found to predict a difficult intubation. It is an indicator of head and neck mobility. Head extension is an important factor in determining difficulty or ease of intubation.

IV. Atlanto-Occipital Joint Extension

Sniffing or Magill position is required for intubation. Intubation requires alignment of oral, pharyngeal and laryngeal axes into an arbitrary straight line. Atlanto-occipital joint extension assess feasibility to make sniffing position. Normal angle of extension is 350 or more.^{3,23,24}

Wilson and his colleagues^{4,25} in 1988 developed another scoring system to identify patients in whom difficult intubation was likely. The risk score was developed between 0 to 10 taking into account 5 variables-Weight in kg, Head and neck mobility (Degrees), Mandibular mobility, Retrognathism, Prominence of upper incisors. A score of 2 or more is predictive of a difficult laryngoscopy (Intubation).

Risk factor	Level	
Weight	0	< 90 kg
	1	90–110 kg
	2	> 110 kg
Head and neck movement	0	Above 90°
	1	About 90°
	2	Below 90°
Jaw movement	0	IG ≥ 5 cm or Slux > 0
	1	IG < 5 cm and Slux = 0
	2	IG < 5 cm and Slux < 0
Receding mandible	0	Normal
	1	Moderate
	2	Severe
Buck teeth	0	Normal
	1	Moderate
	2	Severe

Fig. 3: Wilson Score

Arne and colleagues^{3,26} produced a new scoring system based on multifactorial analysis. Apart from the indicators by Wilson et al, it also included presence or absence of overt airway pathology. The sensitivity and specificity levels of this score was above 90%.

El-Ganzouri Score^{4,27}

It includes all Wilson criteria along with thyromental distance, Mallampati classification and history of difficult intubation. A value of 4 or more has better predictive value than Mallampati classification.

Variable\Score	0	1	2
Interincisor gap	≥4 cm	<4 cm	
Thyromental distance	>6.5 cm	6.0–6.5 cm	<6.0 cm
Modified Mallampati class	I	II	III, IV
Neck movement	>90°	80–90°	<80°
Ability to prognath	Yes	No	
Body weight	<90 kg	90–110 kg	>110 kg
History of D/I	None	Questionable	Definite

Fig. 4: El-Ganzouri Score

A meta-analysis by Shiga et al.⁵ was done to predict difficult intubation in apparently normal patients. Screening tests included the Mallampati oropharyngeal classification, thyromental distance, sternomental distance, mouth opening, and Wilson risk score. Each test yielded poor-to-moderate sensitivity (20-62%) and moderate-to-fair specificity (82-97%). The most useful bedside tests for prediction was found to be a combination of the Mallampati classification and thyromental distance (Positive likelihood ratio, 9.9; 95% confidence interval, 3.1-3.19). Currently available screening tests for difficult intubation have only poor-to-moderate discriminative power when used alone.

In a study conducted by Lynette J. Mark,¹ it revealed that 6.2% incidence of difficult intubation in non-obese, non-obstetric patients with no airway pathology.

D. Radiographic Assessment

1. X-ray lateral cervical film with head in neutral position closed is done to assess the following measurements: Mandibulohyoid distance, Atlanto-occipital gap, Relation of mandibular angle and hyoid bone with cervical vertebra and laryngoscopy grading, anterior/posterior depth of mandible, C1-C2 gap.
2. Plain X-ray to evaluate the nasopharynx, pharynx, trachea, subglottic lesions.
3. Fluoroscopy for dynamic imaging to rule out cord mobility, airway malacia, emphysema.
4. Oesophagogram to rule out inflammation, foreign body, vascular ring, mass.
5. Ultrasonography to evaluate functional and organic airway disorders, anterior mediastinal mass, lymphadenopathy.
6. Computed tomography, MRI to assess congenital anomalies, airway compression.

E. Pulmonary Function Tests²⁸

They provide valuable information about patency of airway passages. Flow volume loops also provide assessment of obstructive lesions such as extrathoracic and intrathoracic.

Obtaining a flow volume loop in the pulmonary function laboratory is simple and effective method of noninvasively evaluating a patient for the presence of an upper airway obstruction.

Fixed lesions cause plateaus in both the inspiratory and expiratory limbs of the flow volume loop. Examples are tracheal stenosis caused by intubation and a circular tracheal tumour.

Variable intrathoracic lesions are characterised by expiratory slowing and flattening of the expiratory limb. Example, a tumour located near the intrathoracic part of the trachea. An important caveat is that these changes may not be present in a patient with coexisting lower airway disease such as COPD or asthma.

Variable extrathoracic lesions cause inspiratory slowing and a plateau on the inspiratory limb of the flow volume loop. This is seen in cases of vocal cord paralysis, extrathoracic goitre and laryngeal tumours.

ASA Difficult Airway Task Force.²⁹

The American Society of Anaesthesiologists published Practice Guidelines for difficult airway management in 1993,²⁹ with follow-up revision in 2003.³⁰ and 2013.² The ASA Difficult Airway Task Force completed an evidence based review of the available literature and concluded that there was insufficient evidence to definitely recommend any specific predictive tool,

although data suggested that some of these markers were “associated” with difficult airways.³⁰

These guidelines were developed to facilitate the management of the Difficult Airway and to reduce the likelihood of adverse outcomes.

The Difficult Airway Task Force developed a series of tools to predict the potentially difficult airway. They are practical and supported by prospective evaluation.

MOANS: Assesses the Potential for difficult Bag Valve Mask Ventilation

Mask seal- inadequate mask seal.

Obesity >26 kg/m².

Aged >55 years.

No teeth.

Stiff ventilation- Asthma, COPD, ARDS.

LEMON: Assesses the Potential for difficult Laryngoscopy

Look injury, large incisors, large tongue, beard.

Evaluate ‘3-3-2’ fingerbreadth 3 fingers.

Hyoid –mental distance 3 fingers.

Thyroid to mouth distance 2 fingers.

Mallampati Score > 3.

Obstruction –any condition causing obstruction.

Neck-limited neck mobility.

RODS: Assesses Difficult Placement of SGA Device

Restricted mouth opening.

Obstruction at or below the level of the larynx.

Disrupted or distorted airway.

Stiff lungs or cervical spine-poor lung compliance or inability to extend neck.

SHORT: Assesses the Potential for Difficult Cricothyrotomy

Surgery -prior neck.

Haematoma-significant midline neck haematoma.

Obesity > 26 kg/m².

Radiation- prior neck radiation.

Tumour- history of head and neck tumour.

Difficult Airway Society.³¹

The Difficult Airway Society is a UK-based medical specialist society formed for further management of the airway of patients by anaesthetists and other critical care practitioners.

These guidelines provide a strategy to manage unanticipated difficulty with tracheal intubation which are founded on published evidence. Where evidence is lacking, they have been directed by feedback from members of the Difficult Airway Society and based on expert opinion. These guidelines have been informed by advances in the understanding of crisis management; they emphasise the recognition and declaration of difficulty during airway management. A simplified, single algorithm now covers unanticipated difficulties in both routine intubation and rapid sequence induction.

Dart difficult Airway Response Team.¹

The multidisciplinary response program worked efficiently always in the OR, but problems remained in non-OR areas like Intensive care units, in patient departments, remote procedural rooms, emergency department. DART was implemented by a team of anaesthesiologists, otolaryngologists, trauma surgeons, emergency medicine physicians, and risk managers in 2005 at The Johns Hopkins Hospital in Baltimore, Maryland. The DART program was designed and implemented in response to adverse airway events which occurred non-OR areas. The program tackles 3 components-operations, safety, and education. These help in improving multidisciplinary difficult airway management.

CONCLUSION

Anaesthesiologist, airway and anticipation are 3A's which are inseparable. The primary role of Anaesthesiologist is to maintain patency of airway so as to provide adequate oxygenation. Predictive tests of difficult intubation are numerous. Some are simple, rapid, affordable having varying degrees of sensitivity and specificity with good positive and negative predictive values. In spite of all, some patients with a difficult airway will remain undetected.

Thus, the role of anaesthesiologist is to be prepared with various plans and must gain expertise in handling all equipment in difficult cart.

Intelligent anticipation, adequate precautions & preparation with timely intervention & close monitoring are the key words to success in airway management.

ACKNOWLEDGMENT

The authors would like to thank Dr. Lalita V. Tuteja, for her guidance and support.

REFERENCES

1. Lynette J Mark, Kurt R Herzer, Renee Cover, et al. Difficult airway response team: a novel quality improvement program for managing hospital-wide airway emergencies. *Anesthesia-Analgnesia* 2015;121(1):127-39.
2. Apfelbaum JL, Hagbery CA, Caplan RA, et al. Practice guidelines for management of the difficult airway: an updated report by the American society of anesthesiologists task force on management of the difficult airway. *Anesthesiology* 2013;118:251-70.
3. Sunanda Gupta, Rajesh Sharma KR, Dimpel Jain. Airway assessment : predictors of difficult airway. *Indian Journal of Anaesthesia* 2005;49(4):257-62.
4. Pierre Diemunsch, Thierry Pottecher. Predictive signs of difficult intubation.
5. Benedetto WJ, Hess DR, Gettings E, et al. Urgent tracheal intubation in general hospital units: an observational study. *J Clinical Anesthesia* 2007;19(1):20-4.
6. Martin LD, Mhyre JM, Shanks AM, et al. 3,423 emergency tracheal intubations at a university hospital: airway outcomes and complications. *Anesthesiology* 2011;114(1):42-8.
7. Mort TC. Emergency tracheal intubation: complications associated with repeated laryngoscopic attempts. *Anesth Analg* 2004;99:607-13.
8. Jaber S, Amraoui J, Lefrant JY, et al. Clinical practice and risk factors for immediate complications of endotracheal intubation in the intensive care unit: a prospective, multiple center study. *Crit Care Med* 2006;34(9):2355-61.
9. King TA, Adams AP. Failed tracheal intubation. *Br J Anaesth* 1990;65(3):400-14.
10. Benumof JL. Definition and incidence of difficult airway. In : Benumof JL. ed . *Airway management: principles and practice*. St Louis Mosby Ch 6, 1996;121-5.
11. Schmitt H, Buchfelder M, Radespiel-Tröger M, et al. Difficult intubation in acromegalic patients: incidence and predictability. *Anesthesiology* 2000;93(1):110-4.
12. Kabbaj S, Ismaili H, Maazouzi W. Intubation impossible après intervention neurochirurgicale. *Ann Fr Anesth Réanim* 2001;20:735-6.
13. Kuczkowski KM, Benumof JL. Tongue piercing and obstetric anesthesia: is there cause for concern? *J Clin Anesth* 2002;14(6):447-8.
14. Arne J. Criteria predictive of difficult intubation in ORL surgery. *Rev Med Suisse Romande* 1999;119(11):861-3.
15. Mallampati SR, Gatt SP, Gugino LD, et al. A Clinical sign to predict difficult intubation: a prospective study. *Can Anaesth Soc J* 1985;32(4):429-34.
16. Lavaut E, Juvin P, Dupont H, et al. Difficult intubation is not predicted by Mallampati's criteria in morbidly obese patients. *Anesthesiology* 2000;A-1364.
17. Calder I. Acromegaly, the Mallampati, and difficult intubation. *Anesthesiology* 2001;94:1149-50.
18. Calder I, Picard J, Chapman M, et al. Mouth opening: a new angle. *Anesthesiology* 2003;99(4):799-801.
19. Cormack RS, Lehane J. Difficult tracheal intubation in obstetrics. *Anaesthesia* 1984;39:1105-11.
20. Patil VU, Stehling LC, Zauder HL. Predicting the difficulty of intubation utilizing an intubation guide. *Anaesthesiology* 1983;10:32.
21. Hung OR, Murphy MFD, John Doyle. Management of the difficult & failed airway. McGraw Hill Company 2008;3-14.
22. Savva D. Prediction of difficult tracheal intubation. *Br J Anaesth* 1994;73:149-53.
23. Banister FB, MacBeth RG. Direct laryngoscopy and tracheal intubation. *Lancet* 1964;2:651.
24. Bellhouse CP, Dore C. Criteria for estimating likelihood of difficulty of endotracheal intubation with the Macintosh laryngoscope. *Anaesth intensive care* 1988;16(3):329-37.
25. Wilson ME, Spiegelhalter D, Robertson JA, et al. Predicting difficult intubation. *Br J Anaesth* 1988;61(2):211-6.
26. Arne J, Descoins P, Bresard D, et al. A new clinical score to predict difficult intubation. *Br J Anaesth* 1993;70(suppl):A1.
27. El-Ganzouri AR, McCarthy RJ, Tuman KJ, et al. Preoperative airway assessment: predictive value of a multivariate risk index. *Anesth Analg* 1996;82(6):1197-204.
28. Lunn WW, Sheller IR. Flow volume loops in the evaluation of upper airway obstruction. *Otolaryngol Clin North Am* 1995;28(4):721-9.

29. Practice guidelines for management of the difficult airway. A report by the American society of anesthesiologists task force on management of the difficult airway. *Anesthesiology* 1993;78(3):597-602.
30. American society of anaesthesiologist task force on management of the difficult airway. Practice guidelines for management of the difficult airway: an updated report by the American society of anesthesiologists task force on management of the difficult airway. *Anesthesiology* 2003;98:126-77.
31. Frerk C, Mitchell VS, McNarry AF, et al. Difficult airway society 2015 guidelines for management of unanticipated difficult intubation in adults. *British Journal of Anaesthesia* 2015;115(6):827-48.