Chapter 1
Airway Management in ED

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Key Points

- Hypoxia secondary to poorly managed airway leads to increased morbidity and mortality.
- Assess the patient to determine the type of airway intervention needed based on the set of circumstances and presentation.
- It is important to be conversant in the use of various anaesthetic agents.
- Avoid hypoxaemia or hypercarbia while preparing or while intubating the patient.
- Always have a backup plan in case of a failed airway. It is important to be conversant with the airway algorithms and also have the correct equipment available.

Introduction

- Airway management is considered a core responsibility of emergency physicians as airway assessment and management is the first step in the management of any acutely unwell patient.
- Patients in extremis requiring resuscitation often have a compromised airway, usually due to decreased consciousness.
- Prompt airway management followed by adequate ventilation mitigates secondary hypoxic damage to the brain and other vital organs.

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S.S. David (ed.), *Clinical Pathways in Emergency Medicine: Volume I*,
DOI 10.1007/978-81-322-2710-6_1

- Rapid sequence intubation is a key skill for any physician working in an emergency department.
- Mismanagement of the airway can lead to catastrophic and often devastating consequences for both the patient and the providers caring for them [1].

Signs and Symptoms of a Potential Airway Problem

A conscious patient who is able to speak is deemed to have a patent airway.

Threatened Airway

- Loud noisy breathing
- Accessory muscles supported respiration
- Abdominal muscle using expiration

Airway Management

Basic Airway Management

- Clear airway of any secretions and look for foreign bodies.
- Head tilt and chin lift (not in trauma).
- Jaw thrust (in trauma cases).

To continue patency of airway that is amenable to basic airway manoeuvres, one of the two basic airway adjuncts can be used.

- Oropharyngeal airway (OPA)
  - The size an OPA by measuring the length from the angle of the mouth to the tragus of the ear. Stand at the head end of the patient. Open the mouth and insert gently behind the tongue. In adults, insert the OPA with the concave side facing the palate. Once the tip reaches the posterior end of the hard palate, turn the OPA to have the concave surface in line with the tongue. Gently push it in until it sits comfortably on the tongue. Never force the OPA. It is not indicated if the patient is gagging on the airway. Alternatively, use tongue depressor or laryngoscope blade for OPA insertion. Tolerance of an OPA indicates loss of gag reflex and becomes an indication for definitive airway management
- Nasopharyngeal airway (NPA)
  - NPA is useful in patients who are not tolerating OPA. Size an NPA by measuring the distance between the tip of the nose to the tragus. Approximate the diameter of the NPA to the patient's nostrils. Lubricate the NPA adequately

and insert by facing the bevel to the septum in order to avoid turbinate injury. Assess patency of the nose and any signs of fracture to the base of the skull (like CSF leak, Battle sign, Raccoon eye). Basal skull or midfacial fractures are only relative contraindications, and an NPA can still be used albeit with caution.

Endotracheal Intubation

It is extremely important to assess the airway prior to intubation. LEMON is a useful mnemonic to perform this assessment which can predict a difficult airway:

(i) L – Look externally
(ii) E – Examine 3-3-2
(iii) M – Mallampati score
(iv) O – Obstructions
(v) N – Neck mobility

In an emergency, where a patient has not been prepared for anaesthetic, airway can be secured with some safety by performing a rapid sequence induction (RSI) for intubation.

Seven Ps of Intubation

1. Preparation
2. Preoxygenation
3. Premedication
4. Paralysis with sedation
5. Protection and positioning
6. Placement of tube and confirmation
7. Post-intubation care

There are three axes, oral axis, pharyngeal axis and laryngeal axis, to consider for positioning of the patient during intubation Fig. 1.1.

Ideally, these three axes should be aligned. In neutral supine position, these axes are in different directions. Recently, one of the most popular methods to improve the chances of successful airway management is called the 'ramp' position. This position is to align the auditory canal with the sternum in a straight line. This 'ramp' position has been studied and validated as one of the most important steps in enhancing the chances of successful airway management [2]. The most common mistake made during intubation is 'cranking back' on the laryngoscope handle to lever the top of the blade to provide better visibility. This manoeuvre may improve glottic visualisation; however, it restricts the operator's ability to

Fig. 1.1 Patient head position for intubation

manipulate the tube by limiting the size of the oral opening and also jeopardises the teeth.

Paralysing agents facilitate intubation and are beneficial in:

1. Tight heads (head injury, ↑ ICP)
2. Tight hearts (CAD, vascular heart disease)
3. Tight lung (bronchial asthma, hyperreactive airway, COPD)
4. Tight vessels (HTN, coarctation of the aorta)

Check the following equipment for their availability and functioning before intubation:

- Suction, oxygen, BVM device and transportable ventilator
- Airway adjuncts – appropriately sized OPA and NPA

- Appropriately sized supraglottic airway devices (SGD) like laryngeal mask airway (LMA0 or iGel)
- Laryngoscope with appropriate blade available and light source checked
- Spare laryngoscope handle
- Appropriately sized ETT: cuff checked plus a size above and below
- Stylet/bougie
- Monitors including $EtCO_2$ monitor
- Drugs
  - Sedatives/anaesthetics – etomidate, midazolam, fentanyl, propofol, thiopentone and ketamine
  - Paralytics – suxamethonium, pancuronium, vecuronium, atracurium and rocuronium
- Others – atropine, lignocaine, preservative free spray 4 % or 10 %, Lubricant

It is important to wear proper personal protection equipment like gloves, plastic apron and visors. Ideally, three assistants are required in performing an RSI: one person for managing the airway, second person for applying cricoid pressure and third person for drug administration. For crash intubation, even one assistant is acceptable.

Preoxygenation

This can be achieved by using BVM device with 100 % O_2 for 3–5 min or by 100 % O_2 through eight vital capacity breaths.

Premedication

This is best remembered by the mnemonic LOAD:

- L: Lignocaine 1–1.5 mg/kg
- O: Opioid – Fentanyl 3 mcg/kg
- A: Atropine 0.02 mg/kg
- D: Defasciculating agents [1/8th of intubating dose of non-depolarising muscle relaxants prior to suxamethonium will reduce the fasciculations]

Induction and paralytic agents Agents used to sedate and obtund reflexes prior to paralysis and intubation are called 'induction' agents – midazolam, fentanyl, propofol, etomidate, ketamine, thiopentone, etc. are agents currently available (Tables 1.1, 1.2 and 1.3).

Suxamethonium is one of the best paralytic agents for emergency intubation. Rocuronium is another paralytic agent that gives equal intubating condition but within just 60 s and without any adverse effects of suxamethonium.

Table 1.1 Sedative induction agents

Agent	Dose	Induction	Duration	Benefits	Caveats
Thiopental	3–5 mg/kg IV	30–60 s	10–30 min	↓ ICP	↓ BP
Methohexital	1 mg/kg IV	<1 min	5–7 min	↓ ICP short duration	BP seizure, laryngospasm
Ketamine	1–2 mg/kg IV	1 min	5 min	Bronchodilator, 'dissociative' amnesia	↑ Secretions, ↑ ICP emergence phenomenon
Etomidate	0.3 mg/kg IV	<1 min	10–20 min	↓ ICP	Myoclonic excitation, vomiting, no analgesia
				↓ IOP, neutral BP	
Propofol	0.5–1.5 mg/kg IV	20–40 s	8–15 min	Antiemetic, anticonvulsant	Apnea, ↓ BP, no analgesia
				↓ ICP	
Fentanyl	3–8 μg/kg IV	1–2 min	20–30 min	Reversible analgesia, neutral BP	Highly variable dose ICP: variable effects, chest wall rigidity

Table 1.2 Succinylcholine

Adult dose	1.0–1.5 mg/kg
Onset	45–60 s
Duration	5–9 min
Benefits	Rapid onset, short duration
Complications	Bradyarrhythmias
	Masseter spasm
	Increased intragastric, intraocular and possibly intracranial pressure
	Malignant hyperthermia
	Hyperkalaemia
	Prolonged apnea with pseudocholinesterase deficiency
	Fasciculation-induced musculoskeletal trauma
	Histamine release
	Cardiac arrest

Table 1.3 Non-depolarising muscle relaxants

Agent	Adult intubating IV dose	Onset	Duration	Complications
Vecuronium (intermediate/long)	0.08–0.15 mg/kg	2–4 min	25–40 min	Prolonged recovery time in obese or elderly or if there is hepatorenal dysfunction
	0.15–0.28 mg/kg (high-dose protocol)		60–120 min	
Rocuronium (intermediate/long)	0.6 mg/kg	1–3 min	30–45 min	Tachycardia
Atracurium (intermediate)	0.4–0.5 mg/kg	2–3 min	25–45 min	Hypotension
				Histamine release
				Bronchospasm

Intubation

Proper laryngoscope technique is essential for successful placement of endotracheal tube (ETT). Failure to intubate is usually due to wrong or poor technique. One of the more common mistakes made during laryngoscopy is of not having adequate control of the tongue. Human tendency is to tilt the laryngoscope blade forward. It results in not only damaging the incisors but also decreasing the chances of having an unobstructed view of the larynx.

- *Straight blades*: The tip should extend underneath the epiglottis and lift it.
- *Curved blades*: The tip should extend into the vallecula with the action of upward movement on the hyoepiglottic ligament exposing the glottic opening.

Optimal External Laryngeal Manipulation (OELM)

This manoeuvre is also known as backward, upward, rightward pressure (BURP) and was first described in 1993 by R. L. Knill [3]. The primary aim is to bring the larynx into view where the glottic opening is located too anteriorly or to the left both of which can impede the view (Fig. 1.2).

Fig. 1.2 Optimal external laryngeal manipulation (OELM)

Two methods have been described:

1. The assistant should know the principle and place pressure on the thyroid cartilage (upwards and to the right).
2. The person performing the laryngoscopy should guide the assistant into the optimal direction and with a degree of pressure that yields the best glottic view.

It is important to note that BURP manoeuvre is not the same as cricoid pressure. Cricoid pressure is applied usually during RSI, where the patient has not been fasted prior to intubation. The usefulness of cricoid pressure during intubation is questionable [4].

Cricoid Pressure

Cricoid pressure is a direct posterior pressure applied over the cricoid ring, by which the oesophagus will be occluded between the cricoid cartilage and vertebral column to prevent regurgitation and aspiration of gastric contents.

Confirmation of Tube Position

Confirmation of a properly placed tube is as important as intubation. A wrongly placed tube in the oesophagus will kill the patient within minutes. An endobronchial intubation will cause hypoxia and contralateral lung collapse.

Primary Confirmation of Tube

1. Intubation under direct vision
2. Chest movement
3. Five-point auscultation
4. Bag compliance
5. Fogging in the tube

All primary confirmation methods are not absolute and sometimes misleading.

Secondary Confirmations

1. $ETCO_2$ – All intubations should be confirmed by $ETCO_2$. This is now considered as a gold standard.

2. X-ray chest – Though this cannot rule out oesophageal intubation, it helps confirm endobronchial intubation.
3. SPO_2 – This is useful to detect misplaced tube in the late phase only.
4. Oesophageal tube detection device [EDD] – This helps to rule out oesophageal tube placement.
5. Ultrasound – This modality can also be used to help confirm correct tube placement.
6. Fibre-optic laryngoscopy and bronchoscopy – These are absolute ways to confirm tube position.

Post-intubation Care

Once the correct tube placement is confirmed, secure the tube to prevent tube migration or accidental extubation. The most common method is with adhesive tape; however, in individuals who have excessive secretions or have full beards, a circumferential tape around the neck has been recommended. Various products available commercially that combine the features of adhesive and nonadhesive methods are available. If the patient is in a hard C-collar, tie ETT over the collar. Manually ventilate patient to achieve $EtCO_2$ of 35–40 mmHg. Give post-intubation sedation for tube tolerance as required. Continue comprehensive monitoring including $ETCO_2$.

Standard timeline for rapid sequence intubation	
T – 10 min	Prepare
T – 5 min	Preoxygenate
T – 3 min	Pretreat
T = 0	Paralysis with induction
T + 30 s	Protection
T + 45 s	Placement
T + 90 s	Post-intubation management

Plan B

If plan A fails, rapidly move to alternate plans. Plan B must be a difficult airway plan.

Difficult Airway

Difficult airway is not just synonymous with difficulty with laryngoscopy and endotracheal intubation but rather is a continuum of degrees of difficulty with:

- Bag mask ventilation (BMV)
- Conventional direct laryngoscopy/intubation (DL)
- Video laryngoscopy Intubation
- Supraglottic airway placement
- Surgical (invasive) airway access.

The difficulty may be provider dependent, situation dependent, patient dependent, equipment and/or device dependent or a combination of these factors.

The '*can't ventilate and can't intubate*' situation is the most difficult and disastrous in airway management.

Can't Ventilate Situation: Plan B

- Change BMV unit.
- Use OPA and NPA.
- Use two-hand ventilation.
- Use two-person ventilation technique.
- Use gauze around the mouth – useful in oedematous patient.
- Use two pillows or remove pillow.
- Use ramp position.

Can't Intubate: Plan B

- Use BURP.
- Release cricoids.
- Release C-collar and change to manual in-line stabilisation.
- Use two pillows, no pillow or pillow under the shoulder.
- Use ramp position and align external auditory canal and sternal angle in the same line.
- Change laryngoscope blade to the next size.
- Change Macintosh to Miller blade or use McCoy laryngoscope blade.
- Use SGD, Combitube or King's airway.
- Use stylet- or bougie-assisted intubation.
- Use video laryngoscope.

Always do call for expert help.
Switch to plan C.

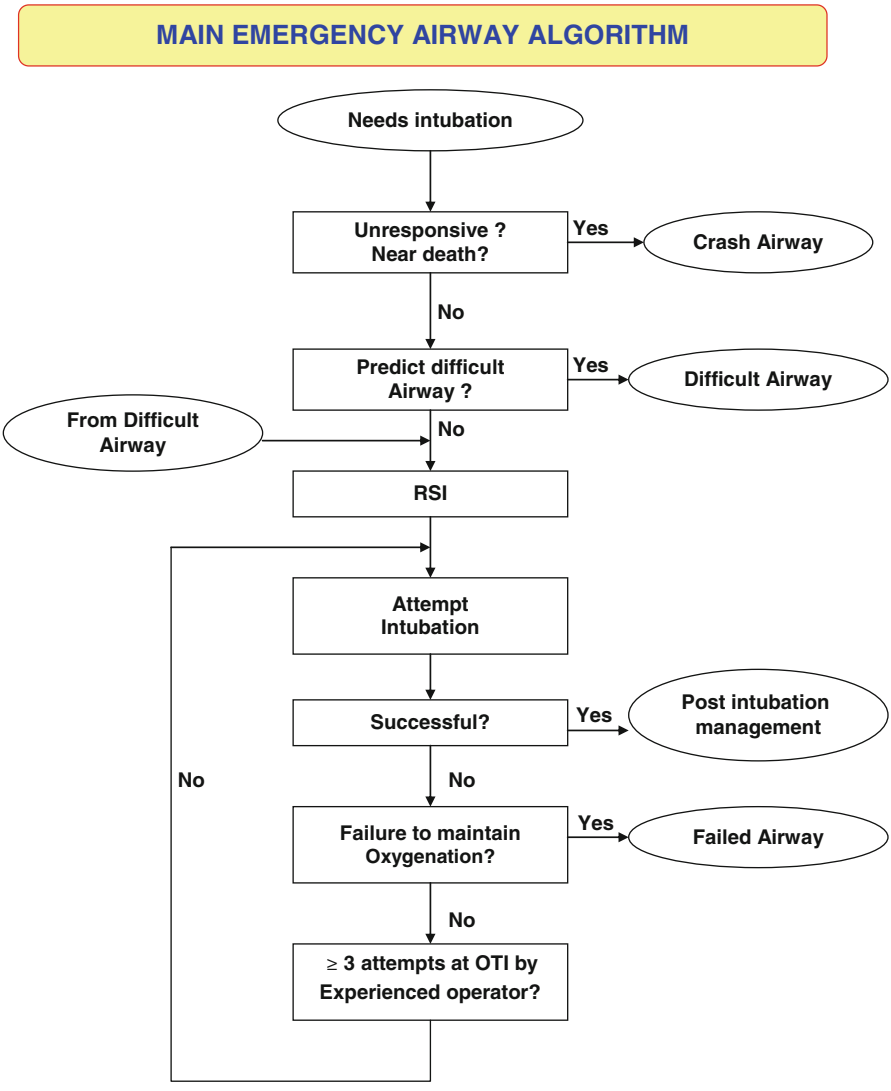
Plan C

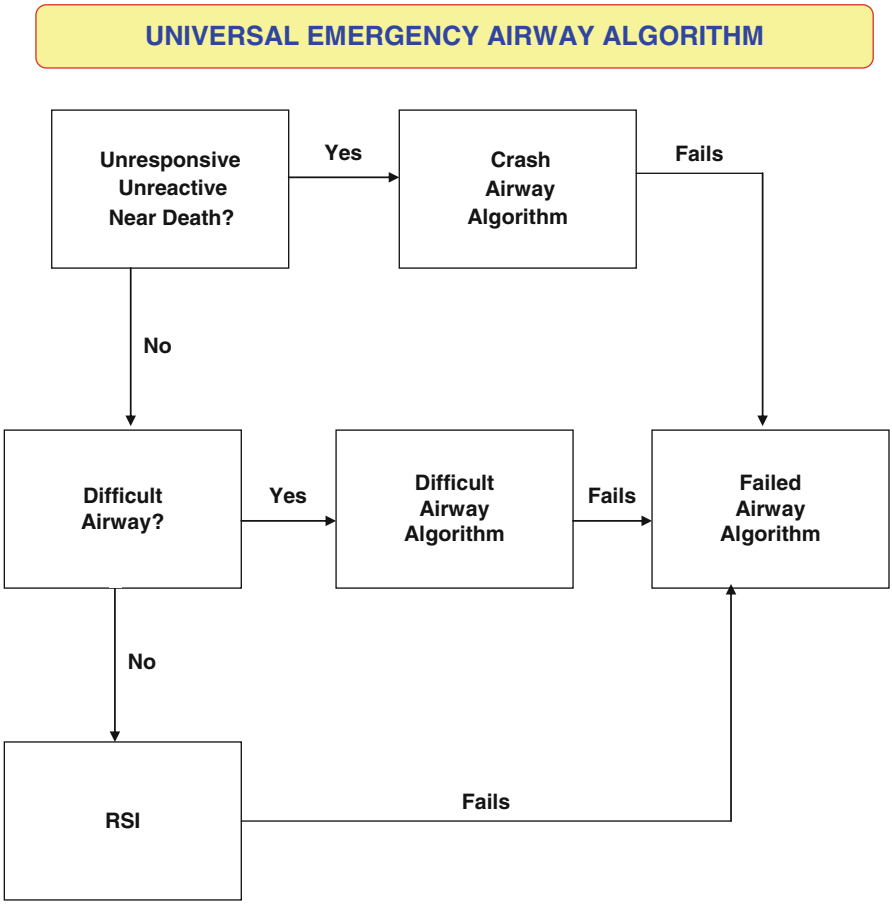
Urgent surgical airway:

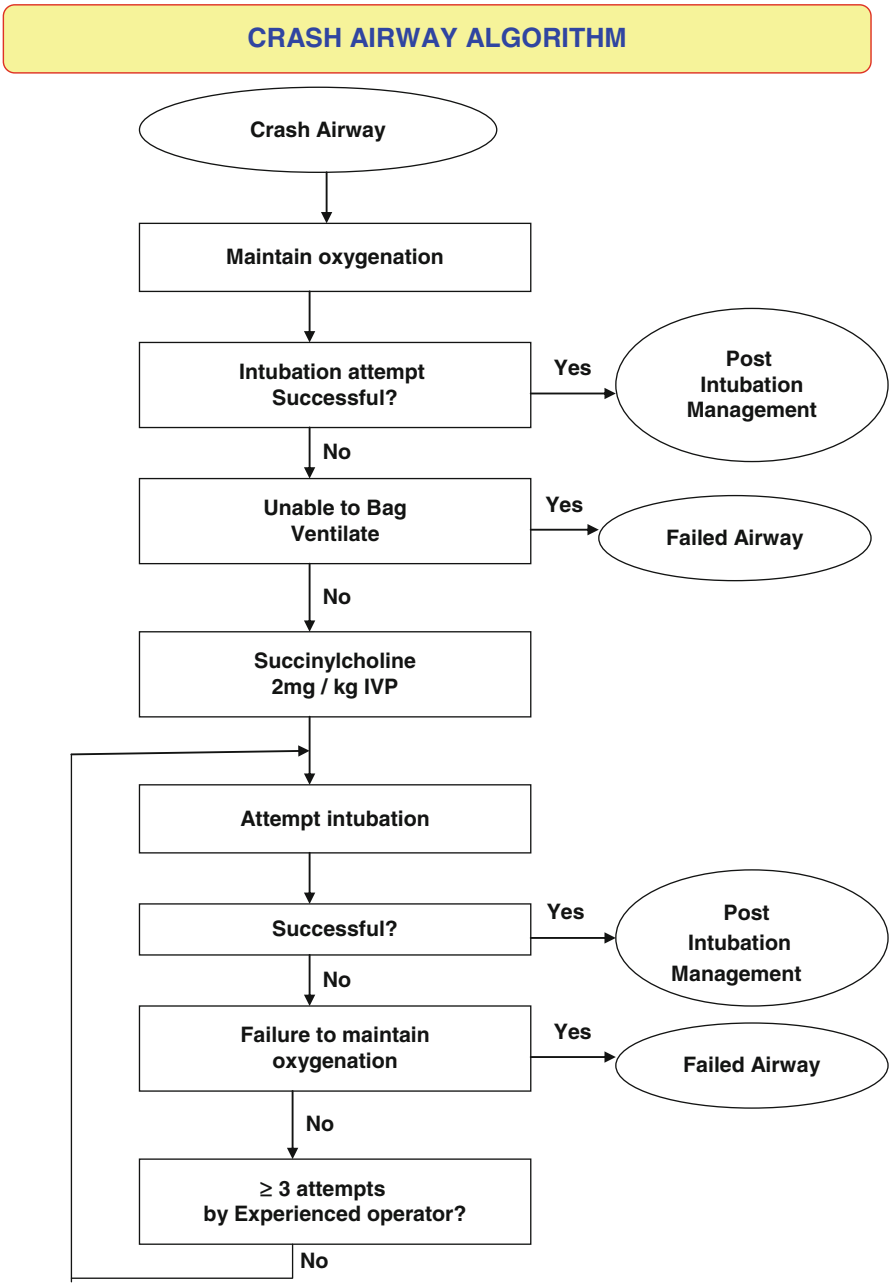
- Needle cricothyrotomy
- Surgical cricothyrotomy

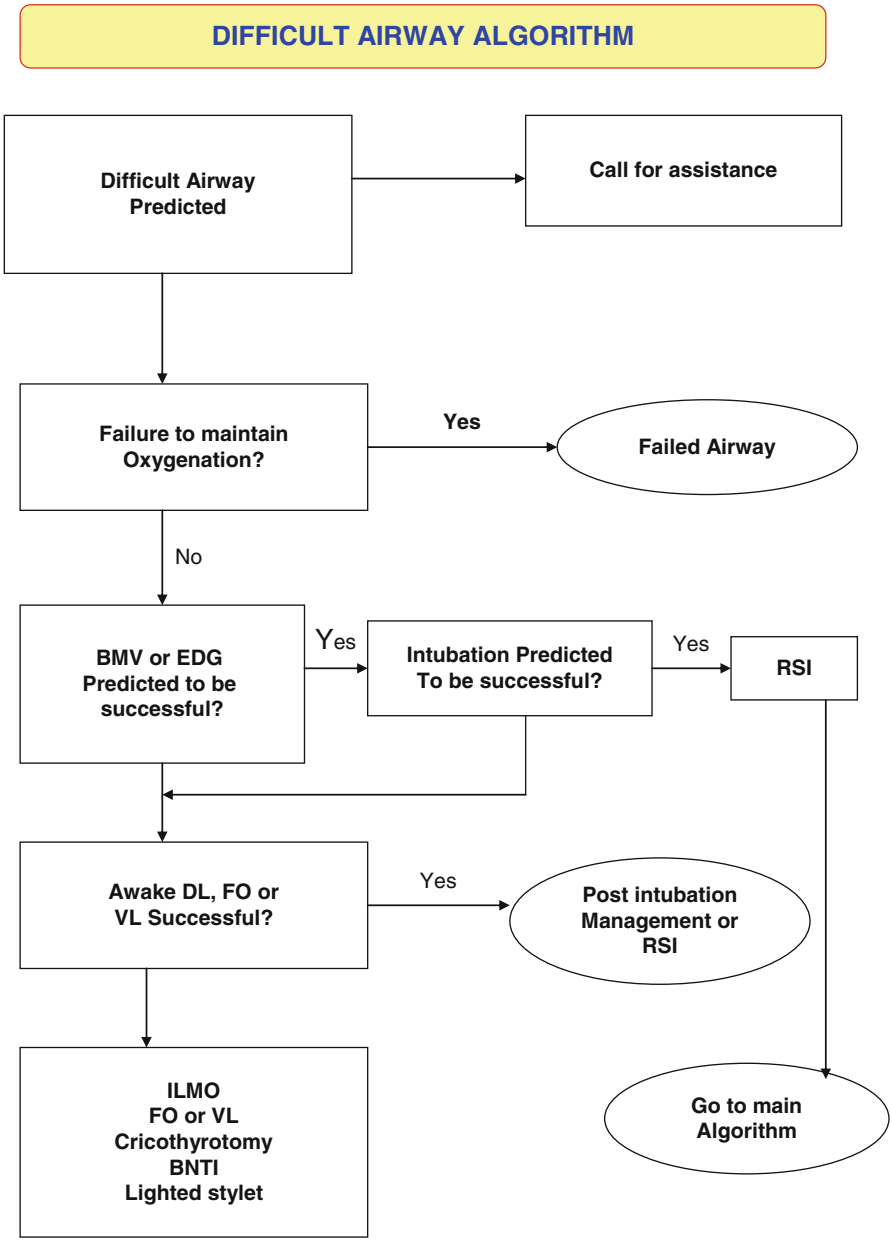
Anticipated Difficulty

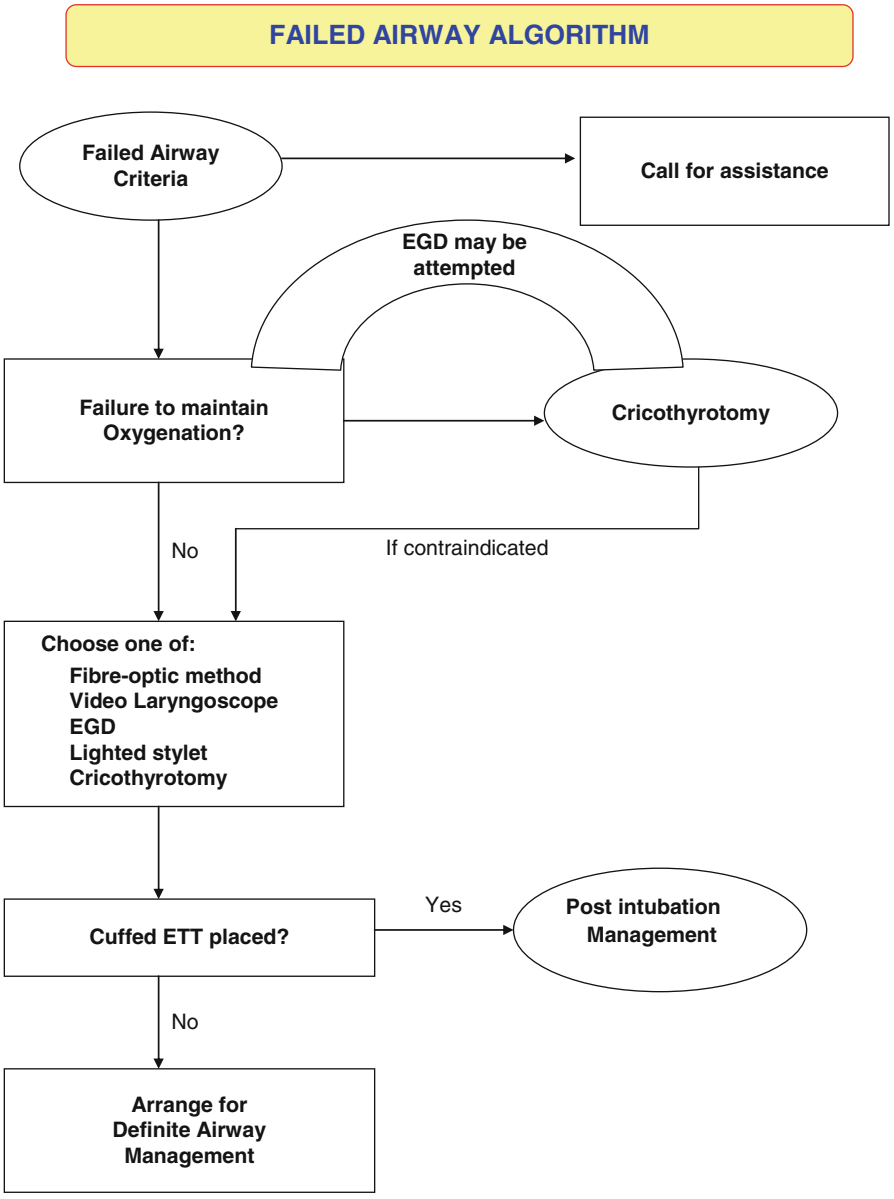
- Call expert help.
- Awake intubation under local anaesthesia.
- Blind nasal intubation.
- Retrograde intubation.
- Fibre-optic laryngoscopy.
- Surgical airway – tracheostomy.




UNIVERSAL EMERGENCY AIRWAY ALGORITHM
Unresponsive
Unreactive
Near Death?
Yes
Crash
Airway
Algorithm
Fails
No
Difficult
Airway?
Yes
Difficult
Airway
Algorithm
Fails
Failed
Airway
Algorithm
No
RSI
Fails


CRASH AIRWAY ALGORITHM
Crash Airway
Maintain oxygenation
Intubation attempt Successful?
Yes
Post Intubation Management
No
Unable to Bag Ventilate
Yes
Failed Airway
No
Succinylcholine 2mg / kg IVP
Attempt intubation
Successful?
Yes
Post Intubation Management
No
Failure to maintain oxygenation
Yes
Failed Airway
No
≥ 3 attempts by Experienced operator?
No


DIFFICULT AIRWAY ALGORITHM
Difficult Airway Predicted
Call for assistance
Failure to maintain Oxygenation?
Yes
Failed Airway
No
BMV or EDG Predicted to be successful?
Yes
Intubation Predicted To be successful?
Yes
RSI
Awake DL, FO or VL Successful?
Yes
Post intubation Management or RSI
ILMO
FO or VL
Cricothyrotomy
BNTI
Lighted stylet
Go to main Algorithm


FAILED AIRWAY ALGORITHM
Failed Airway Criteria
Call for assistance
EGD may be attempted
Failure to maintain Oxygenation?
Cricothyrotomy
No
If contraindicated
Choose one of:
Fibre-optic method
Video Laryngoscope
EGD
Lighted stylet
Cricothyrotomy
Cuffed ETT placed?
Yes
Post intubation Management
No
Arrange for Definite Airway Management

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