

Management of Difficult Airway

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2 Management of difficult airway

2.1 Introduction

The incidence of difficult tracheal intubation following induction of general anaesthesia is rare and has been estimated at 3-18%. It is the most critical emergency that an anaesthetist can be faced with and may lead to hypoxaemic anaesthetic death, brain damage or serious soft tissue damage. When the junior anaesthetist is confronted with an unanticipated difficult tracheal intubation especially out of hours he should concentrate on maintenance of oxygenation and prevention of airway trauma until senior help arrives.

These guidelines will address the following aspects:

These guidelines are constructed with regard to the culture, skill and equipment available in Sri Lanka. Therefore some equipment that are mentioned in standard text books or guidelines formulated in other countries may not be included. That does not preclude the anaesthetist to use them if and when available and if adequately experienced in using them. Wall charts have been produced to use in conjunction with these guidelines for quick reference.

2.2 Objectives

These guidelines are formulated to help the non-specialist anaesthetic medical officers to manage different clinical scenarios associated with unanticipated difficult tracheal intubation in adults. Although these scenarios may be multifactorial, a structured sequence of actions would detect most of the causes. Children with unpredicted difficult airways should be managed by a consultant at an early stage. Management of predicted difficult airway is not within the scope of the non-specialist anaesthetist and he should always discuss such cases with the consultant anaesthetist. When specialist opinion is not available the patient should be transferred to the nearest hospital where a consultant is available, preferably after discussion and stabilization.

2.3 Definitions

2.3.1 Difficult airway: the clinical situation in which a conventionally trained anesthetist experiences difficulty with face mask ventilation, laryngoscopy, tracheal intubation or fails to intubate the trachea.

A difficult airway may be caused by several factors:

- patient factors
- clinical setting
- skills of the practitioner

2.3.2 Difficult face mask ventilation: Inability of an unassisted anaesthetist to maintain oxygen saturation (SpO₂) more than 90% with positive pressure mask ventilation using 100% oxygen in a patient whose oxygen saturation (SpO₂) was more than 90% before induction and/or it is not possible to prevent or reverse signs of inadequate ventilation with positive pressure mask ventilation.

- This may occur due to one or more of the following problems: inadequate mask seal, excessive gas leak, or excessive resistance to the ingress or egress of gas.

- Signs of inadequate face mask ventilation: absent or inadequate chest movement, absent or inadequate breath sounds, auscultatory signs of severe obstruction, cyanosis, gastric air entry or dilatation, decreasing or inadequate oxygen saturation (SpO₂), absent or inadequate exhaled carbon dioxide, and haemodynamic changes associated with hypoxaemia or hypercarbia (e.g., hypertension, tachycardia, arrhythmia).

- **2.3.3 Difficult laryngoscopy:** Inability to visualize any portion of the vocal cords after multiple attempts at conventional laryngoscopy. (Cormack and Lehane laryngoscopy grade 3 or 4)

- **2.3.4 *Difficult tracheal intubation:*** Tracheal intubation which requires more than 3 attempts, or more than 10 minutes with a conventional laryngoscope.
- **2.3.5 *Failed intubation:*** Placement of the endotracheal tube fails after multiple intubation attempts.

2.4 Assessment and preparation for tracheal intubation following routine induction of general anaesthesia in a non-obstetric patient

2.4.1 Pre-operative Assessment of the airway

All patients should undergo an airway evaluation pre-surgery and this should be recorded on the anaesthesia record. But this assessment is imperfect in predicting problems always, so an airway strategy should be drawn up for each patient to cover the entire period of anaesthetic care, particular at the start and end of anaesthesia.

History

- Intubation problems during previous anaesthetics
- Neonates, elderly, pregnant women
- Facial/maxillary trauma, cervical spine injury, previous surgery
- Snoring and sleep apnoea
- Infection or inflammation, orofacial or neck oedema
- Rheumatoid disease or surgery of the neck or degenerative spinal diseases
- Tumours, radiation-related scarring, burns

Physical examination: Any factor which interferes with the line of vision

- Buck teeth, missing or loose teeth, especially upper left incisors)
- Inability to extend the head in the erect position
- Short neck
- Receding mandible (anterior larynx)
- Inability to protrude the lower jaw

Special tests

- Mallampati grade, (also checks the degree of mouth opening, size and mobility of the tongue and other structures in the mouth; Grade e" 3)
- Thyromental distance (< 6.5 cm or < 3 finger breaths)
- Sterno-mental distance < 12.5 cm
- Delikan's sign

See Reference pp. 4-4 for more details (*with permission*)

If preoperative assessment indicates the possibility of a difficult airway, aspiration prophylaxis should be given and the consultant anaesthetist should be consulted. Junior medical officers should not handle a predicted difficult airway in the absence of a consultant anaesthetist.

2.4.2 Preparation for difficult airway management

Anaesthetists should be ready to deal with difficulties in intubation at any time. The correct equipment, drugs and trained personnel must be immediately available. This will include:

2.4.2 (a) Personnel

- A trained anaesthetist (conventionally trained for 6 months and approved by a consultant anaesthetist to be satisfactory). Intubation with a bougie should be practiced simulating a Lehane & Cormack Grade 3.
- A trained assistant: as there are no trained operating department assistants in government hospitals, a nurse or a suitable minor employee should be trained for this purpose when the anaesthetist is on his own.

2.4.2 (b) Recommended equipment for routine airway management

The following list of equipment is recommended for routine intubation.

- Adjustable operating table or trolley
- Wee's detector (Oesophageal detector device)
- ECG, pulse oximetry, NIBP, capnography, stethoscope
- Oxygen source and tubing
- Anaesthetic breathing system / Ambu bag
- Reliable suction equipment
- Facemasks
- Oropharyngeal/ Nasopharyngeal airways: three sizes
- Laryngeal Mask Airways
- Two working laryngoscope handles with a selection of blades
- A variety of endotracheal tubes in a range of sizes, and tape or ties for securing the ETT
- Tracheal tube introducer ("gum-elastic" bougie)
- Magill's forceps
- Malleable stylet
- A cricothyroidotomy kit

2.4.2 (c) Drugs

- Appropriate induction/sedative/ paralytic agents
- Essential emergency drugs

2.4.2 (c) Difficult intubation trolley

- A cart containing the following equipment should be located no more than a couple of minutes from every location where anaesthesia is administered.
- All anaesthetists and anaesthetic assistants should be familiar with the contents and location of the trolley.
- Equipment should be pre assembled & ready to use.
- Equipment should be arranged sequentially in a specially designed trolley with clearly labeled difficult intubation drills displayed

All equipment should be sequentially arranged as follows if possible:



<p>1. <u>Top drawer</u>- Difficult intubation equipment</p>	<ul style="list-style-type: none"> • Laryngoscopes Mackintosh blade (standard & left handed) Sizes 3, 4 Miller sizes 2, 3 McCoy sizes 3, 4 Short handle • Malleable stylet • ET tubes of all sizes (cuffed & uncuffed) • Light wand Trachlight (if available)
<p>2.Side compartment</p>	<ul style="list-style-type: none"> • Gum elastic bougies, • Suction catheters • Magill's forceps • Cook exchange catheters • Fiberoptic accessories(Bermann airways/ swivel connectors)
<p>3. <u>2nd drawer</u> - Difficult ventilation equipment</p>	<ul style="list-style-type: none"> • Guedel/nasopharyngeal airways • Special ET tubes -armoured/microlaryngeal
<p>4. <u>3rd drawer</u></p>	<ul style="list-style-type: none"> • LMA Classic (Sizes3,4,5) • Proseal with introducer • ILMA- intubating LMA • Combitube (if available)

<p>5. <u>4th drawer</u> - Pre assembled invasive airway equipment</p>	<ul style="list-style-type: none"> • Cricothyroidotomy equipment <p>Home made - scalpal blade No20 with handle/ tracheal dilators, ET tubes size 4 mm internal diameter</p> <p>Manufactured 4mm internal diameter</p>
<p>6. <u>Surfaces of the trolley</u></p>	<p>Top – fiberoptic bronchoscope/ monitor FOB module, airway topicalisation equipment (lignocaine spray, needles, catheters)</p> <p><u>Documents:</u> Clearly labeled difficult airway drills displayed</p>

GRADE X Recommended
GRADE Y Desirable
GRADE Z Optional

2.5 Difficult airway drills

2.5.1 Adult non-obstetric difficult airway management drill

2.5.1.1

Unanticipated difficult laryngoscopy/intubation after routine induction of anaesthesia

Activate PLAN A

PLAN A: Correct possible causes GRADE X

- If there is a difficulty in inserting laryngoscope, consider and correct possible causes:

Poor head position - adjust pillows

Breast in the way - retract breast and/or use short handle or polio blade

Use BURP (Backward, Upward, Rightward Pressure)

Relaxation sub optimal - wait

Difficult intubation:

Cormack and Lehane Grade 3 or 4 after optimal positioning, adequate muscle relaxation and best attempt.

- Send for skilled help (nurse to phone)
- Use external laryngeal manipulation or BURP manoeuvre (Backward, Upward and Rightward Pressure on the thyroid cartilage)
- If grade 4 view:
 - maintain oxygenation with mask ventilation with or without an oral airway
 - send a nurse to call consultant
 - awaken patient

- If grade 3 (only epiglottis seen)
 - maintain oxygenation with mask ventilation with or without an oral airway
 - maintain anaesthesia with inhalational agent
- Use a gum elastic bougie or an alternative laryngoscope if available
- **Use of a bougie** – Pass the bougie along the under surface of the epiglottis. This technique should be practiced on a normal airway by simulating a Grade 3 laryngoscopy view.

1. Confirm the position of the bougie:

- If the bougie is in the trachea clicks will be felt by the tip of it hitting the tracheal cartilages.
- If no clicks, gently advance to a maximum of 45 cm. If there is slight resistance to further advancement bougie is held up in the bronchial tree, so proceed with intubation. Patient may cough if not fully paralyzed which also indicates correct placement.

2. Passing the endotracheal tube

- The tube can be either loaded on to the bougie initially or it can be railroaded later especially if the oral cavity is small.
- Railroad the tube with laryngoscope in the mouth keeping the larynx in view and rotating the tube 90⁰ anticlockwise.
- If neither clicks, nor resistance nor coughing, the bougie may be in the oesophagus, remove and reattempt, provided saturation is above 90%.
- An additional attempt by an experienced anaesthetist can be justified.

GRADE X

PRIORITY – MAINTAIN OXYGENATION

- Send for help early
- Do not attempt laryngoscopy > 3 times
- Attempt only if an improvement on the first attempt is made
- Stop earlier if saturation < 90%



ACTIVATE PLAN B IF FAILED TO INTUBATE

PLAN B : Use of an upper airway device which keeps the airway open maintaining oxygenation and ventilation while facilitating tracheal intubation Grade X

- Insert a LMA (Laryngeal Mask Airway) or intubating LMA (ILMA) if available. Do not attempt more than twice. Cricoid pressure may need to be reduced.
- Confirm satisfactory positioning, oxygenate and ventilate through LMA and maintain anaesthesia.
- If satisfactory oxygenation and ventilation can be achieved with a LMA, the decision to proceed or postpone surgery has to be taken by the consultant anaesthetist.
- Intubation through LMA/ILMA: blind intubation may be attempted by an experienced anaesthetist (consultant) through an ILMA. But blind intubation through a conventional LMA is not recommended.
- Fibreoptic intubation through LMA or ILMA has high success rates in experienced hands.

GRADE X

PRIORITY – MAINTAIN OXYGENATION WITH A LMA

- **Decision to proceed or postpone by consultant anaesthetist**
- **Activate plan c if saturation < 90% with LMA**

ACTIVATE PLAN C IF FAILED TO OXYGENATE:

**Saturation < 90% with 100% Oxygen via LMA/ILMA
Failed Plan A & B**

**PLAN C : Maintainance of oxygenation, ventilation, postponement of surgery and awakening the patient
GRADE X**

- Try to maintain oxygenation and ventilation through LMA.
- Discontinue anaesthetic gases and try to wake up the patient.
- If oxygenation is impossible with LMA, remove and maintain airway with oral/nasal airway and ventilate with a facemask.
- Implement plan D immediately if ventilation is impossible and serious hypoxaemia is developing [Can't Intubate, Can't Ventilate – CICV situation].

PRIORITY – MAINTAIN OXYGENATION

- **Oxygenate and ventilate with a LMA / face mask**
- **Try to awaken the patient**

ACTIVATE PLAN D IF FAILED TO INTUBATE AND VENTILATE WITH INCREASING HYPOXAEMIA

PLAN D : Immediate invasive life-saving interventions

GRADE X

Can't Intubate Can't Ventilate situation

Incidence: 0.01–2 cases per 10,000 anaesthetics.

- Immediate invasive intervention if severe hypoxaemia is developing rapidly, especially if associated with bradycardia.
- Emergency tracheostomy is not an option in this situation.
- Options for emergency interventions:
 - a) Cannula cricothyroidotomy
 - b) Surgical cricothyroidotomy

Cannula cricothyroidotomy

- Insertion of a cannula through the cricothyroid membrane with high pressure ventilation.
- The oxygen flush system of the anaesthetic machine and ventilation through a 2 ml syringe connected to 4 mm ETT connector and catheter mount does not provide sufficient pressure for effective ventilation.

Highly dangerous in unskilled hands, therefore not recommended

Surgical cricothyroidotomy

Low pressure ventilation can be used with this technique.

CALL THE SURGEON FOR HELP

Technique

- Identify cricothyroid membrane after optimal positioning by extending the head.
- Ask the surgeon to make a stab incision through skin and membranes (short and rounded scalpel No 20 or minitrach scalpel if available).
- Perform blind dissection to enlarge the incision with scalpel handle, forceps or dilator.
- Insert a 4 mm endotracheal tube and inflate the cuff avoiding endobronchial intubation.
- Check for correct placement and ventilate with a breathing system/Ambu bag.
- For difficult cases eg: obese patients, use a bougie through the incision or a tracheostomy retractor to pull the cricoid cartilage downwards.

- **Every anaesthetist should be able to perform invasive rescue airway interventions**
- **Invasive airway access is a temporary measure to restore oxygenation**
- **Convert to a formal tracheostomy within 24 hours**

2.5.1.2

Unanticipated difficult intubation during rapid sequence induction (RSI) in a non-obstetric patient

- These patients are at risk of vomiting or regurgitation and subsequent pulmonary aspiration of gastric contents. Laryngoscopy and insertion of a bougie or LMA may prove difficult due to cricoid pressure.
- All patients undergoing RSI should be preoxygenated and cricoid pressure applied as consciousness is lost. The recommended force is 30 N, which should be reduced if laryngoscopy is difficult or airway obstruction occurs.

Plan of action for difficult laryngoscopy at first attempt after RSI

ACTIVATE MODIFIED PLAN A

MODIFIED PLAN A: Correct possible causes

GRADE X

- Adjust position, technique; use BURP (backward, upward, rightward pressure).
- If poor view: reduce cricoid force, but maintain, use a bougie or alternative techniques if available.
- Maintain oxygenation and anaesthesia with face mask oral/nasal airway during attempts.

PRIORITY – MAINTAIN OXYGENATION

- **Call for help early**
- **Do not attempt laryngoscopy > 3 times**
- **Maintain cricoid pressure**
- **Maintain oxygenation and anaesthesia with face mask during attempts**

ACTIVATE MODIFIED PLAN C IF FAILED TO INTUBATE

Main problems are risk of aspiration and spasm associated with wearing off of suxamethonium. Therefore, in this case scenario, if it is not emergency surgery, failure of intubation

**PRIORITY – MAINTAIN OXYGENATION
& AWAKEN THE PATIENT**

- **Oxygenate and ventilate with a LMA**
- **Try to awaken the patient**

activates a plan of ‘wake-up’. A laryngeal mask airway (LMA) should not be attempted at this stage.

MODIFIED PLAN C

- Maintain oxygenation and ventilation with one or two person mask technique with or without oral/nasal airway.
- Maintain cricoid pressure
- Postpone surgery and awaken the patient.
- If condition is immediately life-threatening continue anaesthesia with face mask or LMA.
- Consider reducing cricoid pressure if ventilation is difficult or insertion of LMA is difficult.

GRADE X

**PRIORITY – MAINTAIN OXYGENATION & AWAKEN
THE PATIENT**

- **Maintain oxygenation with face mask +/- oral/nasal airway**
- **Do not put the patient in lateral position**
- **Do not give further doses of suxamethonium**
- **Discontinue anaesthesia and awaken the patient**

Failed oxygenation ($SpO_2 < 90\%$ with 100% O_2 via face mask)

- Insert a LMA if unable to maintain saturation >90% with face mask ventilation.
- Reduce cricoid force if difficult to insert LMA.
- Discontinue anaesthesia and awaken the patient.
- If condition life-threatening discuss with the consultant and proceed with deep inhalational anaesthesia.

GRADE X

PRIORITY – MAINTAIN OXYGENATION & AWAKEN THE PATIENT

- **Maintain oxygenation with LMA if oxygenation is impossible with face mask**
- **Reduce cricoid force during insertion of LMA**
- **Proceed with deep inhalational anaesthesia if condition life-threatening**

ACTIVATE PLAN D IF FAILED TO VENTILATE AND OXYGENATE AFTER RSI (CICV situation)

PLAN D: Immediate invasive life-saving interventions

GRADE X

Surgical cricothyroidotomy

SEE above for details

2.5.2 Obstetric difficult airway management drill

INTRODUCTION

- Although frequency of general anaesthesia in obstetric is declining, it still remains the single most frequent anaesthetic cause for maternal morbidity and mortality. Hypoxic brain damage and death due to failure of maintaining adequate oxygenation at the time of induction and intubation are the most dreaded complications. Anatomical and physiological changes in pregnancy and emergency intervention in inadequately assessed patients make the situation more challenging. The incidence of failed intubation is almost 10 times higher in obstetric population than in the general surgical population. Therefore regional anaesthesia should be considered first in every case. This guideline is intended for use in adult obstetric patient who are undergoing general anaesthesia. This guideline is not intended for use in non-obstetric adult patients.

OBJECTIVES

- To avoid general anaesthetic related maternal morbidity and mortality by providing definitive guidelines so that recommended techniques will be used at every stage of general anaesthesia.
- To assess and evaluate pregnant mothers early with regard to anticipated difficult airway and formulate plans for intubation.

COMPETENCY/TRAINING

All qualified anaesthetists who are involved in obstetric anaesthesia must initially complete a six month in house training in non-obstetric rapid sequence induction and difficult airway management and should obtain competency before embarking on general anaesthesia in obstetrics. Training and post-training period should include at least 10 general anaesthetics in obstetric patients under supervision before working unsupervised.

2.5.2.1

Airway assessment in obstetric patients

- All obstetric patients who may require surgical intervention must have a detailed airway evaluation in order to detect possible difficulties and allow adequate time for planning of technique, resources and expert/senior help.
 - Use the following tools collectively in addition to airway history:
 - Mallampati score
 - Thyromental distance
 - Mouth opening
 - Neck mobility
- Facial oedema- especially in PET
Because of poor predictive value, anaesthetists should not completely rely on one or two airway assessment tools.
- Explain the procedure and risks/benefits and obtain informed consent for general anaesthesia.
 - All mothers predicted to have a high risk of airway problems and needing elective surgical intervention should be evaluated by a consultant anaesthetist in advance.
 - Adequate training should be provided to all anaesthetists to manage a difficult obstetric airway. All theatre personnel and obstetric teams must be educated regarding this anaesthetic complication to obtain all possible help in the event of an emergency.
 - All obstetric theatre suites should be equipped with a difficult airway trolley *See: Difficult intubation trolley in the previous guideline.*
 - The suggested algorithm should be followed in the event of unanticipated difficult airway. Adherence to a specific algorithm avoids/minimizes confusion regarding possible next safe step during crisis and improves outcome of the patient.

Procedure for Rapid sequence induction in an obstetric patient

- Ensure availability of cross-matched blood and provision of acid prophylaxis.
- Ensure wide bore i.v. access, preferably 14G or 16G
- Establish full monitoring (ECG, Pulseoxymetry, NIBP, Capnography)
- Make sure mother is in optimum intubation position, which includes placing one or two pillows under her head with 15 degree left lateral tilt to avoid aorto-caval compression.
- Method of induction must be rapid sequence irrespective of fasting status of the mother.
- Ensure adequate preoxygenation (breathing 100% oxygen through breathing attachment/circuit with good sealed mask for 3-5 minute or 3 good vital capacity breaths.) before intravenous induction.

- Apply and maintain cricoid pressure with loss of eyelid reflex and administer suxamethonium. Attempt insertion of laryngoscope once full muscle relaxation is established.
- Visualize glottis following successful laryngoscopy and insert the endotracheal tube and confirm with capnography. Make sure both lungs are being ventilated equally with chest expansion and auscultation and then secure the tube.

2.5.2.1 Unanticipated difficult laryngoscopy/intubation after rapid sequence induction in an obstetric patient

ACTIVATE MODIFIED PLAN A

MODIFIED PLAN A

GRADE X

- If there is a difficulty in inserting laryngoscope, consider following possibilities and apply suggested corrective measures:

- Poor head position - adjust pillows
- Breast in the way - retract breast and/or use short handle or polio blade
- Cricoid hand in the way - reposition but maintain, use BURP (Backward, Upward, Rightward Pressure)
- Relaxation sub optimal - wait
- Muscle rigidity or anatomical abnormality - abandon procedure and call for help

- Consider use of gum-elastic bougie and/or McCoy blade to intubate if the glottic view is either Lehane-cormack grade II or III. Follow steps in the previous section regarding the use of bougie.

Failed intubation / Lehane- Cormack Grade 4 following RSI in an obstetric patient (Failed plan A)

The mother is at risk of aspiration of gastric contents and airway spasm can occur due to wearing off of suxamethonium. Therefore, a plan of 'wake-up' should be activated unless there is an immediate life-threatening condition with need to continue surgery.

ACTIVATE MODIFIED PLAN C (FAILED INTUBATION DRILL)

MODIFIED PLAN C

- Do not panic.
 - Call for senior help. Send somebody other than the involved anaesthetist.
 - Maintain oxygenation with 100% oxygen and cricoid pressure with one or two person mask technique with or without oral /nasal airway. Provision of adequate oxygenation must be the priority at this stage.

 - Attempt gentle positive pressure ventilation while maintaining cricoid pressure to provide/maintain oxygenation and to protect airway.
 - Do not repeatedly attempt to insert laryngoscope or to visualize glottis.
 - Do not give second dose of suxamethonium.
 - Do not turn the mother to a side as this makes maintenance of airway and oxygenation more difficult. But maintain the left lateral tilt.
 - If adequate positive pressure ventilation is possible, and oxygenation is adequate ($SpO_2 > 93\%$), determine whether there is urgency/need to proceed with the planned operation.
 - **If surgery is not life-saving,** awaken the patient:
 - Discontinue inhalation agent, maintain airway with 100% oxygen until patient is awake.
 - Turn to lateral position once awake.
 - Decision to proceed with surgery at this stage using spinal/epidural or CSE should be made after discussing with the consultant anaesthetist.
- GRADE X**
- If regional anaesthesia is contra-indicated consider local infiltration anaesthesia by the surgeon.

The degree of anaesthesia and analgesia may be sub optimal and therefore mother should be fully informed about the technique. **GRADE X**

- If regional techniques are not indicated, awake fiber-optic intubation followed by general anaesthesia may be considered when facilities and expertise is available. **GRADE Y**

• **If surgery is life-saving,** continue anaesthesia with SPONTANEOUSLY BREATHING TECHNIQUE:

- Deepen anaesthesia with inhalational agent in 100% oxygen while allowing the mother to breathe spontaneously.
- Maintain airway with existing method. Maintain saturation > 93%.
- Provide adequate analgesia /hypnosis / amnesia once the baby is born. Consider fentanyl, alfentanil, midazolam, propofol.
- Start an infusion of syntocinon to overcome uterine relaxation caused by high dose of inhalational agents.

FAILED OXYGENATION ($SpO_2 < 90\%$) VIA FACE MASK.

- Maintain tight seal with face mask and apply oxygen with closed breathing system valve.
- Ease cricoid pressure to allow adequate ventilation. If the ventilation is possible without cricoid pressure, allow the patient to wake up if surgery is not life-saving. If operation is life-saving consider spontaneous breathing technique as above.
- Insert a laryngeal mask airway (LMA) if ventilation is difficult / impossible even without cricoid pressure.
- If ventilation is possible with the laryngeal mask airway, consider waking up or continuing deep anaesthesia depending on the urgency as above.

ACTIVATE PLAN D IF VENTILATION IS IMPOSSIBLE AND SATURATION IS < 90%

PLAN D: Immediate invasive life-saving interventions to rescue the mother

GRADE X

- a) Cannula cricothyroidotomy
- b) Surgical cricothyroidotomy

SEE Page 20 for details

MATERNAL CARDIAC ARREST

- Perform Caesarean section and deliver the baby as soon as possible.
- CPR will be otherwise unsuccessful as the gravid uterus impedes the cardiac output.

- In each successfully managed difficult airway situation, recovery should be very cautious as premature extubation could lead to serious complications again.

2.5.3 Management of acute upper airway obstruction

2.5.3.1 Introduction

Obstruction of the airway occurs quite commonly in association with general anaesthesia. The anaesthetist is often called to stabilize and intubate patients who present with acute airway obstruction in the ETU/ICU or ward set up.

Airway management is a fundamental anaesthetic responsibility and skill. Airway obstruction demands a rapid and organised approach to its diagnosis and management and undue delay usually results in desaturation and a potential threat to life.

An uncomplicated pre-learned sequence of airway rescue instructions is an essential part of every anaesthetist's clinical practice requirements.

2.5.3.2 Definition

It is a potentially life-threatening event caused by a blockage of the upper airway, which can be in the trachea, larynx or oropharynx.

2.5.3.3 Common causes

1. Upper airway
 - Oropharyngeal : tumours, haematoma, infection (epiglottitis, croup), foreign bodies, sleep apnoea, obesity, facial oedema, burns
 - Lesions in and around the larynx : malignancy, infections, laryngospasm, laryngeal oedema, inhalational injury
2. Mid-tracheal obstruction
 - Retrosternal goitre
 - Tracheal stenosis
3. Lower tracheal and bronchial obstruction
 - Tumours

2.5.3.4 Presentation

2.5.3.4 a) Partial airway obstruction-

- Stridor-
Inspiratory –obstruction at or above upper trachea
Expiratory - obstruction of the lower trachea or bronchi.
- Increased work of breathing –suprasternal, intercostal and subcostal retraction along with an increased use of accessory muscles of respiration. Paradoxical 'see-saw' movement of abdomen and chest.

- Choking – sudden onset associated with coughing and aphonia indicates foreign body inhalation.
- Wheezing
- Agitation, panic, changes in consciousness or unconsciousness
- Desaturation, hypercapnia

2.5.3.4 b) Complete airway obstruction-

- Cyanosis
- Inability to speak or breathe
- Severe desaturation associated with bradycardia, cardio-respiratory arrest

2.5.3.4 c) Upper Airway Obstruction under anaesthesia-

Breathing spontaneously:

- Poor movement of the reservoir bag with or without above signs

On IPPV :

- Increased airway pressure with decreased chest movement
- Noisy respiration
- Wheezing

2.5.3.5 Management

2.5.3.5 a) Life threatening upper airway obstruction in the ETU/ICU/Ward

- Send for senior help; ask a nurse to phone.
- Do not disturb the patient or delay for investigations, i.v. cannulation etc.
- Do not change the patient's preferred position.
- Administer 100% humidified O₂ via facemask, attach pulse oximeter.
- Nebulized adrenaline 1: 1000 5mg (400 mcg/kg up to a maximum of 5mg for children)
- Take the patient to the theatre. Induce anaesthesia with halothane or sevoflurane in oxygen and intubate with a small ETT. Have the ENT surgeon ready to intervene if necessary (tracheostomy or rigid ventilating bronchoscopy)
- Do not give i.v. induction agents, sedatives or muscle relaxants before intubation as these may lead to catastrophic CICV (Can't Intubate Can't Ventilate) situation.

2.5.3.5 b) Options for immediately life threatening events and senior help not available

- ❖ **Severe cases:** Perform cricothyroidotomy or tracheotomy under local anaesthesia if intubation is not possible.
- ❖ **Less severe cases:** Perform intubation or tracheostomy under deep inhalational anaesthesia with face mask or LMA if not improving with nebulized adrenaline.
- ❖ **Children and uncooperative patients:** Administer deep inhalational anaesthesia with preservation of spontaneous breathing. Apply a moderate degree of CPAP which is effective at keeping the airway open. Local anaesthetic spray to the larynx may be helpful once the patient is deep and stable and give atropine to prevent bradycardia in children.

2.5.3.5 c) Acute upper airway obstruction under anaesthesia

Laryngospasm : Acute glottic closure by the vocal cords

This is a common cause for acute airway obstruction in the peri-operative period.

It is a potentially life-threatening condition which, if poorly managed can cause severe hypoxaemia, pulmonary aspiration and post-obstructive negative pressure pulmonary oedema.

Causes

- Surgical stimulation or airway instrumentation or removal under light anaesthesia
- Regurgitation, vomiting or aspiration
- Blood or secretions in the pharynx
- Irritant volatile agent and exacerbation of a soiled airway
- Children are more prone to laryngospasm and become cyanosed more rapidly than adults. Hypoxia associated with severe bradycardia is a preterminal event in them.

Presentation

- Inspiratory stridor/airway obstruction/absent inspiratory sounds if complete obstruction.
- Increased respiratory efforts, tracheal tug
- Paradoxical chest/abdomen (“see-saw) movements
- Desaturation, bradycardia, central cyanosis

Immediate management

- Call for help
- Stop stimulation
- Remove oral airway/LMA if cause for laryngospasm
- Clear the airway
- Open the airway (head tilt, chin lift and jaw thrust)
- Give 100% oxygen (with inhalational agent if appropriate)
- Deepen anaesthesia if appropriate (propofol 1-2 mg/kg iv bolus) or allow to wake up
- Insert oral /nasal airway if depth of anaesthesia adequate
- Apply CPAP (close the expiratory valve and maintain a tight seal by holding the mask with two hands) and gently ventilate while looking for a cause
- If all above measures fail give suxamethonium 0.25 - 0.5 mg/kg IV or 2-4 mg/kg IM if access is not available. Use early in complete airway obstruction as IPPV exacerbates the condition by inflating the stomach and forces the arytenoids and false cords against the true vocal cords. Give atropine 10mcg/kg for children or if associated with bradycardia.
- Intubate and ventilate if necessary

Subsequent management

- Monitor in the recovery until stable, or in a HDU or ICU depending on the condition
- Exclude pulmonary aspiration, negative pressure pulmonary oedema
- Explain what happened and reassure the patient as awareness is possible.

2.5.4 Management of Desaturation under anaesthesia

2.5.4.1 Introduction

Desaturation under anaesthesia ($SpO_2 < 93\%$) is a potentially life-threatening event that can result from many causes. Inability to recognize the cause and manage it promptly may lead to hypoxic brain injury or death. Correct use of a structured drill has been shown to identify 99% of possible causes for desaturation within 40-60 seconds.

Persistent desaturation should be managed with hand ventilation using 100% oxygen, return to a supine position and completion of a checklist of possible causes (COVER-ABCD). Blood gases, chest X-ray and bronchoscopy may be required if no apparent cause can be found.

2.5.4.2 Causes for desaturation under anaesthesia:

I Equipment problems

a) Anaesthetic machine – related :

- Hypoxic gas mixture
- Anaesthetic machine error
- No gas flow during preoxygenation
- Disconnection, leaks,
- Breathing system : damage to inner tube in Bain system, obstruction of tubings, catheter mount, connectors, filter
- Monitor error

b) Endotracheal tube –related:

- Leaks, kinking, obstruction
- Misplacement- oesophageal, endobronchial, accidental extubation
- Failed intubation / failed ventilation

II Patient problems

- a) **Airway** - obstruction if unintubated- secretions, blood or debris, gastric contents, foreign body, laryngospasm
- b) **Breathing** – hypoventilation, bronchospasm, lobar collapse, pneumo- or haemothorax, gaseous distension of the abdomen (esp. in infants)
- c) **Circulation** – cardiac arrest, haemodynamic instability, congestive cardiac failure with pulmonary oedema, obstruction to circulation from excessive intrathoracic pressure (inadvertent PEEP), pulmonary embolism, cardiac tamponade, reversal of a shunt
- d) **Other** – worsening of pre-existing conditions, obesity, sepsis
- e) **Drugs** – anaphylaxis, malignant hyperpyrexia

2.5.4.3 Desaturation drill

- Confirm diagnosis: check pulse oximeter waveform
- Exclude cardiac arrest
- Call for help
- Administer 100% oxygen and hand ventilate
- Complete “COVER ABCD” algorithm if intubated or “AB COVER CD” if breathing spontaneously to identify the cause for desaturation.

“COVER ABCD”

C1 Circulation

- Check rate, rhythm and volume of the central pulse.
- Check ETCO_2 which indicates cardiac output.
- Initiate CPR if no central pulse.

C2 Colour

- Give 100% oxygen; ensure that only oxygen flow meter is operating. Look for central cyanosis. Check pulse oxymeter.

O1 Oxygen

- Check flow meter settings to ensure that mixture is not hypoxic.

O 2 Oxygen analyzer

- Check that the oxygen analyser shows a rising oxygen concentration distal to the common gas outlet.

V1 Ventilation

- Ventilate the lungs by hand to assess breathing circuit integrity, **check the patency of the catheter mount, connector and filter***, airway patency, chest compliance and air entry by “feel” and careful observation and auscultation.
- Also inspect capnography trace.

V2 Vaporiser

- Note settings and levels of agents. Check all vaporiser filler ports, seatings and connections for liquid or gas leaks during pressurisation of the system.
- Consider the possibility of the wrong agent being in the vaporiser.

E1 Endotracheal tube

- Systematically check the endotracheal tube (if in use). Ensure that it is patent with no leaks or kinks or obstructions.
- Check capnograph for tracheal placement and oximeter for possible endobronchial position.
- If necessary, adjust, deflate cuff, pass a catheter, or remove and replace.

E2 Elimination

- Eliminate the anaesthetic machine and ventilate with self-inflating (e.g. Ambu) bag with 100% oxygen (from alternative source if necessary).
- Retain gas monitor sampling port if available (but be aware of possible problems).

R1 Review monitors

- Review all monitors in use (preferably oxygen analyser, capnograph, oximeter, blood pressure, electrocardiograph (ECG), temperature and neuromuscular junction monitor). For proper use, the algorithm requires all monitors to have been correctly sited, checked and calibrated.

R2 Review equipment

- Review all other equipment in contact with or relevant to the patient (e.g. diathermy, humidifiers, heating blankets, endoscopes, probes, prostheses, retractors and other appliances).

A Airway

- Check patency of the unintubated airway.
- Consider laryngospasm or presence of foreign body, blood, gastric contents, nasopharyngeal or bronchial secretions.
- Mucus plugs or bronchial secretions can cause marked desaturation especially in young children.

B Breathing

- Assess pattern, adequacy and distribution of ventilation.
- Consider, examine and auscultate for bronchospasm, pulmonary oedema, lobar collapse, pneumo- or haemothorax and impaired ventilation due to retractors.

C Circulation

- Repeat evaluation of peripheral perfusion, pulse, blood pressure, ECG and filling pressures (where possible) and hypovolaemia or any possible obstruction to venous return such as embolism, raised intrathoracic pressure (e.g. inadvertent PEEP), sepsis, myocardial depression and poor cardiac output or direct interference to (e.g. stimulation by central line) or tamponade of the heart.
- Note any trends on records.

D Drugs

- Review intended (and consider possible unintended) drug or substance administration.
- Consider whether the problem may be due to unexpected effect (anaphylaxis, malignant hyperpyrexia), a failure of administration or wrong dose, route or manner of administration of an intended or “wrong drug”.
- Review all possible routes of drug administration.

2.6 Extubation & Follow up

When the airway has proved difficult to manage a difficult airway follow-up should be initiated in the postoperative period.

2.6.1 Strategy for Extubation of the Difficult Airway

The strategy should depend on the surgery, the condition of the patient, and the skills and preferences of the anaesthetist.

Take the following into consideration before extubation:

GRADE X

1. Risks and benefits of awake extubation versus deep extubation with the use of a nasopharyngeal airway or LMA.
2. Extubate with the expiratory valve tightly closed to produce a cough.
3. Presence of any general clinical factors that may impair ventilation after extubation.
4. Short-term use of a device that can serve as a guide for reintubation if necessary. Eg : Cook airway exchanger – it is usually inserted through the lumen of the tracheal tube and into the trachea before the tracheal tube is removed. It is rigid to facilitate intubation and hollow to facilitate ventilation and administer oxygen.
5. Give prophylactic dexamethasone if there is a risk of laryngeal oedema and monitor closely in the post-operative period.

2.6.2 Follow-up Care **GRADE X**

- Document the presence and nature of the airway difficulty and management strategy in the anaesthetic record.
- Explain to the patient or responsible person the difficulty, and the importance of informing the next anaesthetist of the problem.
- Evaluate and follow up complications of difficult airway management: sore throat, difficulty in swallowing, pain or swelling of the face, bleeding, tracheal and esophageal perforation, chest pain, pneumothorax, aspiration, and dental damage. ENT referral if necessary. Express regret for morbidity.

2.6.3 COMPLETE A DIAGNOSIS CARD AND HAND OVER TO THE PATIENT- this is a useful way of making certain that you have documented events properly.

Equipment used:

Other information:

		Reasons/comments
Difficult mask ventilation?	Is awake intubation necessary in the future? Yes / No	
Difficult direct laryngoscopy?	Yes / No	
Difficult tracheal intubation?	Name of anaesthetist: Grade: YES / NO	Date:
Laryngoscopy grade	If you require further information please contact the	

Anaesthetic Department.

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