SAFE EXTUBATION OF DIFFICULT AIRWAY

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III YEAR POSTGRADUATE (M.D.)
DEPT OF ANAESTHESIOLOGY & CRITICAL CARE
KIMS, NARKETPALLY
• DEFINITIONS
• ETIOLOGY
• MECHANISMS
• MANAGEMENT
• PREVENTIVE STRATEGIES
• CONCLUSION
Difficult airway is defined as, “the clinical situation in which a conventionally trained anesthesiologist experiences difficulty with face mask ventilation of the upper airway, difficulty with tracheal intubation, or both.”
Difficult Airway Assessment
LEMON

LOOK at the patient’s anatomy
small mandible
large tongue
short bull neck
obese
abnormal facial/neck anatomy

EVALUATE – 3, 3, 2 finger widths between
teeth
hyoid and mentum
hyoid and thyroid

MALLAMPATI

OBSTRUCTION
secretions, stridor, muffled voice, mass, fb

NECK MOBILITY
c-spine immobilization, RA, Ankylosing Spondylitis
3. WILSON SCORING SYSTEM

5 factors - Weight, upper cervical spine mobility, jaw movement, receding mandible, buck teeth

- Each factor: score 0-2
- Total score  
  < 5 – Easy laryngoscopy.
  6 to 7 - Moderate difficulty.
  > 7 - Severe difficulty.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Risk</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>&lt; 90</td>
<td>90 – 110</td>
<td>&gt; 110</td>
<td></td>
</tr>
<tr>
<td>Head &amp; neck movement</td>
<td>&gt; 90</td>
<td>= 90</td>
<td>&lt; 90</td>
<td></td>
</tr>
<tr>
<td>IID (cm)</td>
<td>&gt; 5</td>
<td>= 5</td>
<td>&lt; 5</td>
<td></td>
</tr>
<tr>
<td>SL</td>
<td>&gt; 0</td>
<td>= 0</td>
<td>&lt; 0</td>
<td></td>
</tr>
<tr>
<td>Receding mandible</td>
<td>None</td>
<td>Moderate</td>
<td>severe</td>
<td></td>
</tr>
<tr>
<td>Buck teeth</td>
<td>None</td>
<td>Moderate</td>
<td>severe</td>
<td></td>
</tr>
</tbody>
</table>

IID – Interincisor Gap
SL – Maximal Forward Protrusion of Lower incisors beyond upper incisors.
Management of unanticipated difficult tracheal intubation in adults

**Plan A: Facemask ventilation and tracheal intubation**
- Optimise head and neck position
- Preoxygenate
- Adequate neuromuscular blockade
- Direct / Video Laryngoscopy (maximum 3+1 attempts)
- External laryngeal manipulation
- Bougie
- Remove cricoid pressure
- Maintain oxygenation and anaesthesia

If in difficulty → call for help

- Succeed → Confirm tracheal intubation with capnography

**Plan B: Maintaining oxygenation: SAD insertion**
- 2nd generation device recommended
- Change device or size (maximum 3 attempts)
- Oxygenate and ventilate

- Declare failed SAD ventilation

- Succeed → Options (consider risks and benefits):
  1. Wake the patient up
  2. Intubate trachea via the SAD
  3. Proceed without intubating the trachea
  4. Tracheostomy or cricothyroidotomy

**Plan C: Facemask ventilation**
- If facemask ventilation impossible, paralyse
- Final attempt at facemask ventilation
- Use 2 person technique and adjuncts

- Declare CICO

- Succeed → Wake the patient up

**Plan D: Emergency front of neck access**
- Scalpel cricothyroidotomy

**STOP AND THINK**

**Post-operative care and follow up**
- Formulate immediate airway management plan
- Monitor for complications
- Complete airway alert form
- Explain to the patient in person and in writing
- Send written report to GP and local database

This flowchart forms part of the DAS Guidelines for unanticipated difficult intubation in adults 2015 and should be used in conjunction with the text.
EXTUBATION

• Tracheal extubation has received relatively limited critical scrutiny compared with that accorded to intubation

• It is frequently ignored aspect of management, despite the observation that airway complications are significantly more likely to be associated with extubation than intubation

• Considering this, The ASA Task Force on Management of the Difficult Airway has formulated strategies for safe extubation in difficult airway.
EXTUBATION FAILURE

- Extubation failure has been defined as “the inability to tolerate removal of the translaryngeal tube,” and it is generally treated with tracheal reintubation.

<table>
<thead>
<tr>
<th>Causes of extubation failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laryngospasm</td>
</tr>
<tr>
<td>Upper airway edema</td>
</tr>
<tr>
<td>Haematoma compressing airway</td>
</tr>
<tr>
<td>Tracheomalacia</td>
</tr>
<tr>
<td>Airway soft tissue collapse sec to anaesthetics</td>
</tr>
</tbody>
</table>
“At-risk” extubation is a situation in which the ability of a patient to maintain airway patency and/or oxygenation after tracheal extubation is uncertain.

**Examples of At-risk extubation**

- Full stomach patients
- Unstable cardiovascular physiology
- Acid – Base derangement
Difficult Extubation

- A “difficult extubation” in the sense of a “difficult decannulation of the airway” is a rare situation that depends on mechanical factors related to patient, surgery, or anesthesia.

<table>
<thead>
<tr>
<th>Patient related</th>
<th>Surgeon related</th>
<th>Anaesthesia related</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unrecognised Subglottic stenosis</td>
<td>Surgical stitch anchoring ETT to tracheal wall</td>
<td>Incomplete deflation of Cuff</td>
</tr>
<tr>
<td>Severe edema preventing removal of ETT</td>
<td></td>
<td>Malfunctioning Cuff Pilot</td>
</tr>
</tbody>
</table>
Weaning Failure

- “Weaning failure is the inability to tolerate spontaneous breathing without ventilatory support,” and its treatment includes tracheal reintubation and invasive ventilation or, in selected patients, noninvasive ventilation.
- Assessing the adequacy of weaning variables and predictors of airway patency, as well as confirming the integrity of airway reflexes, are important preparatory steps for a successful extubation.
- This concept is particularly relevant in the ICU setting, where patients may successfully pass a weaning trial but fail extubation due to airway obstruction.
Early vs Late

- The term “Early Reintubation” will apply to the immediate postextubation period (within minutes and up to 6 hours after tracheal extubation).

- The term “Late Reintubation” will indicate events occurring between 6 and 72 hours after extubation.

- Both in the Postoperative and ICU settings, Reintubations after extubation failure occur most frequently between 0 and 2 hours postextubation, and seldom after 24 hours.
• Early reintubation is a relatively rare event in the postoperative period of elective surgeries and after planned anesthesia & analgesia extubation, with reported rates of reintubation in the OR and postanesthesia care unit (PACU) between 0.1% and 0.45%.

• Overall, these data suggest that extubation failure in the early postoperative setting is rare, especially after elective surgery, but it is associated with extremely severe outcomes and litigation, even more frequently than airway-related complications occurring in other phases of anesthesia.
### Table. Routine Extubation Criteria

<table>
<thead>
<tr>
<th>Awake, alert, able to follow commands</th>
<th>Arterial blood gases reasonable with FiO₂ 40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustained eye opening for pediatric patients or patients unable to understand commands</td>
<td>pH &gt;7.30</td>
</tr>
<tr>
<td>Vital signs stable</td>
<td>PaO₂ ≥60 mm Hg</td>
</tr>
<tr>
<td>Blood pressure, pulse rate, temperature</td>
<td>PaCO₂ &lt;50 mm Hg</td>
</tr>
<tr>
<td>Respiratory rate ≤30 breaths per minute</td>
<td>Respiratory mechanics adequate</td>
</tr>
<tr>
<td>O₂ saturation</td>
<td>Tidal volume &gt;5 mL/kg</td>
</tr>
<tr>
<td>Protective reflexes returned</td>
<td>Vital capacity &gt;15 mL/kg</td>
</tr>
<tr>
<td>Gag</td>
<td>Negative inspiratory force &gt;-20 cm H₂O</td>
</tr>
<tr>
<td>Swallow</td>
<td>For patients at risk for laryngeal edema, consider cuff leak test and airway inspection</td>
</tr>
<tr>
<td>Cough</td>
<td>Evaluation by fiber-optic bronchoscopy</td>
</tr>
<tr>
<td>Adequate reversal of neuromuscular blockade</td>
<td></td>
</tr>
<tr>
<td>Train-of-4 stimulation 4/4, sustained tetany at 50 Hz</td>
<td></td>
</tr>
<tr>
<td>Strong hand grip</td>
<td></td>
</tr>
<tr>
<td>Usassisted head lift (&gt;5 sec)</td>
<td></td>
</tr>
</tbody>
</table>
Preparation of extubation

• Initial Plan
  1. “Deep” extubation
  2. “Awake” extubation
  3. Deep replacement of the tracheal tube with a laryngeal mask airway

• Other Preparations
  1. Patient position plan
  2. Bite block in place
  3. Throat pack removed
  4. Pre oxygenation
  5. Aspiration of Secretions from the pharynx (the trachea also if indicated)
Tracheal extubation: awake or anaesthetized?

- When deciding when to extubate, two main considerations should be taken care:
  1. was there any previous difficulty in controlling the airway?
  2. what is the risk of pulmonary aspiration?
ANTICIPATE DIFFICULT EXTUBATION

- Difficult mask ventilation
- Difficult intubation
- Potential airway collapse
- Restricted Post surgical airway access
- Potential for extubation failure
- Increased risk for aspiration of gastric contents
Systematic approach

Can this patient be extubated when deeply anaesthetized?

Can this patient be extubated immediately following surgery and emergence of general anaesthesia?

This patient requires continued intubation and mechanical ventilation?
Can this patient be extubated when deeply anaesthetized

**YES**
- No residual neuromuscular block
- Easy mask ventilation
- Easily intubated
- Not at increased risk for regurgitation/aspiration
- Normothermic

**NO**
- Difficult mask ventilation
- Difficult intubation
- Residual neuromuscular block present
- Full stomach
  - Pregnant
  - Obese
  - Recent ingestion of food
  - Diabetic
  - Has ascites
Can this patient be extubated immediately following surgery and emergence of general anaesthesia?

**YES**

- Awake
- Following commands
- Breathing spontaneously
  - well oxygenated
  - not excessively hypercarbic
    \(\text{PaCO}_2 \leq 50 \text{ mmHg}\)
- Fully recovered from neuromuscular blockers
  - sustained head lift
  - strong hand grip
  - strong tongue protrusion

**NO**

- Hypoxic (\(\text{O}_2\) saturation < 90 mmHg)
- Excessively hypercarbic (\(\text{PaCO}_2 > 50 \text{ mmHg}\))
- Hypothermic (< 34°C)
- Residual neuromuscular block present
- Patient may be unable to protect his or her own airway
  * Airway swelling
    - long surgery in Trendelenberg position
    - airway surgery
    - patient received excessive intravenous fluid volume
  * Impairment of cough/gag reflex
    - brainstem surgery
    - intraop cerebral ischemic events
  * Vocal cord paralysis
  * Inadequate strength
- Excessively long surgical procedure
- Airway may be difficult to re-establish
- Unexplained hemodynamic instability
Patient position

- The traditional practice of extubating in the left lateral, head-down position maintains airway patency by positioning the tongue away from the posterior pharyngeal wall and also protects the airway from aspiration.

- Laryngoscopy and reintubation may be favourable in this position for experienced anaesthetists.
• Patients who have undergone upper airway surgery, the supine semi-upright position also facilitates spontaneous respiration and diaphragmatic expansion, aids an effective cough reflex, increases functional residual capacity (FRC) and encourages lymphatic drainage and reduction of airway oedema.

• Recent practice guidelines for patients with obstructive sleep apnoea recommend a semi-upright, lateral or any non-supine position for extubation and recovery
Time of extubation

- The mean threshold for glottic closure is increased during inspiration.

- Thus, extubation is usually carried out at end-inspiration when the glottis is fully open to prevent trauma and laryngospasm.

- Direct laryngoscopy, suctioning of the posterior pharynx, administration of 100% oxygen, ventilation to aid washout of inhalation agents, and positive pressure breath at extubation to prevent atelectasis are routine manoeuvres before extubation.
Problems associated with extubation

<table>
<thead>
<tr>
<th>BOX 50-1</th>
<th>Complications of Routine Extubations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Unintended extubation</td>
<td></td>
</tr>
<tr>
<td>• Fixation of endotracheal tube</td>
<td></td>
</tr>
<tr>
<td>• Hypertension, tachycardia</td>
<td></td>
</tr>
<tr>
<td>• Coughing, breath-holding</td>
<td></td>
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<tr>
<td>• Laryngeal injury</td>
<td></td>
</tr>
<tr>
<td>• Laryngospasm or vocal cord paralysis</td>
<td></td>
</tr>
<tr>
<td>• Stridor, airway obstruction</td>
<td></td>
</tr>
<tr>
<td>• Negative pressure pulmonary edema</td>
<td></td>
</tr>
<tr>
<td>• Laryngeal incompetence</td>
<td></td>
</tr>
<tr>
<td>• Aspiration</td>
<td></td>
</tr>
</tbody>
</table>
CAUSES AND MECHANISMS OF EXTUBATION FAILURE

- Pharyngeal Obstructions
- Laryngeal Obstructions
- Postoperative Bleeding
- Presence of Masses and Lesions
- Effects of Drugs Administered in the Perioperative Period
- Specific Mechanisms of Airway Obstruction After Cervical Spine Surgery
- Cough Strength and Endotracheal Secretions in ICU Patients
Mechanical causes of difficult extubation

- Possible causes of inability to remove the tracheal tube are
  1. failure to deflate the cuff caused by a damaged pilot tube
  2. trauma to the larynx
  3. cuff herniation
  4. adhesion to the tracheal wall
  5. Surgical fixation of the tube to adjacent structures
Management:

- The problem is usually solved by puncturing the cuff transtracheally or using a needle inserted into the stump of the pilot tube.
- Rotation and traction of the tube;
- Using a fibreoptic scope for diagnosis;
- Surgical removal of tethering sutures.
Cardiovascular response

- Tracheal extubation is associated with a 10 – 30% increase in arterial pressure and heart rate lasting 5 – 15 min.

- In healthy patients not on antihypertensive agents or other cardioactive drugs exhibit increases in HR and SBP of more than 20% in association with extubation.

- Patients with coronary artery disease experience a 40 – 50% decrease in ejection fraction.
Management:

- The response may be attenuated by pharmacological interventions including:
  1. esmolol (1.5 mg/ kg i.v. 2 – 5 min before extubation)
  2. glycercyl trinitrate
  3. magnesium
  4. remifentanil/alfentanil infusion
  5. i.v. lidocaine (1 mg/ kg Over 2 min), topical lidocaine 10%
  6. perioperative oral nimodipine with labetalol.

- Alternatively, tracheal intubation can be converted to a laryngeal mask before extubation
Respiratory complications

- coughing and sore throat
- Early post operative hypoxemia

- inadequate minute ventilation,
- airway obstruction
- increased ventilation perfusion mismatch,
- diffusion hypoxia,
- post-hyperventilation hypoventilation,
- shivering
- inhibition of HPV
- mucociliary dysfunction
MANAGEMENT

- Filling the tracheal tube cuff with liquid avoids overinflation as a result of an increase in temperature or N2O diffusion.

- Lidocaine 2% with NaHCO3 1.4 or 8.4% has an excellent diffusion profile across the PVC cuff (45 – 65% in 6 h), is safe and less irritant in case of cuff rupture, especially if 1.4% NaHCO3 is used (more physiological pH).

- This technique significantly reduces the incidence of sore throat in the 24 h postoperative period, coughing, bucking, restlessness, and hoarseness during emergence, without suppressing the swallowing reflex.
• administration of high inspired oxygen (100% oxygen) before extubation.

• continuous positive airway pressure can decrease the incidence of early hypoxaemia post-extubation
Airway obstruction

- A differential diagnosis of post-extubation upper airway obstruction (UAO) includes
  1. laryngospasm,
  2. laryngeal oedema,
  3. haemorrhage,
  4. trauma
  5. vocal cord paralysis/dysfunction
Laryngospasm

- Laryngospasm is a common cause of post-extubation airway obstruction.

- A variety of triggers are recognized, including

  1. vagal, trigeminal, auditory, phrenic, sciatic, and splanchnic nerve stimulation are triggers for laryngospasm.

  2. cervical flexion or extension with an indwelling ETT

  3. vocal cord irritation from blood, vomitus, or oral secretions
Laryngospasm causes bilateral adduction of the true vocal folds, vestibular folds, and aryepiglottic folds that outlasts the duration of the stimulus & muscles responsible are cricothyroids, lateral cricoarytenoids, and thyroarytenoid muscles.

This is protective to the extent that it prevents aspiration of solids and liquids. It becomes maladaptive when it restricts ventilation and oxygenation.

Complications of Laryngospasm

1. Negative pressure pulmonary edema
2. Subsequent hypoxic cardiac arrest
Management

- Ongoing stimulus should be stopped and 100% O2 should be administered.
- Chin lift/jaw thrust or Larson’s maneuver should be applied.
- Larson’s maneuver: Apply firm steady pressure in space between ascending ramus of mandible and mastoid process.
- Administer 0.5-0.8mg/kg Propofol to alter plane of anaesthesia.
- Unresponsive spasm may need administration of 0.1-0.3 mg/kg succinylcholine.
- While all this is being done, continuous positive pressure and bag & mask ventilation should be attempted.
- If needed, tracheal intubation and ventilatory support is given.
- Superior laryngeal nerve Blockade can be achieved by injecting 2ml of local anaesthetic 1cm medial to superior cornu of hyoid through the thyrohyoid membrane prior to awake fiberoptic intubation.
Laryngeal oedema

- Laryngeal obstruction is due to oedema is recognised by stridor, inspiratory prolongation, and use of accessory muscles.

- Associated risk factors include a
  1. tight fitting tube,
  2. trauma at intubation,
  3. coughing on the tube
  4. duration of intubation >1 hr
  5. change of head and neck position during surgery.

- It is common in adults after prolonged translaryngeal intubation in the critically ill
**Management:**

1. warm, humidified, 100% oxygen
2. nebulized epinephrine 1:1000 (0.5 ml /kg up to 5 ml)
3. dexamethasone 0.25 mg /kg followed by 0.1 mg /kg six hourly for 24 h
4. Heliox (60:40 or 80:20) temporarily stabilizes respiration giving other modalities time for effect
5. reintubation with a smaller tube in severe cases
Vocal cord paralysis

- Vocal fold paralysis results from injury to the vagus or one of its branches (i.e., recurrent laryngeal nerve [RLN] or external division of the superior laryngeal nerve [ex-SLN]).

- When vocal fold paralysis occurs as a surgical complication, it is usually associated with neck, thyroid, or thoracic surgery.

- The RLN supplies all of the intrinsic laryngeal muscles except the cricothyroid, the true vocal cord tensor, which is innervated by the ex-SLNs.
• Unilateral ex-SLN injury results in a shortened, adducted vocal fold with a shift of the epiglottis and the anterior larynx toward the affected side.
• This produces a breathy voice but no obstruction and usually resolves within days to months.
• Bilateral ex-SLN injury causes the epiglottis to overhang, making the vocal folds difficult to visualize.
• This produces hoarseness with reduction in volume and range but no obstruction.
• Unilateral RLN injury causes the vocal fold to assume a fixed paramedian position and produces a hoarse voice. There may be a marginal airway with a weak cough.
• Bilateral RLN injury results in both vocal folds being fixed in the paramedian position and inspiratory stridor, often necessitating a surgical airway.
Tracheomalacia

- Softening or erosion of the tracheal rings leading to tracheal collapse and UAO may be primary or secondary to a prolonged insult by a
  1. retrosternal thyroid or other tumours,
  2. enlarged thymus,
  3. vascular malformations, and
  4. prolonged intubation.
- Failed extubation, complicated by inspiratory stridor or expiratory wheezing, may be the first signs of the condition.
- Techniques for extubation include deep extubation to avoid coughing and maintenance of continuous positive airway pressure (CPAP) to maintain airway patency
Pulmonary aspiration

- One-third of cases of pulmonary aspiration occur after extubation.
- The swallowing reflex is obtunded by anaesthetic agents and laryngeal function may be disturbed.
- With an inability to sense foreign material for at least 4 h, even in apparently alert postoperative patients.
- More common with when using N2O during anaesthesia.

- Prophylactic treatment with anti emetics can prevent this event.
- Extubation in lateral position shows benefit.
CLINICAL PREDICTORS

- Cuff leak test
  1. Quantitative
  2. Qualitative

- Cough strength and secretions
Cuff-leak test

- Assessment of upper airway patency is challenging in the intubated patient.
- Qualitative and quantitative cuff-leak tests have been described to assess the degree of laryngeal oedema and subsequent risk of reintubation.
- An association between the absence of an audible air leak after deflation of the TT cuff and the development of post-extubation stridor has been demonstrated (qualitative cuff leak test).
- Patients with a cuff leak volume of <110 ml or of ~20% of tidal volume (quantitative cuff leak test) may be at high-risk for the presence of laryngeal oedema and subsequently for re-intubation.
COUGH STRENGTH TEST

Semiobjective scale of cough strength (single observer method)

0—no cough on command,
1—audible movement of air through the endotracheal tube but no audible cough,
2—weakly (barely) audible cough,
3—clearly audible cough,
4—stronger cough,
5—multiple sequential strong cough.

White card test (WCT) (single observer method)
White file card 1–2 cm from the end of the endotracheal tube.

Patients asked to cough, up to 3–4 times. If any wetness appears on the card, it is classified as a positive WCT result (reported PPV 88% for successful extubation).
DAS Extubation Guidelines: Basic algorithm

**Step 1**
Plan extubation
Assess airway and general risk factors
- Airway risk factors
  - Known difficult airway
  - Airway deterioration (trauma, oedema or bleeding)
  - Restricted airway access
  - Obesity / OSA
  - Aspiration risk
- General risk factors
  - Cardiovascular
  - Respiratory
  - Neurological
  - Metabolic
  - Special surgical requirements
  - Special medical conditions

**Step 2**
Prepare for extubation
Optimise patient and other factors
- Optimise patient factors
  - Cardiovascular
  - Respiratory
  - Metabolic / temperature
  - Neuromuscular
- Optimise other factors
  - Location
  - Skilled help / assistance
  - Monitoring
  - Equipment

Risk Stratify

- **Low risk**
  - Fasted
  - Uncomplicated airway
  - No general risk factors
- **‘At risk’**
  - Ability to oxygenate uncertain
  - Reintubation potentially difficult and/or general risk factors present

**Step 3**
Perform extubation
- Low risk algorithm
- ‘At risk’ algorithm

**Step 4**
Postextubation care
Recovery or HDU / ICU
- Safe transfer
- Handover / communication
- $\text{O}_2$ and airway management
- Observation and monitoring
- General medical and surgical management
- Analgesia
- Staffing
- Equipment
- Documentation
**DAS Extubation Guidelines: Low risk algorithm**

**Step 1** Plan extubation

- Plan
- Assess airway and general risk factors

**Plan**
- Low risk extubation
  - Fasted
  - Uncomplicated airway
  - No General risk factors

**Step 2** Prepare for extubation

- Prepare
- Optimise patient and other factors

**Prepare**
- Optimise patient factors
  - Cardiovascular
  - Respiratory
  - Metabolic / temperature
  - Neuromuscular
- Optimise other factors
  - Location
  - Skilled help / assistance
  - Monitoring
  - Equipment

**Step 3** Perform extubation

- Select deep or awake extubation

**Deep Extubation**
- Advanced technique
- Experience essential
- Vigilance until fully awake

**Awake Extubation**
- Perform Awake Extubation
  - Preoxygenate with 100% oxygen
  - Suction as appropriate
  - Insert a bite block (e.g. rolled gauze)
  - Position the patient appropriately
  - Antagonise neuromuscular blockade
  - Establish regular breathing
  - Ensure adequate spontaneous ventilation
  - Minimise head and neck movements
  - Wait until awake (eye opening/obeying commands)
  - Apply positive pressure, deflate the cuff & remove tube
  - Provide 100% oxygen
  - Check airway patency and adequacy of breathing
  - Continue oxygen supplementation

**Step 4** Postextubation care

- Recovery and follow up

**Recovery and follow up**
- Safe transfer
- Handover / communication
- O₂ and airway management
- Observation and monitoring
- General medical and surgical management

**Analgesia**
- Staffing
- Equipment
- Documentation

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The technique described for awake extubation is a suggested approach. Practice may vary in experienced hands.

Difficult Airway Society Extubation Algorithm 2011
Strategies for difficult extubation

- Substituting a laryngeal mask for a tracheal tube while the patient is still anaesthetized and paralysed

- Extubation over a flexible bronchoscope

- Use of a tracheal tube exchange catheter (reversible tracheal extubation)
Substituting a laryngeal mask for a tracheal tube

- A laryngeal mask airway (LMA) is inserted while the patient is in a deeper plane of anaesthesia after tracheal extubation.

- Muscle relaxation is then antagonized and the LMA removed when spontaneous breathing resumes and commands are obeyed.

- This avoids coughing and a pressor response to extubation and there is lesser need for airway manipulation compared with deep tracheal extubation with insertion of Guedel airway
Extubation over a flexible bronchoscope

- This can be considered in suspected laryngeal paralysis, tracheomalacia or tube entrapment.
- An LMA is substituted as mentioned earlier and the patient is allowed to resume spontaneous ventilation while still anaesthetized.
- A flexible bronchoscope is then advanced through the LMA.
• This enables visualization of the anatomy and assessment of laryngeal function.

• If required, reintubation can be facilitated using an Aintree intubation catheter which jackets the flexible bronchoscope.

• The latter is then removed along with the LMA and the patient is reintubated over the catheter.
Use of a tracheal tube exchange catheter (reversible tracheal extubation)

- This strategy is especially useful for patients expected to be difficult to reintubate.
- Tracheal tube exchangers (e.g. the Cook airway exchange catheter) are long hollow catheters with connectors for jet and/or manual ventilation and respiratory monitoring;
- Most have depth and radio opaque markers, and end or distal side holes.
- They can be introduced through a tracheal tube permitting extubation.
Use of Airway Exchange Catheters (AECs)

1. Commonly used and recommended model and sizes: Cook AEC catheters 11 F and 14 F compatible with tracheal tubes of internal diameters >4 and 5 mm, respectively.

2. The catheter should be semirigid as opposed to rigid to minimize trauma. Hollow catheters are preferred, as they offer the ability to insufflate oxygen and/or ventilate through their lumen.

3. Oxygen insufflation and jet ventilation through AEC may be associated with significant risk of barotrauma and should be reserved to selected lifethreatening situations and administered by expert providers.

4. Appropriate depth of insertion of the catheter well above the carina and administration of local anesthetic through the AEC can help minimize patient discomfort.
5. During reintubation over an AEC, use of advanced laryngoscopy (video-assisted or optical) has been suggested to improve visibility of the periglottic structures and facilitate advancement of the ETT into the trachea.

6. Most common complications associated with AEC use: pneumothorax (unilateral or bilateral, with or without subcutaneous emphysema), pneumoperitoneum and pneumomediastinum, hypoxia during airway management and unintended esophageal misplacement leading to gastric perforation.
Figure 50-7 The Endotracheal Ventilation Catheter (ETVC) is avail-
conclusion

- For a difficult intubation, anticipate extubation failure and plan preventive strategy.
- Airway exchange catheter with insufflating oxygenation port will help for reintubation.
- In Cannot Intubate - Cannot Oxygenate (CICO) proceed for cricothyroidotomy or tracheostomy.
- Shift to PACU and postextubation monitoring and care.