Nursing Guidelines on Assisting with Intubation and Extubation of Infants and Children

2nd Edition

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Contents

<table>
<thead>
<tr>
<th></th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Assisting with the Intubation of an Infant /Children</td>
<td>2</td>
</tr>
<tr>
<td>a) Cuffed Endotracheal Tube – Checking Cuff Pressure</td>
<td>9</td>
</tr>
<tr>
<td>2. Extubation of an Infant /Children</td>
<td>10</td>
</tr>
<tr>
<td>a) Suspected Accidental Extubation</td>
<td>14</td>
</tr>
<tr>
<td>3. Care of an Infant / Child with a Nasopharyngeal Tube</td>
<td>15</td>
</tr>
<tr>
<td>5. Appendices</td>
<td>16</td>
</tr>
<tr>
<td>6. References</td>
<td>20</td>
</tr>
</tbody>
</table>
1. Intubation

Introduction
Intubation is the placement of an endotracheal tube in the trachea and is the gold standard and method of choice for establishment and maintenance of an airway (Chethan and Hughes 2008).

Indications for Intubation / Ventilation
Maintenance of patent airway / upper airway obstruction
Worsening Respiratory Distress / Respiratory Failure
Inadequate ventilation
Worsening hypoxia, despite oxygen therapy
Elective Intubation, i.e. following neonatal surgery, cardiac surgery or prior to general anaesthesia
Trauma i.e. facial injuries
Neurological i.e raised intracranial pressure (ICP), deteriorating Glasgow Coma Scale (GCS) i.e. < 8 with no gag reflex
Inhalation Burns

Equipment (Appendix I)

- Cardiac monitor with audible QRS tone
- Oxygen saturation monitor
- Blood pressure monitoring of patient
- Rebreathing circuit (bag), mask (appropriate size) and oxygen source
- Airway appropriate size
- Appropriate size ETT, one 0.5mm smaller and 0.5mm larger (internal diameter measurement mm ET tube
- Appropriate sized laryngoscope i.e.
  - **Straight blade** (Miller)
    - Preterm Infant – Size 0
    - Infants - Size 0-1
    - Small Child - Size 1 or 2
  - **Curved blade** (Mackintosh) Child
    - Infant / Child (< 12kgs) Size 1
    - Child (< 22kgs) Size 2
    - Large Child (< 30kgs) Size 3
    - Adolescent Size 3-4

NB: (Attach blade and check light and have spare light, blades and batteries to hand

- Wall suction with yankauer
- Suction catheters, appropriate size
- Magill’s forceps appropriate size
- Gauze and K-Y Jelly
- Nasogastric tube prn
- Elastoplast tape (cut in trouser legs x 2)
- Duoderm
- Cavilon™ Swabs
- Ventilator with appropriate settings checked by anaesthetist
- Stethoscope
- Scissors
- Trolley or clear surface for equipment

Optional:
- Introducer / Stylet
- Artery forceps
- Gum elastic bougie (older child)
- End tidal CO₂ detector

Tracheal Tubes

<table>
<thead>
<tr>
<th>Estimating Endotracheal Tube Size and Length</th>
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<tbody>
<tr>
<td><strong>Size</strong></td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td><strong>Length (cms)</strong></td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td><strong>Nasal Tube</strong></td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

* Formulas are appropriate for children > 1 year.
* Preterm Infants 2.5 ETT
* Infant < 6 months 3.0 – 3.5 ETT
* Infant 6-12 months 3.5 – 4.0 ETT

(APLS 2011)
**Microcuff Endotracheal Tubes**

- **Recommended Sizes**

<table>
<thead>
<tr>
<th>Tube Size (mm)</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0</td>
<td>Newborn (3kgs) – &lt; 8 months</td>
</tr>
<tr>
<td>3.5</td>
<td>8 months - &lt; 2 years</td>
</tr>
<tr>
<td>4.0</td>
<td>2 - &lt; 4 years</td>
</tr>
<tr>
<td>4.5</td>
<td>4 - &lt; 6 years</td>
</tr>
<tr>
<td>5.0</td>
<td>6 - &lt; 8 years</td>
</tr>
<tr>
<td>5.5</td>
<td>8 - &lt; 10 years</td>
</tr>
<tr>
<td>6.0</td>
<td>10 - &lt; 12 years</td>
</tr>
<tr>
<td>6.5</td>
<td>12 - &lt; 12 years</td>
</tr>
<tr>
<td>7.0</td>
<td>14 - &lt; 16 years</td>
</tr>
</tbody>
</table>

(Kimberly-Clark 2006a)

**Tube Insertion Depth (cms) for Preterm Infants**

<table>
<thead>
<tr>
<th>Infants Wt (Kgs) + 6</th>
<th>&lt; 1kg</th>
<th>6-5 – 7cms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2kgs</td>
<td>7-8cms</td>
<td></td>
</tr>
<tr>
<td>2-3kgs</td>
<td>8-9cms</td>
<td></td>
</tr>
<tr>
<td>3-4kgs</td>
<td>&gt;9cms</td>
<td></td>
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</tbody>
</table>

(Kattwinkel et al 2000)

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**Intubation Equipment** *(Appendix I and II)*

**Endotracheal Tubes** *(Cuffed or Uncuffed Tubes)*

All endotracheal tubes have a preformed curve which conforms to the child’s anatomy of the airway, aiding insertion and preventing kinking whilst in situ. The tube is oval in cross section but the distal end is cut at an oblique angle (bevelled) so that the aperture opens on the left side. This facilitates visualisation of the tip of tube as it passes through the cords when introduced with the right hand by the anaesthetist. There is a hole at the bevelled end (Murphy’s eye) which allows an alternative route for gas flow should the bevelled end become obstructed by blood, mucus or the tracheal wall. It is also believed that it allows ventilation to the other lung should inadvertent main stem intubation occur. Tubes have markings from top to bottom in cms and a radio-opaque longitudinal line. Sizes are in millimetres (mms) of internal diameter. Uncuffed endotracheal tubes have traditionally been used in infants / children < 8 years because their airway is funnel shaped and narrowest at the cricoid cartilage which acts as a physiological seal compared to a cylinder airway in the older child / adult.

**Endotracheal Tubes (Mallinckrodt)**

Made from siliconized PVC, with black line ® (radioopaque) and come with standardised 15mm ISO connector. Cuffed tubes have high volume, low pressure (HVLP) Soft-Seal Profile ®. A spring loaded one way valve helps ensure the integrity of cuff inflation.

**Microcuff ® Tubes**

Microcuff ® paediatric endotracheal tubes (ETT) have been designed to be anatomically correct for the paediatric airway and have a thinner more distensible cuffed tube. The short cylindrical ultrathin (10 micron) walled polyurethane, puncture resistant HVLP cuff is placed in the lower trachea, to allow expansion of cuff for ‘tracheal sealing’ instead of ‘cricoid sealing’. They are capable of sealing at very low pressures (< 20 cms of water), average 11 cms of water compared to PVC ETT; which is almost half the pressure of conventional cuffed ETT. The cuff also fills the gap between tracheal wall and tube without folds and channels, clinging and draping to the wet mucosa almost like ‘clingfilm’ at lower pressures compared to PVC. There is maximum reduced airleak, improving the efficacy of ventilation. Anatomically based depth markings with 4 pre-glottic markings, ensures a cuff-free subglottic area, thus reducing the risk to the pressure sensitive larynx and the development of subglottic stenosis. There is also sufficient margin for preventing inadvertent tracheal extubation or endobronchial intubation. Microcuff tubes also reduce the risk of aspiration, need for re-intubations and lower pollution of environment and staff by gases. The microcuff endotracheal tube may be used by anaesthetists for specific situations i.e. facial / inhalation burns (Kimberley Clark 2006a, 2006b).

**Laryngoscopes**
This is a rigid instrument that the anaesthetist uses to examine the larynx and facilitate endotracheal intubation. It consists of the handle containing the battery and the blade which is used to move tongue and soft tissues aside to ensure a good view of the larynx. At the blade tip is an incandescent bulb, which turns on when blade and handle are attached together and locked into a 90 degree angle.

**Straight Blade** – Usually used for infants and enables anterior laryngeal placement. Epiglottis can be lifted to view vocal cords. However it can cause vagal stimulation resulting in bradycardia or laryngospasm.

**Curved Blade** – Usually used in children > 1 year. Its curved blade flange is large enabling better control of the tongue and is able to move the epiglottis forward by lifting from the front. There is less need to exert leverage on the child’s upper teeth which reduces the risk of dental damage. The tip of the blade is inserted into the vallecula (mucosal pocket) at base of tongue, anterior to the epiglottis and moved forward. Vocal cords can be visualised with less vagal stimulation as the mucosa of vallecula is innervated by the glossopharyngeal nerve.

**Magill Forceps**

Used to grasp the endotracheal tube, especially when inserting through the nose and pass it through the vocal cords.

**Intubation Adjuncts**

**Introducer / Stylet**

This is a long bendable rod which can be inserted into the endotracheal tube and used to help facilitate a difficult intubation. It is placed into the endotracheal tube before the procedure. Care is necessary to ensure that the tip doesn’t protrude beyond the end or side holes of the endotracheal tube during the procedure to avoid trauma to the tissues. Following successful placement of the tube the stylet is removed.

**Bougie**

This is a straight semi-rigid stylet type device with a bent tip that can be used to facilitate intubation. It is carefully advanced through the cords into the larynx until the tip enters the main stem bronchus. The endotracheal tube is then threaded into the larynx. Once correct placement has been achieved the bougie is removed.

**Laryngeal Mask Airway**

The laryngeal mask airway (LMA) is a supra-glottic airway device. It consists of tube PVC (single use) or silicone (usually reusable). It fills the gap between face mask and endotracheal tube. In children a smaller size is used which makes it easy to position. However it may give a false sense of security because the mask is also easy to dislodge, therefore vigilance is essential. It may be used in the PICU in an emergency when failed intubation has occurred, where it helps establish and maintain the child’s airway. Positive pressure ventilation can be applied. The LMA however does not protect against aspiration and is contraindicated where there is a risk of regurgitation. (Chethan and Hughes 2008, Fine 2008, Gerber 2008a,2008b, Maxwell 2008, National Maternity Hospital 2008, APLS 2011, Mitchell and Patel 2011, University of Virginia 2011).

**Medication for Intubation (Given by anaesthetist)**

- Atropine (0.01mg – 0.02 mg / kg). ( Usually minimum dose of 0.1 mg/kg to prevent paradoxical bradycardia)
- 0.9% Normal Saline flush (dated and timed)

**Induction Agents**

- Thiopentone (3 – 5mgs / kg)
- Ketamine (2mgs / kg)
- Propofol (2-3mgs / kg) (Over 3 years, ensure no egg allergy) (Ghanta et al 2007)

**Muscle Relaxants**

- Suxamethonium (1.5mg – 2mgs /kg)
- Pancuronium / Vercuronium (0.1 – 0.3mg /kg)
- Atracurium besylate (0.5mg / kg)

**Rapid Induction Pack (Available in ward fridges for emergency use)**

- Suxamethonium (50mgs / ml) 2ml ampoule
- Thiopentone (25mgs/ ml) 20 ml ampoule
- Ketamine (10mg / ml) 20 ml vial
- Pancuronium (2mg / ml) 2 ml ampoule x 2

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<table>
<thead>
<tr>
<th>ACTION</th>
<th>RATIONALE &amp; REFERENCE</th>
</tr>
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<tbody>
<tr>
<td><strong>Pre Procedure</strong></td>
<td></td>
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<tr>
<td><strong>Patient Preparation</strong></td>
<td>Prepare child and family where possible</td>
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<td></td>
<td>Gather all equipment.</td>
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<td></td>
<td>Test the cuff, pilot balloon and valve of each tube of cuffed endotracheal tube i.e. Microcuff tube, prior to use. Insert a luer tip syringe into cuff inflation valve and inject enough air to fully inflate the cuff. After test inflation, fully evacuate the air prior to use.</td>
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<td>The child should be nil by mouth (NPO) prior to the procedure, 4-6 hours when possible, unless emergency. Insert nasogastric tube and aspirate nasogastric tube prior to procedure.</td>
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<td></td>
<td>Check IV access is patent (central or best peripheral).</td>
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<td>Record the child’s heart rate (with audible QRS sound), B/P, oxygen saturations and respiratory rate.</td>
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<td></td>
<td>Ensure suction working and attach appropriate size yankauer suction with catheters nearby.</td>
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<td></td>
<td>In the neonate or preterm infant ensure infant is kept warm i.e. radiant warmer, giraffe incubator.</td>
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<td></td>
<td>Put on personal protective equipment (PPE) following risk assessment i.e. apron, goggles etc. Wash hands. ANTT Level 3.</td>
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<tr>
<td><strong>Procedure</strong></td>
<td></td>
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<tr>
<td><strong>Rapid Sequence Induction (RSI)</strong></td>
<td>Is usually performed with any patient considered at risk of regurgitating their stomach contents. Muscle relaxant and sedative is administered in rapid sequence.</td>
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<tr>
<td></td>
<td>Ensure infant / child is supine with head at side of incubator/ radiant warmer or the top of the cot / bed. The anaesthetist stands at the child’s head which is positioned midline with minimal extension of the neck (infant neutral and child in sniffing position). A roll may be placed under shoulders. NB: Avoid: - Hyperextending or rotating the neck. - Flexing the head towards the chin. Anaesthetist will manually ventilate the child with 100% oxygen, using a rebreathing bag, mask, valve for a</td>
</tr>
<tr>
<td></td>
<td>To reassure parents and child, gain confidence and cooperation (Hockenberry and Wilson 2011).</td>
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<td></td>
<td>To facilitate completion of the procedure in a timely manner (Trivits-Verger and Lebet 2008).</td>
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<tr>
<td></td>
<td>To ensure patient safety and equipment is working satisfactorily prior to use (Kimerley-Clark 2006b).</td>
</tr>
<tr>
<td></td>
<td>To empty the stomach and prevent aspiration of contents during the procedure (Levin et al 1997).</td>
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<td></td>
<td>To be able to administer pharmacological agents.</td>
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<td></td>
<td>Attain base line vital signs (Hazinski 1999).</td>
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<td></td>
<td>Early detection of adverse effects of intubation i.e. bradycardia due to hypoxia or vagal stimulation. To be prepared for the procedure.</td>
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<td></td>
<td>To protect against cold stress and its detrimental effects (Karlsen 2006).</td>
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<td></td>
<td>The aim is to minimise the risk of gastric aspiration during intubation. It also facilitates airway visualisation through muscle relaxation, control of agitation and prevention of involuntary reflexes i.e. gag reflex (Hazinski 1999, Gardiner and Grindrod 2005, Zelicof-Paul et al 2005).</td>
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<td></td>
<td>Opens airway fully and aligns the trachea which allows visualisation of glottis and larynx (APLS 2011, NSCNN 2005, National Maternity Hospital 2000). The glottis will be raised above the line of sight and narrow the trachea and under flexing will cause the posterior pharynx to be viewed but prevent direct visualisation of the glottis (National Maternity Hospital 2008).</td>
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<td>Fill the reserve lung volume with oxygen rather than room</td>
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**August 2012**

**Minimum of 3 minutes, prior to intubation.**

**NB: Maintenance of oxygenation is a priority during the procedure**

Procedure should be limited to maximum of 20 seconds.

Ensure yankauer and suction available to hand at infant / child’s shoulder to allow easy access for the anaesthetist.

**Cricoid Pressure**

The anaesthetist may request the nurse to apply cricoid pressure (Sellick’s manoeuvre).

**NB:** Cricoid cartilage is just below the thyroid cartilage (Adam’s Apple) which is the first complete cartilage ring of the trachea. **Do not remove pressure until requested by the anaesthetist.**

Cricoid pressure should be applied before loss of consciousness.

Observe the child’s heart rate, blood pressure and oxygen saturations during the procedure and notify the doctor of any changes.

Child is induced by the anaesthetist.

Ensure intubation equipment is to hand for the anaesthetist i.e. laryngoscope, magill forceps, endotracheal tube, gauze with KY jelly.

The anaesthetist may select as clinically indicated: **Orotracheal** intubation for an emergency intubation **Nasal** intubation for an elective intubation or following stabilisation with an oral endotracheal tube.

When the anaesthetist is able to visualise the glottis the endotracheal tube is inserted whilst the vocal cords are open, until the vocal cord guide is at level of the vocal cords (black ring around tip of the tube).

The procedure should be stopped if the infant / child deteriorates i.e. bradycardia and / or desaturates. The anaesthetist will handventilate with 100% oxygen until the infant’s cardiovascular and respiratory status stabilises.

**Post Procedure**

**Confirmation of Endotracheal Tube Placement is MANDATORY**

Observe chest wall movements, ensuring equal symmetrical chest expansion and listen with stethoscope for bilateral air entry to both lungs.

**air to minimise the risk of desaturation or bradycardia (Levin et al 1997).**

To prevent hypoxia (APLS 2011, Henderson 2011).

Bradycardia and oxygen desaturations can occur within 55 seconds (Bottor 2009).

Pharyngeal suction may be required to ensure good visualisation of the cords.

Cricoid pressure compresses the cricoid cartilage against the cervical vertebrae, closing the oesophagus and thus preventing passive regurgitation and aspiration of gastric contents. It also minimises gastric inflation during manual handventilation and may help with visualisation of the vocal cords thereby facilitating the insertion of ETT (Jagim 2003, Jukes 2003, Gardiner and Grindrod 2005, Nolan et al 2005, APLS 2011).

The splinter effect of the oesophagus, preventing regurgitation is lower once the patient is unconscious (Brimacombe and Berry 1997).

Early detection of significant changes in vital signs i.e. bradycardia which may be a sign of hypoxia and hypotension may result from medication administered or underlying cardiovascular instability (Hazinski 1999, Tritis-Verger and Lebet 2008).

To aid the procedure.

This should place the endotracheal tube midway between carina and vocal cords (National Maternity Hospital 2008).

Bradycardia is a sign of hypoxia. To restore oxygenation (Henderson 2011).

To avoid mortality from hypoxaemia due to delay or failure to recognise oesophageal intubation. There is also a risk of morbidity due to accidental endobronchial and supra glottic positions (Henderson 2011).

**NB: Final confirmation is the responsibility of anaesthetist.**

Ensure no sounds i.e. gurgling noted over stomach or gastric distension.

Ensure colour, oxygen saturations and heart rate are satisfactory.

Anaesthetist may use an end tidal CO2 detector connected to ETT to confirm position if clinically indicated.

Once the position of the endotracheal tube has been ascertained and the anaesthetist has confirmed placement at the nose / lips, formal securing of the tube can take place.

**Securing the Tube**

Assist with fixation of endotracheal tube and nasogastric tube (Appendix III).

This procedure **should** always be performed by 2 people.

Children with burns or scalds to the face will require an alternative method for securing the endotracheal tube. The anaesthetist intubating the child will decide this at the time of intubation.

Ensure skin is clean and dry.

Apply Cavilon skin protectant to cheeks followed by a colloid dressing strip i.e. duoderm is applied to cheeks as clinically indicated.

Cut 2 pieces of elastoplast approx. 10 – 15 cms long into “trouser legs” as clinically indicated.

1. Place one piece of uncut portion of tape on child’s cheek and one portion of cut tape is drawn across the upper lip.

2. The second cut portion of tape is then wrapped around the ETT at least 2 – 3 times.

3. & 4. Repeat steps 1 – 2, with second piece of tape and apply in a similar way on the opposite side.

Suction the infant /child post intubation.

Obtain blood gas post intubation

Ensure chest x-ray is requested by anaesthetist and obtained post intubation with head in midline position.

 colour changes from purple to yellow in presence of exhaled carbon dioxide. The detector should also cycle between purple- yellow and purple to yellow during inflation – exhalation and inflation and exhalation (National Maternity Hospital 2008).

- To secure tubes and prevent accidental extubation.

- To maintain a clear airway.

Evaluate respiratory status.

To verify endotracheal tube position approximately 1-2cms
When infant is stable the external part of the tube may be shortened if necessary by the anaesthetist.

**Air Leak**
The endotracheal tube is checked for presence of air leak at 25-30 cms water using manometer, by the anaesthetist:

- **Appropriate tube size** – a small air leak is present when child is handventilated.
- **Tube too small** – Significant air leak present.
- **Tube too large** – Air leak not detected until inspiratory pressure > 30cms water.

Remove personal protective equipment (PPE) and wash hands.

Document procedure in the nursing notes including size and type of endotracheal tube and length to nose or lips. Also insertion of nasogastric tube as appropriate.

Ensure that all medication has been documented in the drug kardex by the anaesthetist.

Discuss with the anaesthetist, the ventilation plan for the child i.e. ventilation mode / settings and need for sedation / analgesia.

If intubation occurred on a ward organise safe transfer to PICU.

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1. a) **CUFFED ENDOTRACHEAL TUBE: Checking Cuff Pressure**

**Nursing Considerations with Cuffed Endotracheal Tubes**

NB: Always discuss with consultant anaesthetist regarding specific patient requirements and inflation pressures for cuffed endotracheal tube.

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<th>ACTION</th>
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<tbody>
<tr>
<td>Following endotracheal intubation an air leak should be present around the ETT at 20 cms water (positive) airway pressure with the cuff not inflated.</td>
<td>If no air leak is detected the tube may be too large and the anaesthetist may consider changing the tube (Kimberley-Clark 2006b, Microcuff 2011)</td>
</tr>
<tr>
<td>Cuff should be carefully inflated using a cuff pressure manometer or syringe until air leak is no longer present. (Attach syringe to valve port). Cuff pressure should not exceed 20 cms water.</td>
<td>(Kimberley-Clark 2006b, Microcuff 2011)</td>
</tr>
</tbody>
</table>
Figure 1: Paediatric Cuff Pressure Gauge (VBM).

Remove syringe from valve after cuff inflation.

Monitor and record ETT cuff pressures routinely a minimum of every 4 hours, if inflated as clinically indicated.

Aim to keep ETT cuff pressures
- Malakroft Tube – Aim < 20cms water.
- Microcuff Tube – Aim 10 – 15cms water.

Reduce pressure if it exceeds 20cms water.

NB: Manual compression of the pilot balloon should be avoided.

Routine cuff deflation is not necessary if pressures are kept below 20cms water.

Cuff should not be routinely deflated except for extubation. If cuff inflation is not required the cuff should be released with a cuff pressure manometer.

Keeping the syringe attached will keep valve open and allow the cuff to deflate (Kimberley-Clark 2006b).

(STRS 2007, Gerber 2008)

Deviation from selected seal pressures should be corrected (Kimberley-Clark 2006b, STRS 2007)
Sealing of the microcuff tube is superior within the trachea at pressures of 10 -15cms water, average 11cms water (Gerber 2008, Spiegel 2010).

Maximum pressure for ETT cuff and may predispose infant child to excessive pressure in the airway (Kimberley-Clark 2006b).

(STRS 2007)

To avoid creation of membrane folds (STRS 2007).
2 Extubation

Introduction
Extubation is the process of removing an oral or nasal endotracheal tube when it is no longer required (Urden et al 2006, Scales and Pilsworth 2007). Extubation should be elective, planned and carried out in a controlled manner, as per anaesthetic consultant / team’s orders.

Indications and Readiness for Extubation
- Child is not in respiratory distress with a good respiratory pattern.
- Minimal ventilation i.e. pressure support / CPAP 5 is required
- Satisfactory blood gas and oxygen saturations with oxygen requirements < 40%
- Child is haemodynamically stable, peripherally warm and well perfused
- Apyrexial
- HB normal / upper limits
- Chest clear with minimal secretions
- Child is awake and responsive and requiring minimal or no sedation
- Cough, swallow and gag reflexes present in child without a disability
- Satisfactory nutrition with adequate respiratory muscle strength and ventilatory drive
- Child should have an audible leak at 20cms water prior to extubation.
  
  NB: If no leak present Dexamethasone I.V. 6 hourly is charted for 24 hours prior to extubation to reduce the incidence of post extubation stidor.


Equipment
- Rebreathing circuit and mask (checked)
- Airway (appropriate size)
- Suction and catheters (checked)
- Yankauer
- Oxygen cannula / tube
- Bubble humidifier
- Duoderm tape
- Plaster removal swabs i.e. Appeel™
- Tegaderm dressing
- Scissors
- 5 / 10 ml syringe
- Stethoscope
- Emergency intubation trolley nearby
- Nebuliser circuit and mask
- Racemic Epinephrine
- Non-sterile gloves

  (Scales and Pilsworth 2007)

<table>
<thead>
<tr>
<th>ACTION</th>
<th>RATIONALE, EVIDENCE &amp; REFERENCE</th>
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<tbody>
<tr>
<td>Pre Procedure</td>
<td>To reassure parents and child, gain confidence and cooperation (Hockenberry and Wilson 2011).</td>
</tr>
<tr>
<td>Prepare child and family.</td>
<td>There is more nursing and medical support available during the day post extubation to ensure timely intervention if necessary. This is important if the child’s condition deteriorates, gets into respiratory distress / failure and requires reintubating or non-invasive ventilation (Lancaster 2007, Scales and Pilsworth 2007).</td>
</tr>
<tr>
<td>It is best for extubation to take place early in the morning if possible.</td>
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<tr>
<td>Ensure physiotherapy is carried out prior to extubation, if requested by medical staff.</td>
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</tbody>
</table>
Withhold feeds 2-4 hours prior to extubation. Prior to procedure aspirate nasogastric tube.

NB: The neonate may require maintenance fluids whilst nil by mouth.

Wean sedation as appropriate i.e. morphine infusion decreased to maximum 20 mcg/ kg/ hour.

Ensure suction and oxygen equipment are functioning properly.

An appropriate size bag, face mask and airway should be available at the child’s bedside.

Establish and set up oxygen therapy for post extubation.

Ensure all necessary equipment is available including intubation equipment.

Wash hands using a aseptic non-touch technique (ANNT) level 3.

Put on personal protective equipment (PPE) i.e. goggles, glasses, apron, gloves.

Monitor child’s vital signs and oxygen saturation.

Procedure

Inform anaesthetist immediately prior to procedure.

The procedure is performed by the anaesthetist assisted by nurse or 2 nurses, one of which is a senior PICU / recovery nurse who is deemed competent in the procedure and is working within her scope of practice.

Elevate head of bed for infants or sit an older child in a comfortable upright position.

Suction child prior to the procedure.

Ensure infant / child awake, with stable vital signs and good motor responses

Explain procedure to child as appropriate and reassure.

If a cuffed endotracheal tube is in situ, deflate the cuff using a 5-10 ml syringe.

To decrease the risk of aspiration during the procedure and ensure the stomach is empty should reintubation be required (Hazinski 1999, De 2005, Parker 2007)

The neonate is more at risk of hypoglycaemia.

To ensure the child will not have respiratory depression due to sedation on extubation.

To ensure patient safety (Hazinski 1999).

Airway problems are more common during extubation and recovery compared to intubation (Mitchell 2011).

Most patients require 5-10% more inspired oxygen post extubation.

To ensure the procedure is completed smoothly in a safe and coordinated manner (Cull 1999, Dougherty and Lister 2008).

To prevent cross infection (Infection Control Association 2002, OLHSC 2007, OLCHC 2010)

There is a high risk of droplet contamination of the eyes during the procedure as the child may cough / expectorate (Lancaster 2007).

To ensure timely intervention should child’s condition deteriorate.

If reintubation is required, staff need to be prepared. Anaesthetist needs to be on the Paediatric Intensive Care Unit (PICU) and available to reintubate if the child fails extubation (Hazinski 1999, Lancaster 2007).

To ensure a safe and coordinated extubation by competent practitioners (An Bord Altranais 2000).

To facilitate spontaneous breathing, diaphragmatic expansion, maximises lung expansion and the work of breathing is decreased as gravity assists in lung expansion. Facilitates an effective cough (Lancaster 2007, Karmarkar and Varshney 2008).

To clear the airway.

To ensure patient is ready for extubation.

To relieve anxiety and gain cooperation.
| Gently remove tapes from the child’s face using the appropriate adhesive remover. | This frees the endotracheal tube from child’s face for easy removal (Trivits-Verger and Lebet 2008). |
| Secure nasogastric tube to child’s forehead. | To provide reassurance and support for the child prior to and during the procedure (Trivits-Verger and Lebet 2008). |
| Affix face mask to rebreathing circuit, in preparation for post extubation. | To ensure oxygenation is optimised and secretions are cleared (Lancaster 2007). |
| Support and encourage child as appropriate. | Tracheal extubation has been demonstrated to greatly impair oxygenation (Karmarker and Varshney 2008). |
| Encourage deep breathing and coughing during the procedure as appropriate. | To free tube and remove any remaining secretions. Procedure is carried out on expiration when glottis is fully open to prevent laryngospasm and trauma (Karmarker and Varshney 2008, Hodd et al 2010). |
| Give suction support prior to extubation. | Extubation may result in vocal cord or tissue damage or cause laryngeal spasm which may occlude the patents airway (Lancaster 2007). |
| Remove the endotracheal tube in a swift motion on expiration whilst suctioning. An older child may be able to do this themselves with direction as appropriate. | To prevent Hypoxemia (Trivits-Verger and Lebet 2008). |
| **NB:** Do not stop or reinsert the tube during the removal. | To maintain a clear airway and prevent secretion accumulation. Minimise aspirate of oral content with first breath after extubation (Parker 2007, Trivits-Verger and Lebet 2008, Mitchell 2011). There is a risk of trauma t the soft tissues if suction blindly (Mitchell 2011). |
| Apply oxygen via re breathing circuit and mask. | Evaluate if patient can breathe without endotracheal tube. |
| Suction the oropharynx under direct vision as clinically indicated. | A stridor may indicate an obstructed airway and require timely intervention.. |
| Asses respiratory status for signs of respiratory distress, desaturation and stridor. | Minimise metabolic requirements and prevent hypoxia (Hazinski 1999). Maximum 2 litres oxygen via nasal cannula. |
| Note if there is an audible stridor report to anaesthetist immediately and document. | To evaluate respiratory status and early detection of upper airway obstruction or respiratory distress (Levin et al 1997). |
| **Post Procedure** | NB: A drowsy child may be hypercapnoeic (high CO2) whilst a restless child may be hypoxic. |
| Secure supplementary oxygen therapy via nasal cannula as clinically indicated. | To ensure timely intervention should the child’s condition deteriorates. |
| Minimal handling of patient initially. | |
Arterial or venous blood gas post extubation if access available (1 hour post extubation and repeated depending on the child’s condition while in the PICU).

- Chest x-ray if ordered.

The infant should be placed on an apnoea monitor (MR10) as clinically indicated.

Observe for post extubation distress i.e. croupy cough with inspiratory stridor.

- If present administer Racemic Epinephrine nebulised as prescribed.

Encourage child to cough and deep breath, suction as necessary.

Ensure chest physiotherapy is performed as requested.

Recommence feeds once respiratory status is stable, 2-4 hours post extubation.

Dispose of clinical waste appropriately.

Remove personal protective equipment (PPE) and wash hands.

Document procedure and child’s response in the nursing notes.

To establish if child is able to maintain adequate pulmonary perfusion and exchange of gases (Lancaster 2007).

Early detection of further respiratory problems i.e. collapse / atelectasis.

This may be due to laryngospasm, airway obstruction or laryngeal oedema. 1mm subglottic oedema in the infant decreases cross-sectional by 35% (Karmarkar and Varshney 2008). To decrease vasoconstriction and bronchodilation and thereby treat upper airway oedema and stridor (Levin et al 1997, Karmarkar and Varshney 2008; Trivits-Verger and Lebet 2008).

To promote hyperinflation of the lungs and helps remove secretions (Trivits-Verger and Lebet 2008).

This allows the pharyngeal sensation to return to normal and reduce the risk of reintubation (Parker 2007).

To promote safety and prevent cross infection (OLCHC 2008).

To prevent cross infection (Infection Control Association 2002, OLHSC 2007, OLCHC 2010)

Maintains continuity of care and accountability through accurate recording of medical and nursing intervention. (An Bord Altranais 2002).

2. A). ACCIDENTAL EXTUBATION

Recognition

- Actual witnessed ETT removal by the infant / child.
- Increased respiratory effort / respiratory distress
- Desaturation, deterioration in patients’ central colour
- Decreased chest movement
- Reduced air entry
- Any audible patient sound i.e. any sound at all – cry, whimper etc.
- Bradycardia

Suspected Extubation  *(This is an emergency)*
• Call for assistance / alarm
• 2nd nurse
  o Double bleeps anaesthetist bleep 652 (PICU 2) or bleep 468 (PICU 1)
  o Emergency Number 2222 if clinically indicated
• Connect rebreathing circuit to ETT
• Manually ventilate patient for 2 breaths
• Second nurse listens and observes chest movement for equal and bilateral air entry
• Listen over stomach to exclude oesophageal intubation

If in doubt take it out

(Decision is made in conjunction with most senior nurse present i.e. shift leader)

Confirmed Accidental Extubation

• Contact anaesthetist immediately (as above)
• Swiftly remove endotracheal tube (deflate cuff if cuffed tube)
• Maintain Airway, Breathing and Circulation (ABC)
• Place infant / child flat on back, (infant neutral position / child sniffing position) to open airway
• Apply appropriate size mask to the rebreathing circuit and manually ventilate with 100% oxygen
• Observe chest movement for chest rise
• If no chest rise, reposition airway and ensure no leak around mask, until chest rise is observed
• Observe infant / child’s colour, oxygen saturation and heart rate
• Prepare equipment for re-intubation and ensure availability of reintubation medication
• Aspirate stomach contents
• Reassess sedation level
• Assess patients own respiratory effort as may not need to be manually ventilate if nearly ready for extubation i.e. on CPAP
### 3. Care of an Infant with a Nasopharyngeal Tube

**Nursing Considerations with a Nasopharyngeal Tube**

A nasopharyngeal tube may be used to deliver nasopharyngeal CPAP as an elective procedure post extubation in an infant < 6 months. This will assist the infant who has respiratory distress by reducing the work of breathing and minimise the need for reintubation.

<table>
<thead>
<tr>
<th>ACTION</th>
<th>RATIONALE, EVIDENCE &amp; REFERENCE</th>
</tr>
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<tbody>
<tr>
<td><strong>Size</strong>&lt;br&gt;The length of tube is estimated by measuring from the tip of the infant’s nostril to the tragus of the ear and taped at the nostril. Anaesthetist will make final decision regarding length.&lt;br&gt;A Malakroft endotracheal tube (ETT) is usually used and shortened to correct length.&lt;br&gt;Size of nasopharyngeal tube is same as for ETT.&lt;br&gt;Length measured from side of the infants’ nostril to the tragus of the ear.&lt;br&gt;Secured in place as for ETT (Appendix III)&lt;br&gt;The tube is lubricated along side of tube prior to insertion using K.Y jelly.</td>
<td>To ensure correct placement (Resuscitation Council UK 2008, APLS 2011).&lt;br&gt;(Resuscitation Council UK 2008, APLS 2011).&lt;br&gt;To aid insertion and prevent trauma to nasal mucosa which is very vascular.&lt;br&gt;To be prepared for emergency reinsertion of a new nasopharyngeal tube, if tube becomes blocked.&lt;br&gt;<em>NB: This can be done by the nurse.</em>&lt;br&gt;If nasopharyngeal tube blocks the tube needs to be removed and replaced.&lt;br&gt;Airway suctioned and handventilation as clinically indicated.&lt;br&gt;Early detection of any respiratory deterioration and to ensure timely intervention.&lt;br&gt;To ensure patient safety.&lt;br&gt;The nasopharyngeal tube does not pass the vocal cords.&lt;br&gt;To maintain patent airway. Nasopharyngeal tubes are prone to blocking.&lt;br&gt;Optimise humidity.</td>
</tr>
<tr>
<td><strong>Safety</strong>&lt;br&gt;A spare approximately cut nasopharyngeal tube is kept by the infants’ cot / radiant warmer.&lt;br&gt;An oxygen face mask is attached to the rebreathing circuit.</td>
<td></td>
</tr>
<tr>
<td><strong>Monitoring of Infant</strong>&lt;br&gt;Close observation of the infant for signs of respiratory distress / failure.&lt;br&gt;Ensure apnoea, oxygen saturation and respiratory monitoring is on including alarms.&lt;br&gt;The infant will be able to vocalise.&lt;br&gt;Regular suctioning of the nasopharyngeal tube .&lt;br&gt;Ensure infant is receiving humidity from a Fisher Paykel Humidifier set at 37 celsius.</td>
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Appendix II

Equipment for Intubation

Figure 5: Magill Forcep

Figure 6: Magill Laryngoscope and Straight Blades (OLCHC).

Figure 7: Miller Straight Laryngoscope Blades.

Figure 8: Mallintosh Laryngoscope and Blades (OLCHC).

Figure 10: Duoderm Extra Thin

Figure 11: Cavilon Wipes
Figure 12: Gum elastic Bougle (Intubation Adjunct) (OLCHC)

Figure 13: Stylet (Intubation Adjunct) (OLCHC)

Figure 14: Laryngeal Mask (OLCHC)
Appendix III

Securing an Endotracheal Tube.

Patients with burns or scalds to the face will require an alternative method of securing the endotracheal tube (ETT). The anaesthetist intubating the patient will decide this at time of intubation. The procedure should be performed by anaesthetist, assisted by a 2nd registered practitioner (medical / nursing).

- Ensure emergency equipment is available.
- Discuss need for sedation for procedure with anaesthetist as clinically indicated.
- Check length of tube at nostril / mouth with anaesthetist and agree length to be taped at.
- The tube is held securely at the agreed length.

1. Cut two pieces of elastoplast approximately 10 – 12 cms into ‘trouser legs’ prior to intubation.
2. Ensure skin is clean and dry. Apply cavilon swab to cheeks as clinically indicated i.e. neonate.
3. Cut 2 strips of duoderm for either side of face, from ear to nose and apply from edge of nose to ear.
4. Align the first strip of the elastoplast over the duoderm to one side of the face closest to the ETT.
5. Ensure position of endotrachea tube (ETT) is correct.
6. Apply the upper trouser leg across the nasal bridge to the other side of the face.
7. Strap the lower trouser leg under and around the ETT at least 2 - 3 times ensuring it remains in position.
8. Ensure the nostril is visible and ETT secure in position secure in position.
9. The ETT should be pointing downwards and away from the nasal rim to prevent pressure necrosis.
10. Apply the second ‘trouser leg’ from the opposite side of the face, below the ETT and along the upper lip boarder.

11. The uppermost ‘trouser leg’ should pass along the basal bridge and above the ETT. Wrap the second tape around the ETT.

12. The ETT should be secure from both directions (right and left) of the face.

13. Retape if the ETT position is incorrect on the x-ray or if the tapes become wet and loose.
5. References


OLCHC (2011) *Aseptic Non Touch Technique*. Our Lady’s Children’s Hospital Crumlin: Dublin.


