Intubation and Premedication for Neonates

This guideline is applicable to neonatal unit staff in West of Scotland Neonatal units. It should be used with reference to the relevant pharmacy monographs. It covers:

- Intubation rationale and background
- Use of premedication
- Intubation Pause
- Procedure guide
- Appropriate ET tube placement
- Post-procedure management
- Trouble shooting
- Appendix 1 - Intubation Pause
- Appendix 2 - Practical Tips for Successful Intubation

Rationale & Background

Neonatal tracheal intubation may be required for a number of reasons including airway management, assisting ventilation in respiratory insufficiency and for surfactant administration.

The procedure has the potential to provoke marked physiological changes and should never be undertaken lightly\(^{(1-5)}\). In addition to possible cardio-respiratory instability, there are significant complications that may arise from trauma to the tissues, including perforation of the pharynx, oesophagus or trachea.

Intubation therefore requires the presence of a member of staff who is skilled in intubation\(^{(2)}\) and management of the infant airway, generally an experienced middle grade doctor, suitably experienced ANNP and/or a consultant.

Although intubation is an important method of establishing an airway, simpler methods can be used in the interim to achieve stability and when preparing for intubation, or while waiting for senior help to arrive. This includes using IPPV with a correctly fitted and applied mask, air way manoeuvres such as jaw thrust and a two person technique, and use of airway adjuncts e.g. guedel.

If a difficult intubation is expected senior help should be sought early and a clear plan including an escalation strategy must be in place. This includes situations such as:

- Previously difficult intubation
- Suspected airway abnormality
- Congenital anomaly of the head and neck

Following assessment of the infant and decision to proceed with intubation, a structured and safe approach should be taken, as is covered in this guideline.
Premedication

Premedication for intubation makes the procedure easier, safer and better tolerated by the baby\(^{(1-3)}\). It provides analgesia and aids in smoother passage of the ET tube. Using a combination of a sedative and muscle relaxant has been shown to shorten time to successful intubation and lessen the physiological unwanted effects\(^{(1-8)}\). Intubation without drugs is associated with hypoxia, vagal bradycardia and hypertension, with secondary effects on intracerebral perfusion in the preterm baby\(^{(1-3)}\).

Premedication can be used for most elective and emergency intubations on the neonatal unit if time permits\(^{(1-3)}\). It is not appropriate for intubations required in the delivery suite. If there are concerns about airway obstruction, caution is required using premedication\(^{(2)}\) and there should first be a discussion with the consultant.

While the best combination of sedative and muscle relaxant is not clear, the regime below has the most evidence for the preterm population. Routine practice in the West of Scotland involves the use of fentanyl and suxamethonium. In order to shorten time of drug preparation, standardise dosing and therefore improve safety by minimising potential drug errors, pre-made packs of fentanyl and suxamethonium are available. Where these packs are not used the drugs should be diluted according to pharmacy monographs.

Due to the mechanism of action and potential side effects of the drugs, the order and timing of administration is important. All drugs must be drawn up and checked before the first one is given. All staff giving premedication must be familiar with the correct administration procedures and the team leader must ensure this prior to starting the procedure.

**Standard Intravenous Drugs:**

1. **FENTANYL**
   - Synthetic opioid.
   - Used to provide analgesia for light anaesthetic procedures.
   - Fast acting (within 1-2 minutes) with a short duration of action.
   - Must be given slowly over 3-5 minutes, followed by a slow saline flush over a few minutes.
   - Important side effects of laryngospasm and chest wall rigidity\(^{(9,10)}\) have the potential to impair ventilation - less likely if administered as a slow bolus and will resolve with use of a muscle relaxant.
   - Other side effects include respiratory and cardiovascular depression and vomiting\(^{(9)}\).
   - Caution required:
     - In renal impairment (prolonged half life in preterm neonates secondary to delayed renal excretion: **Use 50% of standard dose in severe renal impairment** (i.e. Oliguria <0.5ml/kg/hr, Creatinine >120mmol/l or increasing >30mmol/l in 24hrs)).
     - When giving fentanyl to infants already on morphine infusions or other sedative medications (due to the potential summative sedation effects).

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Pre-Made Syringe Dose (if available)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fentanyl</td>
<td>5 microgram/kg</td>
<td>0.5 ml/Kg</td>
</tr>
<tr>
<td></td>
<td>Over 3-5 minutes</td>
<td>(10 micrograms/ml solution)</td>
</tr>
</tbody>
</table>
N.B This guideline introduces a lower dose of Fentanyl than used previously in the West of Scotland. The lower dose of 5mcg/kg is associated with a reduced risk of adverse effects (2,4,7,10). This dosage adjustment is in accordance with current UK BNFc formulary recommendations (9) and in line with widespread international practice, where doses of 1-5 micrograms/kg are used (2,7).

2. SUXAMETHONIUM
   - Neuromuscular blocking agent
   - Causes muscle relaxation including relaxation of the vocal cords, allowing easier passage of an ET tube.
   - Short onset (<30 seconds) and duration of action (up to 5 minutes).
   - **Given shortly after the fentanyl and saline flush.**
   - Consider potential need to give immediately following the saline flush if concerns regarding chest wall rigidity.
   - Important potential side effect of bradycardia (9).
   - Caution required in (9):
     - Hepatic impairment (risk of prolonged apnoea)
     - Severe sepsis (risk of transient hyperkalaemia)

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Pre-Made Syringe Dose (if available)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suxamethonium</td>
<td>2 mg/kg</td>
<td>0.5 ml/Kg (4mg/ml solution)</td>
</tr>
</tbody>
</table>
Additional Intravenous Drugs:

- **ATROPINE**
  - Antimuscarinic drug.
  - *Not used routinely for premedication.*
  - Used only in the emergency treatment of vagotonic side effects i.e. in persistent bradycardia.
  - Immediate onset of action with long duration of action (up to 6 hours).
  - Side effects include urinary retention, tachycardia and impaired GI motility\(^9\).
  - Consider having available if using multiple doses of suxamethonium (N.B. This is not recommended within this guideline)
  - Caution required when using in neonatal sepsis

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atropine</td>
<td>15 micrograms/kg</td>
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</table>

Other Drugs:

N.B. There may be situations where an alternative drug may be indicated e.g. ketamine as a sedative in cardiac cases. The appropriate drug should be discussed with the on call consultant and/or speciality team involved and administered only by those experienced in giving such drugs.
INTUBATION PAUSE

The intubation pause has been introduced to act as a visual prompt for staff involved in an intubation. It is designed to provide organisation and structure to the procedure in order for it to go as safely and smoothly as possible. It ensures all equipment is available and checked, the patient is fully prepared and that the team is briefed and confident of the plan and escalation procedures. It is to be attached to all airway trolleys and can be displayed throughout the neonatal unit for reference. Below is an extended version which breaks down the various components of the pause.

EQUIPMENT

All of the following equipment should be available, checked and working prior to intubation.

- **NEOPUFF & MASK**
  - Set to appropriate pressure & FiO$_2$ for infant
  - Correct sized face mask selected

- **SUCTION**
  - Appropriate size suction catheter attached

- **VENTILATOR**
  - Set up correctly
  - Settings entered (N.B. consider higher back up rates in muscle relaxed babies)

- **DRUGS**
  - Premedication drugs: prescribed and checked
  - Surfactant (if required)

- **AIRWAY TROLLEY**

  All of the following equipment should be set out on a sterile towel and prepared as cleanly as possible in order to **minimise contamination:**

  - Laryngoscope handle (with bright light)
  - Laryngoscope blade of correct size (Miller 00, 0 or 1)
  - ET tube of correct size for gestation
    - Ensure other ET tube sizes are available in case selected size proves inappropriate
  - Introducer if required
  - Carbon dioxide detector (Pedi-cap)
  - ET tube fixation device
  - Stethoscope
PATIENT

- **IV Access**
  - Flushed and ready for use
- **NG Tube aspirated**
- **Monitoring in place**
  - ECG & saturation monitoring
- **Planned ET position known**
- **Baby positioned appropriately**
- **Measures to maintain temperature of baby**
- **Baby adequately saturated**

TEAM

- **Allocate Roles**
  - Team Leader
  - Intubator
  - Airway assistant
  - Drug administration
  - Scribe (if available)
- **Escalation plan agreed**
- **Team leader briefs team on procedure plan including:**
  - Clarification of drug administration procedures
  - Overall procedure plan
- **Everyone happy with plan?**
Pre-Procedure

Guide for Endotracheal Tube Size

The following tables provide guidance for choosing the correct ET tube size. Ideally this should be done based on a baby's weight, however if the baby's weight is not known, the gestation can be used.

- **Guide for ET Tube size based on weight:**

<table>
<thead>
<tr>
<th>Weight (grams)</th>
<th>ET Tube Size (Diameter in mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1000</td>
<td>2.5</td>
</tr>
<tr>
<td>1000-1899</td>
<td>3.0</td>
</tr>
<tr>
<td>1900-3699</td>
<td>3.5</td>
</tr>
<tr>
<td>&gt;3700</td>
<td>4.0</td>
</tr>
</tbody>
</table>

- **Guide for ET Tube size based on gestation:**

<table>
<thead>
<tr>
<th>Gestation (weeks)</th>
<th>ET Tube Size (Diameter in mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;28</td>
<td>2.5</td>
</tr>
<tr>
<td>28-34</td>
<td>3.0</td>
</tr>
<tr>
<td>34+ – Term</td>
<td>3.5</td>
</tr>
<tr>
<td>Term+</td>
<td>4.0</td>
</tr>
</tbody>
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Guide for Endotracheal Tube Length

Measure the naso-tragal length from the base of nasal septum to tragus, and add:

- **1cm for oral intubation** or
- **2cm for nasal intubation**

\[\text{NTL} - \text{base of nasal septum to tip of tragus}\]
\[\text{Position at lips} = \text{NTL} + 1\text{cm}\]
Procedure

Prior to commencing procedure perform intubation pause. Optimise ventilation with CPAP, neopuff or bag and mask. Aim to maintain saturations appropriate for gestation and take care not to hyper-oxygenate the preterm infant.

- When team fully ready, give drugs:
  1. Fentanyl slowly over 3-5 minutes
  2. Saline flush slowly over a few minutes
  3. Suxamethonium
  4. Saline flush

- As soon as paralysis has been achieved, the intubator should be poised with the laryngoscope in left hand and then open the baby's mouth

- Place laryngoscope blade in the centre of the mouth, aiming backwards towards the uvula to ensure you are in the midline

- Lift the laryngoscope handle upwards and forwards to lift the tongue and jaw, bringing the posterior larynx and vocal cords into view as shown below:

- If the above view is not seen, consider slowly pulling the laryngoscope handle back and the cords may fall into view

- Consider the use of cricoid pressure

- Use suction only if secretions are occluding the view (NOT required routinely)

- Insert ET tube (with or without introducer) through the cords, using the black marker near the tip of the tube as a guide to depth of insertion initially, and confirm with nasotragal + 1cm measurement

- Confirm correct ETT position (see below)

- Secure ET with an appropriate fixation device ensuring a good seal to the skin

- Attach ETT to ventilator and adjust settings as required

- Move infant back into position
Appropriate ET Tube placement

End-tidal carbon dioxide monitoring is recommended to allow immediate confirmation of a correctly positioned ET tube\(^{12-14}\). This can be achieved with a colorimetric device or a side stream CO\(_2\) monitor. The most widely used device in the West of Scotland is Pedi-cap, as shown below. Pedi-cap is a non-toxic chemical indicator which rapidly responds to exhaled CO\(_2\) with a simple colour change.

It is easily attached to the ET tube and breathing device as shown below:

The colour change result should be interpreted following 6 positive pressure breaths. As end-tidal CO\(_2\) is a reflection of ventilation, cardiac output, pulmonary blood flow and metabolism, caution is required when interpreting the colour changes, as false positives and negatives may occur\(^{13,14}\).

- **False negatives**
  A colour change may be delayed, equivocal or absent despite correct ET tube placement in a number of situations including:
  - ET tube in right main bronchus
  - Extremely low birth weight or preterm infants
  - Babies with poor perfusion or in cardiac arrest
  - Reduced pulmonary blood flow (e.g. cardiac anomalies)
  - Severe airway obstruction (e.g. meconium aspiration)

- **False positives**
  May be seen in:
  - Contamination with gastric contents
  - Contamination with drugs including adrenaline
➢ **Colour Changes**

Tracheal Intubation: Purple to yellow/gold

Oesophageal Intubation: Purple to beige

Oesophageal Intubation or Tracheal Intubation if poor or absent pulmonary blood flow and/or cardiac output: No colour change

➢ **Physiological Indicators**

In addition to end-tidal CO₂ measurement, it is also good practice to note other physiological indicators of appropriate ET position:

- *Increase in heart rate* (best physiological indicator of adequate ventilation)
- Effective chest wall movement
- Misting of the ETT on expiration
- Maintenance or improvement in the oxygen saturation is (N.B. improvement in oxygenation may be slow in the presence of pulmonary hypertension)
- Equal air entry on both sides of the chest

➢ **Chest X-Ray**

A chest x-ray is *gold standard* in confirming correct ETT position\(^{13}\). The tip of the ET tube should be visible 1cm above carina (T1-T3).
**Post Procedure**

- Ensure accurate documentation of the procedure including the position of the ET tube on chest x-ray and whether or not adjustments were made.
- Consider shortening the ETT following this to minimise dead space.
- Update parents if not done prior to procedure.

**Trouble shooting**

- If persistent leak >25% and difficulties with ventilation, consider upsizing the ET tube.
  - N.B. If a change of ET tube is required ensure that the fixation device from the new tube size is used as these are not interchangeable.
- If difficulties following intubation use the DOPE acronym below to trouble shoot for problems:

<table>
<thead>
<tr>
<th>Problems Post Intubation? Consider &quot;DOPE&quot;</th>
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<tbody>
<tr>
<td>D - Displacement or dislodged ETT</td>
</tr>
<tr>
<td>O - Obstruction (Blocked airway with blood/secretions, ETT at carina or in bronchus)</td>
</tr>
<tr>
<td>P - Pneumothorax</td>
</tr>
<tr>
<td>E - Equipment failure</td>
</tr>
</tbody>
</table>

- If difficulties in ventilation with a Murphy ETT, it is important to ensure that the side stopper is securely screwed on. This can become dislodged fairly easily so must be checked if problems encountered.
References & Further Reading


9. BNFc - British National Formulary for Children


Acknowledgements
All images within this guideline were sourced from the internet.
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Replaces GGC_Intubation_Neonates

Implementation / Review dates
Implementation 14-07-16 Next Review 01-07-19
### Appendix 1 - GG&C Intubation Pause

#### Neonatal Intubation Pause

**Equipment**
- NEOPUFF & MASK
- SUCTION
- VENTILATOR
- DRUGS
- AIRWAY TROLLEY:
  - Laryngoscope handle & blade
  - ET tube (selection of sizes)
  - Introducer
  - ET CO₂ detector (Pedi-cap)
  - ET tube fixation device
  - Stethoscope

**Patient**
- IV access
- NGT aspirated
- Monitoring applied
- Planned ET position known
- Baby positioned appropriately
- Maintain warmth of baby
- Baby adequately saturated

**Team**
- Allocate Roles:
  - Team Leader
  - Intubator
  - Airway assistant
  - Drug administration
- Team leader briefs team on procedure plan including:
  - Clarification of drug administration procedures
  - Escalation plan
- Everyone happy with plan?

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Team leader’s responsibility intubation pause is performed prior to commencing procedure.
# EMERGENCY DRUG DOSES

<table>
<thead>
<tr>
<th>DRUG</th>
<th>PREPARATION</th>
<th>DOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fentanyl</td>
<td>Pre-made syringe (if available)</td>
<td>5 micrograms/kg = 0.5ml/kg</td>
</tr>
<tr>
<td>Suxamethonium</td>
<td>Pre-made syringe (if available)</td>
<td>2 mg/kg = 0.5ml/kg</td>
</tr>
<tr>
<td>Atropine</td>
<td>600 micrgrams/ml</td>
<td>15 micrograms/kg</td>
</tr>
<tr>
<td>Adrenaline</td>
<td>1:10,000</td>
<td>0.1ml/kg</td>
</tr>
<tr>
<td>Sodium Bicarbonate</td>
<td>4.2%</td>
<td>2ml/kg</td>
</tr>
<tr>
<td>Volume</td>
<td>0.9% NaCl or O negative blood</td>
<td>10-20ml/kg</td>
</tr>
</tbody>
</table>

**Problems Post Intubation? – Consider “DOPE”**

- D - Displacement or dislodged ETT
- O - Obstruction (Blocked airway or ETT, ETT at carina or in bronchus)
- P - Pneumothorax
- E - Equipment failure
Appendix 2 - Practical Guidance for a successful intubation

- **Set the scene**
  - **Choice of intubator**
    - Emergency intubations not ideal for novice intubators, their success rate is low and they can be put off for future attempts if the experience is stressful
    - Ideal for juniors to start with controlled non-emergent intubations
  - **Audience**
    - When first learning to intubate, a large audience (especially parents or multiple senior colleagues) reported to increase the stressfulness of the situation
    - The novice intubator may not have the confidence to ask to reduce the audience but their instructor does
  - **Reassure**
    - This is commonly reported to be a stressful situation for a novice intubator
    - They may appreciate being reminded that the child is in safe hands and that the overall clinical care of the infant is the responsibility of their supervisor not them. They will be told to stop the attempt if the baby is desaturating etc, they do not need to worry about the infant’s numbers, the duration of the attempt etc.
  - **Describe the stages involved**
    - Open the mouth wide
    - Sweep tongue to the left
    - Keep to the midline (The uvula is a midline structure and good reference point)
    - Advance the blade over the base of the tongue and then lift up (not rotate the laryngoscope) to reveal the airway
    - If the airway not visible, will need to be guided if not far enough in or too far, ensure that scope is midline
    - Insert tube in from the side, make sure it is seen going through the cords
    - Don’t leave go!!!
    - The tube is always too far in, correct to required distance
    - Secure
  - **Time to prepare**
    - to reduce stress
  - **Stylet?**
    - The STINT study (Kamlin et al 2013) found no difference in intubation success
    - Stylet takes time to insert
    - CANNOT be wrapped around the tube or extend beyond the tube tip

- **During the intubation attempt**
  - Instructors hand on the infants neck can feel the blade tip (to help guide if the scope is too far in or not far enough)
  - Open the mouth wide
    - After premeds, there is often muscle spasm that may need to be overcome
  - **Too far left**
    - The uvula is a midline structure
    - If not midline the scope is usually heading too far left
  - **Suction**
    - Time consuming!
    - Juniors need all the time they can get to pass the tube, they generally will suction because they are unsure what they are looking at. Try to find the airway first, it is rare that secretions obscure the view enough to require suction
  - **Holding the tube**
    - Much easier to direct the tube towards the airway if its natural slope is facing forward
    - If the tube is held up high it is easier to guide
  - **Feeding the tube in from the side**
    - The tube needs to be seen going through the cords, therefore has to be fed in from the side
  - **Tube always too far in!!**
    - Need to know what depth the tube should be at
    - Never give surfactant until clear that the tube is at an appropriate depth (ideally confirmed on x-ray)
  - **Don’t let the tube fall back out**
    - Index finger holding tube against hard palate securely holds the tube while allowing the fixation device to be attached
Video examples:

Example 1 - Successful intubation
Good view of the cords, ET successfully inserted, although placed too far into trachea.

Example 3 - Unsuccessful intubation
View of cords seen initially, laryngoscope then slips and view lost

Example 4 - Successful intubation
Note secretions seen but good view of cords so suction not required.

Example 5 - Unsuccessful intubation
Tongue obstructing view and on the wrong side but cords brought into view. ET then inserted into oesophagus.

Example 6 - Successful intubation
Good view of the cords, ET successfully inserted, although placed too far into trachea