# ANZCOR Guideline 13.5 – Tracheal Intubation and Ventilation of the Newborn Infant

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## 1. Tracheal Intubation and Ventilation

### 1.1. Indications

A decision to perform tracheal intubation will depend on the gestation of the infant, degree of respiratory depression, response to facemask (or laryngeal mask) ventilation, and the skill and experience of the resuscitator. Preterm gestation or very low birth weight should not be the only factor that drives the decision to intubate.

Tracheal intubation may need to be performed:

- If ventilation via a facemask (or laryngeal mask) has been unsuccessful (heart rate remains low, oxygen saturation falling or failing to rise) or prolonged
- In special circumstances, such as congenital diaphragmatic hernia, or extremely low birth weight
- For infants born without a detectable heartbeat, consideration should be given to intubation as soon as possible after birth.

### 1.2 Laryngoscope and endotracheal tube size and depth of insertion

Endotracheal tube (ETT) internal diameter in millimetres can be calculated as gestational age in weeks divided by 10. Typically, a 2.5 tube is appropriate for infants <1kg weight, a 3.0 tube for infants weighing 1-2 kg, a 3.5 tube for infants 2-3 kg, and a 3.5 or 4.0 tube for infants over 3 kg.

A laryngoscope with a straight blade (size 1 [10 cm] for term infants and larger pre term infants, size 0 [7.5 cm] for premature infants < 32 w or 00 [6cm] for extremely low birth weight infants) is preferred. Some experienced operators use curved blades.

The approximate depth of insertion of the endotracheal tube from the middle of the upper lip, in centimetres, can be calculated as weight in kg + 6 cm.[1] However, the following table is likely to result in greater precision.[2] ANZCOR recommends its use for extremely low birth weight infants and premature infants after the newborn period [Class A, expert consensus opinion].

| Corrected gestation (weeks) | Actual weight (kg) | ETT mark at lip (cm) |
|---|---|---|
| 23–24 | 0.5–0.6 | 5.5 |
| 25–26 | 0.7–0.8 | 6.0 |
| 27–29 | 0.9–1.0 | 6.5 |
| 30–32 | 1.1–1.4 | 7.0 |
| 33–34 | 1.5–1.8 | 7.5 |
| 35–37 | 1.9–2.4 | 8.0 |
| 38–40 | 2.5–3.1 | 8.5 |
| 41–43 | 3.2–4.2 | 9.0 |

Table: Recommended ETT length to the nearest 0.5 cm by corrected gestation (gestation at birth plus postnatal age) and weight at time of intubation [Class B, LOE IV[2]].

Appropriate depth of insertion must always be verified by comparing the markings on the tube with the formula or table (see also "Verification of endotracheal tube position" below) [Class A, expert consensus opinion].

## 1.3  Equipment to Prepare for and Perform Endotracheal Intubation

- T-piece infant resuscitator (or flow-inflating bag) and self-inflating bag (~240 mL)
- Neonatal facemasks (range of sizes suitable for premature and term infants)
- Medical gases:
    o a source of medical oxygen (reticulated and/or cylinder, allowing flow rate of up to 10 L/min) with flow meter and tubing
    o a source of medical air plus air/oxygen blender
    Suction apparatus and suction catheters (6F, 8F, and either 10F or 12F)
- Laryngoscopes with infant blades (00, 0, 1) plus spare bulbs and batteries. Ensure end light is bright
- Endotracheal tubes (sizes 2.5, 3, 3.5, and 4 mm internal diameter). Important characteristics of the tube include:
    o uniform diameter, without a shoulder
    o no eye
    o uncuffed
    o standard curve
    o clear or translucent
    o radio-opaque
    o centimetre markings along the length to indicate depth of insertion
- Endotracheal stylet or introducer (optional for oral intubation, not used for nasal intubation)
- Supplies for securing endotracheal tubes (e.g. scissors, tape)
- Neonatal stethoscope
- Exhaled $CO_2$ detector
- Magill neonatal forceps  (optional)

## 1.4  Ventilation technique

Considerations are similar to those for ventilation via a facemask (Guideline 13.4).

### 1.5   Verification of endotracheal tube position

The effectiveness of ventilation via an endotracheal tube is confirmed by three observations, which tend to occur in the following sequence:

1. Chest moves with each inflation
2. Increase in the heart rate to above 100/min
3. Oxygen saturations improve.

If the chest does not move and the heart rate does not increase, the location of the endotracheal tube and technique of ventilation need to be re-evaluated.

**Other signs to verify correct endotracheal tube position**

- By visual inspection of the endotracheal tube passing through the larynx.
- Mist may condense on the inside of the endotracheal tube during exhalation.
- Colour change in a colorimetric end-tidal $CO_2$ detector. A $CO_2$ detector, attached to the endotracheal tube adaptor, is recommended as the most reliable method to confirm endotracheal tube placement in neonates who have spontaneous circulation [Class A, LOE IV[3]]. However, false negative readings may occur in infants if there is very low or absent pulmonary blood flow (LOE IV[3]), so if the chest wall is moving well in a very depressed infant, some caution is needed to avoid unnecessary extubation and reintubation. False positives may occur with colorimetric devices contaminated with adrenaline (epinephrine) or surfactant (extrapolated evidence[4]).
- Symmetrical air entry over lung fields (upper chest) auscultated with a stethoscope.

**Signs that the endotracheal tube is not in the trachea**

- No chest movement with inflations.
- A heart rate <100 beats per minute that does not increase soon after intubation and inflation is started.
- No expired CO2 detected.
- No improvement in oxygenation.
- The absence of breath sounds in the axillae.

The lack of symmetrical chest movement with adequate inflating pressure may indicate that the endotracheal tube is too far down. The depth of insertion should be checked.

Devices to monitor gas flow and volume have been shown to improve mask ventilation technique in simulation training and there is limited evidence of feasibility in clinical settings. However to date, there is insufficient evidence of clinical benefit, so ANZCOR suggests against the routine use of flow and volume monitoring or end tidal CO2 monitoring during newborn resuscitation. (CoSTR 2015, weak recommendation, low quality of evidence)[5]

## 2.  Laryngeal Masks

A laryngeal mask (LM) should be considered during resuscitation of the term and near term newborn (>34 weeks, approximately 2000 grams) if facemask ventilation is unsuccessful. (CoSTR 2015, weak recommendation, low quality evidence)[5]

In particular, it should be considered as an alternative to tracheal intubation if facemask ventilation is unsuccessful and tracheal intubation is unsuccessful or not feasible. [Class A, expert consensus opinion][5] The LM may be considered as a primary alternative to a facemask for positive pressure ventilation among newborns weighing more than 2000 grams or delivered ≥34 weeks gestation, although there is insufficient evidence to support its routine use in this setting. [5] A size 1 LM is suitable for infants up to 5 kg.

Effectiveness of ventilation should be checked using signs indicated above for endotracheal ventilation (chest wall movement, improvement in heart rate, improvement in oxygenation). In addition, the chest should be auscultated. For newborns receiving ventilation via an LM, the accuracy of colorimetric $CO_2$ detectors to confirm position and seal has not been reported. The LM has not been evaluated during chest compressions.

## References

1.  Peterson J, Johnson N, Deakins K, Wilson-Costello D, Jelovsek JE, Chatburn R. Accuracy of the 7-8-9 Rule for endotracheal tube placement in the neonate. J Perinatol 2006;26:333-6.

2.  Kempley ST, Moreiras JW, Petrone FL. Endotracheal tube length for neonatal intubation. Resuscitation 2008;77:369-73.

3.  Aziz HF, Martin JB, Moore JJ. The pediatric disposable end-tidal carbon dioxide detector role in endotracheal intubation in newborns. J Perinatol 1999;19:110-3.

4.  Hughes SM, Blake BL, Woods SL, Lehmann CU. False-positive results on colorimetric carbon dioxide analysis in neonatal resuscitation: potential for serious patient harm. J Perinatol 2007;27:800-1.

5.  Wyllie J, Perlman JM, Kattwinkel J, et al. Part 7: Neonatal resuscitation: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation. 2015;95:e169-201.