

Guideline

Management of a neonate with a difficult airway in PaNDR

1. Scope

To be used by the Neonatal transport team in the background of a neonate with a difficult airway. Techniques and equipment included in this guideline are specific for PaNDR neonatal transport team.

2. Purpose

To serve as a guideline to support skilled healthcare practitioners with the safe management and transfer of a neonate with an unanticipated neonatal difficult airway.

This guideline is to be used only in conjunction with current skills and knowledge, suitable for the clinical setting.

3. Abbreviations

BAPM	British Association of Perinatal Medicine
APA	Association of Paediatric Anaesthetists
LNU	Local Neonatal Unit
SCBU	Special care baby unit
DAS	Difficult Airway Society
ETT	Endotracheal tube
FONA	Front of neck access
NICU	Neonatal intensive care unit
NPA	Nasopharyngeal airway
OPA	Oropharyngeal airway
NDAT	Neonatal difficult airway trolley
RCoA	Royal College of Anaesthetists
SGA	Supraglottic airway
LMA	Laryngeal Mask Airway
i-gel®	Supraglottic airway device

4. Indications

This guideline provides an approach to aid in the transfer of a neonate with difficult neonatal intubation where it is possible to ventilate the baby, but difficult to intubate. **It must be remembered that the primary goal is to adequately oxygenate the baby until a definitive airway can be established. Intubation is not always required to achieve this, and multiple unsuccessful intubation attempts can further compromise a difficult airway.**

- **Undertaken by staff groups**

Any skilled healthcare practitioner capable of recognising a potential or actual neonatal difficult airway scenario can implement use of this neonatal difficult airway guideline – able to ventilate but cannot intubate.

- **Considerations and planning for use**

All the staff who are potentially involved in an intubation scenario should have a working knowledge of this algorithm.

The potential intubation scenarios may include, but are not limited to:

- Planned intubation for a procedure.
- Unplanned intubation for a procedure
- Unplanned intubation in an emergency scenario
- Semi-elective intubation in an emergency scenario
- Planned replacement of an endotracheal tube

BAPM has recently published the Neonatal Difficult Airway Guideline.¹

The **purpose of this guideline** and algorithm is therefore to **support an early recognition of the difficult airway in a neonate and to limit multiple attempts at intubation to avoid trauma.** It highlights the importance of gaining senior help early and where appropriate to enable early mobilisation of other specialties. It encourages the use of airway adjuncts to enhance ventilation and oxygenation in the 'cannot intubate but can ventilate' neonate to enable the transfer of a neonate with a difficult neonatal airway. This is particularly important where the neonate is in a special care baby unit, SCBU or Local Neonatal Unit, LNU where Paediatric ENT or Paediatric Anaesthetic expertise may not be available to help the local team in getting a definitive airway.

The following abnormalities should raise the suspicion that intubation may be difficult:²

1. Craniofacial abnormalities:
 - Achondroplasia
 - Beckwith Weidemann syndrome
 - Cleft palate
 - Goldenhar syndrome
 - Pierre-Robin sequence
 - Treacher-Collins syndrome
2. Other genetic conditions like trisomy 13, 18 and 21.

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3. Vascular malformations involving the head and neck
4. Recurrent previous intubations leading to laryngeal oedema
5. Previous difficult intubation.

5. Main Body

The guideline is described as plan A, plan B, plan C and plan D when followed sequentially should highlight any difficulty in securing a definitive airway and act as a prompt to in seeking appropriate help when intubating a neonate.

Plan A

If there is clinical indication for intubation but initial two tracheal intubation attempts were unsuccessful **Plan A** should be initiated. Plan A comprises following steps.

- 1) Mask ventilation should be optimised.
 - Check for good chest movement and increase in heart rate.
 - Check for head position. Head should be in neutral position.
 - Ensure the facemask is the correct size and applied correctly with no or minimal leak.
 - Use two-person jaw thrust technique to deliver mask ventilation.
 - Any secretions/blood/mucus impairing the mask ventilation should be identified and corrected with suction under direct vision.
 - Use appropriate PIP and PEEP during mask ventilation. Titrate FiO₂ appropriately and increase to FiO₂ of 100% pre-intubation.
 - Ensure there are no equipment faults.
 - Place a nasogastric tube to decompress gastric air and be vigilant for pneumothorax.
- 2) Consultant Paediatrician/Neonatologist on-site should be contacted if not already done.
- 3) Conditions should be optimised prior to further attempt at intubation by second person with advanced airway capabilities as per BAPM neonatal safety standard (Appendix 2). This must be a senior Paediatric or neonatal trainee/clinical fellow/ANNP or Consultant on site. Following considerations should be made during intubation attempts. Avoid multiple intubation attempts as this can compromise the airway.
 - Check head alignment. It should be in neutral position.
 - Use gentle Cricoid pressure during the procedure. Acronym BURP could be helpful to remember the Backward, Upwards and Right Pressure applied. Care taken not to compress airway preventing advancement of ETT.
 - Use appropriate size (length) laryngoscope blade and consider using video laryngoscope.
 - Consider smaller endotracheal tube size.
 - Use appropriate sedation and consider muscle relaxation.
 - Suction under direct vision.
 - Consider IV access (where possible).

Plan B – Recognised difficult airway

If two clinicians (one of them with advanced airway capabilities which could be a consultant) have failed endotracheal intubation (2 attempts each) but the team is able to provide good mask ventilation move to Plan B. Oxygenation is the priority here.

- Seek help from second neonatal or paediatric consultant on site/anaesthetic team.
- Increase peak inspiratory pressure
- Increase FiO₂ to 100%.
- Airway adjuncts like oropharyngeal airway could be considered to provide optimal conditions
- Consider a supraglottic device: Size 1 i-gel® or laryngeal mask airway.
- Consider using Video laryngoscope if available during intubation.
- Consider using Bougie/ smaller endotracheal tube during intubation.

If two clinicians with advanced airway capabilities (could be consultants on site) fail to intubate (maximum two attempts each) at this stage, **Plan C** should be instigated (even if mask ventilation remains adequate).

Consider help from PANDR neonatal transport team if all the above have been tried. PaNDR team is not commissioned as a difficult airway service and may be arriving cot-side only at later stages. PaNDR hotline is available 24x7 for advice.

Plan C – Can't intubate, Can Ventilate

Rapid recognition of the 'can't intubate but can ventilate' will aid with better outcome for the neonate. It is important to avoid repeated attempts at intubation and focus on optimising ventilation through face mask or supraglottic device and get appropriate help as soon as possible. Discuss options with the team including local ENT and anaesthetic team.

- Continue mask ventilation or ventilation using supraglottic device until further help arrives.
- Seek help from local ENT and Anaesthetic team. If Paediatric ENT or Paediatric anaesthetic team is available seek their help.
- Consider reversal of the sedation and paralysis.
- Use Video laryngoscope.
- Consider seeking input from regional transport team. Regional transport teams may be able to help though they are not commissioned as difficult airway teams.

Plan D: Can't intubate, Can't Ventilate (CICV) Situation

Plan D should be used in situations of 'Can't intubate, Can't ventilate'. Plan A, Plan B and Plan C should be followed initially in such situations. Despite trying all the above measures mentioned, if still the baby has not got an established airway in a 'Can't intubate, Can't ventilate', **emergency**

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cricothyrotomy should be considered with specialist input from anaesthetic team. Large-bored cannula (grey) is inserted through the cricoid membrane to ventilate in case of suspected laryngeal atresia. This can be obtained from Labour Ward in most of the district general hospitals. If emergency cricothyrotomy is done, manual jet ventilation with **high I:E ratio of 1:4 or 1:5 should be used**^{3,4} (See Appendix 3).

Neonatal airway anatomy, the shortness of the neonatal neck and the relative thickness of the anterior neck tissues mean that establishing a front of neck airway is difficult. **BAPM do not recommend front of neck access (FONA) like emergency needle cricothyrotomy or emergency tracheostomy in neonates with difficult airway in any setting outside established Paediatric ENT surgery service.**^{3,4}

Difficult airway algorithm/flowchart

See Appendix 1

PS: PaNDR team is not commissioned as a difficult airway service and may be arriving cot-side only at later stages. PaNDR hotline is available 24x7 for advice.

Use of a Supraglottic airway device in neonate

The Supraglottic airway device can be used in the following scenarios –

- Failed or unsafe endotracheal intubation
- Congenital abnormality of upper airway
- Extubation during transport (especially fixed wing or helicopter)
- Airway stabilisation by personnel without advanced skills in intubation

The suggested supraglottic airway of choice is the i-gel® or LMA.^{5,6} The advantage of the i-gel® is the ease of use. The size advocated for use in a neonate is the size 1.0 which can be used for a neonate with a weight range between 2-5 Kgs (with discussion between referring centre and transport team this can also be used in a neonate weighing 1.2 to 2 kg).⁶

The i-gel® is NOT intended as a replacement for the endotracheal tube, which remains the gold standard in securing an airway, particularly in the context of neonatal transport. However, it can be used for neonatal transport in rare, difficult scenarios after discussions with tertiary neonatologist, paediatric ENT, and paediatric anaesthetics team.

Steps to be followed for the insertion of a supraglottic airway

- Who to inform
 - Ensure the neonatal/ Paediatric Consultant is aware of the neonatal difficult airway
 - Where possible inform local/ tertiary Anaesthetic and ENT Team
- Once decision has been made to use the supraglottic airway device empty the gastric contents and remove the nasogastric or orogastric tube.

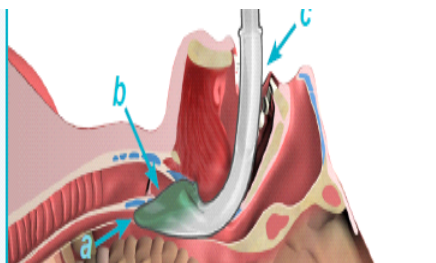
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- Refrain from using muscle paralysis as this will decrease the respiratory drive and may lead to an increase in the Peak Inspiratory Pressures needed to gas exchange. Intravenous Morphine infusion could be considered (not exceeding 20 micrograms/kg/hour)
- Method of insertion of the i-gel®
 - Where possible, using a T-piece, pre-oxygenate
 - Lubricate the back and sides of the LMA/ i-gel®
 - Tilt the head of the baby back slightly, open the mouth and apply jaw thrust.
 - Insert the tip of the LMA/ i-gel® along the hard palate with open side facing the tongue.
 - Continue inserting the LMA/ i-gel® along the posterior pharyngeal wall. Resistance is felt when the tip sits on the oesophagus. The opening of the mask should cover the entrance to the larynx (See **figure 1a,1b**).
 - If using an LMA, inflate the cuff until a good seal is formed.
 - Secure the LMA/ i-gel® with adhesive tape (See **figure 1c**).

Figure: 1a



1b



Glide the device downwards and backwards along the hard palate with a continuous but gentle push until a definitive resistance is felt.

The tip of the airway should be located into the upper oesophageal opening (a) and the cuff should be located against the laryngeal framework (b). The incisors should be resting on the integral bite block (c).

1c



Use of a Video laryngoscopy device in the cannot intubate but can ventilate neonate

Video-laryngoscope and blades available:

Video laryngoscope available in transport is CMAC device. **Figure 2a, 2b**

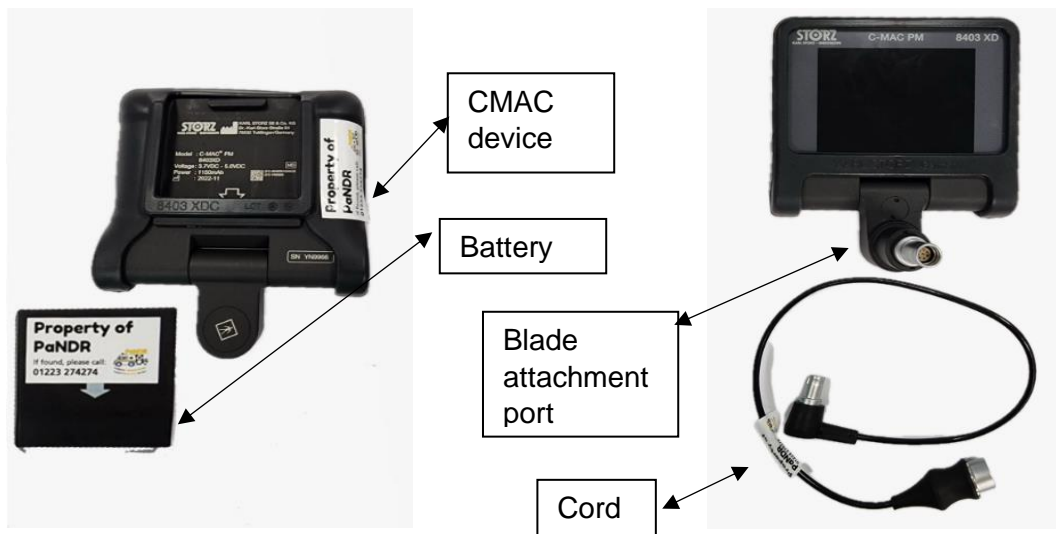


Fig 2c Available blades are: (Top to bottom)

- MAC-0 (curved McIntosh size 0 blade)
- MIL-0 (straight Miller size 0 blade)
- MIL-1 (straight Miller size 1 blade)



Fig 2d, 2e:

Tristel wipes used to clean laryngoscope and blades.

Use QR code to download the method to use the wipes.

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Intubation using Video laryngoscope:



PS: (a) Please wear gloves while intubating babies. (b) The video laryngoscope's screen run time is about 8 minutes, so should be turned on only at the point of use.

These above figures show the anatomy seen while using video laryngoscope for intubation of trachea. It is important to keep the tip of laryngoscope blade behind epiglottis as the camera view is more anterior compared to direct laryngoscopic view. Always use stylet when using video laryngoscope to align with the slightly anterior view of the larynx. C-MAC also has a cord to attach to the camera, this is important when intubating extreme preterm babies, due to the overall weight of the equipment.

Advantages of video laryngoscope:

1. Assists in obtaining better view of airway and allows team to assess the airway together
2. Also helps in documenting the ETT is correctly placed
3. Has been shown to provide higher success rate on first and subsequent attempts at intubation.

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Use of bougie during neonatal intubation:

A bougie can be useful when a partial view of the vocal cords is obtained. This can be passed through the vocal cords and a tracheal tube 'railroaded' into place. It should be noted that a **bougie is different to a 'stylet' used to stiffen a tracheal tube**. A stylet should not be used as a bougie, as tracheal perforation has been described as a complication of injudicious stylet use.

6. References

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8. Bould, M.D. and Bearfield, P. (2008), Techniques for emergency ventilation through a needle cricothyroidotomy. Anaesthesia, 63: 535-539. <https://doi.org/10.1111/j.1365-2044.2007.05404.x>

7. Resources

Appendix 1: Difficult airway algorithm for transport
Appendix 2: Expected range of capability- BAPM neonatal airway safety standards
Appendix 3: Reversal of sedation- Naloxone
Appendix 4: Weight, gestational age limits and endotracheal tubes
Appendix 5: Connections if ventilating through emergency cricothyrotomy
Appendix 6: Difficult airway pack equipment

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8. Monitoring compliance with and the effectiveness of this document

Audit standards:

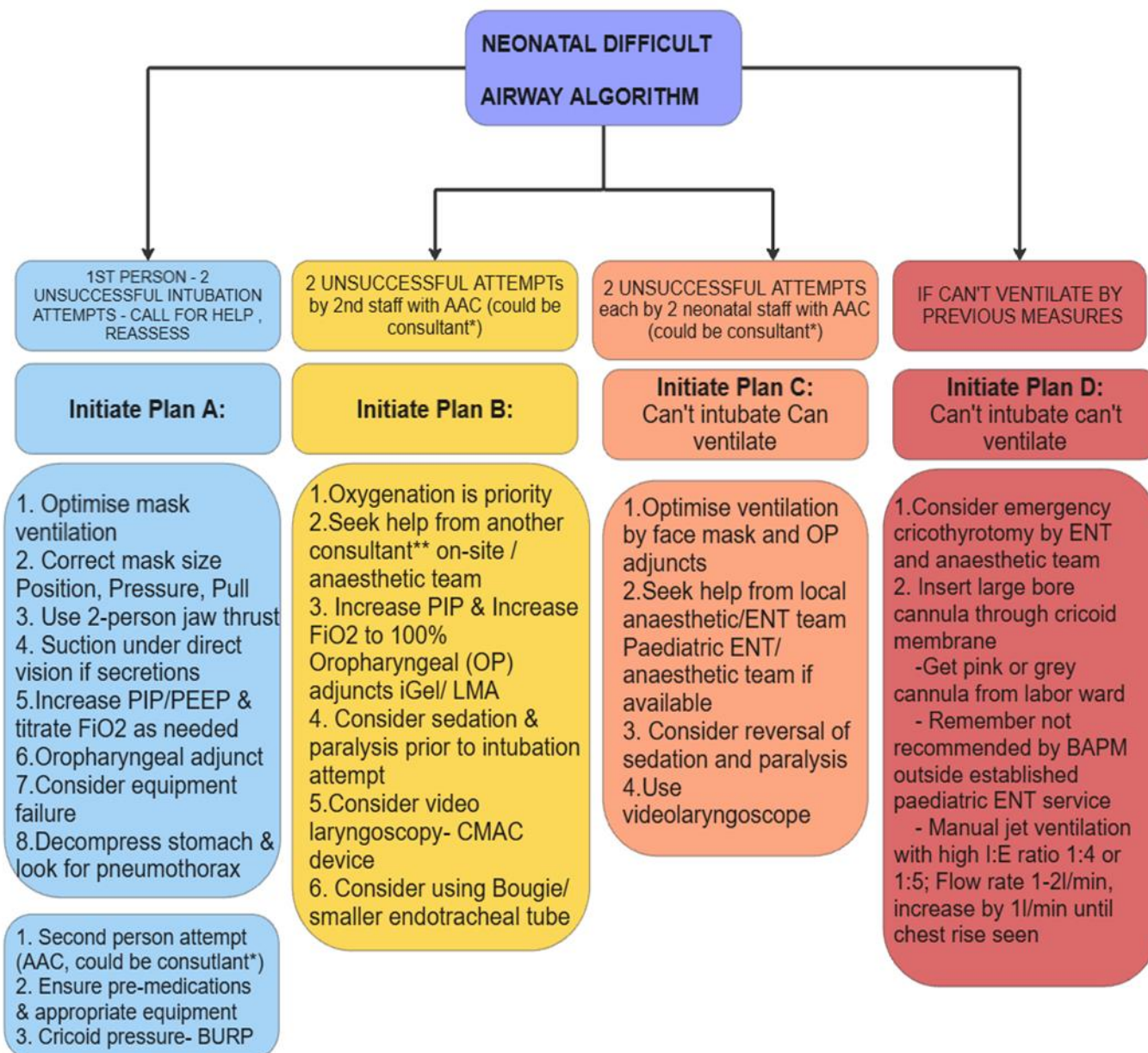
The PaNDR team will monitor compliance with this document by undertaking regular audits which will be reported back to the consultants and lead nurse.

The effectiveness of the document will be monitored by review of any reported incidents by the lead consultant and nurse for risk

9. Document Manager

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Appendix 1: Difficult Airway Algorithm for Transport



***AAC: Advanced Airway capability as per BAPM guidelines;**

****Consultant: Paediatric/ neonatal consultant on-site**

Ensure scribe for difficult airway management; Discuss with parents as soon as possible

PaNDR team is not commissioned as a difficult airway service and may be arriving cotside only at later stages. PaNDR hotline is available 24x7 for advice.

Appendix 2: Expected range of capability- BAPM neonatal airway safety standards ⁷

Capability	Basic	Standard	Intermediate	Advanced	Specialist
Staff Type	Can provide effective airway support and ventilation via facemask or LM for babies \geq 34 weeks with #normal anatomy.	Effective airway and ventilatory management for preterm and term infants using a wide range of airway adjuncts and non-invasive respiratory support. Has limited or no intubation experience.	As for standard capability and can intubate the trachea under optimal conditions but not able to consistently intubate in urgent/emergency settings and/or across all gestations.	As for standard capability and can consistently intubate most babies with normal anatomy including extreme preterm infants.	As for advanced capability and can intubate or manage the neonatal airway in most situations including those presenting with a difficult airway.
Midwifery Staff					
Neonatal Special Care nurses					
Neonatal ICU/HDU nursing staff					
Tier 1 medical staff e.g. ST1-3, FY1-3, GP Trainees, ENNPs					
Neonatal Transport nursing staff					
Tier 2 trainee ST3-4 (not neonatal SPIN or GRID)					
Tier 2 trainee ST5-7 (not neonatal or paediatric critical care SPIN or GRID)					
Junior ANNPs <3 years' NICU experience					
SCU Consultant					
ST 5-6 (neonatal SPIN or GRID) or equivalent					
LNU consultant					
Senior ANNPs >3years in NICU					
ST7 (neonatal SPIN or GRID) or equivalent/ Neonatal Transport Doctor/ANNP					
NICU Consultant					

Appendix 3: Reversal of paralysis/ sedation

Drug	Dose	IV Bolus
Naloxone (For opioid reversal)	10 micrograms/kg, if no response, repeat at intervals of 2-3 minutes up to 5 times. If no response, then give a single dose of 100 micrograms/kg	Administer as IV bolus over 3-5 minutes. If required, it may be diluted to a convenient volume with compatible fluid (D5, D10, NS) immediately prior to use

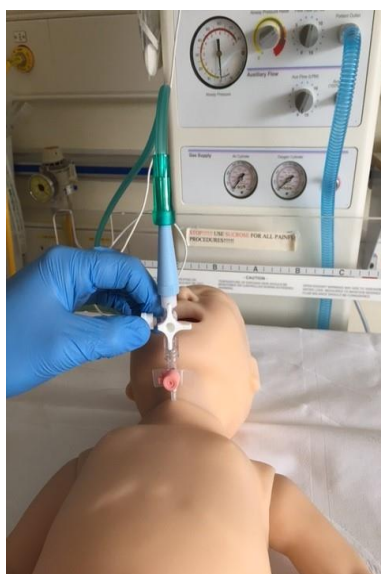
E.g. Dilute 200micrograms to 10ml to give a concentration of 20micrograms/ml 10micrograms=0.5ml

Appendix 4: Weight, gestational age limits and endotracheal tubes

GA (week)	Weight (gms)	ETT size (mm)	Length at tips (cm)
23-24	500-600	2.5	5.5
25-26	700-800	2.5	6.0
27-29	900-1000	2.5	6.5
30-32	1100-1400	2.5/3.0	7.0
33-34	1500-1800	3.0	7.5
35-37	1900-2400	3.0/3.5	8.0
38-40	2500-3100	3.5	8.5
41-43	3200-4200	3.5	9.0

(Thames Valley and Wessex Neonatal ODN.)

Appendix 5: Connections if ventilating through emergency cricothyrotomy



(Open- Inspiration)



(Closed-Expiration)

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If emergency cricothyrotomy is done, manual jet ventilation with **high I:E ratio of 1:4 or 1:5 should be used**. A flow rate of 1 to 2L/minute to begin, which should be increased by increments of 1L/minute up to a maximum flow rate of 12L/minute⁸. An oxygen supply of at least 400kPa should be used for ventilating through cricothyrotomy.

Appendix 6: Difficult Airway Pack Equipment

- Laryngoscope handles
- Miller blades size 00, 0, 1
- Macintosh blades size 0, 1
- Blades for video laryngoscopy McIntosh and Miller
- Endotracheal tubes size 2.0, 2.5, 3.0, 3.5
- Introducers/ Stylets
- Neonatal bougies
- Guedel airways size 00, 0, 1
- Yankauer suction catheters
- Neonatal size Magill's forceps
- Laryngeal masks airways- Size 00, 0, 1
- i-gel® size 1
- ETT fixators of all sizes
- Pedicap
- Elastoplast
- Lubricating gel
- Pink or grey cannula
- 3 way taps
- Green oxygen tubing
- 5ml IV syringes
- Scissors