

## Episode 142 Neonatal Resuscitation

*With Emily MacNeill, Jabeen Fayyaz and Hilary Whyte* Prepared by Winny Li and Lorraine Lau, May 2020

## General approach to neonatal resuscitation

- 1. **ABC** rather than CAB as recruitment of the lungs using positive pressure support, oxygenation and ventilation takes precedence over chest compressions
- 2. Goals of resuscitation: "warm, pink and sweet"
- 3. Prepare yourself, your team and your gear

#### Preparation

- 1. **Yourself**: box breathing, positive self-talk, visualization, tell the mother that "*we've got this*"
- 2. Your team: call on RT, anesthesia, pediatrics, team debrief
- 3. **Your gear**: a warmer and a box of NRP equipment prepared in advance in the ED

#### NRP Gear

- ETT 3 sizes
- Miller blades 0 and 1
- Video laryngoscope if available
- Supraglottic airway
- Oxygen masks (pediatric sizes)
- BVM
- Clamp and scissors for cord
- Towel for drying
- Plastic bag / Ziploc bag
- UVC catheter kit

## **Delayed Cord Clamping**

**Consider delayed cord clamping in all vigorous neonates with good tone.** Delaying clamping and cutting of the umbilical cord (60-90 seconds after birth) improves blood transfusion from the placenta to neonate with benefits such as decreasing the rate of intraventricular hemorrhage and necrotizing enterocolitis in preterm infants. While an increased rate of jaundice has been associated with delayed cord clamping, there are rarely any significant clinical sequelae.

## **AHA Neonatal Resuscitation Algorithm 2015**



#### Term? Good tone? Breathing or crying?

If "*Yes*" (the neonate is term, has good tone and is breathing or crying) position airway, dry with towels, place infant on mother's chest.

If "*No*" (the neonate is *not* term, does *not* have good tone or *not* breathing or crying) priorities are to warm the infant (see below), position the airway and stimulate.

\*Routine suctioning of secretions or meconium is no longer recommend unless overt airway obstruction is present

## Temperature management in the neonate: warming options and goals

Newborns lose heat rapidly. Hypothermia has been associated with increased mortality, intraventricular hemorrhage, respiratory complications, hypoglycemia dn late onset sepsis. Warm the infant who is >32 weeks gestational age with good tone and respirations by drying the neonate with a towel and placing them on their mother's chest. Options for warming the neonate who is  $\leq$ 32 weeks, has abnormal tone or respirations include:

- Place the neonate in an infant warmer set to 25°C.
- Place the wet infant (do not dry the infant) directly in a plastic bag up to their neck
- Thermal mattress (noninferior to infant warmer)
- Heated blankets

Do *not* towel dry the preterm infant <32 weeks gestational age as the skin is very fragile.

#### Target temperature is 36.5-37.5°C axillary

**Key concept**: avoid hypothermia at all costs as it is associated with increased mortality, intraventricular hemorrhage, respiratory complications, hypoglycemia and late onset sepsis.

# Positioning the airway on the neonate in the sniffing position

Compared to adults, neonates have larger tongues, tonsils, epiglottises and occiputs. Key positioning/airway maneuvers taking these differences into account are:

• Roll under the shoulders shifts the head to neutral/slightly extended position; may require headrest in addition to achieve the following:

- 1. Align the chin with the glabella
- 2. Ensure that the anterior neck space is open
- 3. Align the external auditory meatus horizontally with the suprasternal notch
- Tongue lift: lifting the tongue with a jaw thrust and/or placement of an oral or a nasal airway is essential to minimize upper airway obstruction in a sedated or obtunded neonate.



**Pitfall:** Hyperextension of the head on the neck may result in airway obstruction; be sure to position the head and neck in a neutral "sniffing" position which may require a roll under the shoulder, head rest, tongue lift and jaw thrust.

**Clearing secretions.** The primary focus should be on lung recruitment, oxygenation and ventilation. Previous routine nasopharyngeal and oral suctioning is no longer recommended. Even when meconium is present, suctioning is *not* recommended unless it is causing complete airway obstruction.

## Stimulation of the neonate

Stimulate with rubbing the back or assertive flicking of the soles of the feet until the infant cries. Towel drying in the well infant >32 weeks gestational age provides stimulation as well.





If the infant has labored breathing or persistent cyanosis, but HR is > 100:

- 1. Reposition and clear airway if you haven't already
- 2. Jaw thrust
- Place SpO2 monitor to guide resuscitation (pre-ductal with oxygen saturation monitor on the right hand or wrist)
- 4. Apply supplemental O2 as needed, consider positive pressure ventilation
- 5. Heart rate monitoring with 3-lead ECG

If the neonate is apneic or gasping or has a HR <100, provide positive pressure ventilation in addition to above steps

Target 40 breaths/minute and effective ventilation.

#### Measuring the heart rate: The 3-lead ECG

Obtaining an accurate heart rate measurement is of utmost importance as it helps guide resuscitation and is the most sensitive indicator of adequate resuscitation as a normal heart rate reflects adequate oxygenation/ventilation. Place an oxygenation saturation monitor on the neonate's **right hand or wrist**. It is important to realize that the oxygen saturation monitor may take time to pick up and display the oxygenation saturation, that palpation of the umbilical stump is unreliable, and that auscultation is often difficult in a noisy environment. **The most accurate and efficient method to measure the heart rate is using a 3 lead ECG**.

## **Neonatal oxygenation**

Ventilation is more important than oxygenation as it takes about 10 minutes for babies to normally achieve "normal" oxygen saturation levels. **Oxygen saturation targets** in newborns are much lower than in adults and normally gradually rise over the first 10 minutes.

- For term and late-preterm newborns (≥35 weeks) receiving respiratory support at birth, the initial use of 21% oxygen is reasonable
- For preterm newborns (<35 weeks) receiving respiratory support at birth, it may be reasonable to begin with 21% - 30% oxygen then titrate based on pulse oximetry
- 100% FiO2 should *not* be used to initiate resuscitation as it is associated with increased mortality

## **Neonatal ventilation**

#### **Mask Ventilation**

While general recommendations for sizing of oxygen masks in neonates are **size 0 for preterm**, round type and **size 1 for term infant**, use the mask that fits well over bridge of nose to chin to minimize air leak. Ensure open mouth and jaw thrust while minimizing pressure on the submental tissue to avoid tongue obstruction. Two-person technique is preferred. Avoid over ventilation while bagging by applying just enough pressure to the bag to cause adequate chest rise or PIP of 20.

**Pitfall:** over-bagging leading to pneumothorax and/or pneumomediastinum is not uncommon; avoid over-bagging by applying just enough pressure to the bag to cause adequate chest rise or PIP of 20.

Deliver PPV through <u>**T**-piece resuscitator</u> or <u>flow-inflating bag</u>, providing:

- 1. CPAP PEEP 5-8
- 2. PPV PIP 20 or until chest rise

**Key concept:** continuous positive airway pressures and positive endexpiratory pressures are required to open up the alveoli and to recruit the lungs.



#### Corrective ventilation steps

After 30 seconds of effective ventilation, if no effective outcome, remember "MR. SOPA" for corrective ventilation steps:

- **M** Mask adjustment
- **R** Reposition airway
- **S** Suctioning nares
- **O** Opening mouth
- P Pressure increase to PEEP 6-8 and PPV>20 (max 40)
- A Advanced airway, consider supraglottic airway

Box 5



After 30 secs of PPV, reassess HR. If HR >100 – continue PPV 40-60 breaths/min there is spontaneous effort. If HR <60, establish adequate ventilation *before* beginning chest compressions. Ventilation is the main priority.

#### Establish advanced neonatal airway within 40 seconds

The goal is to establish an advanced airway in <40 seconds, as delays beyond this are associated with increased morbidity and mortality. Strongly consider using a supraglottic airway (SGA) rather than BVM and endotracheal intubation in neonates  $\geq$ 34 weeks GA and  $\geq$ 1.5kg requiring advanced airway management. A Cochrane review in 2018 found that SGA demonstrated comparable efficacy to endotracheal intubation. When compared to BVM, SGA was associated with shorter resuscitation and ventilation times, and less requirement for endotracheal intubation.

#### **Caveats for SGA**

- Cannot use in infants <34 weeks or <1.5kg (no SGA small enough)
- 2. No evidence for giving epinephrine through SGA
- 3. Unclear if asynchronous chest compressions can be given with SGA

**Key concept:** You have 40 seconds to secure the airway of a sick neonate; SGA is your tool of choice in sick neonates > 34 weeks. **Pitfalls of SGA use** 

- If SGA is inserted too far, the esophagus can be fully intubated and distended by the SGA tip, which would require it to be withdrawn slightly.
- Bending the epiglottis over the laryngeal inlet can cause significant airway obstruction that may be resolved by repositioning of the SGA and/or the neonate's head and neck.
- Tip of the SGA can fold on itself during insertion, preventing effective gas exchange. This can generally be corrected by withdrawing the SGA such that it is no longer folded over and then reinserting it.

#### **Neonatal endotracheal intubation sizing** ETT size

Birth Weight (kg)	Gestational Age (weeks)	ET Tube size (mm) Internal diameter	Insertion depth
< 1	< 28	2.5	6 – 7 cm
1-2	28 - 34	3.0	7 – 8 cm
2-3	34 - 38	3.5	8 – 9 cm
> 3	> 38	3.5 - 4.0	9 – 10 cm

### **ETT depth** = 6 cm + weight in kg \*have tubes half size bigger and half size smaller available

#### Blade size

Term infant: #1 Miller blade, 3.5mm Preterm infant: 0 Miller, 3.0mm

**ETT depth** = 6 cm + weight in kg

## VL or DL? Which one is preferred?

**Video laryngoscopy** has been associated with improved success in tracheal intubation and a decreased risk of complications in neonates compared to direct laryngoscopy.

## **RSI medications in neonatal resuscitation**

Premedication and neuromuscular blockade use have been associated with improved intubation success and decreased complications in neonates. RSI medications have been shown to improve glottic visualization, decrease the number of intubation attempts, and decreases airway trauma.

#### Rule of 2s for neonatal RSI medications

Atropine 0.02 mg/kg IV Fentanyl 2 mcg/kg IV Succinylcholine 2 mg/kg IV

### Chest compressions in neonatal resuscitation

**Ensure adequate ventilation is established first**. Securing an advanced airway and initiating positive pressure ventilation is strongly recommended *before* starting chest compressions.

**Technique:** <u>2 thumb technique</u> on lower 1/3 of sternum to a depth of 1/3 chest diameter, ideally from head of bed is preferred over the 2 finger technique and has been shown to improve chest compression quality

**Rate:** 3:1 coordinated with PPV (90 compressions: 30 ventilations/min) = "1 and 2 and 3 and breathe" = 120 events per minute

**Duration:** 60 secs between pulse checks

## Vascular Access in neonatal resuscitation: Umbilical vein catheter or IO?

**Umbilical vein catheter is the preferred route**. Intraosseous access is only suitable for term infants > 3kg, requiring a slightly more caudal approach than in older children, and immediate anchoring given the thinner bone cortex in neonates.

Box 6



If the HR is remains <60 after 90 seconds of effective PPV and 60 seconds of chest compressions, add epinephrine, consider hypovolemia and pneumothorax

## Epinephrine dosing in neonatal resuscitation

Draw up in a 1 mL syringe and label "for IV/UVC" 0.1 mL/kg by IV 0.1 – 0.3mL (remember 0.2 in "rule of 2" for simplicity) First dose can be given through ETT while establishing IV access. After 120 seconds of effective PPV and 90 seconds of chest compressions, add a fluid bolus.

### **DOPE mnemonic in neonatal resuscitation**

In scenarios where there is difficulty ventilating or oxygenating, consider the DOPE mnemonic to research for potential causes

- Displacement
- Obstruction blood or meconium
- Pneumothorax
- Equipment failure

## Fluid and glucose management in neonatal resuscitation

Unlike older children and adults neonatal arrest is very rarely due to hypovolemia, so aggressive fluid resuscitation is rarely a priority in this age group.

Start with NS bolus of 10 mL/kg over 20 minutes. If a second bolus is required, consider at this time adding an inotrope.

**Check the capillary glucose** and provide **2 mL/kg DW10 bolus** within 30 mins of birth to avoid hypoglycemia.

## **Goals of resuscitation**

Use the **STABLE** mnemonic to help you remember the targets of resuscitation.

- Sugar (4-6)
- Temperature  $(36.5^{\circ}C 37.5^{\circ}C \text{ axilla})$
- Airway
- **B**reathing (oxygen saturation of 90-95% after 10 mins)
- Labs (CO2: 45-55)
- Emotional support for family

+minimum BP target: MAP = Gestational Age

## Take home points for neonatal resuscitation

- ABC rather than CAB as recruitment of the lungs using positive pressure support, oxygenation and ventilation takes precedence over chest compressions
- Goals of resuscitation: "warm, pink and sweet"
- Prepare yourself, your team and your gear and call for help early
- Avoid hypothermia at all costs using an infant warmer at 25°C or thermal mattress, plastic bag for ≤32 wks GA or unwell, targeting axillary temperature of 36.5-37.5 °C
- Consider delayed cord clamping (60-90 secs) in all vigorous neonates with good tone
- Ensure optimized airway positioning in "sniffing position"
- Nasopharyngeal suctioning is reserved only for neonates with complete airway obstruction
- Drying the neonate is reserved for well appearing newborns > 32 weeks GA; all other newborns should be placed, wet, in a plastic bag up to their neck
- Place an oxygenation saturation monitor on the neonate's right hand/wrist to measure pre-ductal saturation
- Obtain accurate heart rate measurement by 3 lead ECG
- SGA is faster and associated with better outcomes than ETT but there is no SGA that is small enough for preterm babies <34 weeks</li>

- Ventilation is more important than oxygenation as it takes about 10 minutes for babies to normally achieve "normal" oxygen saturation levels
- Neonates are rarely hypovolemic and the initial bolus is NS bolus 10ml/kg over 20 mins
- Rule of 2s for RSI: Atropine 0.02 mg/kg IV, Fentanyl 2 mcg/kg IV and Succinylcholine 2 mg/kg IV
- Corrective ventilation steps: MR SOPA mnemonic
- Troubleshooting post intubation: DOPE mnemonic
- Targets of resuscitation: STABLE mnemonic

#### References

- Escobedo MB, Aziz K, Kapadia VS, et al. 2019 American Heart Association Focused Update on Neonatal Resuscitation: An Update to the American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Pediatrics. 2020;145(1).
- 2. Qureshi MJ, Kumar M. Laryngeal mask airway versus bag-mask ventilation or endotracheal intubation for neonatal resuscitation. Cochrane Database Syst Rev. 2018;3:CD003314.
- Soar J, Maconochie I, Wyckoff MH, et al. 2019 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: Summary From the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. Circulation. 2019;140(24):e826-e880.
- 4. Park RS, Peyton JM, Kovatsis PG. Neonatal Airway Management. Clin Perinatol. 2019;46(4):745-763.

#### Neonatal Resuscitation Algorithm-2015 Update

