Chapter 4

Pediatric Cardiac Care

Neonatal Resuscitation

Scope of Guideline

This guideline is designed for North American healthcare providers who are looking for an up-to-date summary for clinical care, as well as for those who are seeking more in-depth information on resuscitation science and gaps in current knowledge. The science of neonatal resuscitation applies to newly born infants transitioning from the fluid-filled environment of the womb to the air-filled environment of the birthing room and to newborns in the days after birth. In circumstances of altered or impaired transition, effective neonatal resuscitation reduces the risk of mortality and morbidity. Even healthy babies who breathe well after birth benefit from facilitation of normal transition, including appropriate cord management and thermal protection with skin-to-skin care.
The 2015 Neonatal Resuscitation Algorithm and the major concepts based on sections of the algorithm continue to be relevant in 2020. The following sections are worth special attention.

- Positive-pressure ventilation (PPV) remains the main intervention in neonatal resuscitation. While the science and practices surrounding monitoring and other aspects of neonatal resuscitation continue to evolve, the development of skills and practice surrounding PPV should be emphasized.

- Supplemental oxygen should be used judiciously, guided by pulse oximetry.

- Prevention of hypothermia continues to be an important focus for neonatal resuscitation. The importance of skin-to-skin care in healthy babies is reinforced as a means of promoting parental bonding, breast feeding, and normothermia.

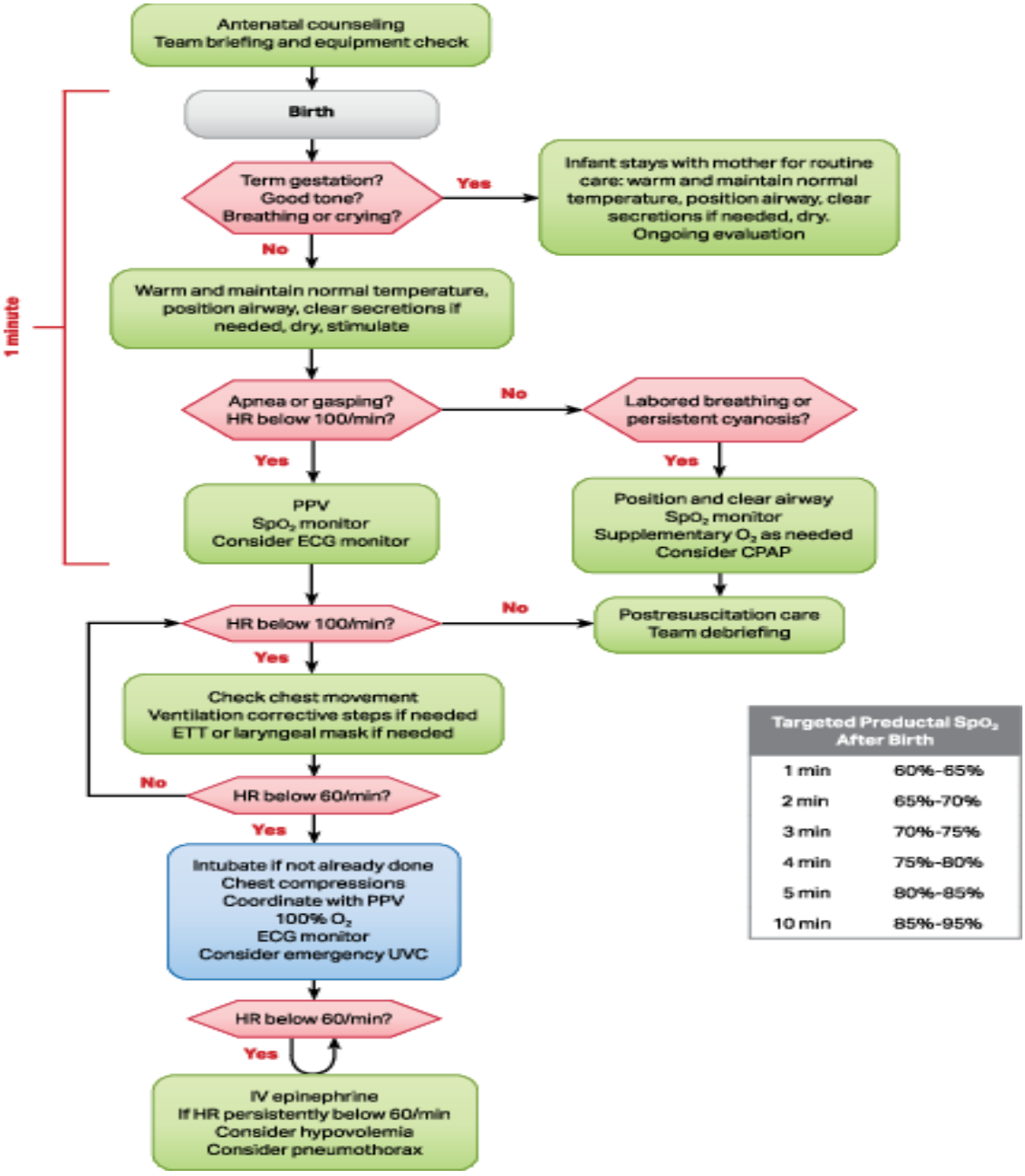
- Team training remains an important aspect of neonatal resuscitation, including anticipation, preparation, briefing, and debriefing. Rapid and effective response and performance are critical to good newborn outcomes.

- Delayed umbilical cord clamping was recommended for both term and preterm neonates in 2015. This guideline affirms the previous recommendations.

- The *2015 American Heart Association* (AHA) *Guidelines Update for Cardiopulmonary Resuscitation* (CPR) *and Emergency Cardiovascular Care* (ECC) recommended against routine endotracheal suctioning for both vigorous and nonvigorous infants born

with meconium-stained amniotic fluid (MSAF). This guideline reinforces initial steps and PPV as priorities.

Pediatric Resuscitation Algorithm



Ref: American Academy of Pediatrics. Jan. 2021. https://doi.org/10.1542/peds.2020-038505E

Standard Pediatric Cardiac Arrest Procedures (PALS)

Rationale:

Cardiac arrest in children is often secondary to a respiratory component. It is essential these patients receive rapid, decisive care in the pre-hospital setting. Primary treatment includes intubation and epinephrine administration. The patient's environment may provide clues as to the underlying cause.

Pediatric Care

Level I

- Note the patient's environment.
- Wear appropriate Personal Protective Equipment (PPE).
- Perform a primary assessment and emergency treatment.
- Assess for Death Scene Criteria.
- Determine pulselessness and apnea.
- Perform CPR with appropriate airway device.
- AED/cardiac monitor as indicated (age > 1 years old).
- Perform a secondary assessment.
- Check a blood glucose level.

Level II

- Determine cardiac rhythm and follow treatments in the appropriate protocol.
- Establish an ALS airway if needed with ET tube (1 attempt only) or King Airway (>12kg or 25lbs).
- Confirm airway placement with capnography and 2 other documented methods.
- Establish vascular access by IV or IO.

Asystole

CPR 2 minutes
Check Pulse

Resume CPR immediately
Give epinephrine

- IV/IO: 0.01 mg/kg
  (1:10,000: 0.1 mL/kg)
- If Endotracheal tube: 0.1 mg/kg
  (1:1000: 0.1 mL/kg)

Repeat every 3 to 5 min.
CPR for 2 min. (intubate)

Check rhythmn
Shockable rhythm?

If no pulse and Asystole
Repeat epinephrine

- IV/IO: 0.01 mg/kg
  (1:10,000: 0.1 mL/kg)
- Endotracheal tube: 0.1 mg/kg
  (1:1000: 0.1 mL/kg)

Repeat as necessary

Note:

Identify and treat 6 H's and 5T's.

- Hypoxia
- Hydrogen Ion (Acidosis)
- Hypo/Hyperkalemia
- Hypovolemia
- Hypothermia
- Hypo/Hyperglycemia
- Toxins, Tablets
- Tension Pneumothorax
- Tamponade, cardiac
- Trauma
- Thrombosis-pulmonary, coronary

Bradycardia

Less than 6 months: < 80 BPM
Older than 6 months: < 60 BPM

Severe Cardio-respiratory Compromise
Poor Perfusion
Respiratory Difficulty

No

Observe
Support ABC's
Transport

Yes

Perform chest compressions if
Heart Rate < 80 BPM in an infant
Heart Rate < 60 BPM in a child

Epinephrine
IV / IO 0.01 mg / kg 1:10,000
or ET 0.1mg/kg 1:1000

May repeat every 3 – 5 minutes

Atropine
IV / IO / ET 0.02 mg / kg
Minimum dose of 0.1 mg
Maximum dose of 0.5 mg for a child and 1.0 mg for and adolescent
May repeat same dose once

Consider Transcutaneous Pacing if other treatments are ineffective

Note:

Atropine should not be used on infants less than 30 days of age.
Consider transcutaneous pacing if highly suspicious of beta blocker or calcium channel blocker.

Pulseless Electrical Activity

CPR 2 minutes
Check Pulse

Resume CPR immediately
Give epinephrine

- IV/IO: 0.01 mg/kg
  (1:10,000: 0.1 mL/kg)
- Endotracheal tube: 0.1 mg/kg
  (1:1000: 0.1 mL/kg)

Repeat every 3 to 5 min.
CPR for 2 min. (intubate)

Check rhythm
Shockable rhythm?

If no pulse and Asystole
Repeat epinephrine

- IV/IO: 0.01 mg/kg
  (1:10,000: 0.1 mL/kg)
- Endotracheal tube: 0.1 mg/kg
  (1:1000: 0.1 mL/kg)

Repeat as necessary

Note:

Identify and treat 6 H's and 5T's.

- Hypoxia
- Hydrogen Ion (Acidosis)
- Hypo/Hyperkalemia
- Hypovolemia
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- Tension Pneumothorax
- Tamponade, cardiac
- Trauma
- Thrombosis-pulmonary, coronary

Supraventricular Tachycardia

Rationale:

Supraventricular tachycardia in the pediatric patient is uncommon. Pediatric tachycardias are generally related to pain, fever, or shock and usually originates in the sinus area. Treat the tachycardia pediatric patient aggressively if the tachycardia is other than a sinus origin or the patient is unstable.

SVT rates rule-of-thumb:

Infant rate > 220 bpm
Chile rate > 180 bpm

Normal heart rates in children

Age	Heart rate range	Mean
Neonatal to 3 mo	85-205	140
3 mo to 2 yr	100-190	130
2 yr to 10 yr	60-140	80
>10 yr	60-100	75

Stable

Oxygen
ECG Monitoring
IV Access

Adenosine
0.1 mg / kg (max of 6 mg)
Followed by a NS bolus 20ml

Adenosine
0.2 mg / kg (max of 12 mg)
Followed by a NS bolus 20ml

Call for further orders

Unstable

Oxygen
ECG Monitoring
IV Access

Sedate
Versed
- **IV/IO/IM/Nasal 0.05 mg / kg**
- **Maximum single dose of 1mg may repeat one time (maximum combined dose of 2mg)**

Synchronized Cardioversion
0.5 J / kg
1 J / kg
2 J / kg
4 J / kg

Note:
Do not delay cardioversion for IV Access

Ventricular Fibrillation / Pulseless Ventricular Tachycardia

CPR 2 minutes (5 cycles)

Give 1 Shock

- Manual: 2 J/kg
- AED: > 1 year of age

Use pediatric system if available for 1 to 8 years of age

Resume CPR immediately

CPR 2 minutes

Check rhythm
Shockable Rhythm?

Continue CPR while defibrillator is charging

Give 1 Shock

- Manual: 4 J/kg
- AED > 1 year of age

Epinephrine
IV / IO 0.01 mg / kg 1:10,000
Or ET 0.1 mg/kg 1:000
Repeat Every 3-5 minutes

CPR 2 minutes

Lidocaine 1 mg / kg IV/IO
Repeat Lidocaine 1 mg / kg every 3-5 min. to a maximum dose
3 mg/kg

OR

Amiodarone
5 mg / kg IV/IO in 30 ml N.S. over 30 seconds
Single Dose max 300 mg

Check rhythm
Shockable Rhythm?

Ventricular Tachycardia (Pulse Producing)

Unstable

Sedate
Versed
- **IV/IO/IM/Nasal 0.05 mg / kg**

Ventricular Rate > 150
Immediate Synchronized Cardioversion
0.5 J / kg
1 J / kg
2 J / kg
4 J / kg

If conversion occurs, administer Lidocaine 1 mg / kg and hang a Lidocaine drip.

If cardioversion is unsuccessful utilize pharmacological agents under the stable category along with cardioversion

Stable

Consider Adenosine if rhythm regular and QRS monomorphic

Lidocaine
1 mg / kg IV

OR

Amiodarone
5 mg / kg in D5W given over 20 minutes max dose 300mg

Repeat Lidocaine
1 mg / kg IV
Every 10 minutes to a maximum of 3 mg / kg

If conversion maintenance infusion
20 – 50 mcg / kg / min
300 mg into 250 ml
1 micro-drop / kg / min
Equals
20 mcg / kg / min

Note:
Do not delay cardioversion for IV Access