

# NEONATOLOGY

Primary Care Paramedicine

Module: 18

Section: 04



- Introduction
- General pathophysiology
- The distressed newborn
- Specific neonatal situations

- Neonates
  - A newborn
  - An infant less than one month old
  - Gestational age



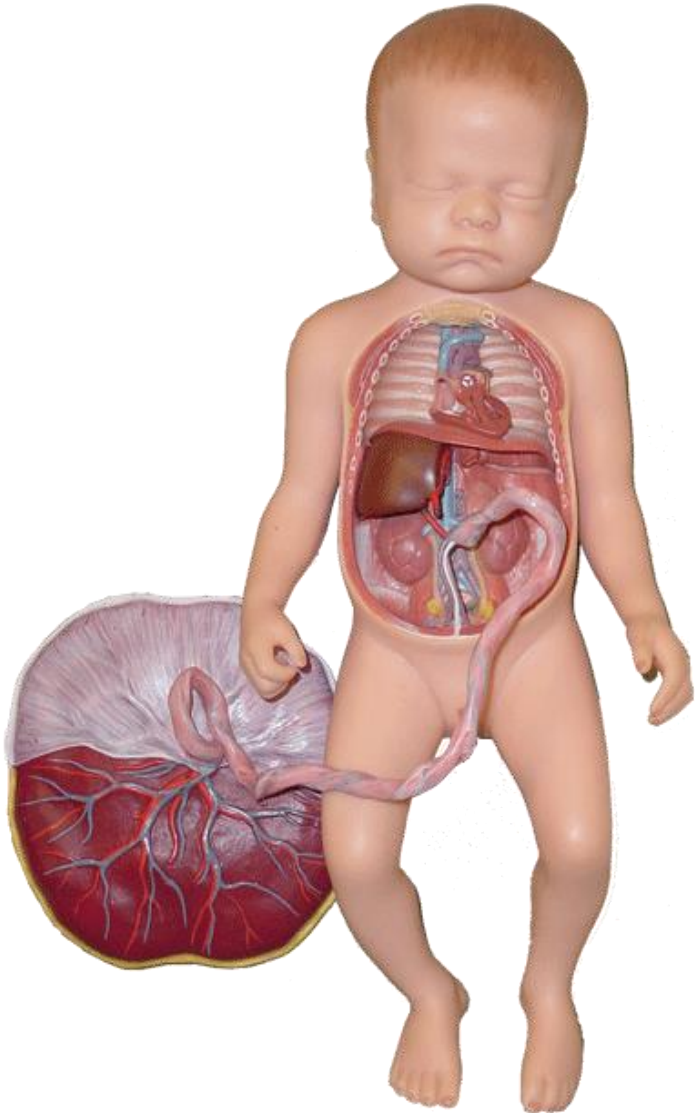


- 90% of term newborns require no resuscitation
  - May require maintenance of temperature, suctioning of the airway, and mild stimulation
- 10% of newborns require some assistance
  - PPV, warming, suctioning
  - Only 1% need major resuscitative measures (intubation, chest compressions, and/or medications) to survive

- Physiological changes at birth
- Risk factors
- Resuscitation procedures
- Special situations
- Premature newborn considerations
- Ethical care and end of life

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# **PHYSIOLOGICAL CHANGES AT BIRTH**



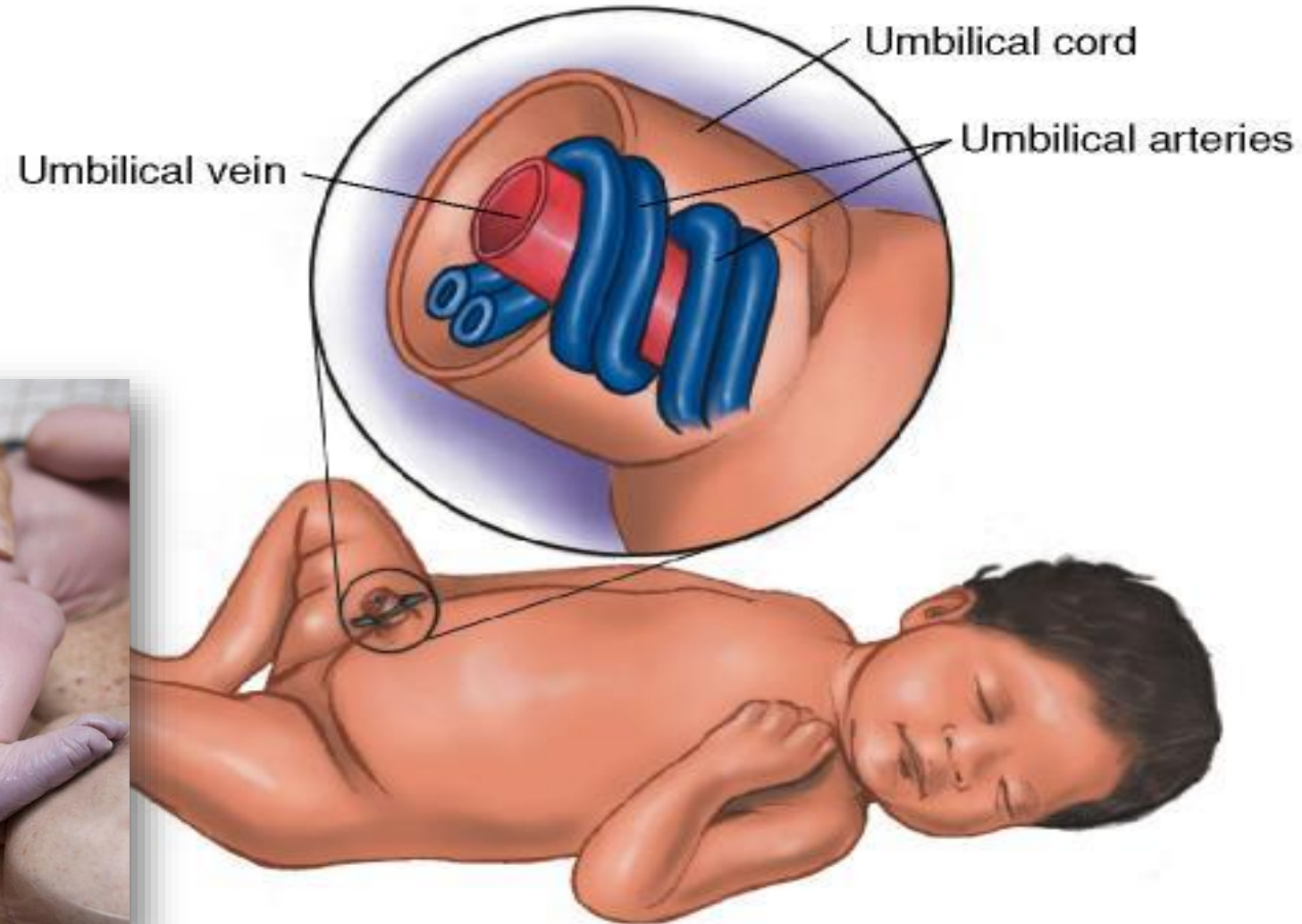
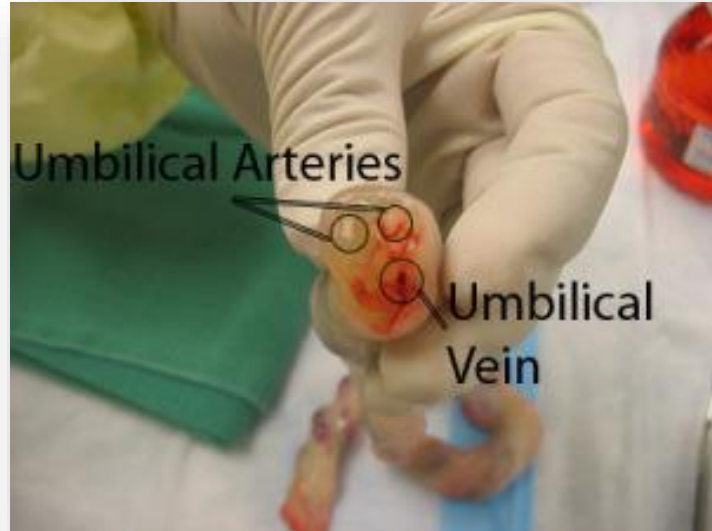
- During the delivery process the newborn must transition from fetal circulation to post-natal circulation
  - Respiratory system must suddenly initiate and maintain oxygenation
  - Infants are very sensitive to hypoxia
  - Permanent brain damage will occur with hypoxemia



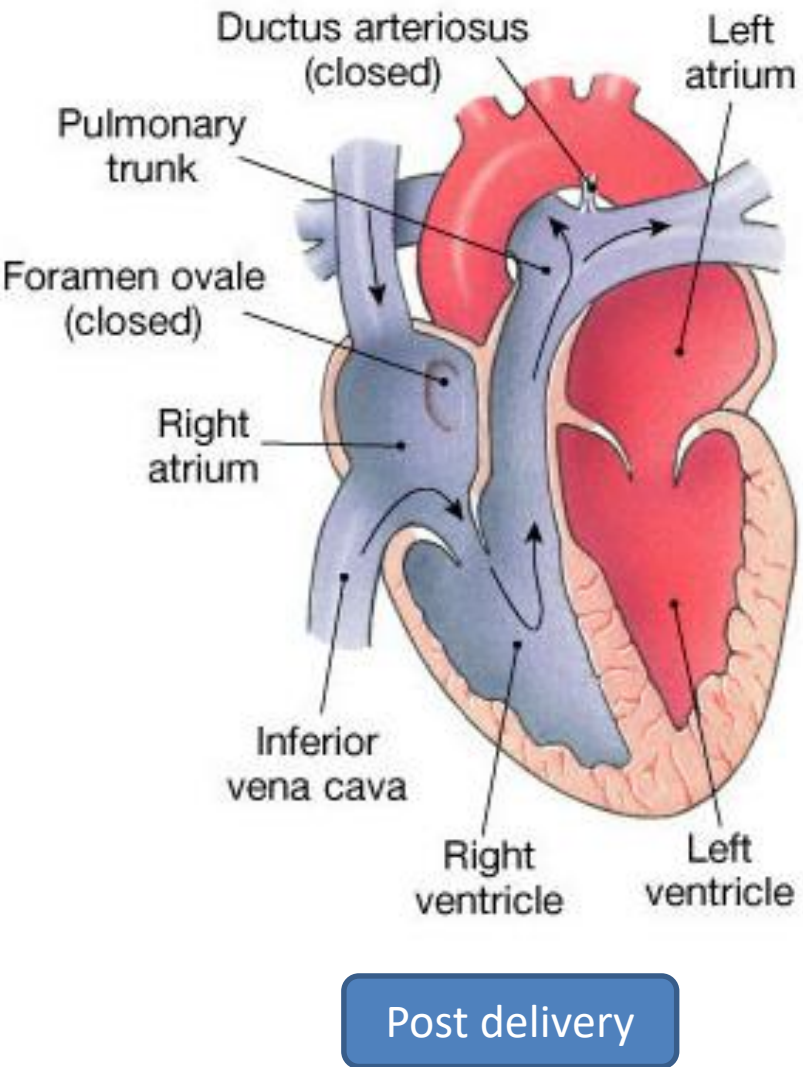
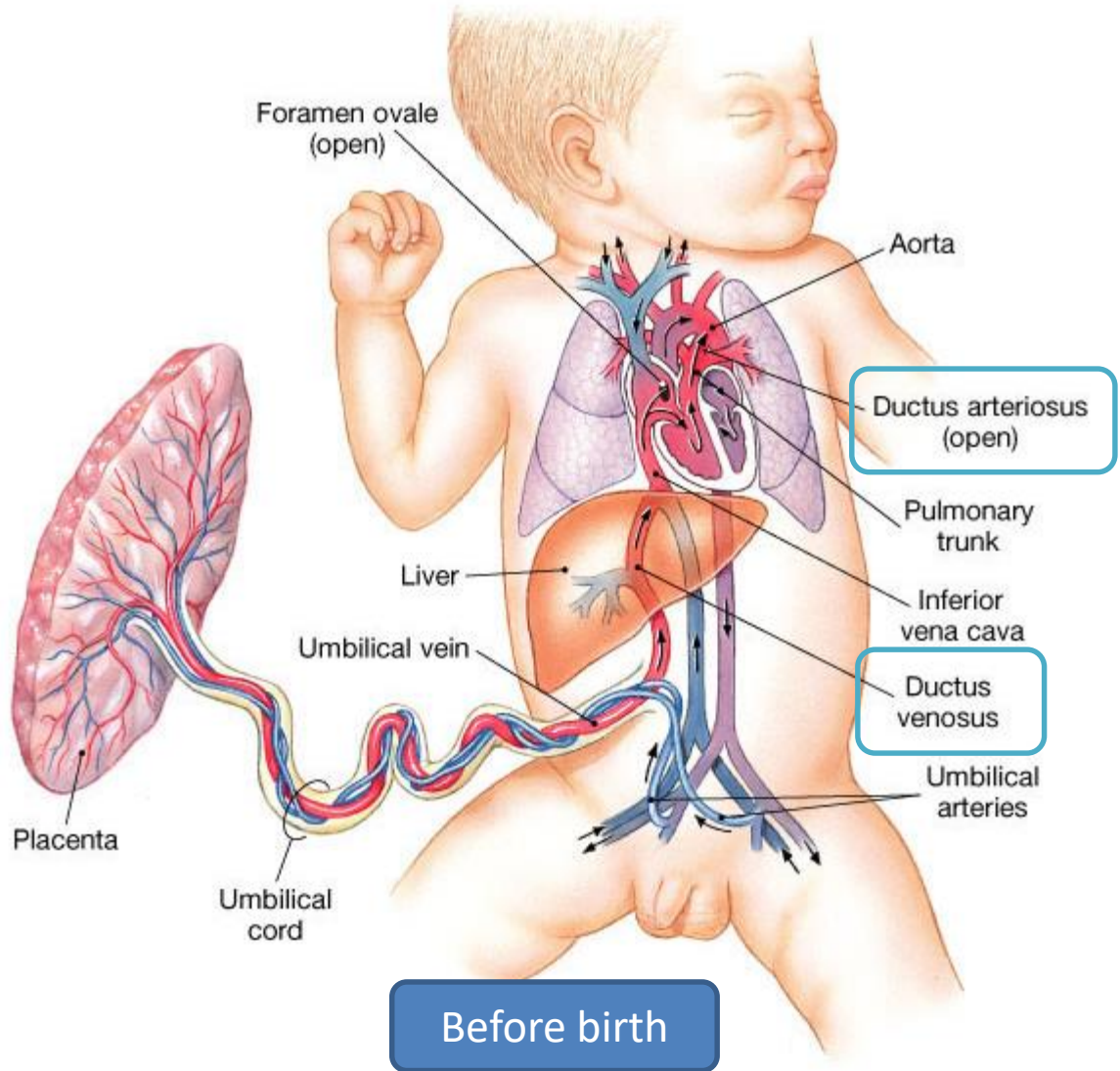


- In utero
  - Dependent on placenta
    - Nutrients and oxygen demands
    - Clearance of waste and metabolites

# The umbilical cord



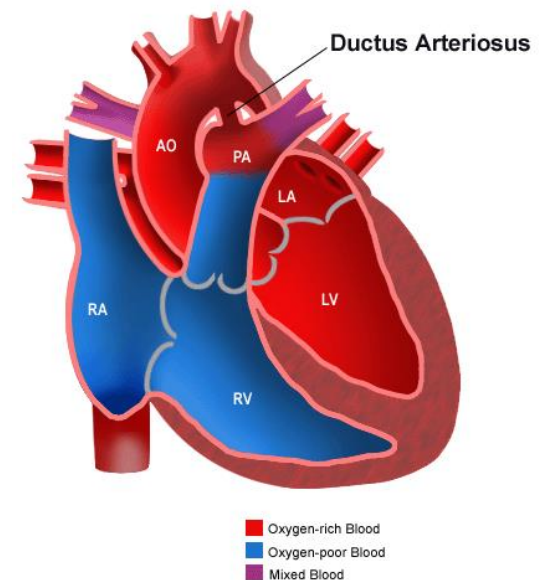
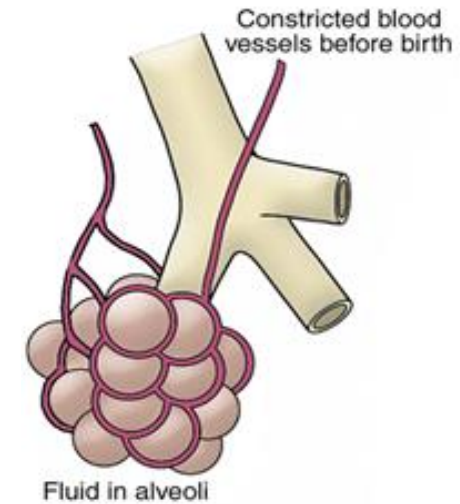
# Fetal Circulation



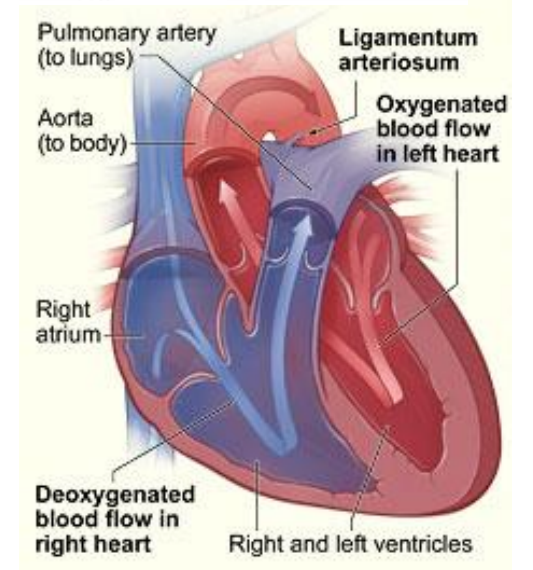
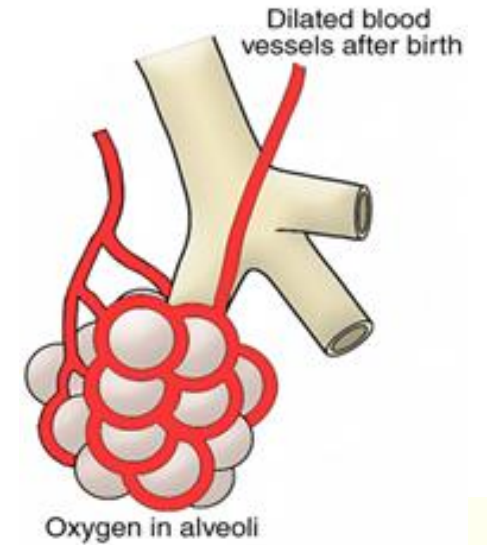
- Umbilical Vein
  - Carries oxygenated blood from the mother
- Umbilical Arteries
  - Two arteries carry deoxygenated blood to placenta
- Foramen Ovale
  - Shunts blood from the right atrium to the left atrium bypassing the right ventricle and the lungs
  - As opposed to the post-natal heart, the fetus' right heart has higher pressure than the left heart
  - Normally closes within 3 months of birth

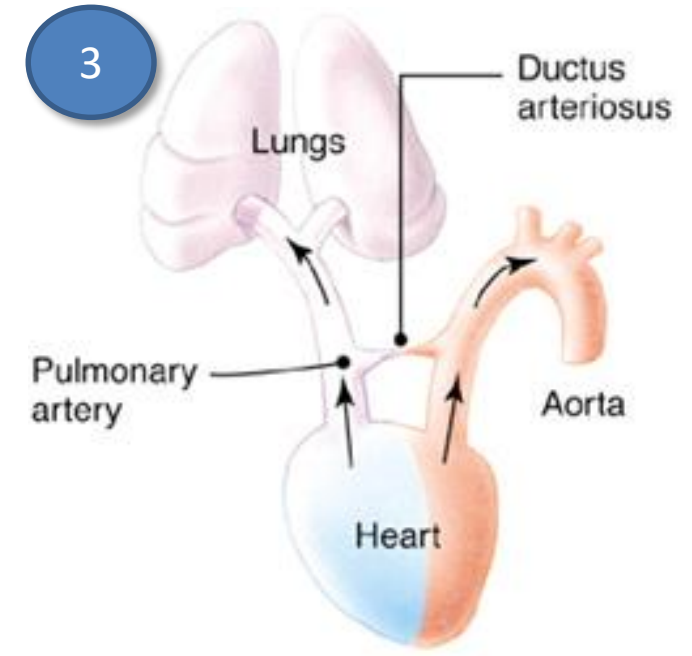
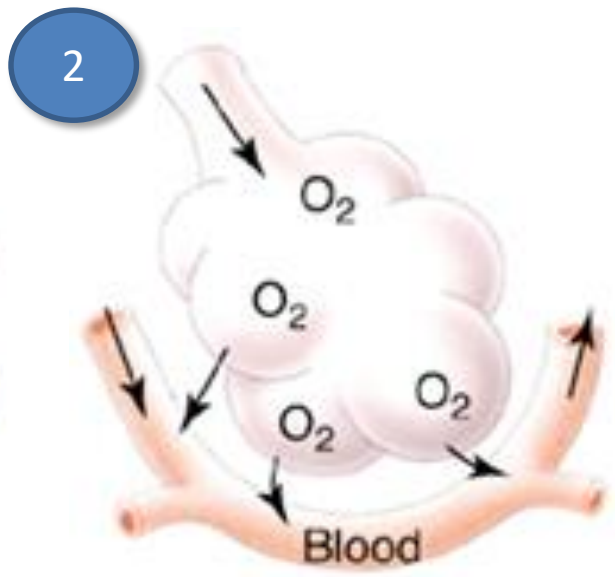
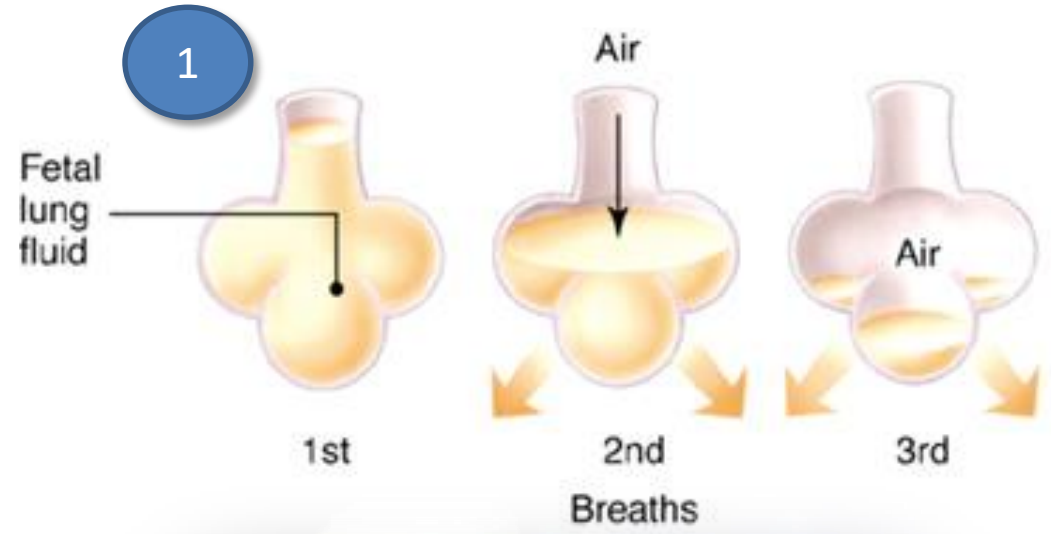
- Ductus Arteriosus
  - Blood from right ventricle and not gone through the foramen ovale is shunted from the pulmonary arteries to the aorta
  - Typically closes once breathing regulates in the newborn baby
- Ductus Venosus
  - Sends approximately 80% of the blood from the umbilical vein to the inferior vena cava
  - Bypasses the fetal liver
  - Within minutes of birth, the ductus venosus does not work but it will take 3-7 days for it to completely close

- Alveoli filled with fluid
- Pulmonary arterioles constricted
  - Pulmonary flow decreased
  - Creates relative pulmonary hypertension
  - Blood flow diverted across ductus arteriosus due to path of least resistance



- Newborn breathing
  - Increases pressures within lungs as air moves in
    - Forces fluid out of alveoli and allows for proper diffusion of oxygen into pulmonary capillaries
  - Oxygen
    - Dilates pulmonary capillaries
    - Constricts ductus arteriosus and ductus venosus







- New born transition from fetal to post-natal circulation is relatively fast
- Transitional issues occur if:
  - Lack of ventilation
  - Prolonged lack of adequate perfusion and oxygenation

## **Primary Apnea**

- Hypoxia occurs
- Attempted rapid breathing followed by primary apnea and dropping heart rate
- Improves with tactile stimulation

## **Secondary Apnea**

- Hypoxia continues
- Apnea continues
- Heart rate and blood pressure continue to drop
- Cannot be reversed with stimulation; assisted ventilation must be provided

- Initial response to hypoxia in the newborn is bradycardia
- Effective ventilation and proper oxygenation will usually improve HR



- Causes of hypoxia
  - Compression of the cord
  - Difficult labor and delivery
  - Maternal hemorrhage
  - Airway obstruction
  - Hypothermia
  - Newborn blood loss
  - Immature lungs in the premature newborn

- Newborns are at great risk for rapidly-developing hypothermia because of:
  - Their larger body surface area
  - Decreased tissue insulation
  - Immature temperature regulatory mechanisms
- Newborns attempt to conserve body heat through vasoconstriction and increasing their metabolism, placing them at risk for:
  - Hypoxemia
  - Acidosis
  - Bradycardia
  - Hypoglycemia

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# **RISK FACTORS**

- Antepartum (before labor and delivery) and intrapartum (during labor and delivery) risk factors may indicate the need for resuscitation
  - Prepare equipment and drugs that may be required for neonatal resuscitation
  - Medical direction should also be advised of the situation so that the appropriate destination hospital can be determined
- Presence of risk factors is only an indicator to be prepared, delivery may still progress normally

- Maternal diabetes
- Preeclampsia
- Chronic HTN
- Previous fetal or neonatal death
- Bleeding in 2nd or 3rd trimester
- Premature rupture of membranes
- Post-term gestation
- Multiple gestation
- Drug therapy
- Maternal substance abuse
- No prenatal care
- Age < 16 or > 35

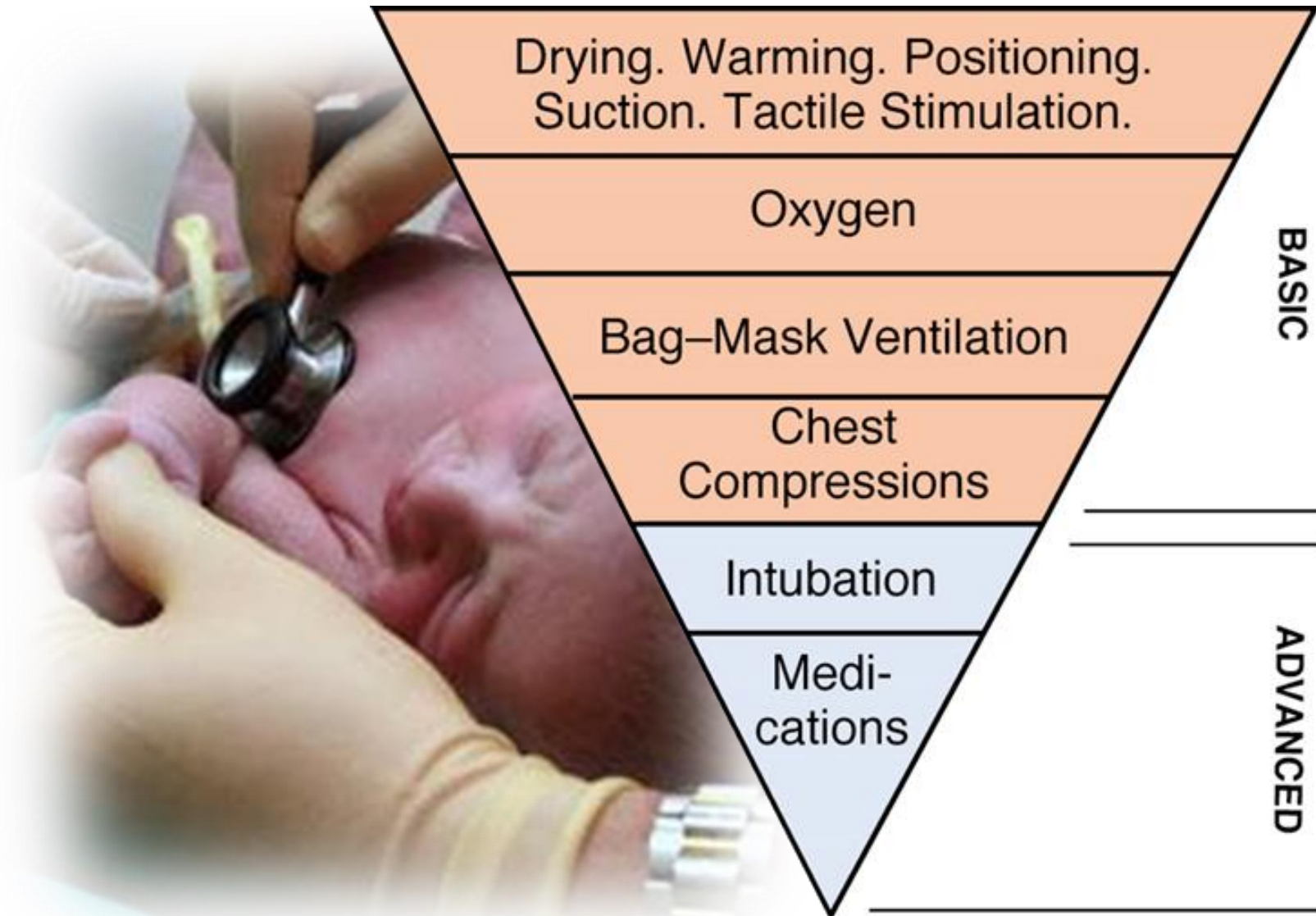
- Breech or abnormal presentation
- Premature labor
- Precipitous labor
- Chorioamnionitis
- Prolonged rupture of membranes (> 18 hours prior)
- Macrosomia
- Narcotics with 4 hours prior
- Meconium stained amniotic fluid
- Prolapsed cord
- Abruptio placentae
- Placenta previa
- Intrapartum bleeding



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# **RESUSCITATION OF THE NEWBORN**

- Assess the newborn immediately after birth.
- Ideally, one paramedic attends the mother while the other attends the newborn.
- Newborns will be slippery and require both hands





- Initial assessment of the newborn
  - Term?
  - Breathing or Crying?
  - Good muscle tone?
- If “yes” to all questions provide routine care to the newborn
  - Provide warmth and dry the off
  - Clear airway if required
  - Assessment of APGAR as required

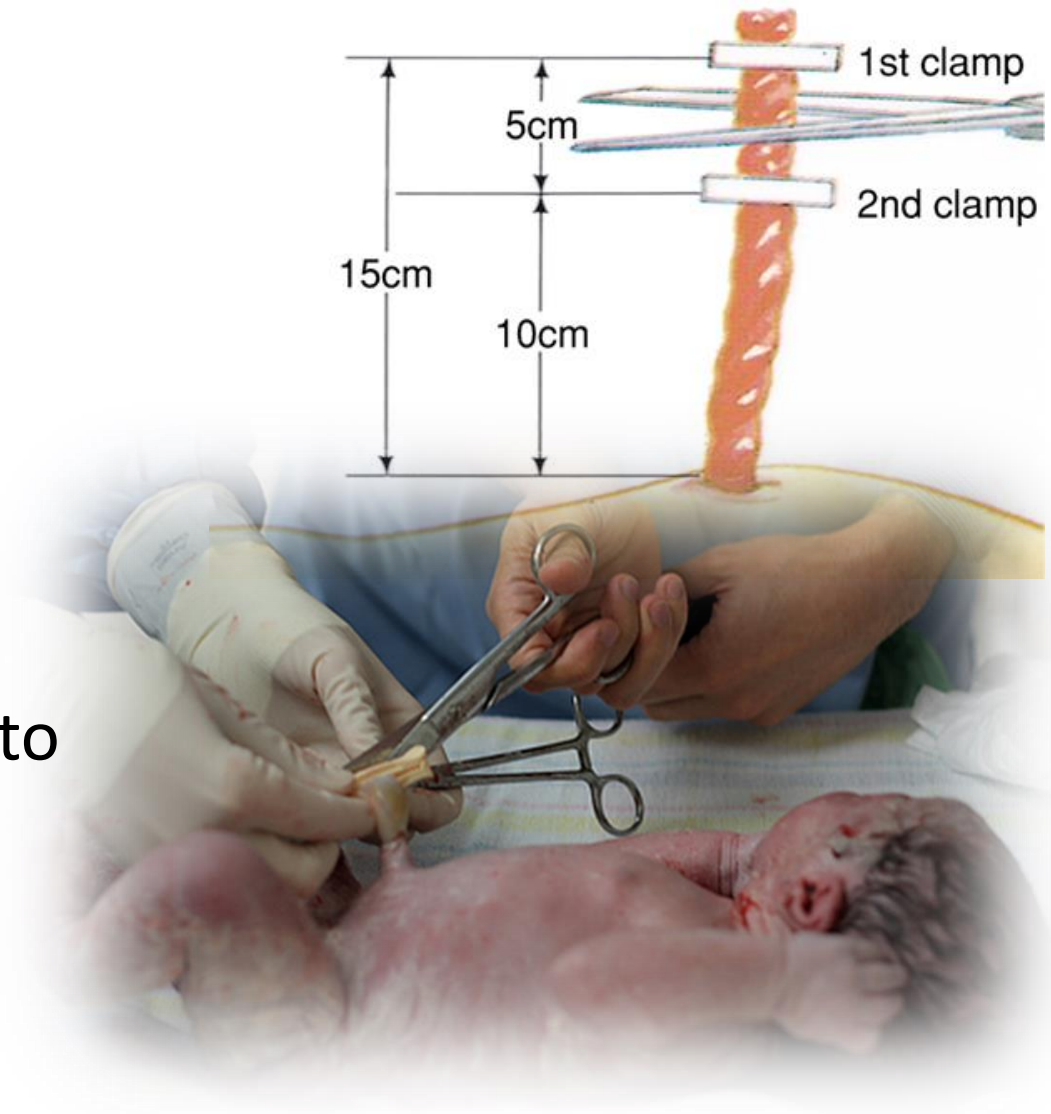
- The presence of fetal stool in amniotic fluid (occurring either in utero or intrapartum)
- May be slightly yellow, light green to a thick “pea soup”
  - Non-vigorous
    - Suction the baby’s oropharynx as much as possible before proceeding with any other steps
  - Vigorous
    - Suction the mouth and nose only, and proceed with resuscitation as required



- Using bulb syringe:
  - Suction the mouth first
  - Then the nose
- If the Newborn has copious secretions coming from the mouth
  - Turn the head to the side so that secretions will collect in the cheek and be easily removed



- Normal delivery
  - Let cord stop pulsating with baby at uterus level and then cut the cord
    - Keep baby warm and dry
- Resuscitation required
  - Clamp and cut cord
  - Move newborn to an area acceptable to provide resuscitation





# Provision of Tactile Stimulation



- If drying and suctioning does not induce respirations, provide additional tactile stimulation
- If the infant remains apneic after a brief period (5 to 10 seconds) of stimulation:
  - Immediately initiate positive-pressure ventilation with a pediatric bag-valve device (40 to 60 ventilations/min)



- Term infants requiring resuscitation
  - Utilize starting gas of 21% (RA)
  - Increase gas as required based on preductal saturations
- In newborns < 35 weeks use 21 - 30%

- Heat loss can be life-threatening to newborns.
- Most heat loss results from evaporation.
- Core temp. can quickly drop 1° C from its original temp

- Observe and evaluate the infant's
  - Respirations
    - Good chest movement
    - Adequate rate and depth (gaspings is ineffective)
  - Heart Rate
    - > 100 bpm
  - Colour
    - Pink lips and trunk

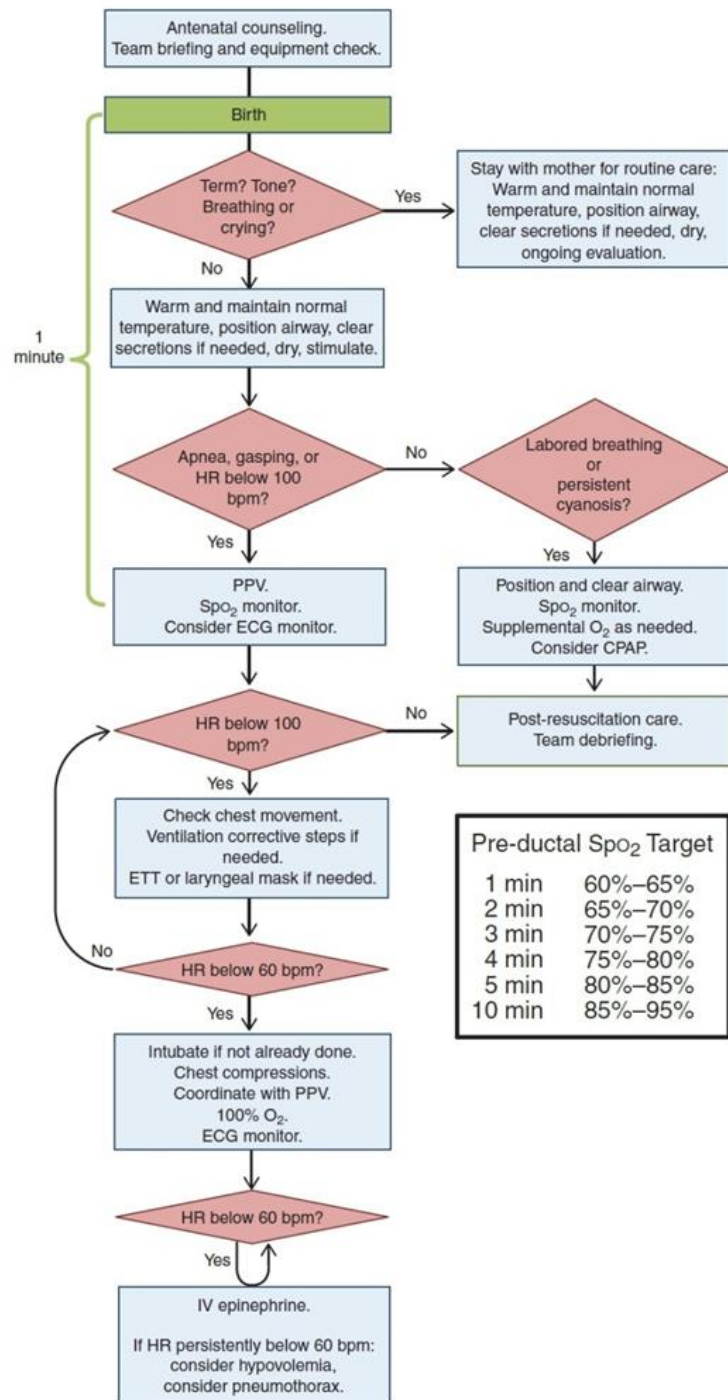
## Central cyanosis



## Acrocyanosis



# NRP Algorithm



Canadian  
Paediatric  
Society

- Positioning the newborn to open the airway

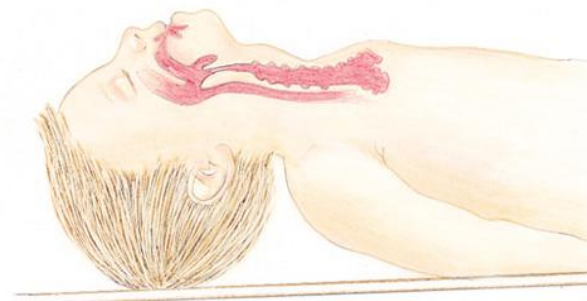
**CORRECT**



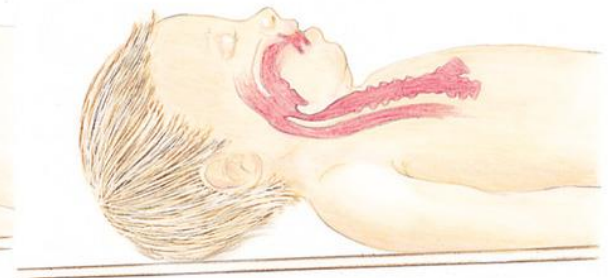
Neck slightly extended

Care should be taken to prevent hyperextension or underextension of the neck since either may decrease air entry.

**INCORRECT**



Neck hyperextended



Neck underextended

- Begin positive pressure ventilation if any of the following is present:
  - Heart rate less than 100
  - Apnea/gasping
  - Persistent central cyanosis
- Ventilation rate of 40 to 60 bpm



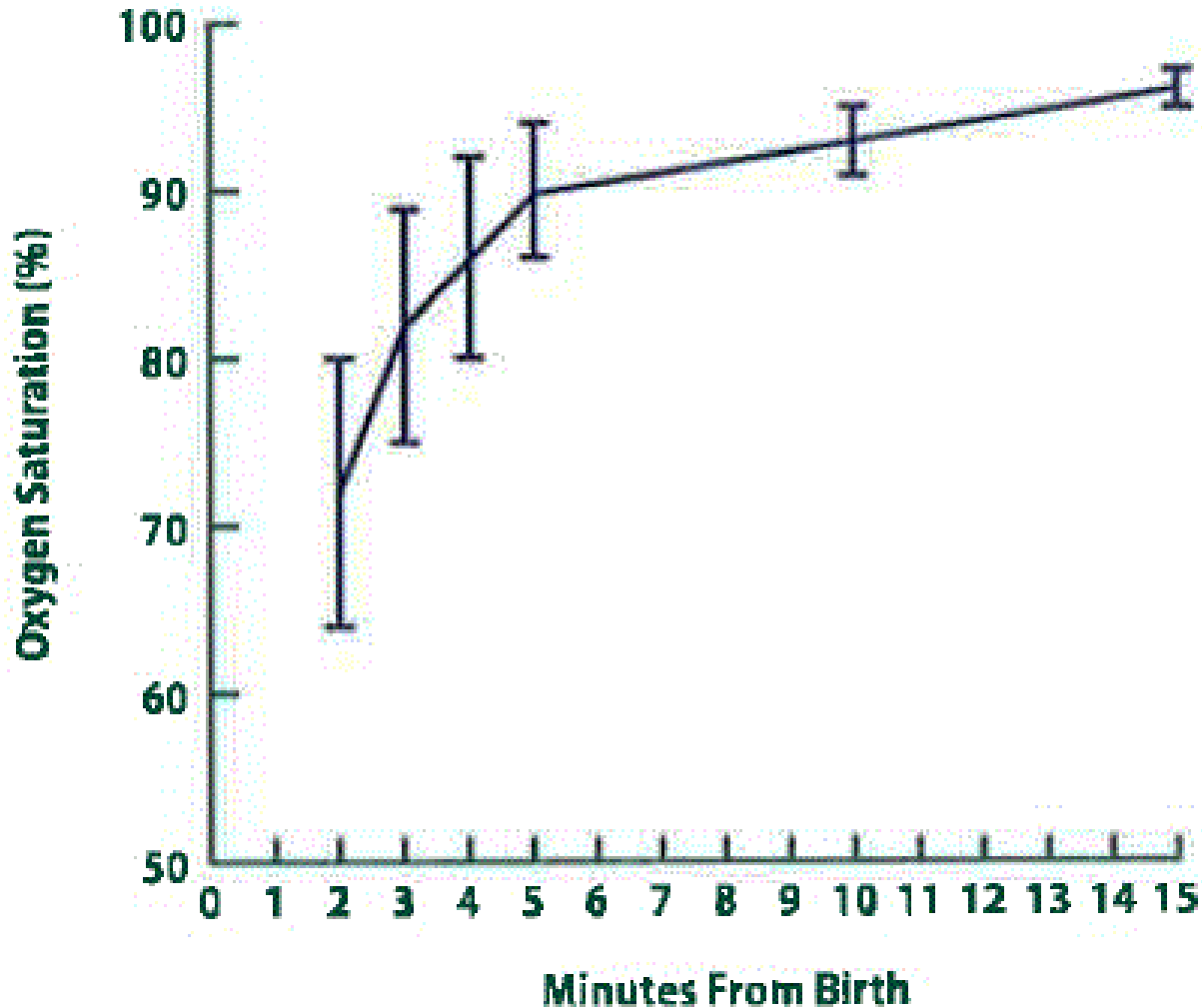


- Babies who require supplemental oxygen require measurement of pre-ductal saturation
- Place probe on right hand or wrist and then plug in to monitor



- Pulse oximetry readings should be used to determine need for free-flow oxygen
- Aim for SpO<sub>2</sub> levels found in normal term newborns
  - Higher mortality rate if resuscitated with 100% O<sub>2</sub>
  - 95% SpO<sub>2</sub> associated with oxidant injury
- If PPV started, use room air (term) or blended oxygen (preterm)
- Increase FiO<sub>2</sub> if no improvement within 90 seconds





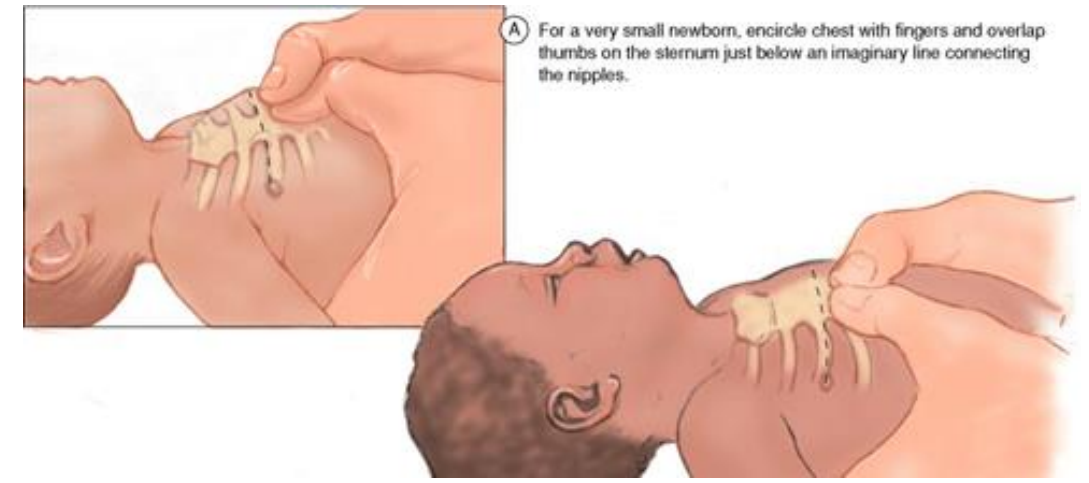
- Normal saturation ranges vary widely
- Initial saturations are as low as 50% at a minute, rising to approximately 90% by 10 minutes of age

Time	Target Preductal SpO <sub>2</sub>
1 min	60 – 65%
2 min	65 – 70%
3 min	70 – 75%
4 min	75 – 80%
5 min	80 – 85%
10 min	85 – 95%

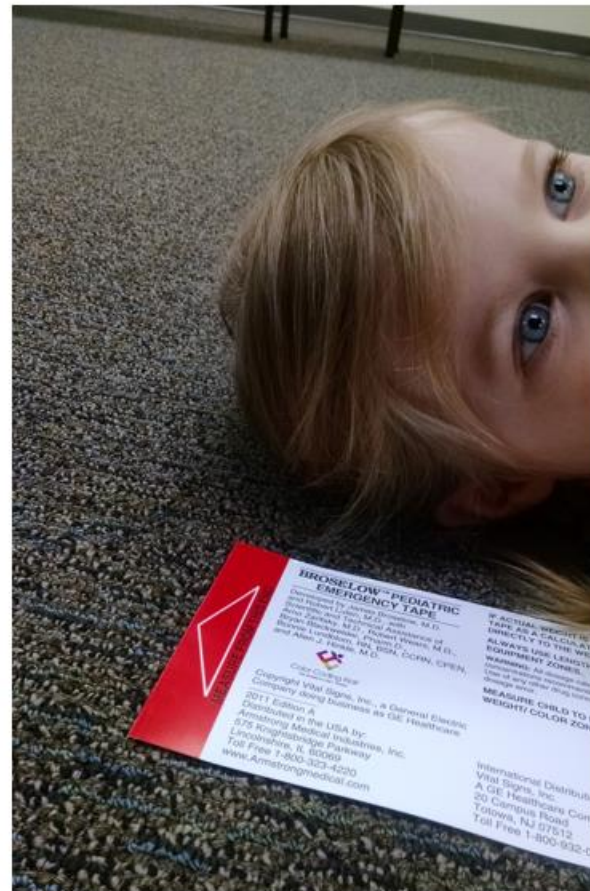


- Ratio of 3:1
  - At least 120 events/minute
  - One cycle of 3:1 should take 2 seconds or less
- Compress 1/3 the diameter of the chest

- Technique
  - Two-thumb (Preferred)
  - Two-finger



- Colour coded tape measure that provides medical instructions including:
  - Medication dosages
  - Size of equipment
  - Defibrillator dose



- Enables rapid evaluation of a newborn's condition at specific intervals after birth
  - Routinely assessed at 1 and 5 minutes of age

Table 40-2 THE APGAR SCORE				
Element	0	1	2	Score
<b>Appearance</b> (skin color)	Body and extremities blue, pale	Body pink, extremities blue	Completely pink	
<b>Pulse rate</b>	Absent	Below 100/min	100/min or above	
<b>Grimace</b> (Irritability)	No response	Grimace	Cough, sneeze, cry	
<b>Activity</b> (Muscle tone)	Limp	Some flexion of extremities	Active motion	
<b>Respiratory effort</b>	Absent	Slow and irregular	Strong cry	
			<b>TOTAL SCORE =</b>	

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# **SPECIAL CIRCUMSTANCES**



- Most effective approach for newborns whose conditions do not continue to improve after resuscitation will depend on the specific clinical presentation:
  - Failure to ventilate
  - Bradycardia or cyanosis
  - Failure to initiate spontaneous respirations

## **Mechanical blockage of airway**

- Meconium or mucus plug
- Choanal atresia
- Airway malformation (e.g. Robin Syndrome)
- Other rare conditions

## **Impaired function**

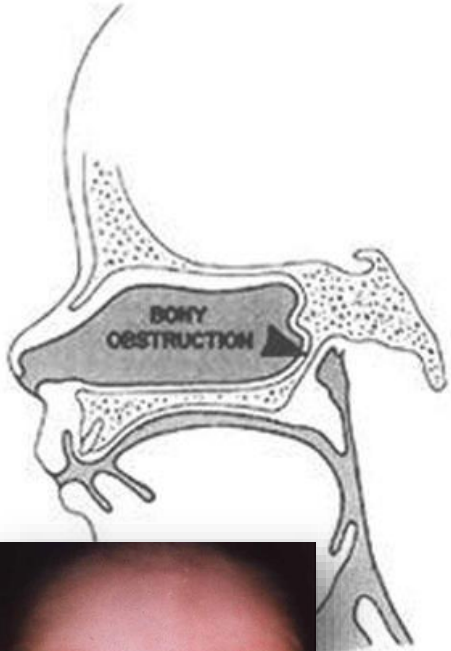
- Pneumothorax
- Congenital pleural effusion
- Congenital diaphragmatic hernia
- Pulmonary hypoplasia
- Extreme prematurity
- Congenital pneumonia

- Choanal atresia

- A bony or membranous occlusion that blocks the passageway between the nose and pharynx
- Can result in serious ventilation problems in the neonate

- Cleft lip

- One or more fissures that originate in the embryo
- A vertical, usually off-center split in the upper lip that may extend up to the nose

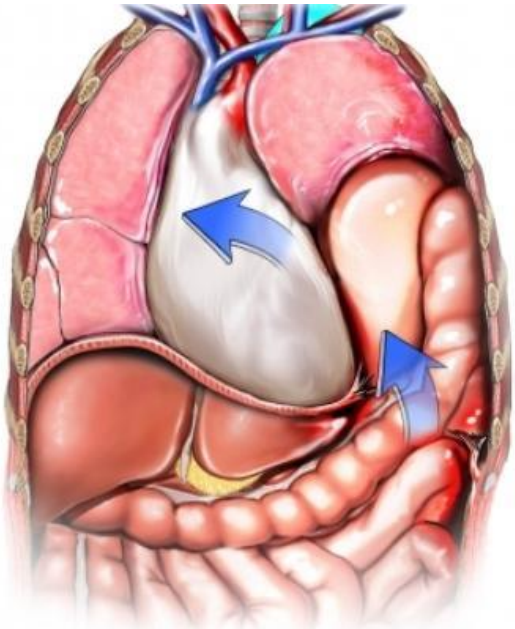




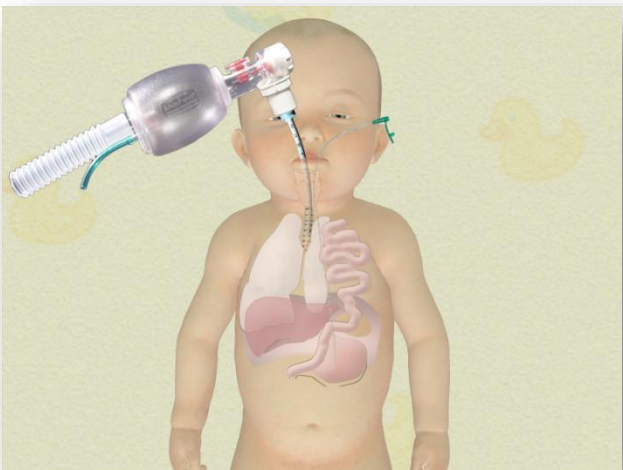
- Cleft palate
  - A fissure in the roof of the mouth that runs along its midline
  - May extend through both the hard and soft palates into the nasal cavities
- Robin syndrome
  - Cleft soft palate
  - High-arched palate
  - Jaw that is very small with small (receding) chin
  - Jaw that is far back in the throat
  - Small opening in the roof of the mouth
  - Teeth that appear when the baby is born (natal teeth)
  - Tongue that is large compared to the jaw



- Can be caused by the delivery process or by over aggressive ventilation pressures during resuscitation
- Increase your suspicion of pneumothorax in a baby who has received positive-pressure ventilation, especially if meconium-stained fluid or a lung malformation is present



- Protrusion of a part of the stomach through an opening in the diaphragm
- Risk factors
  - Bag and mask ventilation can worsen condition
- Pathophysiology
  - Abdominal contents are displaced into the thorax
  - Heart may be displaced
  - Respiratory compromise



- Persistent cyanosis and bradycardia are rarely caused by congenital heart disease
- More commonly caused by inadequate ventilation
  - Ensure chest is moving with ventilation
  - Listen for equal bilateral breath sounds
  - Consider congenital heart block or cyanotic heart disease (rare)

- Consider
  - Brain injury (hypoxic ischemic encephalopathy)
  - Severe acidosis
  - Congenital neuromuscular disorder
  - Maternal drug use



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# PREMATURE

- Refers to a baby born before 37 weeks gestation
  - The weight of these newborns is often between 0.6 to 2.2 kg [1.5 to 5 pounds]
- Resuscitation should be attempted if the infant has any signs of life

- Premature infants have an increased risk for:
  - Respiratory depression
  - Hypothermia
  - Head and brain injury
  - Excessive heat loss
  - Vulnerability to hyperoxic injury
  - Immature lungs and diminished respiratory drive
  - Vulnerability to infection
  - Immature brains that are prone to bleeding
  - Small blood volume, increasing the implications of blood loss

- Maintain room temperature around 25-26°C if possible
  - Preheat radiant warmer
  - Use warming pad
- Babies <28 weeks gestation should be immediately placed up to the neck in a food grade polyethylene bag



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# **OTHER ISSUES**

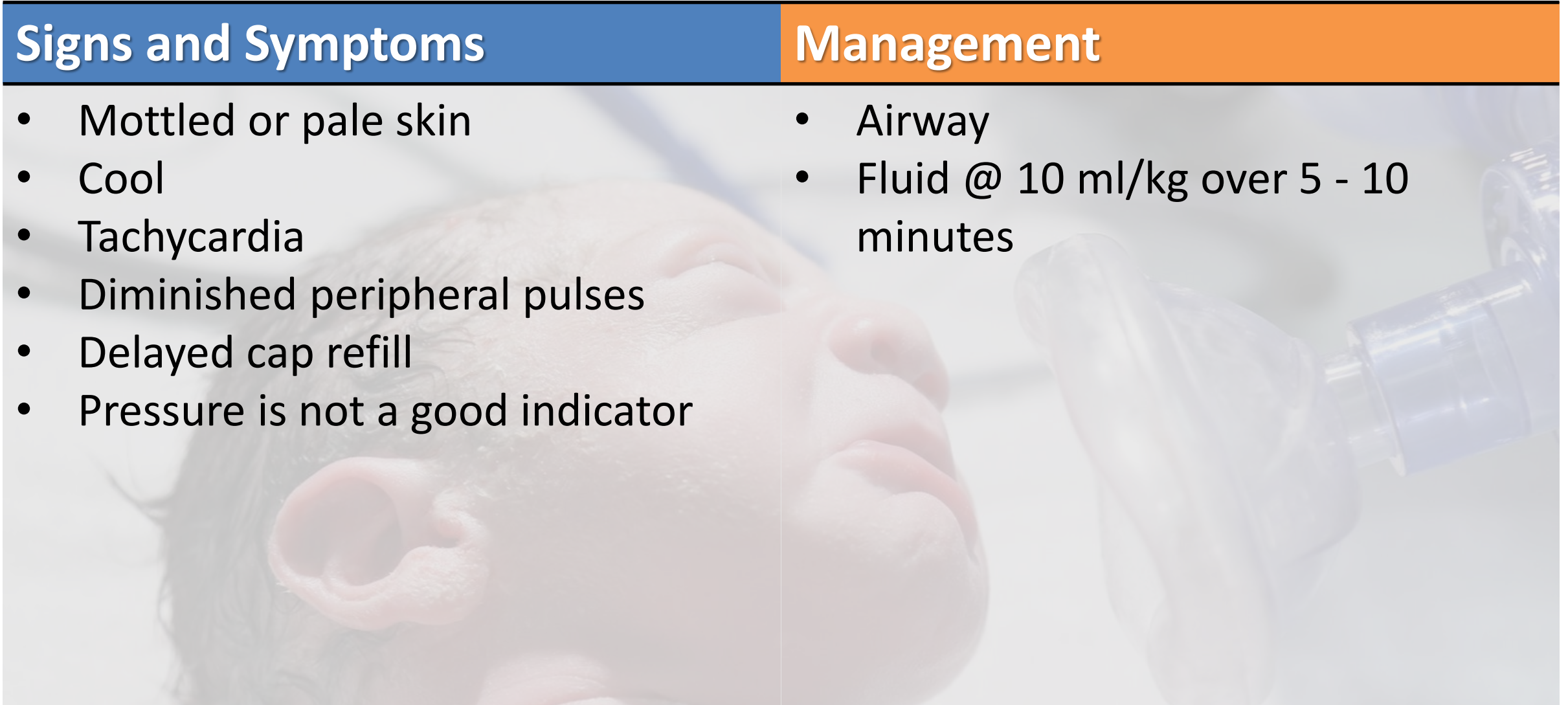
- May result from:
  - Dehydration
  - Hemorrhage
  - Trauma
  - Sepsis
- May be associated with myocardial dysfunction

## Signs and Symptoms

- Mottled or pale skin
- Cool
- Tachycardia
- Diminished peripheral pulses
- Delayed cap refill
- Pressure is not a good indicator

## Management

- Airway
- Fluid @ 10 ml/kg over 5 - 10 minutes



- A blood glucose screening test less than 4 mmol/L indicates hypoglycemia
- Risk factors
  - Asphyxia
  - Toxemia
  - Being smaller twin
  - CNS hemorrhage
  - Sepsis

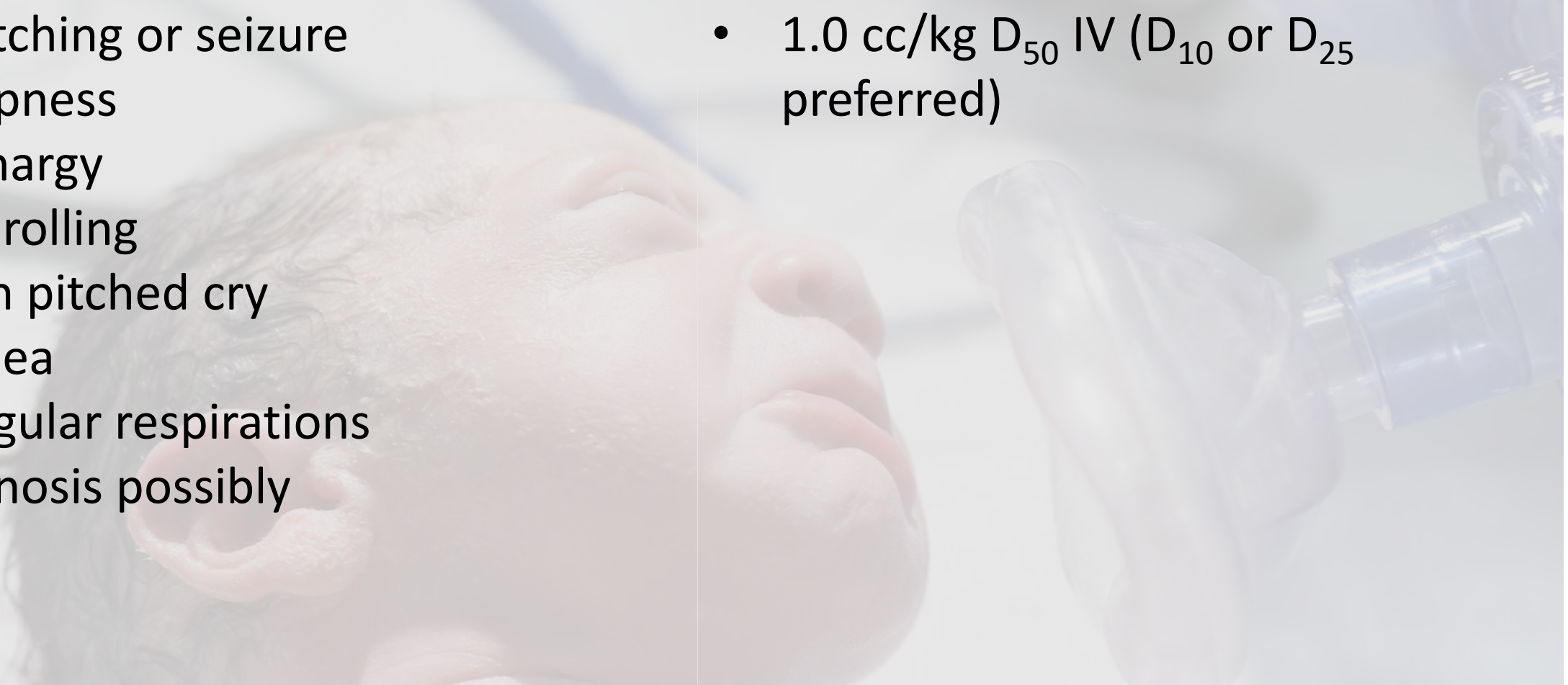


## Signs and Symptoms

- Twitching or seizure
- Limpness
- Lethargy
- Eye rolling
- High pitched cry
- Apnea
- Irregular respirations
- Cyanosis possibly

## Management

- 1.0 cc/kg D<sub>50</sub> IV (D<sub>10</sub> or D<sub>25</sub> preferred)



- 2 - 7 % out of 1000 births results in an injury
- Risk factors include uncontrolled explosive delivery

## Types of injuries seen:

- Cranial injuries
  - Molding of head and overriding of parietal bones
  - Soft tissue from forceps
  - Subconjunctival and retinal hemorrhage
  - Skull fracture
- Intracranial hemorrhage
- Spine or spinal cord injury
- Peripheral nerve damage
- Liver or spleen or kidney
- Clavicle or extremity fracture
- Hypoxia ischemia

## Prehospital care

- Support vital functions
- Rapidly transport to an appropriate medical facility for definitive care

- Be aware of the normal feelings and reactions of parents, siblings, other family members and caregivers while providing emergency care to an ill or injured child
  - These events also are often highly charged and emotional for the EMS crew

- As a rule, emergency responders should:
  - Never discuss the infant’s chances of survival with a parent or family member
  - Not give “false hope” about the infant’s condition
  - Assure the family that everything that can be done for the child is being done
  - Assure the family that their baby will receive the best possible care during transport and while at the emergency department

- During transport of the neonate:
  - Maintain body temperature
  - Oxygen administration
  - Ventilatory support
- In the prehospital phase of care, transport strategies are usually limited to:
  - Providing a warm ambulance
  - Free-flow oxygen administration
  - Warm blankets