MEDAVIE

HealthEd

ÉduSanté

NEONATOLOGY

DND Primary Care Paramedicine

Module: 08

Section: 03

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Lecture Outline

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

Introduction

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

Term Newborn

The Need for Resuscitation

- 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

Neonatal

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

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Neonatology

PHYSIOLOGICAL CHANGES AT BIRTH

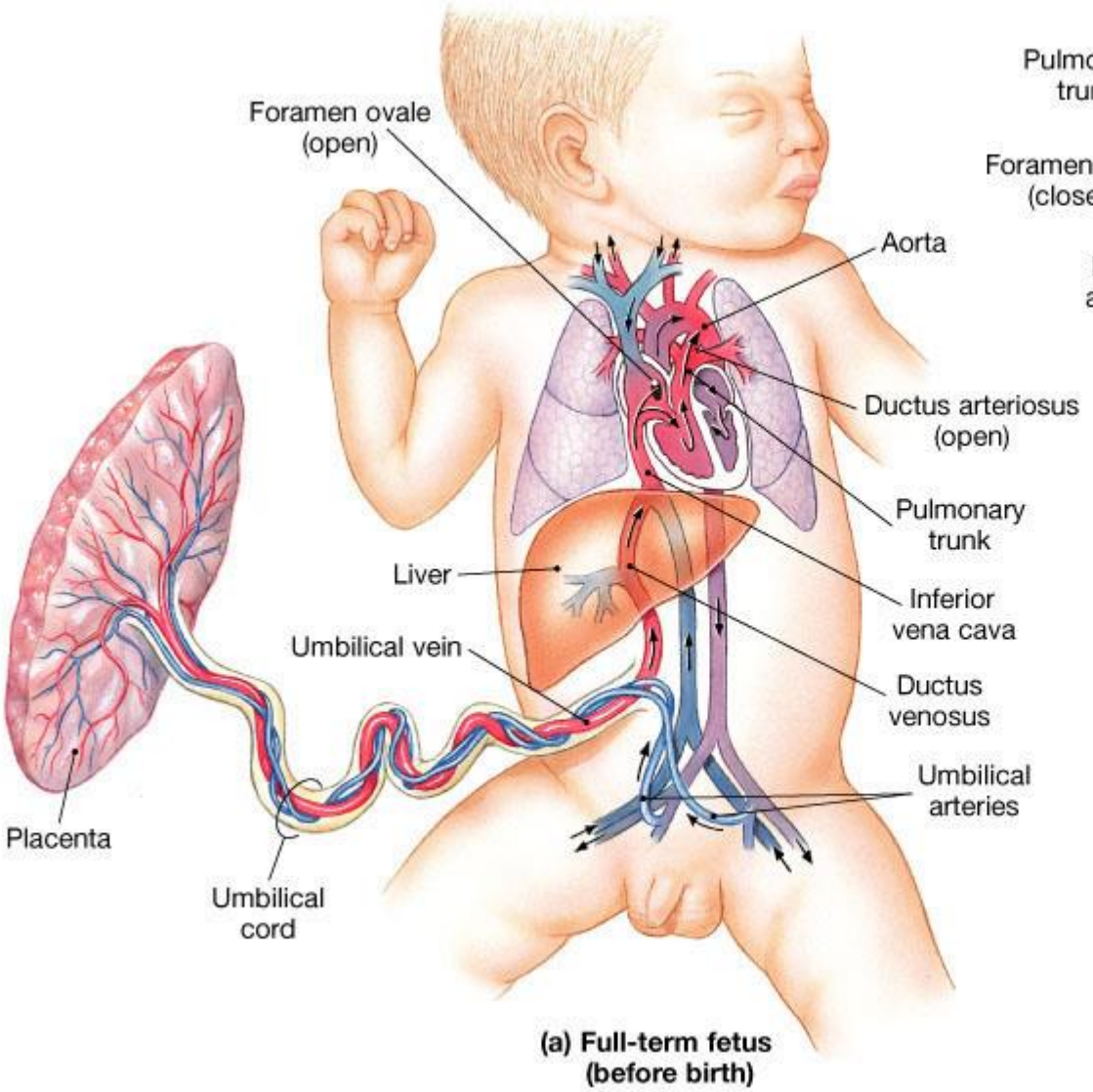
Newborn

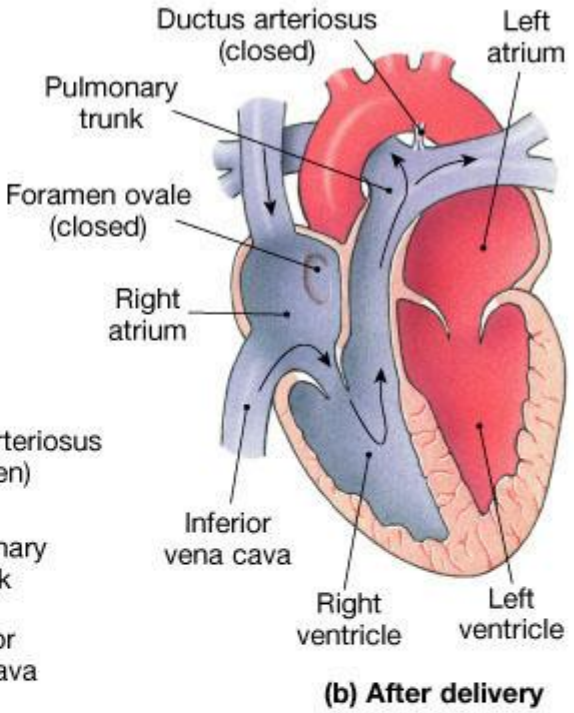
- During the delivery process the newborn must transition from fetal circulation to post-natal circulation
  - Respiratory system must suddenly initiate and maintain oxygenation
  - Infants are very sensitive to hypoxia
  - Permanent brain damage will occur with hypoxemia

Newborn

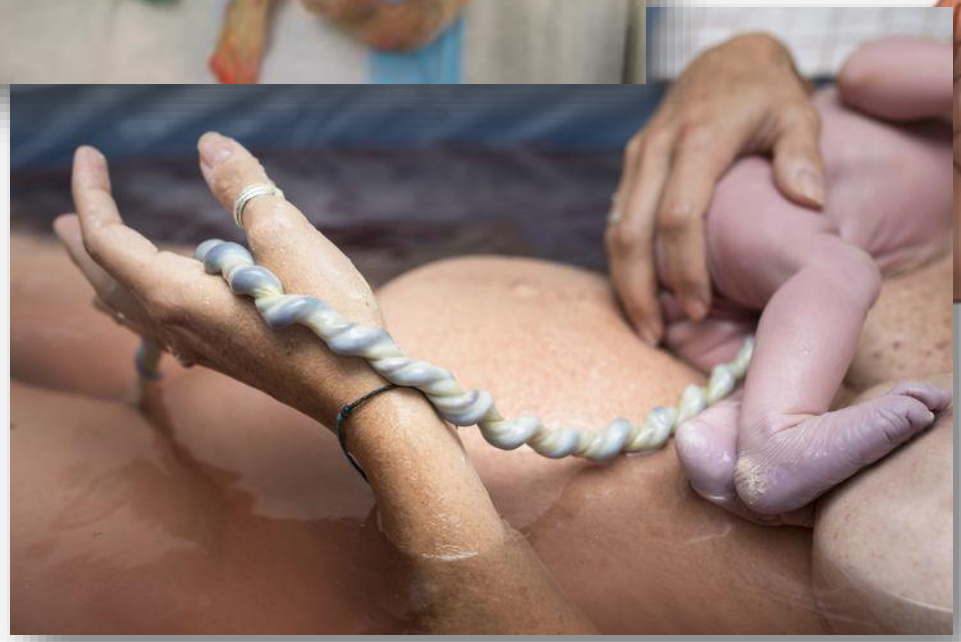
- In utero
  - Dependent on placenta
    - Nutrients and oxygen demands
    - Clearance of waste and metabolites

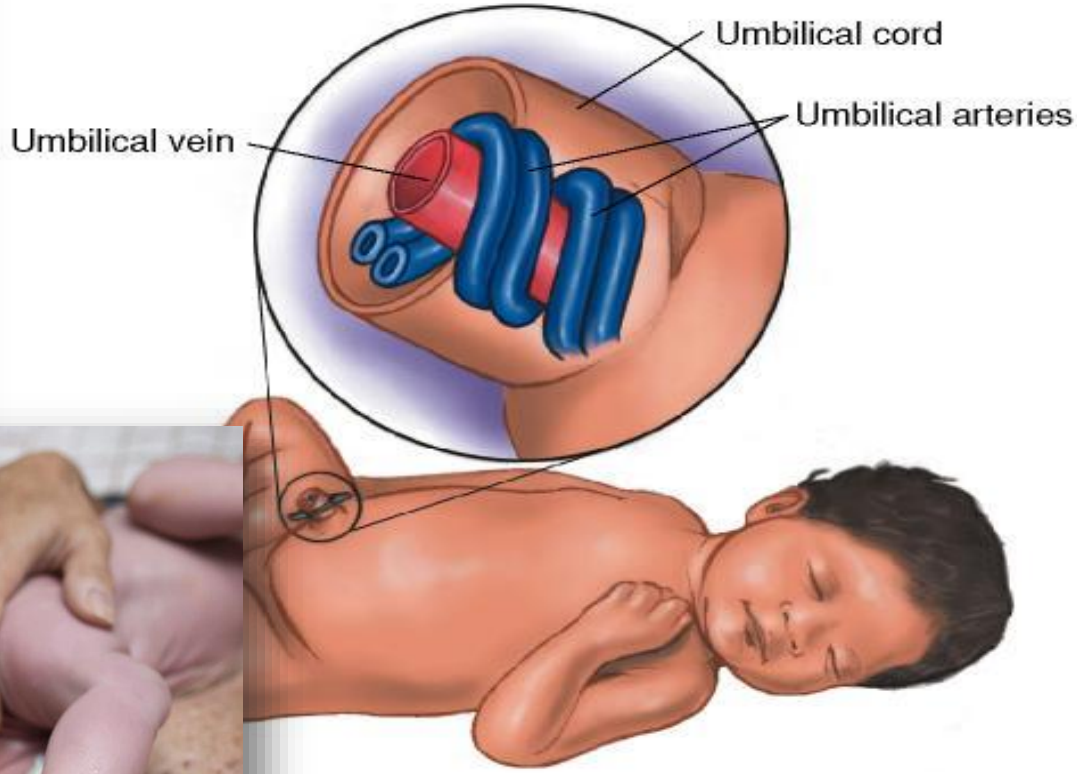
Fetal Circulation





The umbilical cord





Fetal Circulation

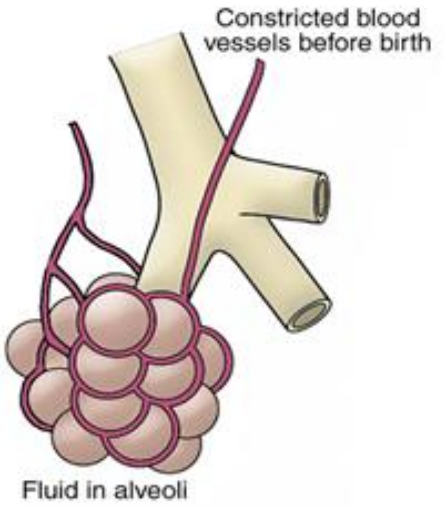
- Umbilical Vein
  - Carries oxygenated blood from the mother
- Umbilical Arteries
  - Two arteries carry deoxygenated blood to placenta
- Foramen Ovale
  - Shunts blood from the right atrium to the left atrium bypassing the right ventricle and the lungs
  - As opposed to the post-natal heart, the fetus'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

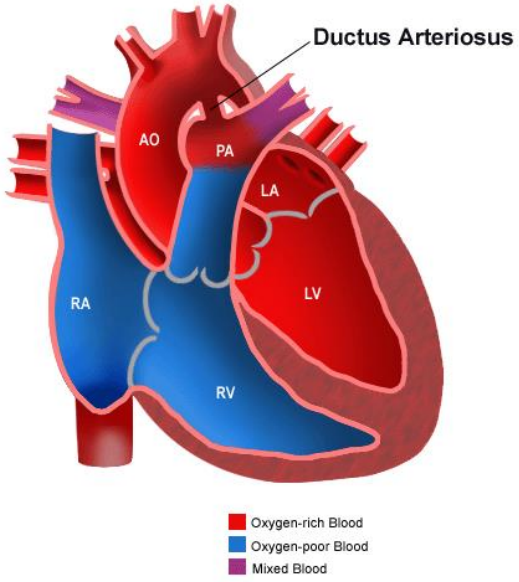
Fetal Circulation

- 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

In Utero

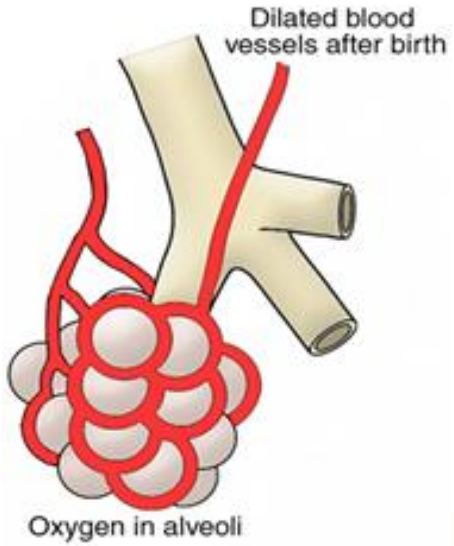
- Alveoli filled with fluid
- Pulmonary arterioles constricted
  - Pulmonary flow decreased
  - Creates relative pulmonary hypertension
  - Blood flow diverted across ductus arteriosus due to path of least resistance

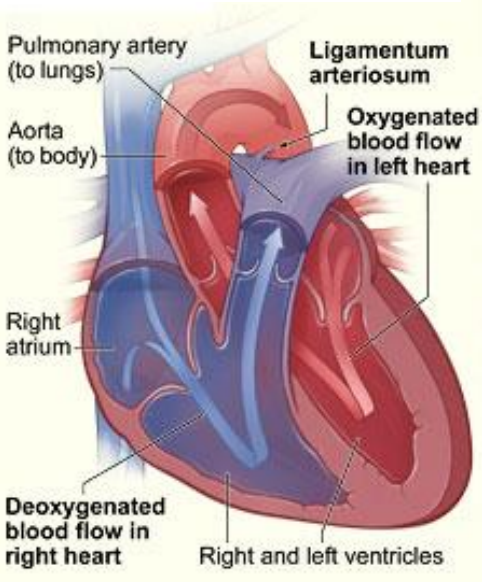




After Delivery

- 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 venous





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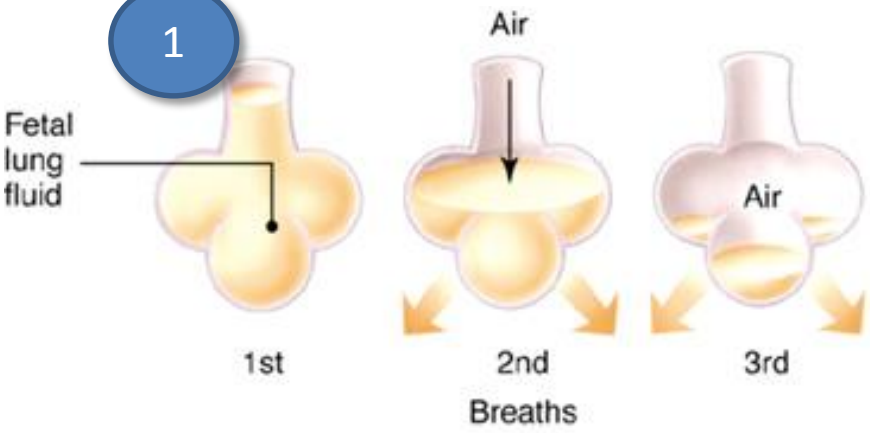
Transition

1



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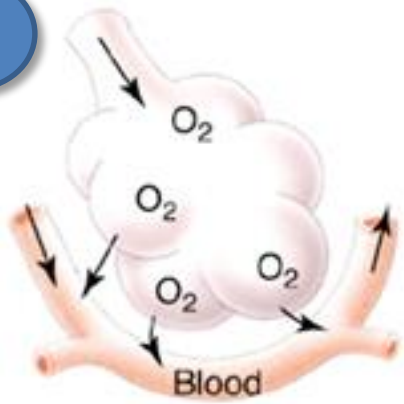

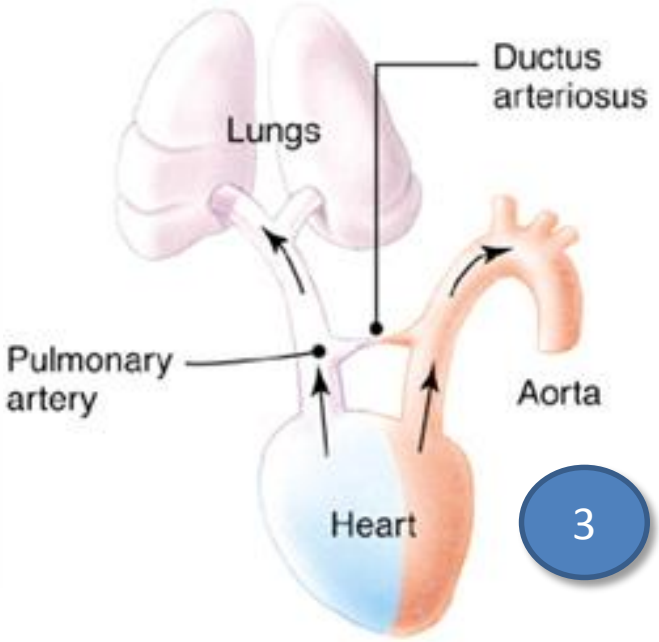

3

Transition Issues

- 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

Apnea

- 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

Hypoxia

- 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

Hypothermia

- 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

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

Antepartum

- 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

Intrapartum

- 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

Assessment

- 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

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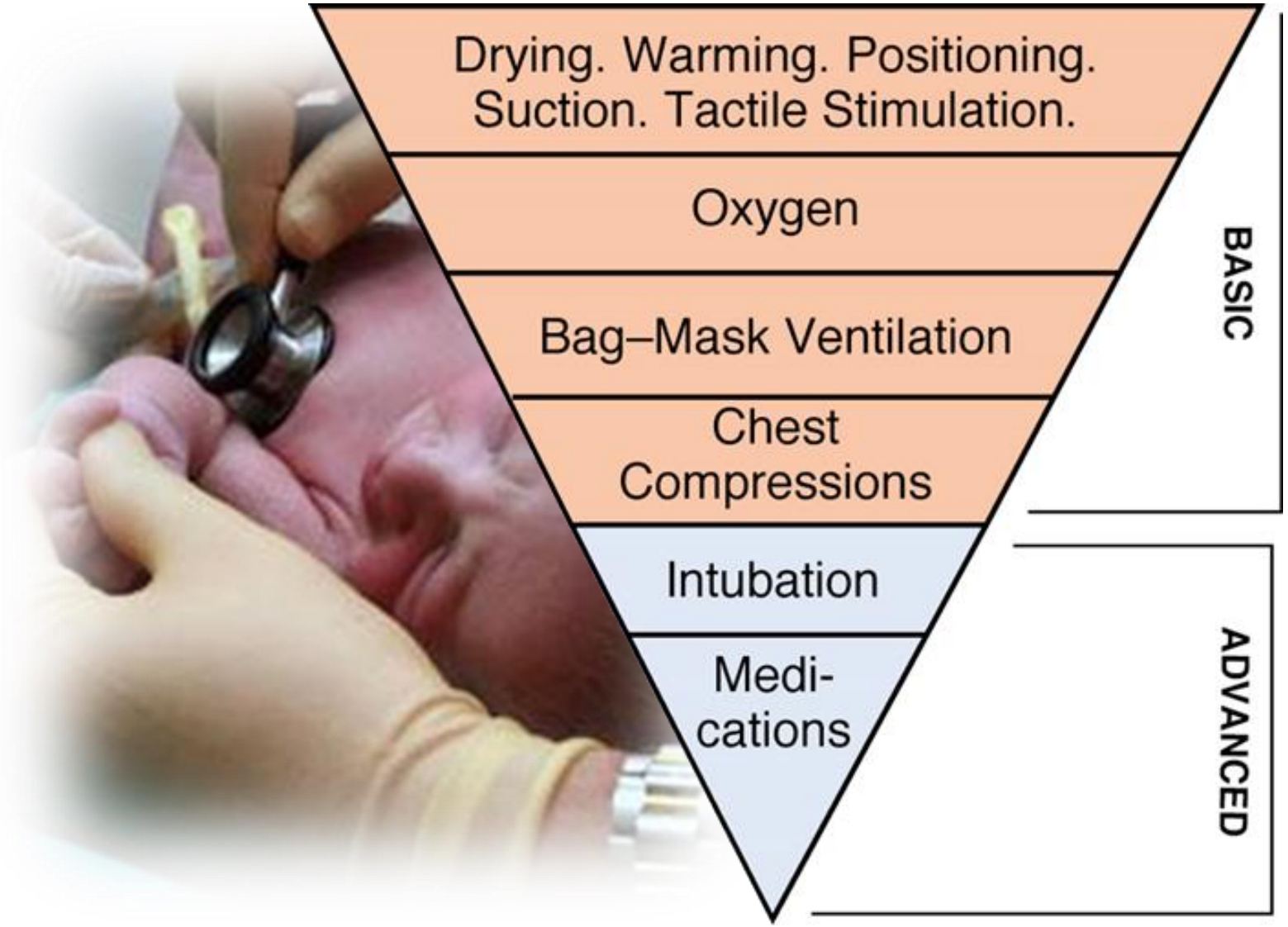
Inverted Pyramid for Resuscitation



Decision Tree

Initial Assessment

- 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

Meconium

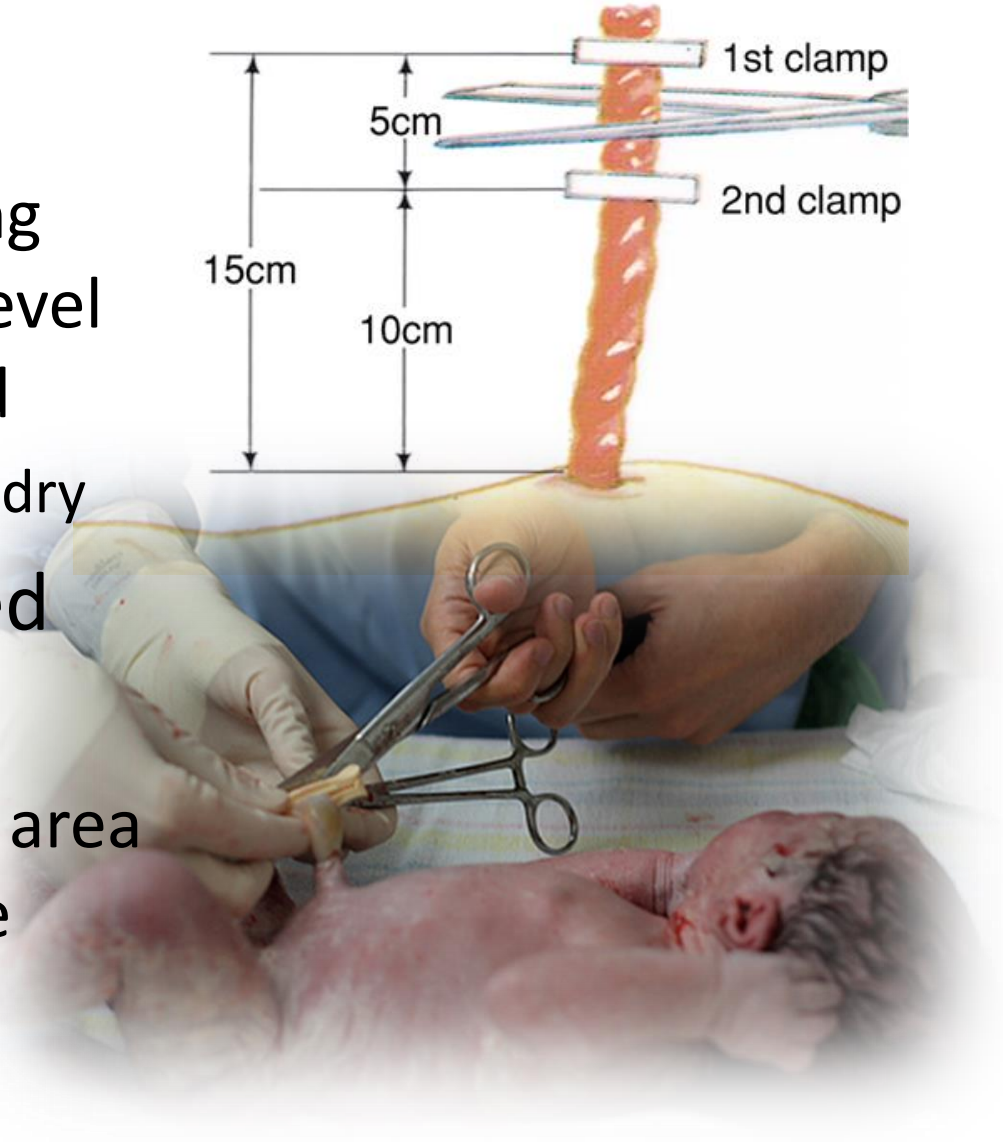
- The presence of fetal stool in amniotic fluid (occurring either in utero or intrapartum)
- May be slightly yellow, light green to a thick “pea soup”
  - Non-vigorous: Suction the baby’s oropharynx as much as possible before proceeding with any other steps
  - Vigorous: Suction the mouth and nose only,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

Clearing the Airway

- 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

Cord

- 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)

Oxygenation

- 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%

Prevention of Heat Loss

- 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

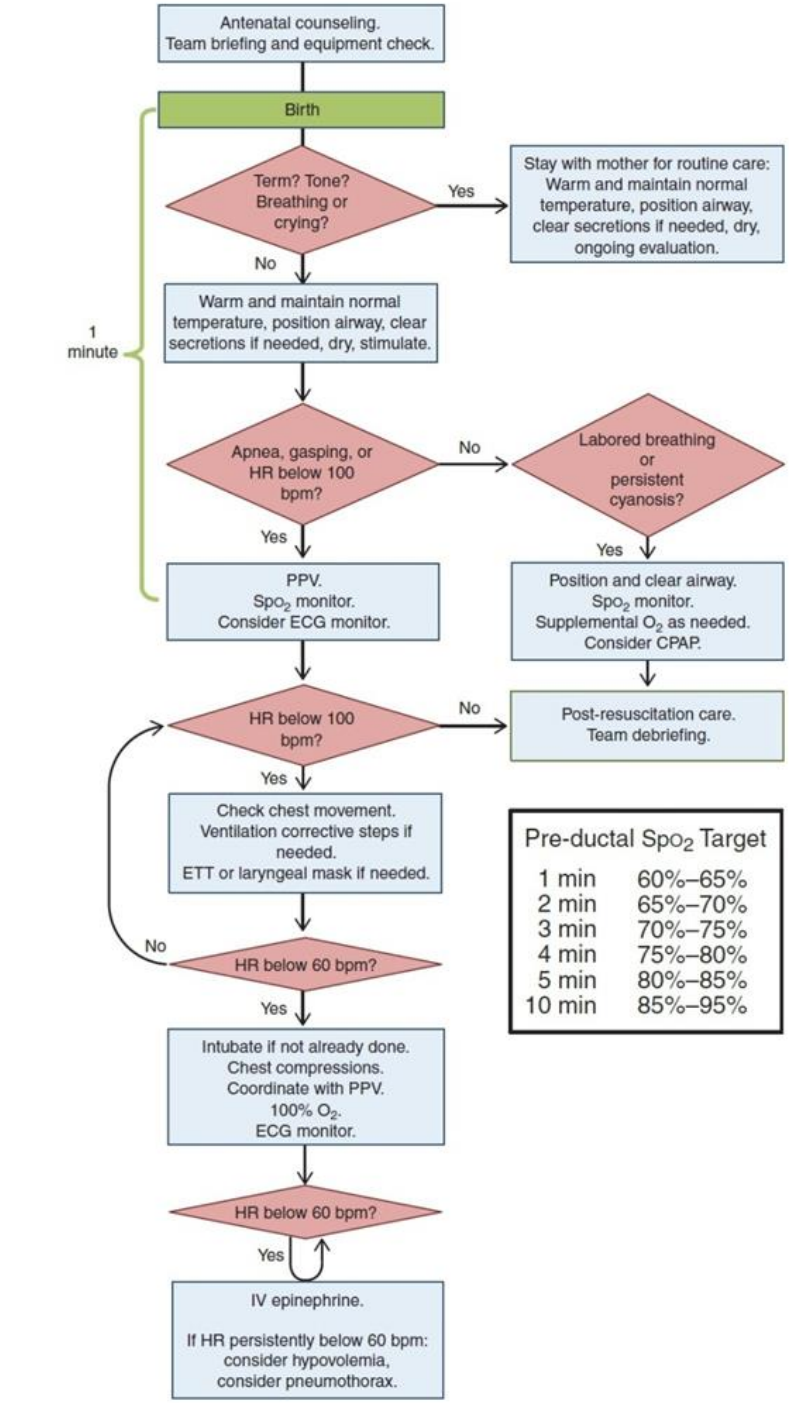
Evaluation of the Infant

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

Cyanosis

- Central cyanosis
- Acrocyanosis

NRP Algorithm



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Airway

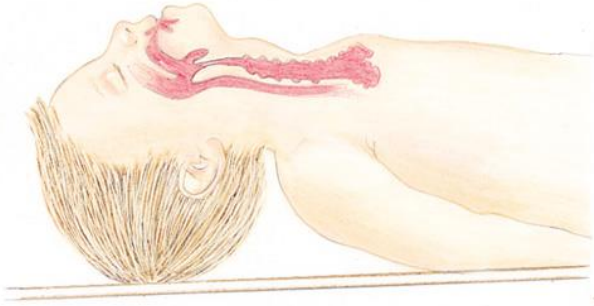
- Positioning the newborn to open the airway

CORRECT

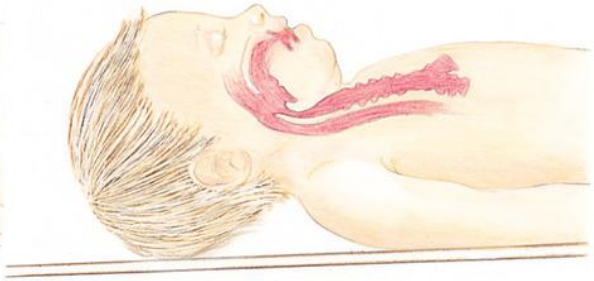
Neck slightly extended

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

INCORRECT



Neck hyperextended



Neck underextended

Airway

- 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

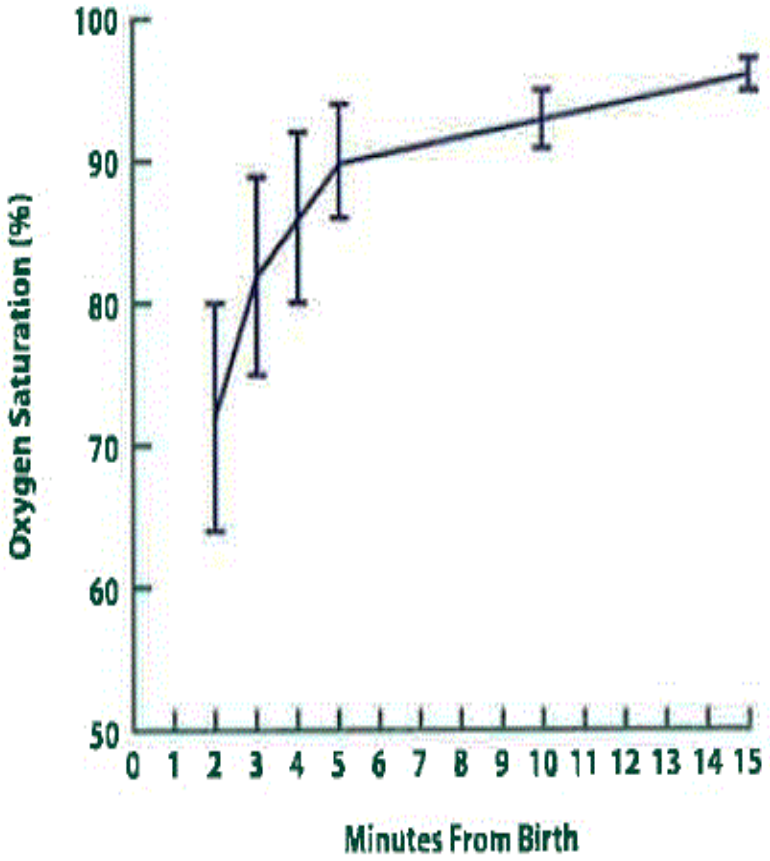
Saturation Monitoring

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

Supplemental Oxygen

- Pulse oximetry readings should be used to determine need for free-flow oxygen
- Aim for SpO_2 levels found in normal term newborns
  - Higher mortality rate if resuscitated with 100% O_2
  - 95% SpO_2 associated with oxidant injury
- If PPV started, use room air (term) or blended oxygen (preterm)
- Increase FiO_2 if no improvement within 90 seconds

Normal Saturations



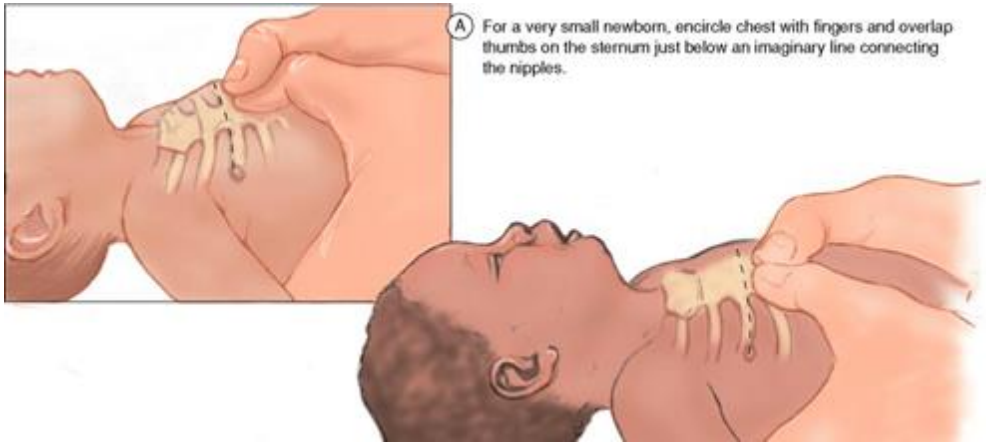
- Normal saturation ranges vary widely
- Initial saturations are as low as 50% at a minute, rising to approximately 90% by 10 minutes of age

Supplemental Oxygen

Time	Target Preductal SpO_2
1 min	60 – 65%
2 min	65 – 70%
3 min	70 – 75%
4 min	75 – 80%
5 min	80 – 85%
10 min	85 – 95%

Chest Compressions

- Ratio of 3:1
  - At least 120 events/minute
  - One cycle of 3:1 should take 2 seconds or less
- Technique
  - Two-thumb (Preferred)
  - Two-finger
- Compress 1/3 the diameter of the chest



Broselow Tape

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

Apgar Score

- 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
Appearance (skin color)	Body and extremities blue, pale	Body pink, extremities blue	Completely pink	
Pulse rate	Absent	Below 100/min	100/min or above	
Grimace (Irritability)	No response	Grimace	Cough, sneeze, cry	
Activity (Muscle tone)	Limp	Some flexion of extremities	Active motion	
Respiratory effort	Absent	Slow and irregular	Strong cry	
			TOTAL SCORE =	

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SPECIAL CIRCUMSTANCES

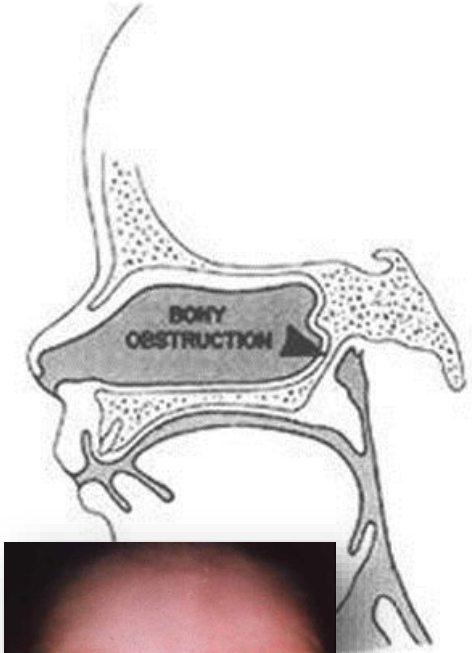
No Improvement

- 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

Failure to Ventilate

- 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

Congenital Anomalies



- 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

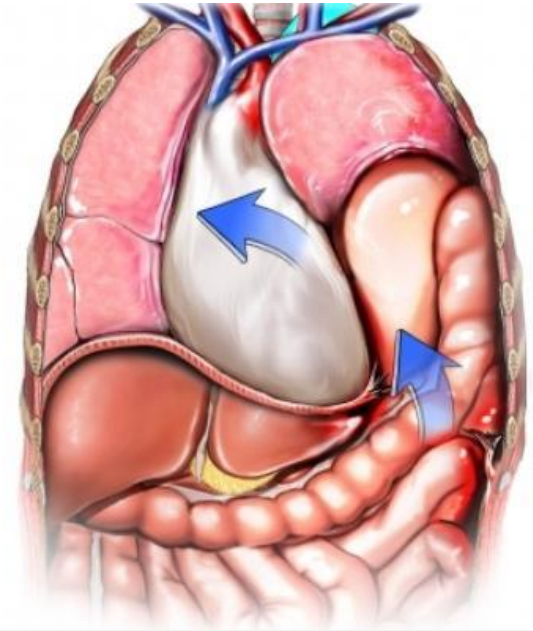
Congenital Anomalies

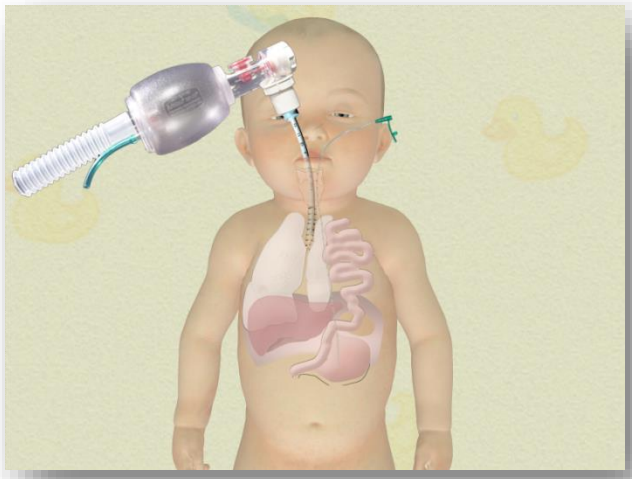
- Cleft palate
  - A fissure in the roof of the mouth that runs along its midline
  - May extend through both the hard and soft palates into the nasal cavities
- Robin syndrome
  - Cleft soft palate
  - High-arched palate
  - Jaw that is very small with small (receding) chin
  - Jaw that is far back 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

Pneumothorax

- 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

Diaphragmatic Hernia





- 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

Cyanosis or Bradycardia

- 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)

Failure to Spontaneously Breath

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

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PREMATURE

The Premature Infant

- 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

Risk Factors

- 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

Warmth

- 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

Neonatology

OTHER ISSUES

Hypovolemia

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

Hypovolemia

- Signs and symptoms
  - Mottled or pale skin
  - Cool
  - Tachycardia
  - Diminished peripheral pulses
  - Delayed cap refill
  - Pressure is not a good indicator
- Prehospital care
  - Airway
  - Fluid @ 10 ml/kg over 5 - 10 minutes

Hypoglycemia

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

Hypoglycemia

- S/S
  - Twitching or seizure
  - Limpness
  - Lethargy
  - Eye rolling
  - High pitched cry
  - Apnea
  - Irregular respirations
  - Cyanosis possibly
- Treatment
  - 1.0 cc/kg D_{50} IV (D_{10} or D_{25} preferred)

Common Birth Injuries

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

Common Birth Injuries

- 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

Psychological and Emotional Support

- 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

Psychological and Emotional Support

- 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

Neonatal Transport

- 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