Newborn Transition to Extra-Uterine Life

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OBJECTIVES:
✓ Understand fetal circulation and circulatory adjustments post delivery
✓ Describe pulmonary adaptation of the newborn at birth
✓ Discuss other adaptations the newborn makes upon delivery
✓ Recognize maternal and newborn risk factors that may impact the newborn’s transitional period

Review PLACENTAL Function
✓ Exchanges O2 and CO2 by simple diffusion
✓ Eliminates waste products
✓ Does the work of the lungs in utero
✓ Uterine venous blood has
  PCO2=38 mmHg
  PO2=40-50 mmHg
  pH=7.36
Review: Fetal Circulation

- One Umbilical Vein - oxygenated blood
- Two Umbilical Arteries - deoxygenated blood
- Three Fetal Shunts...
  - Ductus Venosus - hepatic system
  - Foramen Ovale - between right & left atrium
  - Ductus Arteriosus - vein connects pulmonary artery to descending aorta

TRANSITION BEGINS BEFORE DELIVERY

- The infant prepares by...
  - Fetal breathing (producing surfactant at 34 weeks)
  - Storing glycogen in the liver
  - Producing catecholamines
  - Depositing brown fat
What Happens at CORD CLAMP??
- Placenta no longer works as lungs
- Lungs begin to exchange gases
- First breath inflates lungs and causes circulatory changes
- Lungs inflate - decreased pulmonary vascular resistance, increases blood flow through lungs & blood flow from pulmonary arteries
- This results in Newborn Circulation

Adaptation to extra-uterine life
- Profound physiologic adaptation
- Shift from maternal dependent oxygenation to continuous respiration
- Change from fetal circulation to mature circulation:
  - Increase in pulmonary blood flow
  - Loss of left-to-right shunting
- Commencement of independent glucose homeostasis
- Independent thermoregulation
- Oral feedings
- Physiologic adaptation is considered complete when vital signs, feeding and renal function are normal
Respiratory Adaptation:
MECHANICAL STIMULI

- Compression of neonatal chest during delivery
- Expulsion of fetal lung fluid
- Air is drawn into fetal lungs as thorax recoils (negative pressure) and air fills the alveoli
- As baby cries intrathoracic positive pressure keeps alveoli open.

Respiratory Adaptation: Chemical stimuli

- Stress of delivery can lead to mild hypoxia, increased CO2 and acidosis
- Chemoreceptors tell medulla to trigger respirations
- Surfactant production increases lung compliance, elasticity
- Catecholamines increase due to the stress of labor:
  - Improves lung compliance in hours following delivery
  - Clears the lungs by decreasing lung fluid secretion and increases absorption through the lymphatics
  - Releases surfactant into the lungs
  - (A neonate with a scheduled C-Section may not get this “labor stress” benefit)

Thermal Stimuli

- Sudden cold compared to uterine environment
- Skin receptors send impulses to respiratory center
Sensory stimuli

- Tactile stimulation of the neonate through normal handling and drying after delivery...

Cardiovascular Adaptation

- Increase pressure in left heart w/ increased systemic resistance associated with the physiologic changes associated with lung inflation
- With neonatal respiration, oxygenated blood enters the pulmonary musculature leading to dilation of the pulmonary artery and decreases the pulmonary vascular resistance
- Transition to newborn circulation, involves 3 fetal shunts:
  - 1. Ductus venosus
  - 2. Foramen ovale
  - 3. Ductus arteriosis

Ductus Venosus

- Absence of venous return leads to closure
- Functionally closes within 2-3 days
FORAMEN OVALE

- The foramen ovale is a normal cardiac structure found in all newborns and can be best described as a “door” between the right and left atria.
- Decreased PVR
- Decreased pressure in RA/RV
- Increased SVR
- Increased pressure in LA/LV
- Leads to closure within minutes
- Usually seals by 1st month of life

DUCTUS ARTERIOSUS

- Fully functioning lungs
- More efficient oxygenation
- Increased PaO2 & prostaglandins help constrict ductus
- Usually closes within hours

CardioVascular adaptation after birth

- Fetal Circulation
- Transitional Circulation
- Neonatal Circulation
Immediate care of newborn after delivery
✓ Ensure that there is a qualified person present that is trained & skilled in newborn resuscitation
✓ Ensure the availability of necessary equipment
✓ Stimulate while drying the infant
✓ Ensure thermoregulation
✓ Follow NRP guidelines
✓ Can take a newborn up to 12 hours to transition from intra to extra-uterine life

APGAR SCORE
✓ Provides rapid assessment of newborn's physiologic state & adjustment to extra-uterine life
✓ Standardized approach to determine who may need immediate intervention

- 1952: Dr. Virginia Apgar

Evaluations are made at 1 and 5 minutes
✓ Based on (5) Signs
✓ If score is below (7) it is repeated every 5 minutes up to 20 minutes of life as needed.
Thermoregulation

- Balance between heat loss and heat production
- Heat regulation is critical to newborn transition
- Hypothermia from excessive heat loss is common because newborns have a large surface area to body weight, limited body fat, limited ability to shiver.
- PROMOTE SKIN TO SKIN...

Newborns attempt to stay warm by:

- Increasing muscle activity
- Burning brown fat
- Peripheral vasoconstriction

Convection, Radiation, Evaporation, Conduction
COLD STRESS

- Excessive heat loss through evaporation, convection, conduction, and radiation
- Oxygen consumption increases, pulmonary and peripheral vasoconstriction occur, decreased oxygen uptake by lungs to oxygenate tissue, glycolysis increases, decrease in PO2 and pH, leading to metabolic acidosis, hypoxia, and shock

Signs and Symptoms
- Cool extremities
- Lethargy
- Apnea/Tachypnea
- Poor feeding
- Grunting/Flaring/Refractions
- Hypoglycemia

Tips to prevent cold stress
- Use radiant warmer
- Encourage mother to snuggle skin-skin with infant
- Keep newborn’s clothing and bedding dry
- Double-wrap newborn and use a cap on head
- Reduce the newborn’s exposure to drafts
- Warm objects that will be in contact with the newborn

Feeding
- Healthy term and near-term neonates should have frequent early feedings on demand.
  - Term: maximum of 4 hours between feeds
  - Pre-term: maximum of 3 hours between feeds
  - Late Preterm: maximum of 3-4 hours as per clinical condition
- Evaluate sucking, swallowing and breathing prior to feeding
- Contraindications to feeding
  - HIV, Maternal drug use, CMV+ mother
Glucose needs and feeding

- Delivery stress: conversion of fats and glycogen to glucose for energy
- At 1-2 hours of age, glucose level falls
- Baseline glucose 30 mins-1 hr. of age
- Goal: Glucose level
  - > 45 ml/dl

Risk factors for hypoglycemia

- Asphyxia
- Cold Stress
- Increased work of breathing
- Sepsis
- Premature or SGA
- Infants of mother with diabetes or gestational diabetics
- LGA babies

Signs & Symptoms

**Table 14.2 Clinical Signs**

<table>
<thead>
<tr>
<th>Respiratory</th>
<th>Tachypnea</th>
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<tbody>
<tr>
<td></td>
<td>Apnea</td>
</tr>
<tr>
<td></td>
<td>Respiratory distress</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>Tachycardia</td>
</tr>
<tr>
<td>Neurologic</td>
<td>Jitteriness</td>
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<tr>
<td></td>
<td>Lethargy</td>
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<tr>
<td></td>
<td>Weak suck</td>
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<td></td>
<td>Temperature instability</td>
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Neonatal Assessment considerations
- Maternal...Medications
- Illness
- Labor and Delivery...
  - Fetal Distress
  - Delivery Complications
  - Type of Delivery
- Resuscitation Measures: NRP DRIVEN

Neonatal Assessment considerations
- Vital Signs
- Measurements
- Gestational Age Assessment
- Head to Toe Exam
- Glucose/Feeding

Respiratory Considerations
- Tachypnea
- Apnea ( > 20 sec)
- Abnormal Sounds:
  - Grunting
  - Stridor
  - Wheezing
  - Crackles/rales
  - Retracting
- Retained Lung Fluid
- Pneumonia
- Infection
- Aspiration- Mec
- Insufficient surfactant
- Pneumothorax
- Cold Stress
Acidosis and hypoxia

- If hypoxia or acidosis are present at birth and/or continue without correction, the vessels can remain constricted, limiting blood flow to the lungs.

Problems that may occur during transition:

- Birth Trauma
- Birth Asphyxia
- Pulmonary
- Cardiovascular
- Hemodynamics
- Metabolic Problems
- Infection
- Congenital Anomalies

Medication considerations:

- 0.5% Erythromycin eye ointment give within 2 hrs. of birth
- Vitamin K (phytonadione) give within 2 hrs. of birth
- Hepatitis B vaccine & Hepatitis B immunoglobulin (HBIG) give within 12 hrs. if mom + or unknown
- Hepatitis B vaccine only at d/c if negative
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References