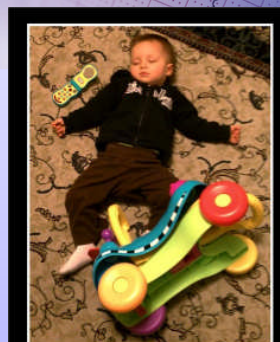


Neonatal Resuscitation and Stabilization



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TEXTING
DANGEROUS EVEN FOR PLAYROOM

Neonatal Resuscitation

Fetal Development

Stage	Gestational Age	Structure Development
Embryonic	5 wk	Bronchi develop and airway branching occurs. Pulmonary veins return to the left atrium.
Pseudoglandular	5-17 wk	Lungs take on a glandular appearance, and there is continual branching of the tracheal bronchial tree (ending at 18-19 wk gestation). Blood vessels and lymphatics begin to form. The diaphragm develops.
Canalicular	13-25 wk	Rich vascular supply develops and capillaries are brought closer to the airways. Primitive respiratory bronchioles begin to form.
Terminal air sac	24-40 wk	Alveoli appear and begin increasing in number. The blood-gas interface develops. Type II alveolar cells appear between 20-25 wk and start producing surfactant between 24-25 wk; however, normal intra-airway concentrations are not reached until approximately 34 wk.
Postnatal	40 wk to 8 y	Thinning of the alveolar sac linings and continued alveolar proliferation occur.

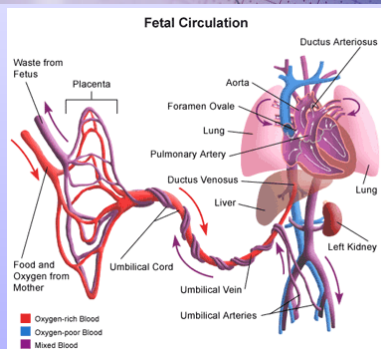
Physiology of Transition

- In utero
 - Lungs are collapsed with a little blood flow
 - Amniotic fluid keeps the lungs compliant
 - Gas exchange occurs at the placenta
 - Pulmonary vascular resistance higher
 - Systemic vascular resistance is low
 - Breathing is practiced

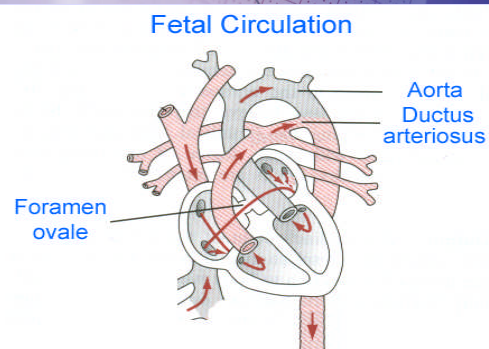
Physiology of Transition

- At Delivery
 - Pulmonary vascular resistance falls by 8-10 times
 - Increase in pulmonary blood flow
 - Thoracic squeeze removes 25-33% of the fluid from the upper airways
 - Labor may facilitate fluids leaving the lungs through catecholamine release

Fetal Circulation



Fetal Circulation



Fetal Hypoxia

- Can occur in utero
 - Pulmonary blood flow increases
 - BP decreases
 - Respirations
 - Increase initially
 - Gasping
 - Cease
- Primary apnea
 - Responds to stimulation of breathing
- Secondary apnea
 - Needs positive pressure ventilation

Airway

- Clearing the airway
 - Bulb Suction
 - Nose then the mouth
 - Obligate nose breathers
 - Blue when not crying – pink when crying
- Mucous plugs
 - OG/NG suction
 - Size 2X ET Tube

Reasons for Intubation

- Need to protect the airway
 - CNS depression
 - Maternal Narcotics
- Hypoxemia
 - Need for positive pressure
- Increased work of breathing
 - Impending respiratory failure
- Apnea
 - Common in infants

Airway

- ET Tube Selection
 - Weight based
 - < 1000 g – 2.0 ET
 - 1000-1500 g – 2.5 ET
 - 1500 – 2500 g – 3.0 ET
 - 2500 – 3500 g – 3.5 ET
 - >3500 g – 4.0 ET
- Depth – 2 X ET tube size

Pearls

- Airway and oxygenation fundamental to stabilization
- Loss of airway is a common pediatric catastrophe
- Source of high anxiety for providers
- Secure airway is of paramount importance
 - Never start transport with insecure airway
 - Assume deterioration during transport
- Transport environment is inherently uncontrolled

Breathing

- 1st Breath with PPV
 - 40 mm Hg
- Then
 - 20 mm HG
- PEEP
 - 5 mm HG
- When might you have to go higher?
- Pulse Oximetry?
- ETCO₂?

Transient Tachypnea of the Newborn

- TTN or wet lung syndrome
- Near Term infants
- LGA babies > 4 kg
- C-Section
- Breech
- Second Twin
- Maternal Sedation

TTN

- Xray
 - Interlobar fluids
 - Flat Diaphragm
 - Pleural effusions
- Symptoms
 - RR 60 to 140 bpm
 - Grunting
 - Retractions
 - Mild cyanosis
 - Nasal Flaring

TTN

- Maintain ABG's WNL
 - pH - 7.35 - 7.45
 - PaCO₂ – 35 – 45
 - PaO₂ – 50 to 70
- FiO₂ – 35 -40%
- CPAP

Cardiovascular

As the neonate adapts to extrauterine life there are five major areas of change in the circulatory function

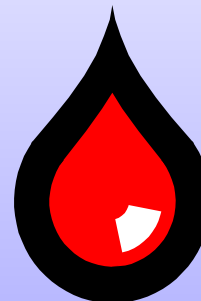
1. Increase aortic pressure and decrease venous pressure
2. Increased systemic pressure and decreased pulmonary artery pressure

Cardiovascular

- 3. Closure of the foramen ovale (over 3-7 days)
 - 4. Closure of the ductus arteriosus (w/in 24hrs.)
 - 5. Closure of the ductus venosus
- Characteristics of cardiac functions are: heart rate, blood pressure, heart murmurs and cardiac workload

Hematologic Adaptations

- Blood volume of the term infant is estimated to be 80-85 ml/Kg of body weight
- Example 3.6Kg (8lbs.) newborn has a blood volume of 290-309ml.



Hematologic Adaptations

Blood volume varies based on the amount of placental transfusion during delivery as well as the following:

- 1. Delayed cord clamping and normal shift of plasma to the extracellular spaces
- 2. Gestational age
- 3. Prenatal and/or perinatal hemorrhage
- 4. The site of the blood sample (peripheral vs central)

Components of Tissue Oxygen Delivery

$$\text{O}_2 \text{ Delivery} = \text{Cardiac Index} \times \text{O}_2 \text{ Content}$$

- Goals**
- Optimize volume
 - Support pump
 - Maximize O₂ saturation
 - Treat anemia

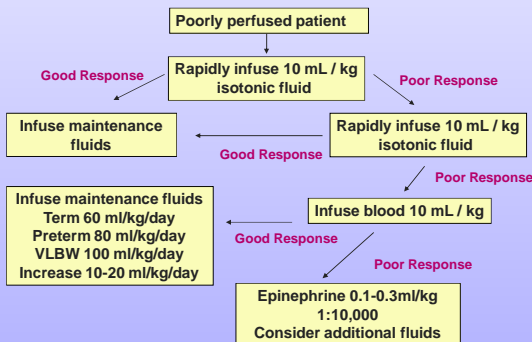
$$(1.34) \times (\text{Hgb}) \times (\text{O}_2 \text{ saturation})$$

Fluid to pump (intravascular volume)
Pump function (contractility)

Principles of Fluid Therapy

- Use isotonic fluids for resuscitation
 - Normal saline
 - Ringer's solution
 - 5% albumin
- Give fluid slowly until response noted
- Do not delay owing to lack of IV access — use intraosseous needle

Fluids and Inotropes



Temperature Regulation



Newborns are homeothermic; they attempt to stabilize their internal (core) body temperatures within a narrow range in spite of temp changes w/in their environment

Thermoregulation

- Heat lost through
 - Evaporation
 - Conduction
 - Convection
- To maintain their temperature
 - Metabolize glucose for energy
 - Byproduct lactic acid
 - Increase respirations
 - Glucose levels fall

Glycemic Control in the Newborn

- Symptoms of hypoglycemia
 - Jitteriness
 - Irritability
 - Lethargy
 - Hypotonia
 - Poor feeding
 - Vomiting
 - Temp instabilities
- Glucose
 - 40-60 mg/dL

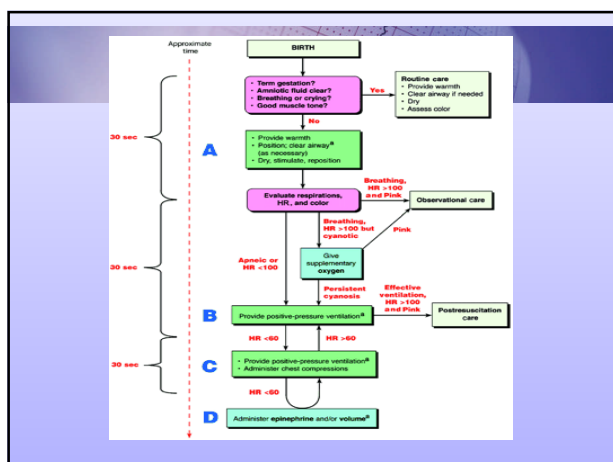
Hypoglycemia Correction

- Respiratory Stabilization
- Temp regulation
- Replace Glucose
 - Slowly
 - Over 750 kg
 - D10 2ml/kg
 - 10 gms glucose in 100 ml
 - Under 750 kg
 - D5 2ml/kg
 - 5 gms glucose in 100ml
 - Recheck every 30 minutes



Neonatal Resuscitation

- Nearly one half of neonatal deaths occur within the first 24 hours
 - Many of these are extremely premature
 - 22-26 weeks
- 10% of all babies born require intervention at birth
- Perinatal asphyxia and prematurity are the top 2 complications that require complex resuscitation



Apgar Scores

- Component
 - Grimace
 - Color
 - Heart rate
 - Tone
 - Respirations
- What do they mean?

Future Considerations

- Animal and Human studies
- Resuscitation with room air
 - 21% oxygen
 - 100% oxygen
- Pulse oximetry
 - Oxygen saturations in utero 30-70%
 - During transition 85% and slowly increase
 - Using pulse oximetry to guide resuscitation

Hepatic Adaptations

In the newborn the liver is frequently palpable 2 to 3 cm below the right costal margin. It is relatively large and occupies about 40% of the abdominal cavity.

Iron is stored in the liver until needed for new red blood cell production as red blood cells are destroyed after birth.

The neonatal liver plays a significant role in iron storage, carbohydrate metabolism, conjugation of bilirubin and coagulation.

Gastrointestinal Adaptation

Adequate maturity of the gastrointestinal tract is achieved by 36 to 38 wks. Gestation with the presence of enzymatic activity and the ability to transport most carbohydrate, fat and protein nutrients across the intestinal membranes

Gastrointestinal Adaptation

- At birth the newborn experiences Swallowing, gastric emptying and intestinal propulsion
- At birth air enters the stomach
- the small intestine is air filled within 12-24 hours
- Large bowel within 24 hours
- salivary glands are immature at birth
- little saliva is manufactured until the infant is about 3 months old
- the newborns stomach has a capacity of 50 to 60ml

Gastrointestinal Adaptation

- The newborn stomach empties intermittently starting with a few minutes of the beginning of a feeding and ending between 2 and 4 hours after feeding
- Digestive function: the term neonate has adequate intestinal and pancreatic enzymes to digest most simple carbohydrates, proteins and fats

Gastrointestinal Adaptation

- Gastric pH is neutral to slightly alkaline
- less acidic in about three weeks
- remains less acidic than that of adults for 2-3 months
- the stomach secretes pepsinogen which is necessary for protein digestion and production of hydrochloric acid
- carbohydrates requiring digestion in the newborn are usually lactose, maltose sucrose

Urinary Adaptations

- Many infants void immediately after birth
- 93% void by 24hrs. After birth
- 98% void by 48hrs

No void by 48hrs. assess for:

- adequacy of fluids
- assess bladder distention
- Restlessness
- symptoms of pain
- notify MD if indicated

Immunologic Adaptation

Newborns move from the sterile, protected environment of the uterus into a world filled with potential pathogens and antigens that challenge their immature host defense mechanisms



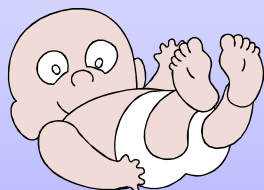
Immune system

- Possess varying degrees of impairment of nonspecific and specific immune responses
- inflammatory response and phagocytosis are altered
- These limitations in the inflammatory response result in failure to recognize, localize and to trace invasive bacteria

Immune system

- Signs and symptoms of infection are often subtle and nonspecific
- the infant has poor hypothalamic response to pyrogens, therefore fever is not a reliable indicator of infections

Immune system



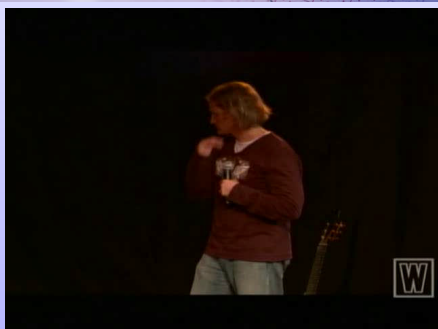
Three major types of immunoglobulins primarily involved in immunity

- IgG
- IgA
- IgM

IgG crosses the placenta

Neonatal Sepsis

- Infected Mother
 - Prolonged ROM
 - GBS +
- Pneumonia/RDS
- Hypo/Hyperglycemia
- Metabolic Acidosis
- Hypothermic
- Poor Feeding



Case Studies

Case One

- Home Delivery
- 33 yr old G1 P0
- Maternal Diabetes in good control
- Fluid clear
- At Birth
 - Ht Rate > 100
 - Respirations – 60
 - Grimace
 - Crying
 - Floppy

Case One

- Priorities?
- Diabetes
- Respiratory Rate
- Floppy
- Support?

Case One

- Within 20 minutes
 - Color - pale
 - Respirations – 72
 - No tone
 - Grunting and Flaring
- Now what?

Case One

- Blood Sugar
 - 34
- Glucose
 - 4ml/kg D25?
- Fluids?
- Outcome
 - Released from NICU to Newborn nursery after serial blood tests and Glucose infusions
 - DC from NICU with BGL 58

Case Two

- 24 yr old, G2 P1
- 36 weeks
- h/o labor for 2 days at home
- Presents with c/o pain and UC's
- SVE 1/th/high
- Membranes intact no bleeding

Case Two

- IV
- Hydration
- EFM

Case Two - Assessment

- T - 98.2, HR - 96, BP 98/60
- EFM
 - Contractions - abdomen rigid and tender without resting tone
 - Fetal HR - 115 BL
- SVE - unchanged
- Pulse ox - 85%
- Color pasty pale with sudden cessation of pain

Case Two - Transport

- IV
- Terbutaline?
- Transport?

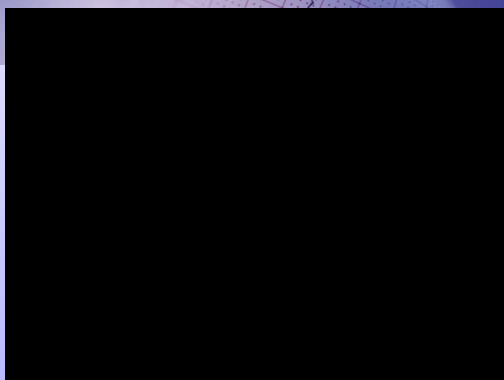
Case Two - Outcome

Baby Comes out of uterus with placenta completely separated from uterus

- Boy Apgars 4 & 6
 - Cord pH arterial 6.65 Base deficit -32
 - Intubated and placed on vent
 - Transferred to NICU
 - Neurology screen for seizures negative
 - DC from vent day 2
 - Feeding well day 5

Case Two - Outcome

- Maternal labs post-op
 - H & H - 6 & 18
 - Platelets - 139
 - Initial DIC screen borderline normal
 - Transfused 2 units PRBC
- DIC is the number one consequence of abruption



Questions?

