Preparing the Neonate For Transport

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Learning Objectives

• Identify risk factors, signs and symptoms and treatment for hypoglycemia
• Discuss physiology of thermal stress, risk factors and methods of prevention and treatment
• Review methods for vascular access and support
• List methods for successful airway stabilization and management
• Discuss causes and initial treatment of the three major types of shock seen in infants: hypovolemic, cardiogenic, and septic shock
• Identify lab work that is useful in the initial management of an ill neonate
• Describe methods to assist families when their infant will be transported

Transport Background

• A significant number of neonates require emergent transfer to a tertiary care center, often because of medical, surgical, or rapidly emerging postpartum problems
• Studies show that shortened inter-facility transport time leads to improved outcomes for the smallest and most critically ill newborns
• Because neonatal transport was required for NICU referral centers, and because pediatric transports to pediatric ICUs (PICUs) were increasing, the American Academy of Pediatrics (AAP) formed a Task Force on Inter-Hospital Transport and subsequently developed guidelines (1986)

Definitions of Preterm

• Preterm: <37 completed weeks
• Late preterm: 34 to 36 weeks
• Moderately preterm: 32 to 36 weeks
• Very preterm: <32 completed weeks

Statistics

• According to the CDC pre-term related deaths account for more than 1/3 of all deaths during the first year of life
• More infants die from preterm causes than any other causes
• 24,000 infants a year and 80 percent of infants born before 27 weeks of gestation will develop respiratory distress syndrome (RDS)

Late Preterm Concerns

• Late-preterm infants are at a greater risk of morbidity and mortality than term infants
• Late-preterm infants are more likely than are term infants to be diagnosed with temperature instability, hypoglycemia, respiratory distress, apnea, jaundice, or feeding difficulties
• During the first month after birth, late-preterm infants are more likely than term infants to be rehospitalized for jaundice, feeding difficulties, dehydration, and suspected sepsis
Risk Factors for the Preterm Infant

- Immature tissues can be damaged by excessive oxygen
- Immature drive to breathe
- Immature lungs and surfactant deficiency
- Fragile capillaries within their brains may rupture
- Weak musculature difficult to breathe effectively
- Large surface area relative to body mass → lose heat quickly
- Immature immune systems → susceptible to infection
- Limited glycogen stores → hypoglycemia

Barriers to Providing Care

- Lack of surfactant
- Size appropriate equipment not available
- Not able to establish secure airway
- Staff that are not trained to resuscitate a preterm/term infant
- Significant transport time and/or distance to tertiary care
- Care giver inexperience

The STABLE Program

- S - Sugar and Safe Care
- T - Temperature
- A - Airway
- B - Blood Pressure
- L - Lab Work
- E - Emotional Support

Safety

- The goal is to successfully stabilize the infant prior to transport
  - Coordinated, timely, organized and consistent
  - Reduces the possibility of adverse events which may lead to a poor outcome
- Patients deserve and expect quality care
- Minimize preventable events
- Freedom from accidental injury
- If possible transport the mother prior to delivery

Sugar

- Sick infants should not be fed prior to transport
- Establish IV access quickly
  - Peripheral IV
  - UVC
- Provide glucose: (5-8 mg/kg/minute) (100 ml/kg/day = 7 mg/kg/minute) Note: Less for LBW/ELBW
  - Primary fuel
  - Infant brain needs a steady supply to function
  - Target Accuchek to at least 45 and 50 is ideal

Signs of Hypoglycemia

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Autonomic Nervous System Manifestations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypotonia, lethargy, apathy</td>
<td>Anxiety, tremulousness</td>
</tr>
<tr>
<td>Poor feeding</td>
<td>Diaphoresis</td>
</tr>
<tr>
<td>Jitteriness, seizures</td>
<td>Tachycardia</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>Palla</td>
</tr>
<tr>
<td>Cyanosis</td>
<td>Vomiting</td>
</tr>
</tbody>
</table>
An umbilical vein catheter should pass through the umbilical vein into the left portal vein. Then through the ductus venosus into a hepatic vein and the inferior caval vein (IVC). The tip should be positioned in the IVC at the level of the diaphragm.

Umbilical artery catheterization provides direct access to the arterial system and allows accurate measurement of arterial blood pressure, blood sampling and intravascular access for fluids and medications. The catheter should be passed through the umbilical artery and enter the aorta by the internal iliac artery. The typical loop from the umbilicus inferiorly into the internal iliac artery should be demonstrated by the catheter. The high position is advisable since it leads to less vascular complications.

- high position: T6-T9
- low position: L3-L5

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### 3 Primary Factors that Impact Blood Glucose

- Inadequate glycogen stores
- Hyperinsulinemia
- Increased glucose utilization

### Hypoglycemia Risk

- Preterm infants less than 37 weeks gestation
- SGA infants
- LGA infants
- IDDM
- Stressed/sick infants
- Medications given to pregnant women
  - Beta-sympathomimetics
  - Beta-Blockers
  - Chlorpropamide used in diabetic mothers
  - Benzothiazide diuretics
  - Tricyclic antidepressants in the 3rd trimester

### Temperature Stabilization

- Hypothermia is preventable
- Well-documented impact on morbidity and mortality
- Especially dangerous in preterm infants
- Maintenance of normal body temperature MUST BE A PRIORITY in all infants, sick or well

### Mechanisms of Heat Loss

- **Convection.** This is the loss of heat from the newborn's skin to the surrounding air. Newborns lose a lot of heat by convection when exposed to cold air or drafts.
- **Conduction.** This is the loss of heat when the newborn lies on a cold surface. Newborns lose heat by conduction when placed naked on a cold table, weighing scale or are wrapped in a cold blanket or towel.
- **Evaporation.** This is the loss of heat from a newborn's wet skin to the surrounding air. Newborns lose heat by evaporation after delivery or after a bath. Even a newborn in a wet diaper can lose heat by evaporation.
- **Radiation.** This is the loss of heat from a newborn's skin to distant cold objects, such as a cold window or wall etc.
Infants at Greatest Risk

- Premature, low birth-weight infants, especially those less than 1500 g
- SGA
- Prolonged resuscitation, especially if hypoxic
- Acutely ill (infection, cardiac, neurologic, endocrine or surgical issues [especially those with open body wall defects])
- Decreased activity secondary to sedation

Physical Signs of Hypothermia

- Grunting, flaring, retracting
- Mottling and poor peripheral perfusion
- Maybe shivering
- Decreased muscle tone
- Initially flexed body position followed by extension

Prevention of Hypothermia

- Remove wet linens
- Bundle in warm blanket and cover head with a hat
- Naked skin-to-skin with mom, cover with warm blanket
- Keeping the infant clothed
- Turning up the room temperature
- Maintain temperature:
  - Axillary between 36.5°C (97.7°F) and 37.5°C (99.5°F)
  - Rectal between 36.8°C (98.2°F) and 38.0°C (100.3°F)

Additional Interventions

- Pre-warm objects that will come into contact with baby
- Place insulation (warm blanket) between baby and cold surface
- Chemical thermal mattress (cover with a thin surface)
- Use servo control with temp probe

First, Do No Harm

- Do not overheat surfaces
- Do not leave infant on warmer for more than 10” without servo
- Use a temperature controlled blanket warmer
  - Do not use top of warmer or microwave
- Do not heat fluids to surround baby in a microwave. Do not let warmed fluids actually touch infant
- Do not apply heat directly to poorly perfused extremities
**Airway-General Principles**

- Infants with some form of respiratory distress account for the largest number of transports
- Determine the reason for respiratory distress
  - Maternal history
  - Infant history
  - Presenting signs
  - Time of symptom onset
  - PE
  - Lab work
  - X-ray
- Respiratory failure occurs quickly in children
  - Continuous assessment for changes
  - Evaluate the degree of respiratory distress
  - Tailor support to improve symptoms

**Respiratory Support**

- Supplemental oxygen
- Hood
- NC
- CPAP
- Assisted ventilation

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**Treat and Monitor Underlying Conditions**

- Establish airway
- Surfactant
- Pneumothorax
- Arterial access
- Pre and Post Ductal Saturation Monitoring
  - Pre-ductal saturation is monitored on the R hand
  - Pre-ductal ABG from R radial artery
  - Post-ductal saturation is monitored on either foot
  - Post-ductal ABG from a UAC or posterior tibialis artery
  - PGE1 if positive

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**Pneumothorax**

- Place chest tube or Needle aspirate air

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**Endotracheal Intubation**

- Place appropriate size ETT

<table>
<thead>
<tr>
<th>Tube Size</th>
<th>Birthweight</th>
<th>Gestational Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0</td>
<td>&gt; 3 kg</td>
<td>Term</td>
</tr>
<tr>
<td>3.5</td>
<td>2-3 kg</td>
<td>28-34 wks</td>
</tr>
<tr>
<td>3.0</td>
<td>1.5-2 kg</td>
<td>35-36 wks</td>
</tr>
<tr>
<td>2.5</td>
<td>&lt; 1.5 kg</td>
<td>&gt; 36 wks</td>
</tr>
</tbody>
</table>

- Secure
  - Tape
  - Place OG tube
  - Verify placement
  - BS
  - CXR
The tip of an endotracheal tube should lie in between the thoracic aperture and 1 cm above the carina. The tip travels downward if the neck is flexed or upward if the neck is extended. The most common misplacement is in the right mainstem bronchus, because of the shallower angle of the right main branch. Here a good positioned tube is in a patient with a pneumothorax on the left.

**Shock**

- Inadequate organ perfusion and oxygen delivery
- A complex state of circulatory dysfunction resulting in insufficient O2 and nutrient delivery to the tissues
- Failure to promptly recognize and treat this state may lead to multiple organ failure and death
- Treatment is prompt and aggressive

**Hypovolemic**

- Results from low circulating blood volume
- Acute blood loss during the intrapartum period
  - Fetal-maternal hemorrhage
  - Placenta previa or abruption
  - Umbilical cord accident
  - Twin-to-Twin transfusion
  - Organ laceration (liver or spleen)

**Symptoms of Hypovolemia**

- Birth history
- Pallor
- Poor peripheral perfusion
- Tachycardia and Tachypnea
- Respiratory distress
- O2 Sats may be normal—don’t be fooled
- Decreased BP
- Hypothermia

**Principles of Cardiac Output**

- Heart fails as a pump
- Cardiac output (CO) is influenced by heart rate (HR) and stroke volume (SV)
  - HR X SV=CO
- The neonatal myocardium is not very compliant
  - Limited capacity to increase stroke volume
  - In response to shock the infant will attempt to increase CO by increasing HR \( \rightarrow \) tachycardia
Neonatal Cardiac Function - Negative Factors

- Decreased volume of venous return to the heart (preload) = less blood to pump with each contraction
- Increased systemic vascular resistance (afterload) = extra work to pump blood to the body
- Decreased myocardial contractility = heart contraction is inefficient so less blood is ejected with each beat

Symptoms of Cardiogenic Shock

- Poor peripheral perfusion
- Active precordium
- Heart murmur
- Weak pulses
- Cyanosis

Early Onset Infection Risk

- Neonatal sepsis is a blood infection that occurs in an infant younger than 90 days old
- Can be devastating in the neonatal period
- Early-onset sepsis is seen in the first week of life, most often appears within 24 hours of birth
- The baby gets the infection from the mother before or during delivery
- The following increases an infant’s risk of early-onset sepsis:
  - Group B streptococcus infection during pregnancy
  - Premature delivery
  - Water breaking (rupture of membranes) more than 24 hours before birth
  - Infection of the placenta tissues and amniotic fluid (chorioamnionitis)

Top Priority

- Evaluation and treatment is a top priority in the pre-transport period
- Review maternal and infant history
- In any infant who appears sick
  - It is common to begin antibiotics until infection is ruled out
  - Be certain to obtain a CBC and Blood Culture prior to the start of antibiotics

Signs and Symptoms of Sepsis

- Lethargy
- Poor feeding
- Temperature instability
- Hypoglycemia
- Respiratory distress
- Poor peripheral perfusion
- Fussy or very quiet

Assessments

- Capillary refill
  - Press firmly for 5 seconds and release → count how many seconds it takes to refill → compare the upper body to the lower body → if greater than 3 seconds on the upper or lower body → if lower is greater than the upper body → report findings
- HR
  - Apical pulse
  - Off monitor
  - Minimize extremes → bradycardia → tachycardia
- RR and Respiratory Characteristics
Blood Pressure

- Unless the baby has an in-dwelling arterial line, the only reliable and accurate way of measuring blood pressure indirectly is by using the os/Biometric method (eg Dynamap).
- To minimize errors of noninvasive BP measurements, the following guidelines are recommended:
  - Cuff width to arm (or calf) circumference ratio as indicated on cuff
  - BP measurement during quiet or sleep state
  - Obtain average of two or three measurements if making management decisions
  - Use mean BP to monitor changes as less likely to be erroneous
  - Noninvasive BP may overestimate BP measurements in VLBW
- To minimize errors when using in-dwelling arterial lines, the following factors should be noted:
  - Narrow catheters will underestimate systolic BP
  - Occlusion of the tip of the catheter (vessel wall or clot) may dampen wave & underestimate BP
  - Even small air bubbles may have an effect on measurement
  - Peripheral lines read higher than umbilical lines

Lab Tests to Evaluate Shock

- **ABG**-metabolic acidosis is present if the pH and HCO3 are low, if respiratory distress, the PCO2 may also be elevated and acidosis will be mixed
  - pH < 7.30 = abnormal
  - pH < 7.25 is concerning in combination w/poor perfusion, tachycardia and/or low BP
  - pH < 7.20 is significantly abnormal
  - pH < 7.10 indicates the infant is in crisis
- **Glucose**-in response to stress, may initially be hyperglycemic. Evaluate frequently until stable
- **Electrolytes**-High or low Na and K
  - Check anion gap if metabolic acidosis is present-normal is 5-15 mEq/L
  - Ionized Ca
  - LFT
  - Renal Function tests
  - Coags
  - Lactate
- **Echocardiogram** to evaluate cardiac function and R/O CHD
- Evaluate urine output for oliguria/anuria
- Evaluate for Sepsis
  - CBC and BC
- If concerned about inborn error of metabolism
  - Obtain NH3
  - Metabolic screens
  - Urine and serum AA

Other Tests to Evaluate Shock

- **CBC and BC**
- **Coags**
- **Lactate**
- **Metabolic screens**
- **Urine and serum AA**

Treatment of Shock

- Identify source
- Correct underlying problems that may impair cardiac function
  - Hypovolemia
  - Tamponade or pneumothorax
  - Excessive airway pressure
  - Electrolyte imbalance
  - Hypoglycemia
  - Hypoxemia
  - Arrhythmias
  - Improve pH
  - Thermal stability

Family Support

- Birth means many different things to families
- Parental reactions are sometimes hard to interpret and coping styles vary
- Approach in a non-judgmental way and observe for non-verbal cues
Emotions

- Guilt
- Anger
- Disbelief
- A sense of failure
- Powerless
- Fear
- Blame
- Depression

Supportive Intervention

- Listen
- Pictures
- Footprints
- Phone numbers, Names and Address
  - Allow them to hold or touch their infant if it is safe
- Explanation and education
- Phone call upon safe arrival
- Checking on baby’s status and helping to explain
- Being present
- Spiritual support as requested

Quality Improvement

- Debrief After Event
  - Was communication clear?
  - Were roles and responsibilities understood?
  - Was situation awareness maintained?
  - Was workload distribution equitable?
  - Was task assistance requested or offered?
  - Were errors made or avoided?
  - Were resources available?
  - What went well?
  - What should improve?

Questions?

References

- Universal Newborn Screening for Congenital Heart Disease MMN.

References

- Stable Program
- AAP Guidelines for transport