Stabilization of the Newborn and the Impact of the new NRP Guidelines

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Risk Factors

- Antepartum:
  - Conditions during pregnancy which predispose mother and fetus to stress and can interfere with successful transition
- Intrapartum:
  - Conditions that predispose the fetus to difficult transition to extrauterine life or signs that the fetus is not tolerating the stresses of labor
  - Unsuccessful transition may ensue
- Newly born period:
  - Signs or conditions in the delivery room or during the transition period that indicate the neonate is having difficulty making all the physiologic changes needed for successful adaptation

Antepartum

- Age < 16 or > 35
- Diabetes
- Hemorrhage, anemia
- Substance abuse
- No or late entry prenatal care
- Poly or oligohydramnios
- Premature ROM
- Decreased fetal activity
- Cardiac, renal, thyroid, pulmonary, endocrine, GI or neuro disease
- Hypertension
- Multiple gestation
- Postterm gestation
- Size and date discrepancy
- Previous pregnancy loss

Intrapartum

- Abn. fetal presentation
- Cesarean delivery
- Fetal heart rate abnorm
- Maternal or fetal blood loss
- Maternal sedation, anesthesia or analgesia
- Maternal fever or infection
- Prolonged labor
- Premature labor
- Precipitous delivery
- Prolonged ROM
- Cord prolapse
- Fetal malformations
- Assisted delivery
- Macrosomia
- Meconium stained fluid

Newly born Period

- Congenital malformations
- Cardiac arrhythmia or murmur
- Extreme color change
- Prolonged capillary refill time
- Respiratory distress
- Temperature instability
- Hyper or hypotonia
- Hypotension
- Seizures
- Hypoglycemia
- Pre or postmaturity
- Anemia/polycythemia
- Feeding difficulty
- Seemingly well then clinically deteriorates
**Equipment**

- "Equipment Check" is a new Performance Skills Station in Lesson 1
- "Quick Pre-Resuscitation Checklist" is new tool to check presence of essential supplies and equipment at radiant warmer
- NO LONGER OPTIONAL in the birth setting:
  - Compressed air source
  - Oxygen blender to mix oxygen and compressed air with flow meter
  - Pulse oximeter for neonatal use and oximeter probe
  - Laryngeal mask airway (size 1)
- Added Laryngoscope blade size 00 (optional)
- Deleted for immediate resuscitation:
  - Sodium bicarbonate 4.2%
  - Naloxone hydrochloride 0.4 mg/mL

**Levels of Post-Resuscitation Care**

- 2 levels only now
- Routine Care:
  - For vigorous term babies with no risk factors
  - For babies who have responded to the initial steps
    - These babies may not need to be separated from mothers to receive close monitoring and further stabilization
- Post-resuscitation Care:
  - For babies who have depressed breathing or activity, and/or require supplemental oxygen
    - Require frequent evaluation
    - Some may transition to routine care; others will need ongoing support
    - Transfer to intensive care may be necessary

**Questions to ask**

- OB Provider:
  - What is gestational age
  - Is the fluid clear?
  - How many babies are expected
  - Are there any additional risk factors
- At birth:
  - Is the newborn term
  - Is the newborn breathing or crying
  - Does the newborn have good muscle tone
  - If NO—receive initial steps at radiant warmer

**Routine Care of Newborn**

- Warm (skin to skin contact is recommended)
- Clear airway by wiping the baby's mouth and nose is needed
- Dry the newborn
- Provide ongoing evaluation of breathing, activity and color
- Suctioning following birth (including bulb suctioning with a bulb syringe) should be reserved for babies who have OBVIOUS OBSTRUCTION to spontaneous breathing or who require positive-pressure ventilation
- The vigorous meconium-stained newborn need not receive initial steps at the radiant warmer, but may receive routine care with appropriate monitoring with his mother

**Initial Steps**

- Open airway, dry, stimulate
- Evaluate respirations and heart rate
  - If HR is >100 bpm and respirations are labored, consider continuous positive airway pressure (CPAP), especially for preterm newborns
- Subsequently, evaluation and decision making are based on respirations, HR and oxygenation (pulse oximetry)
- The flow diagram timeline stops at 60 seconds and adds an extra step (take ventilation corrective steps) to ensure effective ventilation, recognizing that many factors may influence the time required to achieve effective ventilation

- Increase oxygen concentration to 100% when chest compressions begin
- Continue chest compressions coordinated with effective ventilation for at least 45-60 seconds before assessing heart rate
- The time for heart rate assessment has been increased from 30 seconds to 45-60 seconds because coronary perfusion drops every time compressions are interrupted
- If heart rate remains <60 bpm after at least 45-60 seconds of chest compressions coordinated with effective ventilation, administer epinephrine
- The intratracheal route of epinephrine results in lower and less predictable blood levels that are often not effective, but this route is acceptable while the umbilical venous line is being placed
Use of Oxygen and Pulse Oximetry

- Compressed air source, an oxygen blender and a pulse oximeter should be available in the immediate delivery area for every birth.
- Resuscitation of term newborns may begin with 21% oxygen; resuscitation of preterm newborns may begin with a somewhat higher oxygen concentration.
- Use pulse oximetry when:
  - Resuscitation is anticipated
  - Positive-pressure ventilation is required for more than a few breaths
  - Central cyanosis is persistent, or you need to confirm your perception of central cyanosis
  - Supplemental oxygen is administered
- Oximetry can be helpful to assist in judging the accuracy of your assessment, but should not delay your resuscitation actions.
- Stabilization of ventilation, heart rate and oxygenation are priorities.

Targeted Pre-ductal Saturation

<table>
<thead>
<tr>
<th>Age</th>
<th>Pre-ductal Saturation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 min</td>
<td>60%-65%</td>
</tr>
<tr>
<td>2 min</td>
<td>65%-70%</td>
</tr>
<tr>
<td>3 min</td>
<td>70%-75%</td>
</tr>
<tr>
<td>4 min</td>
<td>75%-80%</td>
</tr>
<tr>
<td>5 min</td>
<td>80%-85%</td>
</tr>
<tr>
<td>10 min</td>
<td>85%-95%</td>
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</tbody>
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CPAP

- Consider giving CPAP if a baby is breathing spontaneously and has a heart rate above 100 bpm, but has:
  - Labored respirations
  - Is cyanotic
  - Or has low oxygen saturation
- Cannot be given with a self-inflating bag.

Positive-pressure Ventilation

- Indications:
  - Apnea/gasping
  - Heart rate below 100 bpm, even if breathing
  - Persistent central cyanosis and low oxygen saturation, despite free-flow oxygen increased to 100%
  - "Effective ventilation" is defined by the presence of:
    - Bilateral breath sounds
    - Chest movement (heart rate may rise without visible chest movement, especially in preterm newborns)
- Assess for rising heart rate and improving oxygen saturation. If not evident within 5-10 breaths, ask your assistant to assess bilateral breath sounds and chest movement.
**MR SOPA**

<table>
<thead>
<tr>
<th>Corrective Step</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>Mask Adjustment Make sure there is good seal between mouth and mask</td>
</tr>
<tr>
<td>K</td>
<td>Reposition airway Head in “sniffing” position</td>
</tr>
<tr>
<td>S</td>
<td>Suction mouth and nose Check for secretions and suction if needed</td>
</tr>
<tr>
<td>O</td>
<td>Open mouth Ventilate with mouth slightly open and lift the jaw forward</td>
</tr>
<tr>
<td>P</td>
<td>Pressure increase Gradually increase pressure every few breaths, until there are bilateral breath sounds and visible chest movement</td>
</tr>
<tr>
<td>A</td>
<td>Alternative airway Consider endotracheal tube or laryngeal mask airway</td>
</tr>
</tbody>
</table>

**Chest Compressions**

- Ensure effective ventilation prior to beginning chest compressions
- Indicated whenever the heart rate is below 60 bpm, despite stimulation and at least 30 seconds of effective positive pressure ventilation
- Thumb technique preferred
  - When the heart rate is <60 bpm, the oximeter may not work. Increase the oxygen concentration to 100% until the oximeter is giving a reliable signal and can guide the appropriate adjustment of supplemental oxygen
  - Interruption of chest compressions to check the heart rate may result in a decrease of perfusion pressure in the coronary arteries.
  - If the oximeter is functioning, or if you can feel the pulse easily at the base of the cord, you will not need to stop ventilation to determine the heart rate

**Endotracheal Intubation**

- Recommended when:
  - Tracheal suctioning of the non-vigorous meconium-stained newborn
  - Positive pressure ventilation does not result in adequate improvement and ventilation with a mask is ineffective
  - To improve efficacy and ease of ventilation if PPV lasts beyond few minutes
  - Chest compressions are necessary
  - Special indications such as extreme prematurity, surfactant administration or suspected diaphragmatic hernia
- Intubation procedure ideally should be completed within 30 seconds
- Blades:
  - #1—Term newborn
  - #0—Preterm newborn
  - #00—Extremely preterm newborn
- Primary methods for confirming placement:
  - Increasing heart rate
  - Evidence of exhaled CO₂ in the tube
  - Should also observe: Improvement in heart rate and saturation, breath sounds bilateral, no gastric distention, vapor condensation and symmetrical chest movement
- CO₂ detectors:
  - Colorimetric device—purple or blue changes to yellow
  - Capnograph—good waveform
- Babies with very poor cardiac output may not exhale sufficient CO₂ to be detected reliably by detectors
- If epinephrine is administered via the endotracheal tube and contaminates the colorimetric device, it may turn the screen yellow and give a false positive reading

**Laryngeal Mask Airway**

- Effective alternative for assisting ventilation
- Indicated when:
  - Facial or upper airway malformations render ventilation by mask ineffective
  - Positive pressure ventilation with a face mask fails to achieve effective ventilation and intubation is not possible
- Limitations:
  - Currently available devices are too large for small preterm babies or those less than about 32 weeks’ gestation
  - The device cannot be used to suction meconium from the airway
  - An air leak at the mask-larynx interface may result in insufficient pressure to the lungs
- Insufficient evidence to recommend using for intratracheal medications or prolonged assisted ventilation

**Epinephrine**

- Indicated when heart rate remains below 60 bpm after 30 seconds of effective assisted ventilation (preferably via endotracheal tube) and at least another 45-60 seconds of coordinated chest compressions and effective ventilation
- Intratracheal route is associated with unreliable absorption and is likely to be ineffective
  - Dose: 0.5-1 mL/kg of 1:10,000 solution
- Intravenous route preferred
  - Dose: 0.1-0.3 mL/kg of 1:10,000 solution per umbilical vein
  - Give rapidly
  - Follow with 0.5-1 mL. flush of normal saline
- Check heart rate 1 minute after IV dose (longer after endotracheal dose)
- Repeat every 3-5 minutes
Volume Administration

- Indications:
  - Newborn is not responding to resuscitation AND
  - Newborn appears in shock OR
  - There is a history of a condition associated with fetal blood loss
- Volume might be considered even if there has not been obvious blood loss, but bradycardia persists
- Solution: Normal saline, Ringer’s lactate, or O Rh-negative PRBC’s
- Dose: 10 mL/kg
- Route: Umbilical vein
- Rate: Over 5-10 minutes

Hypovolemia

- Appear pale
- Delayed capillary refill
- Weak pulses
- Persistently low heart rate
- Circulatory status often does not improve in response to effective ventilation, chest compressions and epinephrine
- If certain that effective ventilation, chest compressions and medications are being provided, then consider:
  - Airway malformation
  - Pneumothorax
  - Diaphragmatic hernia
  - Congenital heart disease

Therapeutic Hypothermia

- Following perinatal asphyxia should be:
  - Used only for babies ≥ 36 weeks’ gestation and who meet previously defined criteria for this therapy
  - Initiated before 6 hours after birth
  - Used only by centers with specialized programs equipped to provide the therapy

No changes to

- Choanal atresia
- Robin syndrome
- Pneumothorax
- Diaphragmatic hernia
- Persistent cyanosis and bradycardia
- Post-resuscitation care
- Use of sodium bicarbonate 4.2%
- Use of naloxone 1.0 mg/mL solution
- Resuscitation of the newborn outside the delivery room

Resuscitation of Preterm Babies

- Additional trained personnel, including someone with intubation and emergency umbilical venous catheterization expertise
- To keep the preterm baby warm:
  - Increase the temperature of the delivery room and the area where the baby will be resuscitated to approximately 77° F to 79°F.
  - Use polyethylene plastic wrap for babies delivered at less than 29 weeks’ gestation (or 28 weeks and less). Use a sheet of plastic food wrap, a food grade 1-gallon plastic bag, or a commercially available sheet of polyethylene plastic
  - Place a portable warming pad under layers of towels on the resuscitation table

Ethics and Care at the End of Life

- If mother is a minor, she is “emancipated” and can legally make decisions about her fetus and newborn, but not herself
- Baby’s father has specific legal rights, but only if he is married to the mother or is listed as the father on the official birth certificate
- Unless conception occurred via in vitro fertilization, techniques used for obstetric dating are accurate to 3-5 days if applied in the first trimester, and only to ± 1-2 weeks subsequently. Estimates of fetal weight are accurate only to ± 15 to 20%
- Discontinuation of resuscitation efforts should be considered after 10 minutes of absent heart rate. Decision to continue resuscitation efforts beyond 10 minutes beyond this point should take into consideration factors such as the presumed etiology of the arrest, the gestational age of the baby, the presence or absence of complications, the potential role of therapeutic hypothermia, and the parents’ previously expressed feelings about acceptable risk of morbidity
Non-Initiation of Resuscitation

• Confirmed gestational age of less than 23 weeks or a birth weight of less than 400 grams
• Anencephaly
• Confirmed lethal genetic disorder or malformation
• When available data support an unacceptably high likelihood of death or severe disability

NEWBORN STABILIZATION

Sugar

• Glucose
  – Major source of fuel
  – Needed for brain functioning
• Blood Sugar Monitoring
  – 50-110 mg/dL

Signs of Hypoglycemia

• Jitteriness
• Irritability
• Hypotonia
• Lethargy
• High-pitched or weak cry
• Hypothermia
• Poor suck and coordination
• Tachypnea
• Cyanosis
• Apnea
• Seizures

Factors Influencing Glucose Levels

• Inadequate Glycogen Stores
• Hyperinsulinemia
• Increased Glucose Utilization

Inadequate Glycogen Stores

• Premature
• Small for Gestational Age
• Increased risk in term SGA infants
• Markedly increased in preterm SGA
Hyperinsulinemia

- Infant of diabetic mother
  - Maternal glucose level elevated
  - Glucose crosses placenta
  - Increases fetal insulin production and release
  - After umbilical cord cut
  - Insulin level remains elevated
  - Blood glucose drops rapidly
  - Insulin is major growth hormone

Increased Glucose Utilization

- Birth stress
- Infection
- Shock
- Respiratory Disease
- Cardiac Disease
- Hypoxia
- Hypothermia
- Premature
- SGA

IV Fluids

- Start peripheral IV
  - Hand, foot, scalp
- D10W without electrolytes
- 80 ml/kg/day
- Delivers a glucose dose of 5.5 mg/kg/minute

Temperature

- Healthy infants at reduced risk for hypothermia
- Premature and/or sick infants at increased risk for hypothermia
- Infants at risk:
  - Premature/low birth weight
  - Small for gestational age
  - Infants undergoing prolonged resuscitation
  - Infants who become acutely ill
  - Infants with open skin defects
  - Infants born outside of hospital

Response to Cold Stress-Term

- Vasoconstriction in arms and legs
  - Blood stays in core of body
  - Prevents blood from reaching skin
- Increased movement and flexion of extremities
  - Generates warmth in muscles
  - Decreases surface area for heat loss
- Brown fat metabolism
  - Inadequate prior to late third trimester
  - Mechanism
    - Generates heat when “burned” or metabolized
    - Warms blood circulating past areas with brown fat—mediastinum, scapulae, axillae and kidneys
    - If hypoxic, cannot metabolize brown fat

Response to Cold Stress-Preterm

- Heat loss very rapid—faster than ability to conserve body heat
- Minimal to no brown fat
- No insulating fat
- Poor ability to vasoconstrict first few days of life
- Weak muscle tone, poor flexion
- Limited to no glycogen stores
Detrimental Effects of Hypothermia

- Hypoxemia
- Hypoxia
- Anaerobic metabolism
- Increased morbidity in survivors or death from hypothermia
- Increased lactic acid
- Decreased pH

Rewarming the Hypothermic Baby

- Warm blankets
- Hat
- Skin-to-skin with mother
- Plastic wrap
- Turn heat up in ambulance
- Commercial heat production device
- Place towel between skin and device

Airway

- Respiratory distress most common reason for referral to intensive care
- Deciding best method to support breathing and when to support is often challenging
- Respiratory rate < 30 per minute:
  - If labored, may be sign of exhaustion
  - Assess severity of apnea and quality of air entry
  - Gasping—Ominous sign of impending cardio respiratory arrest!!!!
- Respiratory rate > 60 per minute:
  - Evaluate ventilation and oxygenation
  - Evaluate work of breathing
  - Blood gas

Evaluate Respiratory Distress

- Respiratory rate > 60 per minute and low PCO2
- Consider non-pulmonary causes
- Congenital heart disease
- Metabolic acidosis and shock
- Brain disorders:
  - Hemorrhage
  - Meningitis
  - Edema

Evaluate Respiratory Distress

- Work of breathing or respiratory effort
- Grunting—attempt to increase intrathoracic pressure in response to collapse of alveoli
  - Helps retain small volume of air in alveoli
- Nasal flaring—attempt to decrease airway resistance
  - Sign of air hunger
- Retractions
  - Intercostal
  - Subternal
  - Subcostal
  - Suprasternal

Evaluate Respiratory Distress

- Evaluate work of breathing
- Grunting
- Nasal flaring
- Retractions
- Intercostal
- Subternal
- Subcostal
- Suprasternal
**Oxygen Requirement**

- Evidence of central cyanosis?
  - Bluish discoloration of tongue and mucous membranes
  - Desaturation of arterial blood secondary to cardiac/respiratory dysfunction
- If infant is cyanotic on room air and respiratory distress present
  - Evaluate oxygen saturation and provide oxygen
- How much oxygen is required to keep O2 saturation greater than 90%?
  - Rapidly increasing oxygen requirement may be a sign of respiratory failure
- Oxygen Saturation—percent of hemoglobin that is saturated or bound with oxygen
- Hypoxemia—below normal oxygen content in arterial blood
- Hypoxia—hypoxemia or cardiac failure that results in inadequate tissue oxygenation below physiologic requirements

**Respiratory Failure—Warning Signs**

- Consider endotracheal intubation if:
  - Unable to maintain acceptable saturation for infant’s suspected disease process
  - Rapidly increasing oxygen concentration to maintain oxygen saturation greater than 90%
  - Increased PCO2 and respiratory acidosis
  - Infant with diaphragmatic hernia
  - Labored respiratory effort
    - Mod to severe retractions + grunting + nasal flaring
    - Recurrent severe apnea and bradycardia episodes
    - Gasping—signifies extremely critical state
      - Treat immediately with PPV then intubation

**Blood Pressure—Shock**

- Inadequate vital organ perfusion and oxygen delivery
- Failure to promptly recognize and treat shock may lead to multiple organ failure and even death
- 3 Main Causes:
  - Hypovolemia—Hypovolemic Shock
  - Heart Failure—Cardiogenic Shock
  - Infection—Septic Shock

**Hypovolemic Shock**

- Intrapartum blood loss:
  - Fetal-maternal hemorrhage
  - Placental abruption/previa
  - Umbilical vessel injury
  - Twin-to-twin transfusion
  - Organ laceration/injury

**Cardiogenic Shock**

- Intrapartum or postpartum asphyxia
- Hypoxia and/or metabolic acidosis
- Bacterial or viral infection
- Severe respiratory distress
- Severe hypoglycemia
- Severe metabolic/electrolyte disturbances
- Arrhythmias
- Congenital heart disease

**Septic Shock**

- Neonatal viral or bacterial infections may present with symptoms of respiratory distress and shock
- May rapidly become critically ill
- Hypotension may be profound and respond poorly to fluid resuscitation
- Treatment:
  - Hypovolemic shock therapy
  - Cardiogenic shock therapy
Evaluating for Shock

- Respiratory Effort
  - Increased work of breathing
  - Tachypnea
  - Apnea
  - Gasping
- Weak pulses
- Peripheral perfusion
- Color
- Blood Pressure

Evaluating for Shock

- Heart Rate:
  - Bradycardia:
    - Heart rate < 100 bpm
    - Hypoxemia
    - Hypotension
    - Acidosis
    - Rule out heart block
  - Tachycardia:
    - Sustained heart rate > 180 bpm
    - May indicate decreased cardiac output, congestive heart failure
    - Rule out arrhythmias

Treatment—Hypovolemic Shock

- If no acute blood loss:
  - Normal saline
  - Ringer’s lactate
- If there is acute blood loss:
  - Packed RBC’s
  - Whole blood

Treatment—Cardiogenic Shock

- Treat underlying problems:
  - Hypoxia
  - Hypoglycemia
  - Hypothermia
  - Hypotension
  - Acidosis
  - Arrhythmias
  - Infection
  - Electrolyte and mineral imbalances
- Medications:
  - Sodium Bicarbonate
  - Inotropes

Labwork—Neonatal Infection

- Can be devastating for infants
- Evaluation for and treatment of infection is a top priority in pre-transport period
- In any infant who appears sick, or pre-transport, it is common to begin antibiotics until infection is ruled out
- Major risk factors:
  - Premature rupture of membranes
  - Premature labor/birth
  - Chorioamnionitis
  - Recent maternal infection or illness
  - Intrapartum/postpartum maternal fever > 100.4 F.
  - Rupture of membranes > 18 hours
  - Invasive procedures after birth

Clinical Signs

- Respiratory distress
- Temperature instability
- Abnormal:
  - Skin perfusion
  - Heart rate
  - Blood pressure
  - Neurological status
- Feeding intolerance
Pre-transport Lab Evaluation

• Obtain the 4 B’s
  • Blood count
    – CBC with differential
  • Blood culture
    – Obtain adequate amount
  • Blood sugar
    – Check early and be vigilant
  • Blood gas
    – Respiratory distress
    – Suspected shock

As a reminder…

• Complete blood count (CBC) is a screening tool
• Sepsis may be present even if CBC is entirely normal
• Sepsis may not be present even if CBC is abnormal
• Decision to treat is based upon:
  – Clinical history
  – Signs and symptoms
  – Not only CBC results
• Antibiotics
  – Obtain an adequate volume of blood for culture first
  – Ampicillin 100 mg/kg/dose IV over 5 minutes
  – Gentamicin 4 mg/kg/dose IV over 30 minutes

QUESTIONS?