The Golden Hour of Neonatal Life

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Neonatal Intensive Care Unit
Disclosures

• I have no actual or potential conflicts of interests related to this presentation
• I will not be discussing any off-label use of any medications
• By the end of this presentation, learners will be able to:
  
  1. Describe the importance of the first hour of neonatal life and explain the basics of transition from fetal to neonatal physiology  
  2. Outline the role of the respiratory care provider during the golden hour; to include resuscitation, delivery room management, and early neonatal care
Important Definitions

• Golden Hour: the first 60 minutes of life in both term and preterm neonates

• Preterm: born prior to 37 weeks gestation
  • Late Preterm: born at 34-36 completed weeks gestation
  • Extremely Preterm: born before 28 completed weeks gestation
• The clamping of the umbilical cord and first breath initiate transition from fetal circulation to neonatal circulation
  • In utero, most blood bypasses the lungs, leaving only enough for tissue growth
  • At birth, pulmonary vascular resistance ↓ and systemic vascular resistance ↑, allowing blood to flow to the lungs to receive oxygen
  • Failure of this transition may lead to persistent pulmonary hypertension of the newborn (PPHN)
Prematurity and the Golden Hour

• Why is the Golden Hour so important to preterm infants?
  • Prematurity is the second leading cause of death among infants in the United States
  • Studies evaluating the golden hour of neonatal life have demonstrated a significant reduction in hypothermia, hypoglycemia, intraventricular hemorrhage, bronchopulmonary dysplasia, and retinopathy of prematurity
• The Golden Hour project began as an independent QI initiative at the end of 2019
  • Our NICU did not have a Golden Hour protocol prior to that time, though the data supported improved outcomes in units that did

• In 2023, the project was taken up by a larger, multidisciplinary group

• Our goal is to improve the median time to the completion of the admission process for inborn infants from 116 minutes to 60 minutes by December 1, 2024
Golden Hour Checklist: 22nd – 26th Week Gestation

Bedside Checklist
- Pre-warmed giraffe isolette with humidity
- Warm IVF and prime tubing
- Conventional vent (regardless of GA)
- UVC table prepped by provider with supplies to draw labs – please remember a clear plastic drape to assure infant does not get cold
- Heparin flushes removed from Pydls and mixed into saline / labeled
- Lab tubes (T&C, gas, culture, etc)
- Tape measure
- Tortic sizes (not opened until after HC)
- ELSW care binder

Completed by:

By 30 Minutes of Life

Provider(s)
- Order antibiotics (if indicated), Caffeine, and IVF STAT
- OHR ordered STAT / radiology paged (if being done before umbilical lines)
- Initial assessment

Bedside RN(s)
- *Weight________
- *Placed on monitor and servo mode
- *Vitals #1
- Vitamin K* @ _______ Erythromycin @ _______
- *OG tube @ _______
- *HC _____; Tortic applied pending skin maturity

RT
- Infant placed on ventilator or bubble CPAP
- TCOM placed

Time Completed:

Pre-Delivery Checklist
- Delivery room set up with form completed
- Team roles assigned for delivery & admission with role assignment form completed
- Provider roles assigned for admission – one person to return to NICU and scrub for lines as soon as infant is stable in DR
- Delivery team debriefed on plan for DR

*Goal is to leave the DR by 15 minutes of life*

Completed by:

By 60 Minutes of Life

Provider(s)
- UVC/UAC insertion (priority) with x-ray confirmation
- Bloodwork obtained
- Update parents if able

Bedside RN(s)
- *IV fluid start time _______ (priority after UVC confirmed)
- Glucose _______
- *Vitals #2
- *Antibiotics (if indicated) @ _______
- *Caffeine @ _______
- RT
- *Surfactant (priority) @ _______

Time Completed:

By 90 Minutes of Life

Provider
- Repeat x-ray (if lines adjusted)
- Complete physical exam
- Update parents

Bedside RN
- Medications infusing/finished
- Complete Assessment
- UAC fluids initiated @ _______
- *Top down/30 min hands off @ _______

Time Completed:

Debrief Completed @ _______

Patient Name

Gestational Age

Date of Birth

Time of Birth

Time of Admission

*Indicates data required for QI

Please return completed forms to Kyfah for NICQ QI

11/2023
<table>
<thead>
<tr>
<th>Time</th>
<th>Provider #1</th>
<th>Provider #2</th>
<th>RN #1</th>
<th>RN #2*</th>
<th>RT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-Delivery</strong></td>
<td>- Review birth record medical history</td>
<td>- Gather umbilical line tray and supplies</td>
<td>- Set up admit bed space and pre-warm Giraffe isolette (set up for humidity if &lt;27øC)</td>
<td>- Remove packet from Golden Hour Binder</td>
<td>- Ensure CPAP pole and / or ventilator are at bedside</td>
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<tr>
<td></td>
<td>- Place orders for &quot;baby&quot; meds and IV fluids STAT</td>
<td>- Open supplies to prepare for line placement, cover with sterile towel</td>
<td>- Remove &quot;Golden Hour&quot; bundle from Pyxis, warm IV fluids</td>
<td>- Draw up delivery meds as decided by team</td>
<td>- Setup DR intubation supplies</td>
</tr>
<tr>
<td></td>
<td>- Ensure radiant warmer set up with NeoHelp, hat, thermal mattress</td>
<td>- Pre-Huddle with Team</td>
<td>- Mixed heparin in NS &amp; label</td>
<td>- Pre-Huddle with Team</td>
<td>- Warm / bring surfactant to DR if decided by team</td>
</tr>
<tr>
<td><strong>0-15 Minutes</strong></td>
<td>- Scrub to &quot;catch&quot; baby from surgeon if C/S</td>
<td>- Remain at delivery until patient is stable and it is clear they will not need an emergent umbilical line</td>
<td>- Place ECG leads, assess heart rate</td>
<td>- Start Golden Hour Timer at birth</td>
<td>- Place SpO2 probe on right wrist</td>
</tr>
<tr>
<td></td>
<td>- Lead resuscitation per NRP guidelines</td>
<td></td>
<td>- Assist with resuscitation as needed</td>
<td>- Assist with resuscitation as needed</td>
<td>- Assist with resuscitation / intubation as needed</td>
</tr>
<tr>
<td><strong>10-15 Minutes</strong></td>
<td>- Stabilize and transport to NICU (if not back in NICU)</td>
<td>- Stabilize and transport to NICU</td>
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</tr>
<tr>
<td><strong>15-25 Minutes</strong></td>
<td>- Place admission orders: Caffeine, antibiotics</td>
<td>- Scrub for line placement</td>
<td>- Assess infant, obtain vital signs, place O2 tube &amp; turtle</td>
<td>- Remind team of time at 5-minute intervals</td>
<td>- Transition to ventilator or bubble CPAP</td>
</tr>
<tr>
<td></td>
<td>- Make plan for surfactant administration</td>
<td></td>
<td>- Weigh and measure</td>
<td>- Assist admit RN with delegated tasks</td>
<td>- Monitor SpO2 and adjust FiO2 to maintain target</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Administer Vitamin K and erythromycin as ordered</td>
<td>- Document</td>
<td>- Place TCOM</td>
</tr>
<tr>
<td><strong>25-45 Minutes</strong></td>
<td>- Begin documentation</td>
<td>- Place UVC / UAC</td>
<td>- Secure for UVC placement</td>
<td>- Assist with line placement as needed</td>
<td>- Monitor TCOM and FiO2 requirement</td>
</tr>
<tr>
<td></td>
<td>- Place X-Ray order STAT when needed, ask secretary to cell Radiology</td>
<td>- Draw admission blood gas and glucose (end blood culture if needed)</td>
<td></td>
<td>- Prime dextrose, starter TPN, and UAC fluid lines (if not done)</td>
<td>- Run blood gas</td>
</tr>
<tr>
<td><strong>45-55 Minutes</strong></td>
<td>- Interpret x-ray</td>
<td>- Interpret x-ray, adjust lines as needed and secure</td>
<td>- Initiate IV fluids</td>
<td>- Adjust ETT if needed</td>
<td>- Adjust ETT if needed</td>
</tr>
<tr>
<td></td>
<td>- Set up for and administer surfactant if needed</td>
<td></td>
<td>- Obtain vital signs and temperature</td>
<td>- Warm and administer surfactant if needed</td>
<td>- Warm and administer surfactant if needed</td>
</tr>
<tr>
<td><strong>55-60 Minutes</strong></td>
<td>- Update family</td>
<td>- Complete documentation</td>
<td>- Administer antibiotics and caffeine as ordered</td>
<td>- Monitor TCOM and FiO2 requirement</td>
<td>- Monitor TCOM and FiO2 requirement</td>
</tr>
<tr>
<td><strong>Post-Aximum</strong></td>
<td>Lead debrief with team</td>
<td>Debrief with team</td>
<td>Debrief with team</td>
<td>Debrief with team</td>
<td>Debrief with team</td>
</tr>
</tbody>
</table>

*Charge Nurse: please assign a specific RN to the RN #2 role and assign another RN to cover their assignment during the Golden Hour*

**Unit Secretary:** Place admission binder at bedside, admit to NICU in Epic, give scanning bands to RN, welcome family to NICU, page Radiology when asked
<table>
<thead>
<tr>
<th>Time Range</th>
<th>Task Description</th>
</tr>
</thead>
</table>
| Pre-Delivery | Ensure CPAP pole and / or ventilator are at bedside  
|             | Set-up DR intubation supplies  
|             | Warm / bring surfactant to DR if decided by team  
|             | Pre-Huddle with Team                                                             |
| 0-10 Minutes | Place SpO2 probe on right wrist  
|             | Assist with resuscitation / intubation as needed                                 |
| 10-15 Minutes | Stabilize and transport to NICU                                                   |
| 15-25 Minutes | Transition to ventilator or bubble CPAP  
|             | Monitor SpO2 and adjust FiO2 to maintain target  
|             | Place TCOM                                                                       |
| 25-45 Minutes | Monitor TCOM and FiO2 requirement  
|             | Run blood gas                                                                    |
| 45-55 Minutes | Adjust ETT if needed  
|             | Warm and administer surfactant if needed                                          |
| 55-60 Minutes | Monitor TCOM and FiO2 requirement                                                 |
| Post-Admission | Debrief with team                                                              |
Initiation of Golden Hour Project

Documentation of "Top Down" Time

Time to "Top Down" (minutes) - Run Chart
Respiratory Considerations
Neonatal Resuscitation Program (NRP)

- NRP is an evidence-based approach to the stabilization and care of the neonate at birth.
- NRP recommends that every birth should be attended by at least 1 qualified individual, skilled in the initial steps of newborn care and positive pressure ventilation.
  - If perinatal risk factors are present, at least 2 qualified individuals should be present to solely manage the neonate.
- A qualified team with full resuscitation skills should be available for every resuscitation.
Positive pressure ventilation (PPV) is the cornerstone of neonatal resuscitation.

Most preterm neonates require some degree of respiratory support in the delivery room.
- 10% of term neonates require respiratory intervention following birth (including PPV).
- Up to 77% of preterm neonates require PPV during delivery room stabilization.

Effective PPV improves FRC, facilitates gas exchange, and encourages spontaneous breathing.
- Chest rise and improving heart rate are the two most commonly used indicators of effective PPV in the delivery room.
Devices

• PPV may be provided by a T-piece resuscitator, self-inflating bag, or flow-inflating (anesthesia) bag

• T-piece resuscitators deliver more consistent PIP and PEEP, especially from providers who are less familiar with anesthesia bags

• T-piece resuscitators have been shown to increase likelihood of survival to hospital discharge and survival to hospital discharge without BPD
Hand Positions for Mask Ventilation

• No evidence-based recommendations exist on how to hold a face mask during PPV
• A two-person hold may lead to decreased air leak around the mask, especially for providers with less neonatal-specific experience
• The contoured face mask is the most commonly used for neonatal resuscitation (sizes 00, 0, 1, and 2)
  • A round mask may be helpful for extremely preterm neonates
Effective PPV

• Providing effective PPV is the most essential aspect of neonatal resuscitation, especially for preterm neonates
• Providing effective PPV requires the right equipment and experienced staff
• Effective PPV can lead to improved long-term outcomes, both respiratory and neurodevelopmental
The Preterm Neonate

- There are five stages of fetal lung development: embryonic, pseudoglandular, canalicular, saccular, and alveolar
  - Extremely preterm infants are born during the canalicular stage
  - Preterm infants are born during the saccular stage

- Surfactant production begins at 24 weeks, but surfactant is not adequate to prevent atelectasis until 32 weeks

- Extremely preterm and/or growth restricted neonates often have poor musculature
Early Respiratory Care

• Goal of respiratory care during the golden hour is to support normal gas exchange and oxygenation while preventing oxygen toxicity and lung injury from atelectotrauma, barotrauma, or volutrauma

• Goals of early respiratory management include:
  • Achieve and maintain functional residual capacity
  • Provide appropriate tidal volume and minute ventilation
  • Minimize invasive ventilation where possible
  • Avoid apnea and desaturation
  • Encourage spontaneous breathing

• We aim to utilize the least invasive and most gentle approach that sufficiently supports the patient
Oxygen

- Initiate resuscitation at 21% (infants >35 weeks) or 30% (infants <35 weeks) and titrate to goal SpO2 using NRP guidelines
  - Once over 10 minutes of life, UVMMC utilizes the following SpO2 goal parameters
    - 88-95% for infants <37 weeks (up to 100% if FiO2 is 0.21)
    - 92-97% for infants >37 weeks (up to 100% if FiO2 is 0.21)
- Utilize the lowest FiO2 necessary to achieve goal SpO2
- Appropriate maintenance of FRC will lead to decreased oxygen requirements

<table>
<thead>
<tr>
<th>Targeted Preductual SpO2 After Birth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 min</td>
</tr>
<tr>
<td>2 min</td>
</tr>
<tr>
<td>3 min</td>
</tr>
<tr>
<td>4 min</td>
</tr>
<tr>
<td>5 min</td>
</tr>
<tr>
<td>10 min</td>
</tr>
</tbody>
</table>
Intubation / Advanced Airway in the Delivery Room

- Routine intubation based on weight/gestational age is institution specific
  - At UVMMC, we typically intubate all infants born <25 weeks
- Other indications for intubation in the delivery room include:
  - Ineffective or prolonged bag-mask ventilation
  - Persistent bradycardia <60 bpm despite adequate ventilation necessitating chest compressions
  - Diagnoses in which bag-mask ventilation is contraindicated (such as diaphragmatic hernia)
- If intubation is difficult or an individual able to intubate is not present at birth, an LMA may be considered
- An advanced airway should be in place prior to the initiation of chest compressions
Intubation

- Intubation may also be required in the first hours of life due to respiratory failure as evidenced by oxygen requirement and/or hypercapnia; or due to the need for exogenous surfactant administration.
- Tube size and depth are based on weight and gestational age.
  - Endotracheal tubes are typically un-cuffed for neonates.
  - Endotracheal tube position should be evaluated on chest x-ray immediately following intubation to avoid positioning the ETT in the right mainstem bronchus.

**Neonatal Resuscitation Program recommendations:**

<table>
<thead>
<tr>
<th>Weight</th>
<th>Gestational Age</th>
<th>ETT size</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1000g</td>
<td>&lt; 28 weeks</td>
<td>2.5</td>
</tr>
<tr>
<td>1000g – 2000g</td>
<td>28 – 34 weeks</td>
<td>3.0</td>
</tr>
<tr>
<td>&gt; 2000g</td>
<td>&gt; 34 weeks</td>
<td>3.5</td>
</tr>
</tbody>
</table>
Mechanical Ventilation

• Volume-targeted ventilation has shown to cause reduction in pneumothorax and hypercarbia; as well as the combined outcomes of both death and BPD; and grade 3-4 intraventricular hemorrhage and periventricular leukomalacia
  • Initial volume target = 5 mL/kg (range: 4-6 mL/kg)
  • Initial PEEP = 5-7 cmH2O
  • Initial rate = 30-40 breaths/min

• If pressure-targeted ventilation must be utilized, PIPs should be kept as low as possible while achieving adequate ventilation, in order to decrease barotrauma
Non-Invasive Ventilation Modalities

• **Nasal Continuous Positive Airway Pressure (NCPAP)**
  • Most used modality for preterm infants in the Golden Hour
  • Typically 5-7 cmH2O, can go as high as 10 cmH2O

• **Nasal Intermittent Positive Pressure Ventilation (NIPPV)**
  • Has been shown to be superior to NCPAP as a primary mode of respiratory for decreasing respiratory failure in preterm neonates

• **High Flow Nasal Cannula (HFNC)**
  • Typically, 2-4 LPM, uncommon in the first days of life for neonates

• **Low Flow Nasal Cannula (LFNC)**
  • Typically, 25-125 mL/min, uncommon in the first days of life for preterm neonates but may be utilized for term infants
Nasal CPAP

• Typically utilize 5-7 cmH2O, may go as high as 8-10 cmH2O in some cases

• Most commonly delivered via RAM cannula in our region
  • Assure RAM cannula is 80% occlusive in the nares to optimize CPAP delivery
  • Keep the mouth closed when possible

• Utilizing heated and humidified gas helps maintain normothermia and prevents mucosal dryness, damage, and occlusion
  • Use a CPAP pole with bubble CPAP when possible (rather than T-piece CPAP)

• Place an orogastric or nasogastric tube for gastric decompression
Surfactant Administration

- Rescue surfactant is preferred over prophylactic, preferably in the first 2 hours of life but after infant demonstrates need (oxygen requirement >30% and/or hypercarbia)
- Surfactant may be given via ETT if already intubated
- May intubate for the purpose of surfactant administration and leave intubated (likely for transport) or extubate back to NIV (InSurE method)
- Less Invasive Surfactant Administration (LISA) involves passing an angiocatheter through the cords and administering surfactant without any positive pressure ventilation (unlikely to be utilized by transport team)
### Blood Gases

- Arterial samples are the “gold standard”
- Capillary samples are most often utilized for neonates
  - May be unreliable if there is poor perfusion or heel is not warmed adequately
- Permissive hypercarbia with PCO2 of 50-60 may be utilized if pH is appropriate to decrease lung injury

<table>
<thead>
<tr>
<th></th>
<th>Arterial</th>
<th>Capillary</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.30 – 7.45</td>
<td>7.30 – 7.45</td>
</tr>
<tr>
<td>PCO2</td>
<td>35 – 45 mmHg</td>
<td>35 – 50 mmHg</td>
</tr>
<tr>
<td>PO2 (on room air)</td>
<td>60 – 80 mmHg</td>
<td>not useful for assessing oxygenation</td>
</tr>
<tr>
<td>Bicarbonate (HCO3)</td>
<td>19 – 26 mEq/L</td>
<td>19-26 mEq/L</td>
</tr>
<tr>
<td>Base Excess / Deficit</td>
<td>-4 to +4</td>
<td>-4 to +4</td>
</tr>
</tbody>
</table>
• Goals of stabilization while awaiting NICU transport:
  • Establish FRC early with effective PPV
  • Maintain FRC utilizing the gentlest method that achieves adequate ventilation
  • Titrate FiO2 to maintain goal parameters per gestational age
  • Keep the infant warm!
    • Cold stress can lead to anaerobic metabolism and lactic acidosis (metabolic acidosis), which can worsen respiratory failure
Take-Away Points

• The role of the respiratory care provider is imperative in the initial stabilization and long-term outcome of preterm and term neonates who require resuscitation

• Damage to the lung parenchyma during the golden hour plays an important role in the development of bronchopulmonary dysplasia, and can have long-term impacts on the infant

• T-piece resuscitators have been shown to improve outcomes (as compared to flow-inflating bags)

• The UVMMC NICU is available for consultation as needed!
References
