What's New in Newborn Care!
Part I

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Professor of Pediatrics

I have no relevant financial relationships to disclose.

Danica Camacho, 2.5 kg, born 10/30/2011 in the Philippines is the 7th billion person

Who am I?

Adnan Mević, 3.5 kg, born 10/12/1999 in Bosnia as the 6th billion person is 12.
Matej Gaspar, 3.2 kg, born 7/11/1987 in Yugoslavia as the 5th billion person is 24.

Recent Newborn Topics with Changes

- Neonatal Resuscitation Program
- Late Preterm
- Bilirubin
- Hypoglycemia
- Breastfeeding
- Newborn screening
  - SCID
  - CCH
- GBS guidelines
- Cooling
- Cocooning

Objectives

- Review the new recommendations of Neonatal Resuscitation Program
- Understand the risks and complications of the late preterm infant
- Understand the anticipatory management of the jaundiced newborn

NRP 6th edition

- Online examination
- Simulation-based learning
- No lectures
- Hands-on learning
- Immersive simulations
- Constructive debriefings
- Improve teamwork and communication using Behavior skills

2010 International Liaison Committee on Resuscitation guidelines
Why NRP?

- Newborn resuscitation is one of the most frequent procedures carried out in medicine.
- Approximately 5–7 million of about the world’s annual 130 million newborns need this. (Helping Babies Breathe)
- Approximately 10% of newborns require some assistance to begin breathing at birth.
- <1% requires extensive resuscitation.
- Estimated that 814,000 newborns die of birth asphyxia annually.

Summary of changes:

- Equipment that should be available for every birth:
  - Compressed air source
  - Oxygen blender to mix oxygen and compressed air with flowmeter
  - Pulse oximeter for neonatal use and oximeter probe
  - Laryngeal mask airway (size 1)

Two levels of care

- Routine Care:
  - Vigorous term babies with no risk factors
  - Babies who have responded to the initial steps.
    - No need to separate mothers and babies!
    - Skin to skin care important for breastfeeding initiation and sustenance,
      clear airway by wiping the baby’s mouth and nose if necessary
      with towel, dry the newborn, can provide ongoing evaluation
      of breathing, activity, and color.
- Post-resuscitation care:
  - Babies who have depressed breathing or activity, and/or require supplemental oxygen require frequent evaluation.
  - Some may transition to routine care; others will require ongoing support.
  - Transfer to an intensive care nursery may be necessary.

Ask OB for relevant perinatal history

- What is the gestational age?
- Is the fluid clear?
- How many babies are expected?
- Are there any additional risk factors? What are they?

At birth, 3 questions to determine the need for initial steps at the radiant warmer:

- Is the newborn term?
- Is the newborn breathing or crying?
- Does the newborn have good muscle tone?

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.

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.
After clearing the airway as necessary, drying and removing wet linen, repositioning, and stimulating, evaluate respirations and heart rate (not color).

- If HR < 100 bpm, or if newborn is apneic or gasping, begin positive-pressure ventilation.
- If HR >100 bpm and respirations are labored, consider CPAP, especially for preterm newborns.

Subsequently, evaluation and decision-making are based on respirations, HR, and oxygenation (per pulse oximetry).

### Oxygen

- **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.
- PPV 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.
- Oximeter probe on the newborn’s right hand or wrist (pre-ductal saturation).

### Summary of Evidence

- 3 systematic reviews of 5 trials and 7 individual studies (2,011 newborn infants) have shown that neonatal mortality is reduced by 30-40% if resuscitation is carried out with 21% instead of 100%.
- Room air resuscitation leads to faster early recovery and need for shorter duration of resuscitation.
- 6 studies of ELBW infants have shown that ROP and CLD are significantly reduced if O2 is kept <93-95% compared with higher saturations.
- 2 observational studies associate 2.5- to 3.5-fold increased risk of childhood cancer in infants resuscitated with 100% O2 for a few minutes.

### Pulse oximetry should be used to guide supplemental oxygen concentration to achieve the target values for pre-ductal saturations summarized in the table on the NRP Flow Diagram.

<table>
<thead>
<tr>
<th>Targeted Pre-ductal SPO2 After Birth</th>
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<tbody>
<tr>
<td>1 min</td>
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<tr>
<td>60-65%</td>
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<tr>
<td>2 min</td>
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<tr>
<td>65-70%</td>
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<td>3 min</td>
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<td>70-75%</td>
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<td>4 min</td>
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<td>75-80%</td>
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<td>5 min</td>
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<td>80-85%</td>
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<tr>
<td>10 min</td>
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<td>86-95%</td>
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</table>

Care should be taken to avoid O2 saturation exceeding 95%.

### 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%
  - When PPV begins, assess for rising heart rate and improving oxygen saturation (pulse oximetry).
  - If not evident (within 5-10 breaths), ask assistant to assess bilateral breath sounds and chest movement.
  - If these are not immediately evident, perform as many of the ventilation corrective steps (MR SOPA) as needed to achieve bilateral breath sounds and chest movement.
  - Timeline down the side of the NRP Flow Diagram stops here - it may take longer than 30 seconds to establish effective PPV.
Effective ventilations is the highest priority in neonatal resuscitation.

- If heart rate is still < 60 bpm despite 30 s of effective PPV, increase the O₂ concentration to 100% and begin chest Compressions.
- Oximeter may not function at HR < 60.
- Intubation is strongly recommended when chest compressions begin to help ensure effective ventilation.
- The laryngeal mask airway has been shown to be an effective alternative for assisting ventilation. Indicated uses:
  - 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.

CPAP

- Consider giving CPAP if a baby (particularly preterm) is breathing spontaneously and has HR > 100 bpm but has:
  - labored respirations,
  - Is cyanotic,
  - Or has low O₂ saturations (below targeted saturation levels on table in flow diagram).
- Cannot be given with self-inflating bag.

Epinephrine

- Indicated when HR remains < 60 bpm after 30 s of effective assisted ventilation (via ETT) and at least another 45-60 s of coordinated chest compressions (2 thumb method) and effective ventilation (3:1).
- ET route has unreliable absorption and may be ineffective, but is most accessible.
- Epinephrine Administration
  - Concentration: 1:10,000 (0.1 mg/mL)
  - Recommended route: IV (umbilical vein). Consider ETT ONLY while IV access being obtained
  - Give rapidly.
  - Recommended IV dose: 0.1-0.3 mL/kg in a 1-mL syringe follow with 0.5 – 1 mL flush of normal saline.
  - Recommended ET dose: 0.5 – 1 mL/kg of 1:10,000 solution in a 3-6 mL syringe.
  - Check the heart rate about 1 min after administering epinephrine (longer if via ET).
  - Dose may be repeated every 3-5 minutes.

Wyckoff, M. H. NeoReviews 2010;11:e123-e129
Temperature

- **Therapeutic hypothermia** (Cooling) following perinatal asphyxia for infant with moderate to severe hypoxic ischemic encephalopathy:
  - 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

To help keep the preterm baby warm:
- Increase the temperature of the DR and the resuscitation area to approximately 25°C to 26°C (77°F-79°F)
- Polyethylene plastic wrap for babies delivered at less than 29 weeks' gestation.
- Sheet of plastic food wrap, a food-grade 1-gallon plastic bag, or commercially available sheet of polyethylene plastic.
- Portable warming pad under layers of towels on the resuscitation table.

Apgar score - expanded

<table>
<thead>
<tr>
<th>Apgar Score</th>
<th>Gestational Age (weeks)</th>
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<tbody>
<tr>
<td>0</td>
<td></td>
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<tr>
<td>1</td>
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<td>2</td>
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<td>3</td>
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<td>8</td>
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<tr>
<td>9</td>
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</tbody>
</table>

A record of fetal to neonatal transition

AAP policy, Pediatrics, 2006

Ethics

- Appropriate to consider stopping resuscitation in a newborn who has no detectable heart rate that remains undetectable for 10 minutes.
- Continuation beyond 10 minutes will take into consideration:
  - presumed cause of the arrest,
  - gestational age of the baby,
  - presence or absence of complications,
  - potential role of therapeutic hypothermia,
  - parents’ previously expressed feelings about acceptable risk of morbidity.
- Parents urged to direct questions directly to OB provider regarding concerns they have about events and care before birth; providers of Pediatric care should be careful not to make comments judgmental about OB care.

The Late Preterm Infant


Source: NCHS, Final Natality Data, Prepared by March of Dimes Perinatal Data Center, April 2006.
Infant/Neonatal Deaths by Gestational Age of Birth

Postneonatal death most commonly reported for these infants included sudden infant death syndrome, congenital malformations, and unintentional injuries.


Increased Neonatal Mortality at 37 Weeks


NICU Admissions By Weeks Gestation Deliveries Without Complications, 2000-2003

NICU admissions by weeks gestation:

<table>
<thead>
<tr>
<th>Weeks Gestation</th>
<th>NICU Admissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>37th Week</td>
<td>2.47%</td>
</tr>
<tr>
<td>38th Week</td>
<td>2.65%</td>
</tr>
<tr>
<td>39th Week</td>
<td>3.36%</td>
</tr>
<tr>
<td>40th Week</td>
<td>3.44%</td>
</tr>
<tr>
<td>41st Week</td>
<td>4.26%</td>
</tr>
<tr>
<td>42nd Week</td>
<td>6.66%</td>
</tr>
</tbody>
</table>


Composite Risk Early Term Compared to Late Preterm Births

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Early Term (n=5,151)</th>
<th>Late Preterm (n=6,542)</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age</td>
<td>35-36</td>
<td>37-38</td>
<td>0.81 (0.75-0.88)</td>
</tr>
<tr>
<td>Maternal age</td>
<td>36-37</td>
<td>37-38</td>
<td>0.78 (0.73-0.83)</td>
</tr>
<tr>
<td>Maternal age</td>
<td>37-38</td>
<td>37-38</td>
<td>0.77 (0.72-0.83)</td>
</tr>
</tbody>
</table>

Late Preterm Infant morbidity

- Respiratory distress (ventilator-treated)
- Retained fetal lung liquid syndrome (transient tachypnea of the newborn)
- Intraventricular hemorrhage
- Bacterial sepsis
- Apnea
- Hypoglycemia
- Temperature instability
- Jaundice/Hyperbilirubinemia
- Feeding problems
- Neonatal intensive care unit admission
- Hospital readmission
- Neonatal and postneonatal mortality

Shapiro-Mendoza CK, Neoreviews 2009;

Rehospitalization for late preterm infants

- RSV bronchiolitis
- Esophageal reflux
- Unspecified bronchiolitis
- Jaundice
- Infection

McLaurin KK, Pediatrics. 2009
Weiss J, Evans S. Semin Perinatol. 2006;30:54-60

Cerebral Palsy and Timing of Birth

- CP Based on Insurance Claims

Moster et al. Cerebral Palsy and Timing of Birth. JAMA 2010;304:976-982

Timing of Fetal Brain Development

- Cortex volume increases by 50% between 34 and 40 weeks gestation. (Adams Chapman, 2008)
- Brain volume increases at rate of 15 mL/week between 29 and 41 weeks gestation.
- A 5-fold increase in myelinated white matter occurs between 35-41 wks gestation.
- Frontal lobes are the last to develop, therefore the most vulnerable. (Huttenlocher, 1984; Yakavlev, Lecours, 1967; Schade, 1961; Volpe, 2001).

Childhood

- Cerebral palsy
- Poor school performance
- Special education needs

Why do LPI’s have trouble?

- Immature brain
- Lack of surfactant
- Small size
- If large, may fool you about maturity
- Hypotonia
- Disorganized
- Risk for sepsis
- Risk for complications of hyperbilirubinemia
- Immature UDP-Glucuronyltransferase activity
Guidelines for Caring for the LPI in Hospital

- Assess feeding, respiratory status, jaundice, temperature, hypoglycemia, and sepsis
- Promote exclusive breastfeeding but monitor closely, early and frequent feeding assessment.
- Assist mother with milk expression
- Car seat safety
- Determine if RSV prophylaxis is warranted
- Educate and support family

Recommendations for discharge

- Determination of accurate gestational age
- No discharge before 48 hours
- Vital signs normal for 12 hours prior to discharge
  - RR < 60/min
  - HR 100-160 bpm
  - Axillary temperature 36.5 – 37.4 in open crib with appropriate clothing
  - Passage of 1st stool spontaneously
  - 24 h of successful feeding (coordinate suck, swallow, breath while feeding)
  - Weight loss of < 7%

Discharge

- Formal evaluation of breastfeeding – observation of position, latch, and milk transfer documented by trained care givers at least twice daily after birth
- Develop a feeding plan
- Risk assessment plan for jaundice
- No active bleeding from circumcision site for at least 2 hours
- Maternal and infant blood tests have been reviewed
- Initial Hepatitis B vaccine administered or an appointment made
- Newborn metabolic and genetic screens have been performed

Discharge

- Passed car seat tests
- Hearing assessment has been performed and documented and follow up if necessary
- Family, environmental, and social risks have been assess
- Risk factors should be resolved as reasonable
- Physician follow up 24-48 h

Parental needs:

- Instructions regarding urine/stool frequency
- Umbilical cord and skin care
- Common signs and symptoms of illness
- Specific instructions regarding jaundice
- Specific instructions regarding sleep patterns and positions
- Thermometer use
- Responses to emergency

November is Prematurity Awareness Month®
Hyperbilirubinemia

Jaundice

- Most common neonatal problem (~70%) and for most it is a transient and benign phenomenon.
- The concern is for bilirubin encephalopathy which may have an incidence of 1/100,000 live births.
- The 2004 AAP guidelines recommend a predischarge bilirubin measurement and/or assessment of clinical risk factors to evaluate the risk of subsequent severe hyperbilirubinemia.
- Combining a predischarge measurement of TSB or TcB with clinical risk factors might improve the prediction of the risk of subsequent hyperbilirubinemia.

Risk Factors

- Isoimmune hemolytic disease,
- G6PD deficiency,
- Asphyxia,
- Significant lethargy,
- Temperature instability,
- Sepsis,
- Acidosis,
- An albumin level of <3.0 g/dL (if measured).
Complex Multifactorial Nature of Significant Hyperbilirubinemia

<table>
<thead>
<tr>
<th></th>
<th>Case</th>
<th>Control</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>153</td>
<td>299</td>
<td></td>
</tr>
<tr>
<td>Age at enrollment, median (range), d</td>
<td>2.9 (1.2–5.7)</td>
<td>1.8 (0.8–3.8)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Qualifying bilirubin level, median (range), mg/dL</td>
<td>15.7 (8.4–21.2)</td>
<td>4.6 (1.7–7.7)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Age at highest bilirubin level, median (range), d</td>
<td>2.7 (1.2–4.8)</td>
<td>1.6 (1–3.1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Highest bilirubin level, median (range), mg/dL</td>
<td>18.7 (10.9–22.1)</td>
<td>5.2 (1.9–9.4)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Asian</td>
<td>10 (6.5)</td>
<td>4 (1.3)</td>
<td>.004</td>
</tr>
<tr>
<td>Breast milk only</td>
<td>38 (24.8)</td>
<td>81 (27.1)</td>
<td>.7</td>
</tr>
<tr>
<td>Formula mixed with breast milk</td>
<td>85 (55.6)</td>
<td>112 (37.5)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Formula only</td>
<td>29 (19)</td>
<td>97 (32.4)</td>
<td>.003</td>
</tr>
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