OBJECTIVES

List several morbidities common to late preterm infants
Explore benefits of Baby Friendly initiatives for late preterm infants
Explain briefly the physiology of normal newborn transition
Discuss a practical approach for monitoring late preterm infants in a Baby Friendly setting
HISTORICAL PERSPECTIVE

“Of the time of birth which is called natural or unnatural: The due season is most commonly after the ninth month or about forty weeks after the conception, although some be delivered sometimes, in the seventh month, and the child proves very well. But such as are borne in the eighth month, either they be dead before the birth, or else live not long after.”

Thomas Raynalde, Circa 1540
(The Byrthe of Mankynde, Book II, Chapter 1)

“LATE PRETERM”

- July 2005—NICHD Expert Panel
- Conveys sense of vulnerability (rather than “near term”)
- Value of uniform definition
- 34 0/7 (day 239) to 36 6/7 (day 259)
  - 34 weeks still obstetric milestone—until recently no antenatal steroids
  - Indeed premature with higher risk for mortality and morbidity
  - Need close monitoring, evaluation, and follow-up

EPIDEMIOLOGY

- Preterm birth rate is increasing
  - >30% increase since 1981
  - 2014: SC 13.5%, US 11.32%
- Late preterm
  - Fastest growing subset
  - >25% increase since 1990
  - >70% of all preterm births
  - >73% of preterm singleton births
  - >61% of preterm multiple births
  - 2014: SC 9.08%, US 7.96%
  - >900/day
  - 1/3 of all NICU admissions
**Epidemiology**

- 34-36 weeks
- 32-33 weeks
- <32 weeks


**Morbidities of Late Preterm Infants**

- Physiologic immaturity

  - Small increases in morbidity have major impact

- Morbidity categories
  - Respiratory distress
  - Apnea
  - Seizures
  - Hypertension
  - Hypothyroidism
  - Temperature instability
  - Hypoglycemia
  - Feeding problems
  - Readmission

**Mortality**

- Tomashek et al. (2007)
  - Late preterm infants have 3 times higher mortality rates than term infants
  - Early neonatal deaths (0-6 days): 6 times higher
  - Late neonatal deaths (7-27 days): 3 times higher
  - Post neonatal deaths (28-364 days): 2 times higher
MORTALITY

• Tomashek et al. (2007)
  - Early neonatal mortality
    - 10 times more likely to die of atelectasis
    - 6 times more likely to die of maternal complications
    - 6 times more likely to die of congenital malformations
  - Late neonatal mortality
    - 10 times more likely to die of NEC
    - 5 times more likely to die of sepsis
    - 3 times more likely to die of congenital malformations
  - Post neonatal mortality
    - 3 times more likely to die of congenital malformations, influenza, pneumonia, and sepsis

OVERALL MORBIDITY

Wang et al. (2004)
  - 4 times more likely to have at least 1 medical condition diagnosed
  - 3.5 times more likely to have ≥2 medical conditions diagnosed

Shapiro-Mendoza et al. (2008)
  - Late preterm infants have sevenfold higher risks for morbidity (22% vs. 3%)
  - Rates of morbidity double for each gestational week earlier than 38 weeks
  - Maternal illness increased morbidity risks in late preterm infants

RESPIRATORY MORBIDITY

**Fetal Lung Development**

- Development of lung structures and function
- Expansion of alveolar spaces
- Formation of bronchial tree

**Respiratory Distress**

<table>
<thead>
<tr>
<th></th>
<th>Late Preterm</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escobar et al.</td>
<td>10.7%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Gilbert et al.</td>
<td>3.6%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Rubaltelli et al.</td>
<td>9.6%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Wang et al.</td>
<td>28.9%</td>
<td>4.2%</td>
</tr>
<tr>
<td>Boyle et al.</td>
<td>12.2%</td>
<td>1.7%</td>
</tr>
</tbody>
</table>

**Respiratory Support**

- Severe respiratory disorders treated by mechanical ventilation and/or nasal CPAP
- 19.8% at 34 weeks
- 0.28% at 39-41 weeks
- Each additional week from 34-38 weeks diminishes RR of severe respiratory disorders by a factor of 2-3

*Goyon et al. (2010)*
APNEA

Physiology:
- Increased susceptibility to hypoxic respiratory depression
- Decreased central chemosensitivity to CO2
- Immature pulmonary irritant receptors
- Increased respiratory inhibition sensitivity to laryngeal stimulation
- Decreased upper airway dilator muscle tone
- Developmentally immature CNS

4-7% of late preterm vs. <1% of term

INFECTION/SEPSIS

Wang et al. (2004)
- Four times more likely to be screened for sepsis (36.7% vs. 12.6%)
- Majority screened are treated with antibiotics and likely to be treated longer
- Sepsis screen likelihood increases with decreasing GA

McIntire & Leveno (2008)
- 33% screened at 34 weeks, 12% at 39 weeks
- Only 0.4% screened had culture proven sepsis

Conditions related to prematurity may be the prompt for screening

INFECTION/SEPSIS

Cohen-Wolkowicz et al. (2009)
- Early onset sepsis 4.42 per 1000 admissions
- Late onset sepsis 6.30 per 1000 admissions
- Gram positive organisms
- More likely than those with sterile blood cultures to die if early onset sepsis caused by GNR’s (OR 4.39) or late onset sepsis (OR 3.37)
TEMPERATURE INSTABILITY

- Impaired ability to prevent heat loss and to increase their body heat production in response to low environmental temperatures

  **Physiology**
  - Immature skin
  - High ratio of surface area to birth weight
  - Environmental conditions in the delivery room
  - Less brown fat for heat generation
  - Less white fat for insulation
  - Immature hypothalamus

  *10% of late preterm

HYPOGLYCEMIA

  **Physiology**
  - Immature glycogenolysis and lipolysis
  - Deficient hepatic gluconeogenesis and ketogenesis

  **Nadir** 1-2 hours after birth

  **Incidence** is inversely proportional to gestational age
  - 16% in late preterm vs. 5% in term

  Hypoglycemia requiring glucose infusion more common than in term infants
  - 27% in late preterm vs. 5% in term

FEEDING

  **Physiology**
  - Immature deglutition and peristaltic functions in GI tract organs
  - Difficulty coordinating suck, swallow and breathe
  - Low oromotor tone, function, and neural maturation
  - Cardiorespiratory instability leading to fatigue during feeding
  - Longer sleep intervals contributing to less time for feeding

  **Delay in successful breastfeeding**
  - Metabolic disturbances that necessitate supplementation
  - NICU admission/separation
  - Incomplete emptying leading to poor supply
FEEDING

- Poor weight gain
- Feeding may be transiently successful but not sustained (oromotor skills challenged when milk supply increases)
- Difficulties in 32% vs. 7% of term infants
- 27% required IV fluids vs. 5% of term infants

BABY FRIENDLY INITIATIVES

Short and long-term benefits for late preterm infants.
"The Paradox of Breastfeeding-Associated Morbidity Among Late Preterm Infants"


BREASTFEEDING IN LATE PRETERM INFANTS

Initiation rates in late preterm infants 59-70%, exclusive is rare
Odds of breastfeeding beyond 4 weeks or to the recommended 6 months is less than for term infants (and possibly than earlier preterm infants)
Greater risk for re-hospitalization due to jaundice and poor feeding when compared to term infants or non-breastfeeding late preterm infants
Breastfeeding at birth hospitalization discharge single greatest risk factor for late preterm infants to be re-hospitalized (Shapiro-Mendoza et al., 2006)

DIFFERENCES IN BREAST MILK OUTCOMES

<table>
<thead>
<tr>
<th></th>
<th>31-36/7 gestational age (n=12)</th>
<th>37-41/7 gestational age (n=785)</th>
<th>≧37 gestational age (n=972)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any breast milk given during hospitalization (%)</td>
<td>66.4</td>
<td>63.8</td>
<td>72.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Receiving any breast milk at discharge (%)</td>
<td>53.3</td>
<td>58.7</td>
<td>72.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Exclusive breast milk feeding at discharge (%)</td>
<td>34.2</td>
<td>40.0</td>
<td>65.1</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Boyle, EM et al. (2015)
GIVEN THESE STATISTICS, SHOULD WE EVEN RECOMMEND BREASTFEEDING FOR OUR LATE PRETERM INFANTS?!

YES!

Many benefits of breastmilk for preterm infants
- GI maturation
- Increased immunity → decreased NEC and other infections
- Premature breastmilk has greater total antioxidant capacity than more mature milk
- Acceleration of myelination → possible improved cognition

Breastfeeding benefits
- Positioning favorable for neuromotor development
- Fostering of bonding/secure infant attachment

SKIN-TO-SKIN RATES IN LATE PRETERM INFANTS

Cooper et al. (2012)
Newborn Clinical Outcomes of the AWHONN Late Preterm Infant Research-Based Practice Project
802 infants
- 34 weeks: 52%
- 35 weeks: 48%
- 36 weeks: 46%

SKIN-TO-SKIN AND BREASTFEEDING RATES

Hake-Brooks and Anderson (2008)
66 preterm infants (32 0/7-36 6/7) randomized to standard nursery care vs. unlimited skin-to-skin
- Infants in skin-to-skin group breastfed significantly longer (3 months vs 2 months)
- Breastfed more exclusively
- Mean kangaroo contact per day = 4.67 hrs
EARLY SKIN-TO-SKIN AND HYPOTHERMIA

Nimbalkar et al. (2014)
100 term and late preterm infants randomized to early skin-to-skin (started between 30-60 minutes after birth and continued until 24 hrs with minimal interruptions) vs. conventional couplet care without skin-to-skin
- Average skin-to-skin time 17 hrs over first 24 hrs
- Mean temperature was significantly higher at all time intervals in intervention group
- 4% hypothermia in intervention group vs. 32% in control group
- RR of developing hypothermia in control group = 8.0
- No seasonal variation

EARLY SKIN-TO-SKIN AND HYPOTHERMIA

Bergman et al. (2004)
31 preterm infants with BW 1200-2199 grams randomized to early skin-to-skin vs. incubator and observed for 6 hrs for pre-determined physiologic parameters
- Skin temperature <35.5 degrees C
- HR <100 or >180 x 2
- Apnea >20 sec
- O2 sat <87% x 2
- FiO2 >60%, CPAP >5cm
- Glucose <2.6 mmol/L (~47 mg/dL)
- 3/18 skin-to-skin infants vs. 12/13 control infants met parameters for instability (hypothermia, hypoglycemia, respiratory problems most common)
- 18/18 stable at 6th hour vs. 6/13

ROOMING-IN FOR LATE PRETERM INFANTS

Cooper et al. (2012)
- 36% special care nursery (~1/2 eventually transferred to couplet unit)
- 64% routine nursery or neither couplet unit (10% transferred to higher level of care)

Boyle, EM et al. (2015)
- 52.3% had any care in “rooming in”
- 64.3% had all care in “rooming in”
MANAGING LATE PRETERM INFANTS IN A BABY-FRIENDLY SETTING

A practical approach

TRANSITION

First 4-6 hours of life

Physiologic changes

- Decreased pulmonary vascular resistance
- Increased blood flow to lungs
- Lung expansion with clearance of alveolar fluid
- Improved oxygenation
- Closure of the ductus arteriosus
MONITORING PARAMETERS

Temperature
Respiratory rate
Heart rate
Color
Tone
Glucose
Bilirubin

RECOGNITION OF SPECIAL RISKS

Cooper et al. (2012)

Majority of risk factors occurred within the first 16 hours
- Hypothermia
- Hypoglycemia
- Respiratory distress
- Septic workup

Hyperbilirubinemia peaks later (24-72 hrs)
TRANSFER TO HIGHER LEVEL OF CARE

Ishiguro et al. (2009)

>80% of transfers from “nursery” to ICU due to apnea or hypoglycemia

Admissions due to apnea increased with decreasing gestational age

- Hypoglycemia:
  - 24.3% of NICU admissions for 35 week infants
  - 14.1% of NICU admissions for 36 week infants

NATIONAL PERINATAL ASSOCIATION GUIDELINES

http://www.nationalperinatal.org/Resources/LatePretermGuidelinesNPA.pdf

NPA GUIDELINES—INITIAL ASSESSMENT

- Establish gestational age
  - Prior to delivery if possible
  - New Ballard Score within 12 hours to confirm

- NRP guidelines for resuscitation

- PLACE STABLE INFANTS SKIN-TO-SKIN as soon as possible

- Initial assessment during skin-to-skin if infant remains stable

- Assessments:
  - RR/WOB, HR/rhythm/murmur/pulses/perfusion, axillary temp, tone/activity
  - q30 minutes x 2 hrs, then
  - q4 hrs first 24 hrs, then
  - q8 hrs until discharge

- Support uninterrupted skin-to-skin

- Vitamin K & eye prophylaxis after first feeding (or 1-2 hrs after birth)

- Growth parameters after first feeding (unless needed to adjust care)
NPA GUIDELINES—REDDUCING RISKS OF RESPIRATORY DISTRESS

Monitor RR/WOB by visual inspection during first hour
Maintain skin-to-skin contact if stable
- Decrease infant stress
- Optimize respiration and O2 saturations
- Protect from hypothermia-induced apnea

If signs of respiratory distress present and persistent, evaluate with pulse oximeter, stabilize infant, notify MD/NNP about transfer to higher level of care

NPA GUIDELINES—REDDUCING RISKS OF HYPOTHERMIA

Maintain neutral thermal environment
- Dry after birth
- Skin-to-skin when possible
- Cover back with warmed blanket
- Keep hat on infant when not skin-to-skin

Preserve heat loss when skin-to-skin is not an option OR not effective
- Double wrap
- Increase ambient temperature
- Radiant warmer

Postpone bath until stability is well-established
Notify MD/NNP if temp instability persists despite adequate actions

NPA GUIDELINES—REDDUCING RISKS OF SEPSIS

Identify maternal risk factors for infection
Assess and monitor infant for signs of infection
- Respiratory distress
- Apnea
- Temperature instability
- Glucose instability
- Abnormal color (pale, cyanotic, mottled)
- Lethargy
- Feeding difficulty
- Abdominal distention, vomiting

Septic work-up (CBC, blood culture) if signs/symptoms of sepsis and transfer to higher level of care for antibiotics
NPA GUIDELINES—REDUCING RISKS OF HYPOGLYCEMIA

- Identify additional risk factors for hypoglycemia
- Follow AAP guidelines (2011) or other hospital protocol for monitoring
- Facilitate first feeding at breast within first hour if mother and infant stable
- Frequent ongoing feedings on demand
  - 8–10 formula feedings/day
  - 10–12 breast feedings/day
- Interventions as required per protocol
  - Offer feeding
  - IV glucose as necessary with transfer to higher level of care

SCREENING FOR HYPOGLYCEMIA

NPA GUIDELINES—REDUCING RISKS OF FEEDING DIFFICULTIES

- Identify maternal risk factors
- Educate mothers about risk of feeding difficulties
- Provide assistance to ensure adequate feeding frequency
- Maintain nursing staff lactation competencies
- Offer dedicated lactation consultant (ideally IBCLC)
- Provide or refer to ST/OT/PT if feeding difficulties
- Adopt Baby Friendly Hospital Initiative’s Ten Steps
NPA GUIDELINES—REDUCING RISKS OF HYPERBILIRUBINEMIA

Identify risk factors
- Assess adequacy of feeding (especially breastfeed) and output
- Evaluate for visible jaundice within 1st 24 hours
- Tbil or serum bili if present

Obtain TcB or TSB at 24 hours after birth for all infants
- Plan for repeat testing within 24-48 hours if indicated for infants discharged prior to 72 hours
- (Peak bilirubin levels may occur on days 5-7 in late preterm infants)

RECOMMENDATIONS FOR BREASTFEEDING LATE PRETERM INFANTS

Academy of Breastfeeding Medicine (2008)
- Late preterm infant breastfeeding order set
- Weight loss classifications warranting supplementation
- Lactation consult within 24 hrs of delivery
- Post-hospital follow-up within 48 hrs
- Weekly weight checks through 40 weeks adjusted

Engle et al. (2007)
- Discharge only after 24 hrs of successful feeding
- Formal evaluation of breastfeeding documented twice daily
- Feeding plan

Smith, Danze, and Schuller (2007)
- Home visits by lactation consultant until 40 weeks adjusted

NPA GUIDELINES—SUPPORTING AND MONITORING BREASTFEEDING

Assess mother’s desire to feed, knowledge, and experience
- Facilitate immediate and uninterrupted skin-to-skin contact until after first feeding
- Assist with milk expression if mother and infant separated (ideally within 6 hrs)
- Hospital-grade electric pump if pumping needed
- Document breastfeeding frequency and output
- Assess breastfeeding at least twice daily
- Evaluate milk transfer and help mother hand-express or pump after feeding if milk transfer during feed is inadequate
- Monitor daily weight
**NPA GUIDELINES—SUPPLEMENTATION**

"Supplement feeds only if medically indicated"

Supplement with recommended volumes
- 0-24 hours: 2-10 ml/feed
- 24-48 hours: 5-15 ml/feed
- 48-72 hours: 15-30 ml/feed
- 72-96 hours: 30-60 ml/feed

Supplement with
- EBM
- DBM
- Hydrolyzed formula
- Formula

Supplement by
- SNS
- Cup
- Finger
- Bottle

**IMPLICATIONS FOR PRACTICE**

Appropriately tailored family education throughout the hospitalization
Close monitoring of vital signs during transition
Early lactation consultation
Evaluation for signs of poor milk transfer
Increased screening for hyperbilirubinemia
No early discharges
Detailed discharge instructions

**STAFF SUPPORT**

Transition nurses
- Initial monitoring
- Recognition of abnormal transition

Well-trained nurses in couplet/level 1 nursery
- Staffing ratios
- Competence and skills to recognize complications

Educated physicians

Lactation consultants

SW/OT/PT as needed
REFERENCES


