Transitioning the High Risk Neonate into Primary Care

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Disclosure

I have no relationships with commercial companies to disclose.

Objectives

- Transition of the premature infant from hospital to home
- Define who is at risk for neurodevelopmental morbidity
- Discuss follow-up visits
- Evaluation and treatment of common morbidities in the premature infant

Background

- 12% of premature babies are born annually in the United States
- Advances in medicine have led for the improved survival of premature neonates
- Survival of increasingly smaller infants has added to the complexity of medical conditions

Survival outcomes

<table>
<thead>
<tr>
<th>Gestational age (weeks)</th>
<th>Survival at 1 year (%)</th>
<th>Neonatal survival (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>11-30</td>
<td></td>
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<tr>
<td>24</td>
<td>26-52</td>
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<td>25</td>
<td>54-76</td>
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<tr>
<td>26</td>
<td>80</td>
<td></td>
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<tr>
<td>27</td>
<td>87</td>
<td></td>
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<tr>
<td>28-31</td>
<td>90-95</td>
<td></td>
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<tr>
<td>32-35</td>
<td>98</td>
<td></td>
</tr>
</tbody>
</table>

Adapted from AAP Committee of Fetus and Newborn (2003) and March of Dimes (2005)
High risk TERM infants
- Birth depression/asphyxia
- Persistent pulmonary hypertension
- Meningitis
- Intrauterine growth failure
- Major congenital malformations
- Neonatal seizures
- Extracorporeal membrane oxygenation (ECMO) and nitric oxide therapy
- Persistent hypoglycemia
- Severe hyperbilirubinemia


High risk PRETERM infants
- Birth weight < 750 g or < 25 weeks’ gestation
- Periventricular hemorrhage or infarction
- Periventricular leukomalacia
- Persistent ventricular dilation
- Neonatal seizures
- Chronic lung disease
- Neonatal meningitis
- Subnormal head circumference at discharge
- Parental drug abuse
- Poverty and parental deprivation
- Coexisting congenital malformation


Components in discharge planning
1. Parental education
2. Implementation of primary care
3. Evaluation of unresolved medical problems
4. Development of the home care plan
5. Identification and mobilization of surveillance and support services
6. Determination and designation of follow-up care

AAP Infant Readiness for Hospital Discharge
- A sustained pattern of weight gain
- Adequate maintenance of normal body temperature
- Competent feeding
- Physiologically mature and stable cardiorespiratory function

Role of the Primary Care Provider
- Establish a relationship
- Manage complications of prematurity
- Provide support
- Coordinate various medical and social services needed
- Provide anticipatory guidance

Initial Visit
- History
  - Review prenatal and postnatal information
  - Document discharge weight, HC, and length
- Feeding
  - BF/EBM/Formula
  - Caloric content of formula
  - Discuss length of time of feedings
- Medications
  - Name
  - Emphasize dosage, route, and frequency
  - Discuss side effects
  - Discuss indications for PRN meds
Initial Visit Cont’d

- Physical Examination
  - Weight, HC, and length
  - Chart by CGA
- Documentation
  - Immunizations given
  - NBS, hearing screen results
  - Recent labs
  - Home equipment
- Assessment
  - Determine if infant meets criteria for ECI
  - Educate family and address questions

Physical Examination

- Graph anthropometric measurements
- Blood pressure measurement
- Examination of the head may reveal plagiocephaly
- Genitourinary exam should include a careful check for inguinal hernias

Medical complications in high risk neonates

- Bronchopulmonary dysplasia
- Ventilator dependent with need for tracheostomy
- Failure to thrive
- Necrotizing enterocolitis and short bowel syndrome
- Tube feedings
- Hearing loss
- Epilepsy
- Posthospital care of neonates with congenital heart conditions
- Intraventricular hemorrhage and posthemorrhagic hydrocephalus, periventricular leukomalacia
- Cerebral palsy
- Delayed neurodevelopment
- Retinopathy of prematurity

Nutrition and Growth

- Human milk remains the preferred food
- If human milk not available, AAP recommends the use of nutrient-enriched formula to a postnatal age of 9 months
- The AAP does not recommend the use of soy protein-based formulas for:
  - preterm infants weighing <1800 grams
  - prevention of colic or allergy

Nutrition and Growth

- Healthy preterm infants require 110 to 130 kcal/kg/day
- Infants with chronic illness may need up to 150 kcal/kg/day
- At the time of hospital discharge, most infants are gaining 14 to 16 g/kg/day, comparable to intrauterine growth rates
Caloric supplementation

- When should we increase the caloric concentration?
  - Infant has a flat or decelerating growth curve
  - The infant is unable to take enough volume to follow a growth curve
  - The infant is volume restricted secondary to cardiac or lung disease

Tube Feedings

- Infants at risk are those with chronic health conditions or neurologic impairment
- If tube feedings are necessary, the infant should have opportunities for nonnutritive sucking either by sucking on a pacifier or through partial oral feeding
- Infants who are only tolerating partial oral feeding can be fed by mouth during the day and tube fed at night using either bolus or continuous feeds
- Infants who are anticipated to require a longer period without full oral feeding (more than 2 to 3 months) should have a gastrostomy tube placed

Gastrostomy tubes

- Leakage or irritation and local infection are common problems
- The amount of water in the gastrostomy balloon should be checked periodically (every 2 weeks)
  - infant gastrostomy should typically contain 3 to 5 mL of water
  - older child's balloon should be inflated with 5 to 10 mL of water
- During feeding, the infant should be positioned upright or right side down
- Cauterizing any granulation tissue that develops around the stoma may also reduce leakage
- Localized fungal infections occur frequently and respond to topical antifungal therapy

Growth Velocity of Preterm Infants from Birth to 18 Months

<table>
<thead>
<tr>
<th>Age (months)</th>
<th>Weight (g/day)</th>
<th>Length (cm/mo)</th>
<th>HC (cm/mo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>26-40</td>
<td>3-4.5</td>
<td>1.6-2.5</td>
</tr>
<tr>
<td>4</td>
<td>15-25</td>
<td>2.3-3.6</td>
<td>0.8-1.4</td>
</tr>
<tr>
<td>8</td>
<td>12-17</td>
<td>1.2-2.0</td>
<td>0.3-0.8</td>
</tr>
<tr>
<td>12</td>
<td>9-12</td>
<td>0.8-1.5</td>
<td>0.2-0.4</td>
</tr>
<tr>
<td>18</td>
<td>4-10</td>
<td>0.7-1.3</td>
<td>0.1-0.4</td>
</tr>
</tbody>
</table>


Formulas

- Preterm in the hospital:
  - Nutrient-enriched 20-24 calorie
    - Enfamil premature lipil; Similac special care advance
- Preterm ready for discharge:
  - Nutrient-enriched 22 calorie
    - Enfacare lipil; Neosure advance
- Term in the hospital/ready for discharge:
  - 20 calorie
    - Enfamil lipil; Similac advance
- Hypoallergenic:
  - Nutramigen lipil; Pregestimil; Similac alimentum advance; Elecare; Neocate

Neurodevelopmental Index (NDI)
Risk Factors for Impairment
- Bwt <1500 g
- GA < 28 weeks
- Intrauterine growth restriction
- Male gender
- Neonatal seizures
- White matter injury, PVL, Grade ¾ IVH
- Chronic lung disease
- Infections (meningitis, sepsis, NEC)
- Low socioeconomic status

Outcomes
- More frequent and significant disabilities are associated with decreasing birth weight and lower gestational age
- Data on neurodevelopmental outcomes is difficult to interpret
- Cognitive deficits are more common than motor deficits

Outcomes of preterm infants
- Up to 50% of infants born at extreme prematurity may be found without disability at follow-up
- If a child shows no developmental delays during infancy, the risk of mental deficiency or cerebral palsy is low
- CGA: Most authorities recommend that the correction for developmental milestones be continued until age 2 years

Birthweight-Specific Neurodevelopmental Outcomes

<table>
<thead>
<tr>
<th>Birthweight</th>
<th>Neurologic abnormality (%)</th>
<th>Cerebral palsy (%)</th>
<th>Mean IQ</th>
<th>IQ &lt;70 (%)</th>
<th>Behavioral problems (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 kg</td>
<td>20</td>
<td>&gt;5</td>
<td>86</td>
<td>13</td>
<td>29</td>
</tr>
<tr>
<td>1-1.49 kg</td>
<td>15</td>
<td>4</td>
<td>96</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>1.5-2.49 kg</td>
<td>8</td>
<td>2</td>
<td>96</td>
<td>5</td>
<td>29</td>
</tr>
<tr>
<td>≥2.5 kg</td>
<td>&lt;5</td>
<td>&lt;0.4</td>
<td>&lt;103</td>
<td>0.3</td>
<td>21</td>
</tr>
</tbody>
</table>

Disabilities in VLBW children
- Mental deficiency 10-20%
- Cerebral palsy 5-21%
- Blindness 2-11%
- Deafness 1-3%
- Motor delay 24%
- Language delay 23-42%
- ADHD 7-10%
- Need for special education 9-28%
- Psychological problems 25%

Psychiatric outcomes in adolescent children who had VLBW

Wolke Arch Dis Child 1998:78:567-570

Bronchopulmonary dysplasia (BPD)

BPD

- Respiratory issues are the most common long-term complication in premature children
- 30-40% of ELBW neonates will develop BPD
- BPD is the most common reason for rehospitalization during the first year of life

Chronic lung disease

- When an infant is receiving oxygen therapy, oxygen saturations should be checked with a pulse oximeter every 1 to 2 weeks
- Although the first 2 years of life are often difficult for children with significant chronic lung disease, they should improve as they grow in size and become older

Treatment of BPD

- Oxygen: goal is to limit pulmonary artery hypertension, provide exercise tolerance, and to promote appropriate growth and repair of developing lungs
- Bronchodilators: not universal, reduce bronchospasms, increase lung compliance
- Diuretics: not universal, monitor monthly electrolytes, SE-hypokalemia, metabolic alkalosis
- Oxygen weaning

Apnea of Prematurity
Apnea of prematurity

- Definition: cessation of airflow for ≥20 seconds or interruption of breathing for a shorter duration accompanied by bradycardia (HR <100 bpm) or cyanosis
- Majority of premature infants have mixed apnea
- Incidence is inversely related to gestational age
  - 24-29 weeks’ gestation: 100%
  - 30-32 weeks’ gestation: 50%
  - 34-35 weeks’ gestation: 25%

Apnea

- Generally cease by 40 weeks’ PMA
- The PCP should review monitor use and alarms with parents, inquiring about the type of alarm (apnea, bradycardia) stimulation required (none, minimal, vigorous) and antecedent events (feeding, deep sleep, etc)
- Discussion should include parents understanding of infant CPR

Pathogenesis of apnea

- Developmental immaturity
- Chemoreceptor responses
- Laryngeal reflex
- Poor respiratory muscle coordination
- Other: infection, impaired oxygenation, respiratory distress, drugs, intracranial pathology, seizures

Treatment

- Correct underlying cause
- Tactile stimulation
- Pharmacologic - methylxanthines
- Continuous positive airway pressure (CPAP)

Gastroesophageal Reflux (GER)

GER in premature neonates

- Mechanism:
  - Transient and inappropriate relaxation of the lower esophageal sphincter (most common)
  - Sluggish esophageal motility
- Pathologic reflux (GERD) is associated with
  - Poor weight gain
  - Feeding difficulties
  - Esophagitis
  - Oral aversion
Gastroesophageal Reflux

- The diagnosis is made in the outpatient setting by history, barium swallow, and/or pH probe
- First line medical treatment usually consists of an antireflux wedge and thickened feeds
- Some studies suggest 50% of infants with GER have an associated cow milk allergy

Therapy

- Histamine 2 antagonist
  - (Ranitidine, cimetidine, famotidine, nizatidine)
  - Block gastric cells from producing acid
- Proton pump inhibitors
  - (Omeprazole, lansoprazole, rabeprazole)
  - More potent acid suppressants
  - Inhibit gastric cell acid pump
  - More $$$
- Prokinetic agents
  - 2nd line approach
  - Metoclopramide-extra pyramidal movements or premature infants
  - Erythromycin-a/w hypertrophic pyloric stenosis, cardiac arrhythmias
- Surgical therapy is required in only a small number of infants
  - Potential complications-infection, delayed gastric emptying, small bowel obstruction

Anemia of Prematurity

- Last trimester-high rate of red blood cell (RBC) production and iron storage
- After delivery, premature babies have limited RBC production, decreased RBC survival, and frequent blood draws
- The nadir for a premature neonate occurs at approximately 1-2 months

Prevention of anemia

- At 2-3 months EPO production resumes and Hgb mass begins to increase until iron stores are exhausted
- If exogenous iron is not provided by 3-4 months of age anemia resumes
- AAP recommends that breastfed preterm infants receive at least 2 mg/kg/day of elemental iron beginning at 1 month

Screening and management

- AAP recommends screening for anemia in preterm infants at 4 months of age
- Signs of hypoxemia:
  - Tachycardia, tachypnea
  - Poor feeding, apnea
- If an infant has iron deficiency anemia
  - Treat with 3-6 mg/kg/day of elemental iron for 4 weeks
Blood transfusions
- Ideally want to maintain Hgb level 35-40 for neonates with congenital heart defects and chronic lungs
- Maintain Hct >30% in neonates with:
  - Growth failure
  - Cardiopulmonary disease
  - Significant apnea
- Transfuse any asymptomatic infant with a Hct <21% and reticulocyte count <3%

Immunizations
- The Committee on Infectious Diseases of the American Academy of Pediatrics (AAP) recommends that regular doses of immunizations be given at the infant's chronological age regardless of weight or degree of prematurity
- Influenza vaccine should be considered after 6 months of age, especially for those infants at high risk for respiratory illness, e.g., those with bronchopulmonary dysplasia (BPD) or those who received mechanical ventilation

RSV prophylaxis
RSV prophylaxis: First dose in November, last dose in March or April
RSV recommended for infants:
- <24 months of age with chronic lung disease requiring treatment within 6 months of anticipated start of RSV season
- <24 months of age with hemodynamically significant cyanotic or acyanotic congenital heart disease (receive medications for congestive heart failure, severe pulmonary hypertension, or cyanotic heart disease)
- <6 months of age at start of RSV season, born <32 weeks' gestation
- <12 months of age at the start of RSV season, born <28 weeks' gestation
- <36 months of age at the start of RSV season, born <32 weeks' gestation
- AND who have two or more of the following risk factors:
  - Tobacco exposure
  - Child care attendance
  - School-aged siblings
  - Exposure to environmental air pollutants
  - Congenital airway abnormalities
  - Severe neuromuscular disease