Primary Care Issues for the Healthy Premature Infant

Michelle M. Kelly, RN, MSN, CRNP

ABSTRACT

Premature infants born between 32 to 35 weeks’ gestation have a 98% survival rate and comprise 84% of all preterm infants in the United States. These infants may have a relatively benign hospital course and may be considered by some to be a “healthy premature infant.” At the time of discharge from the neonatal intensive care unit, infants will be gaining weight, feeding by mouth, and maintaining temperature homeostasis. Support of growth, feeding choices, management of gastroesophageal reflux, developmental issues, monitoring at home, and recommended special vaccinations are issues that primary care nurse practitioners will face in caring for preterm infants. This article is Part II of a three-part series focusing on the care of preterm infants after discharge from the neonatal intensive care unit. This installment will look specifically at preterm infants who are considered to be healthy preterm infants. Part I addressed issues related to all premature infants. Part III will focus on the primary care issues in medically complex premature infants. J Pediatr Health Care. (2006) 20, 293-299.

The “healthy premature infant” presents some unique challenges to pediatric health care providers. Premature infants born between 32 to 35 weeks’ gestation have a 98% survival rate and comprise 84% of all preterm infants in the United States (March of Dimes [MOD], 2005). This moderately premature (32 to 35 weeks’ gestation), typically low birth weight (LBW) (<2500 g) infant is admitted to the neonatal intensive care unit (NICU) and may be discharged within a few days or a few weeks.

Discharge criteria for most NICUs include attainment of full nipple feeding, a consistent weight gain pattern, resolution of apnea or bradycardia episodes, and temperature stability in an open crib (Verma, Sridhar, & Spitzer, 2003). Possibly these infants needed some degree of respiratory support and parenteral nutrition or gavage feedings, received antibiotics for suspected or proven sepsis, and underwent treatment for a patent ductus arteriosis. At the time of discharge these infants are doing well and yet have certain risk factors associated with prematurity.

Infants achieve the physiologic maturity to gain adequate weight while nipple feeding at different weights and gestational ages (Carlson, 2005). Achievement of adequate weight gain is a discharge criterion upon which parents and NICU staff become focused. After discharge from the NICU, the primary care provider becomes the judge of adequate growth for the infant. Growth can be limited by the preterm infant’s endurance and coordination with oral feeds. Weight gain of at least 20 to 30 g per day is desirable (Verma et al., 2003). Table 1 highlights goals for catch-up growth (Verma et al.). Children whose early catch-up growth was suboptimal and who are below the 10th percentile at 2
years of age are more likely to continue to be small at 5 and 8 years of age (Marshall, 2003). Infants born weighing less than 1500 g may display increased weight for length in the early months after discharge; however, this is not an indication for restriction of intake (Carlson).

This weight gain may be instrumental in attaining adequate growth by 12 months corrected age (Carlson).

The 1999 Infant Health and Development Program Growth Percentiles for LBW and Very Low Birth Weight (VLBW) Infants (Guo, Wholihan, Roche, Chumlea, & Casey, 1996) are growth curves established for preterm infants. The data used for these graphs may not represent currently attainable growth potential, however, because the data were collected prior to the regular use of increased calorie discharge formulas (Carlson, 2005). The 2000 Centers for Disease Control and Prevention (CDC) Growth Chart, which combines data from breastfed and bottle-fed infants and infants of various races and ethnicities, excluded VLBW infants from its data (CDC, n.d.). Carlson advocates plotting infants on both charts, because this comparison may reinforce the need for growth promotion to both parents and health care providers.

Premature infants, particularly those fed human milk, should have documentation of serum phosphorus, alkaline phosphatase, and urea nitrogen levels at NICU discharge, and those tests should be repeated at 4- to 6-week intervals if the results are abnormal (Marshall, 2003). Concerns should arise if those values indicate a phosphorus level of less than 4.5 mg/dL, an alkaline phosphatase level of more than 450 IU/L, and a urea nitrogen level of less than 5 mg/dL. Delayed growth or abnormal laboratory values may suggest the need for continued fortification of human milk, complementary formula feeding, or increased intake volumes (Marshall).

**TABLE 1. Growth rates of preterm infants through 18 months of age**

<table>
<thead>
<tr>
<th>Age (months)</th>
<th>Weight (g/day)</th>
<th>Length (cm/month)</th>
<th>Head circumference (cm/month)</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</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>

Adapted from Verma, Sridhar, & Spitzer. (2003).

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**FEEDING CHOICES**

Breast milk endures as the ideal source of nutrition for premature babies. The milk of a mother of a premature baby has significantly higher concentrations of lipids, proteins, sodium chloride, iron, and anti-infective properties (Spatz, 2004; Spicer, 2001). This alteration in composition persists throughout the first month of lactation (Spatz). Neuroprotective properties of human milk are evident in the higher visual acuity and intelligence of preterm infants fed human milk (Spatz).

Blaymore Bier, Oliver, Ferguson, and Vohr (2002) looked at the anti-infective properties of human milk of mothers of preterm infants after hospital discharge. Although their sample size admittedly was small, the study supported the idea that human milk of mothers of preterm infants has higher concentrations of immunoglobulin A sustained over longer periods of time than does the human milk of mothers of term infants (Blaymore Bier et al.). Infection protection for human milk fed to premature infants extended through 7 months corrected age as evidenced by decreased incidence of lower respiratory infections (Blaymore Bier et al.).

Recommendations for breastfeeding mothers of premature infants can be found in Spatz’s 2004 article “10 Steps for Promoting and Protecting Breastfeeding in Vulnerable Infants.” The author explained that mothers of preterm infants should pump eight to 12 times per day using a hospital-grade pump and should pump until her breast is empty of milk. Test-weighing to assess intake is recommended (Spatz). The process consists of prefeed weighing, feeding, and postfeed weighing of the infant using an electronic baby weight scale. One gram of weight is equivalent to 1 mL of milk intake (Spatz). Spatz asserted that mothers are capable of and proficient in managing this process and report...
decreased maternal anxiety and stress when they breastfeed.

Postdischarge nutrition of premature infants has received limited study despite the advances in nutrition of premature infants while they are in the hospital (Carlson, 2005). Carlson reviewed multiple preterm infant nutrition studies. The ultimate goal of postdischarge nutrition is the attainment of a normal nutritional status as soon as possible (Carlson). Conclusions based on current research include the following: (a) preterm infants fed human milk after discharge are at risk for osteopenia and may benefit from human milk fortifiers, and (b) formula-fed preterm infants can be fed postdischarge transitional formula safely for up to 12 months corrected age (Carlson). The American Academy of Pediatrics (AAP) (2005) concurs that many VLBW infants require fortification of human milk. Concern regarding nutrient toxicity for infants weighing more than 2500 g who are fed transitional formula is ill- founded because these infants typically exist in a suboptimal nutrient state and experience accelerated growth (Carlson). Primary care pediatric nurse practitioners must stay apprised of the evolving body of research regarding the use of transitional formula, powder supplements, and human milk fortification.

Oral intake of greater than 165 kcal/kg per day may be seen in preterm infants fed ad libitum during postdischarge periods of rapid growth (Carlson, 2005). These infants may require this increased caloric intake to maintain this rapid growth. Preterm infants may not display the same feeding cues as term infants, and parents should be taught to look for alertness and rooting. In the preterm infant, crying is a late sign of hunger (Spatz, 2004).

Formula-fed premature infants receiving transitional formula do not require additional multivitamins. Premature infants receiving a standard term formula (20 kcal/oz) require multivitamins until they reach 3.5 kg or are taking more than 750 mL per day (Verma et al., 2003). Preterm infants fed unfortified human milk should receive 2 to 4 mg/kg per day of an iron supplement (AAP, 2005). All infants fed human milk should receive vitamin D supplements by 2 months of age until they have been transitioned to milk or formula containing vitamin D (AAP, 2005). Soy formulas are not recommended for preterm infants because of the low phosphorus content (Ritchie, 2002).

GASTROESOPHAGEAL REFUX

As many as 50% of all infants between birth and 3 months of age regurgitate at least once a day (Craig, Hanlon-Dearman, Sinclair, Taback, & Moffatt, 2004). Gastroesophageal reflux (GER) is defined as retrograde movement of gastric contents—milk, bile, gastric juice or air—into the esophagus and above, typically caused by relaxation of the lower esophageal sphincter (Jadcherla, 2002). GER itself is a physiologic event, and a distinction between physiologic and pathologic GER is required before therapeutic interventions are considered. A confounding phenomenon of physiologic GER is that with or without intervention, its occurrence will decrease as the child matures (Craig et al.). The list of predisposing factors for GER is long and comprehensive; it includes prematurity and respiratory instability (Jadcherla). Many diagnostic tools are available to evaluate problematic GER. Each has its benefits and limitations; however, no one test assesses all the characteristics of GER in infants (Jadcherla). The gold standard of testing for GER, the pH probe study, underestimates the occurrence of reflux in infants by excluding nonacids reflux events (Jadcherla; Poets, 2004).

RESPIRATORY SYNCYTIAL VIRUS/INFLUENZA

Respiratory syncytial virus (RSV) and influenza prevention warrant specific discussion with regard to the premature infant. Premature infants may be offered vaccinations for these diseases in addition to the standard childhood immunizations. Yearly pediatric hospitalizations for RSV in the United States average about 125,000 per year (Elhassan et al., 2003). In a recent study looking at hospitalization rates for acute respiratory illness, in children younger than 1 year of age, 15 to 40 children per 1000 were admit-
ted to the hospital for RSV (Iwane et al., 2004). Eighty-one percent of hospitalizations for bronchiolitis occur during the months of November through March in the United States, with RSV determined to be the primary causative agent for these admissions (Meissner, Anderson, & Pickering, 2004). Horn and Smout (2003) retrospectively evaluated premature infants prior to the introduction of palivizumab immunoprophylaxis; they determined that infants at 33 to 35 weeks’ gestation have hospital stays and intubation rates similar or higher than that of infants born at less than 32 weeks’ gestation. These results suggest that RSV infections pose a significant risk to even those infants considered by age to be only moderately premature (Horn & Smout).

Premature infants determined to be at risk when discharged from the NICU during the months of October-November through March-April in the United States receive RSV prophylaxis with parental consent prior to discharge (AAP, 2003c). Primary care offices, neonatal follow up programs, or home health agencies provide the subsequent monthly doses. The cost of the monthly therapy must be weighed against potential cost savings through decreased hospital admissions and parental expenses associated with a hospitalized child (Meissner et al., 2004). The recommendations for RSV prophylaxis are listed in the Box (AAP, 2003b).

RSV-related mortality is not significantly reduced in infants who receive the prophylaxis (AAP, 2003b). It should be noted that in addition to palivizumab, respiratory syncytial virus immune globulin intravenous (RSV-IGIV) (RespiGam, Medimmune Inc, Gaithersburg, Md) has been approved by the Food and Drug Administration for prevention of severe RSV infections (AAP, 2003b; 2003c). The intravenous administration and requisite delay of routine immunizations make RSV-IGIV impractical and undesirable for use in premature infants (AAP, 2003b). Neither product is indicated for the treatment of RSV (AAP, 2003c).

Similar to RSV, respiratory and dehydration complications from influenza pose a serious threat to all premature infants. Rates of hospital admission for influenza for infants younger than 1 year of age range from 7 to 19 per 1000 children (Iwane et al., 2004). Starting at 6 months chronologic age, infants should receive vaccination from influenza (AAP, 2003a). Like full-term infants and young children, preterm infants require two doses of influenza vaccine the first year they receive it to produce a satisfactory antibody response (AAP, 2003a). Vaccinating household contacts helps decrease premature infants’ exposure. Influenza vaccine reduces the community-based spread of the disease and is critical for premature infants with respiratory deficiencies and their families (AAP, 2003a; Ritchie, 2002).

**Development**

The 2001 AAP Policy Statement on Developmental Surveillance and Screening of Infants and Young Children compels pediatricians to perform developmental screening at all well-child encounters. Developmental screening is essential for identification of children at risk. Comorbidities associated with prematurity—bionchopulmonary dysplasia, sepsis, retinopathy of prematurity, intraventricular hemorrhage, necrotizing enterocolitis, hearing defects, and birth defects—have adverse effects on developmental and functional outcomes (Bear, 2004). Intrauterine growth restricted and small for gestational age babies remain at risk throughout childhood (Bear). Preterm infants are less likely than their term peers to perform at grade level without supplemental therapies (Davis, Sweeney, Turnage-Carrier, Graves, & Rector, 2004). Family factors play an important role in positive outcomes and should be part of the developmental assessment. Preterm infants with two involved parents (not necessarily married) were three times more likely to perform at grade level than were their pre-

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**BOX. Summary of AAP recommendations for 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
- <6 months of age at the start of RSV season, born 32 to 25 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

Home monitors are recommended for preterm infants who are at increased risk of recurrent episodes of apnea, bradycardia, and hypoxemia after discharge and for those with complex medical needs or who need mechanical ventilation.

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discharged home with monitors, at an estimated cost of $24 million (AAP Committee on the Fetus and Newborn). Apnea of prematurity is defined as sudden cessation of breathing that lasts for at least 20 seconds or is accompanied by bradycardia and oxygen desaturation in an infant less than 37 weeks’ gestational age. Apnea can be further categorized by etiology: central apnea occurs as a result of immature respiratory control mechanisms, obstructive apnea occurs as a result of the collapsibility of the chest wall and diaphragm, and mixed apnea occurs when a combination of both types of apnea exist. Apnea of prematurity typically stops by 37 weeks’ postconceptual age but may persist beyond term, especially in children born before 28 weeks’ gestation (Marshall, 2003). A review by Ambalavanan and Whyte (2003) of evidence-based practices in neonatology looked at the use of methylxanthines for the treatment of apnea of prematurity. Their findings conclude that although no evidence exists that uncomplicated apnea of prematurity is detrimental, methylxanthines decrease apneic episodes and should be utilized because their short-term benefit outweighs the potential for harm (Ambalavanan & Whyte). Caffeine levels may be monitored and adjusted while the infant is experiencing significant apnea of prematurity (McCourt & Griffin, 2000). Many NICUs discontinue caffeine supplementation by 34 weeks postconceptual age or allow infants to “outgrow” their dose by not increasing it with weight gain.

Home monitors are recommended for preterm infants who are at increased risk of recurrent episodes of apnea, bradycardia, and hypoxemia after discharge and for those with complex medical needs or who need mechanical ventilation. The AAP counsels that in cases of immature respiratory control, clinical judgment should determine the use of monitors (AAP Committee on the Fetus and Newborn, 2003). The AAP further advocates that use be discontinued at 43 weeks postmenstrual age or cessation of extreme events, whichever comes last (AAP Committee on the Fetus and Newborn). Rates of infants discharged from the NICU with home monitors vary significantly with geographic location, neonatologist bias, and parent preference.

Home monitoring costs, while significantly less than prolonged hospital stays, are not inconsequential. In 2001 the cost of monitor rental was estimated at $300 to $350 per week; additional costs include the increase in office visits, the fees for downloading and evaluating recorded data, and the invasive studies that may be performed before stopping monitor use. Additional factors to consider regarding home monitoring include family stress, potential for vulnerable child syndrome, limited day-care selection, problems with returning to work, and sibling rivalry.

Resolution of apnea of prematurity often is associated with achievement of full nipple feedings and adequate temperature control (Marshall, 2003). The decision to monitor the premature infant at home is made by the neonatologist prior to hospital discharge, and typically a neonatologist, pulmonologist, or neonatal follow-up program monitors the infant for issues related to the home monitor. Discharge teaching for parents should include training specific to the monitor being used and infant CPR. All individuals caring for the infant should be included in the training. It is important to verify that this training has occurred during the initial patient visit. It is important to recognize that the recurrence of apneic episodes in a discharged premature infant may suggest the presence of a new infection or neuromuscular disorder (Marshall). Primary health care providers should support the family in their experience with the home monitor, encourage parents to work with the specialist monitoring the baby while he or she is on the home monitor, and coordinate services as much as possible. Primary health care providers also should reinforce use of the supine sleep position and stress that prone positioning is not recommended at home regardless of home monitor use.

CONCLUSIONS

Moderately premature infants who have had an unremarkable NICU course present some unique challenges to primary health care providers. Table 2 lists some excellent online resources available to families and health care providers.

<table>
<thead>
<tr>
<th>Resource</th>
<th>Web address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Care Safety Seat Inspection Stations</td>
<td><a href="http://www.seatcheck.org">http://www.seatcheck.org</a></td>
</tr>
<tr>
<td>Information on birth defects and prematurity</td>
<td><a href="http://www.marchofdimes.org">www.marchofdimes.org</a></td>
</tr>
<tr>
<td>Centers for Disease Control and Prevention Growth Charts</td>
<td><a href="http://www.cdc.gov/growthcharts/">www.cdc.gov/growthcharts/</a></td>
</tr>
</tbody>
</table>
Depending on the family’s NICU experience and perception of the child’s health, the family may either fixate on or negate the premature infant’s needs after discharge. If the child is perceived as “well but born early,” there may be a tendency to feed the infant term formula, decline developmental follow-up, or characterize the infant as almost term. These families want to normalize their preterm infant. Conversely, families may perceive their child as “premature and sick,” accentuating the vulnerability of the child. The primary health care provider is uniquely situated to help the family find a middle path that will allow the premature infant to grow and thrive.

Primary health care providers and neonatologists need to be partners in the care of premature infants. Computerized discharge summaries and growth charts facilitate this transfer of information between caregivers. Good communication of the infant’s hospital course, discharge plan, and follow-up requirements is crucial to the success of the child after discharge.

REFERENCES


