Nurses Take the Lead to Improve Overall Infant Growth

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Improving early nutrition

Standardized feeding protocol

Problem Identification

- Our babies were not growing consistently and many of them were falling off their growth curves
- Multidisciplinary group to look at how we could improve our feeding practices and advancements
  - Inconsistencies between Neonatologists
  - Feeding plan derailed during Hospitalists coverage
**What we know**

“Extrauterine Growth Retardation” is very common in VLBW infants. In the tiniest infants (<1000 g) 30-50% are discharged with weight, length or head circumference <10%. This is despite of knowing that:

- Early and adequate nutrition
- Decreases the incidence of sepsis
- Improves growth
- Improves cognitive outcomes
- Early enteral nutrition
- Improves feeding tolerance
- Improves growth
- Decreases complications of prolonged TPN

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**Early Nutrition and Improved IQ**

First week protein and energy influenced MDI at 18 month follow-up:

- 148 infants <1000 gm
- Adjustment for all usual morbidities made
- Charts reviewed for caloric and protein intake
- There was a linear relationship between improved first week intake and improved MDI

At 18 month Follow up:
- For each 10 kcal/kg increase in Week 1 energy intake, there was a 4.6 point increase in MDI
- For each 1 g/kg increase in protein in first week, there was an 8.2 increase in MDI


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**Improving Nutrition**

- Early Parenteral Nutrition
  - Administration of amino acids within the first 24 hours of birth decreases the “protein deficit” of newborn infant
  - Provision of 3 to 4 gm/kg protein improves glucose tolerance in ELBW infants

- Feeding
  - Early introduction of trophic or minimal enteral feedings improves feeding tolerance
  - Early introduction of mother’s breast milk decreases the incidence of late onset sepsis and NEC
What are we doing now?

- Early TPN for most VLBW infants – That’s good!
  - Starter TPN provides approximately 2 gm/kg at 80 ml/kg/day or 1.5 gm/kg/day at 60 ml/kg/day
  - To prevent protein deficit after birth, should advance to 3 - 3.5 gm/kg within 48 hours of birth
- Initiating feedings
  - The literature suggests that for most VLBW infants, trophic feedings should be started within 24 hours of birth
  - We start later and advance more slowly than recommended. Many of our <1000 gram babies are not on full feeds until over 3 weeks of age

<table>
<thead>
<tr>
<th>BW group</th>
<th>Mean BW</th>
<th>Mean GA</th>
<th>Day 1st Feed</th>
<th>Now 1st Feed</th>
<th>Day Full Feed</th>
<th>Now Full Feed</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;750 g</td>
<td>628</td>
<td>25.8 wk</td>
<td>Day 8.4 (3-32)</td>
<td>Day 12.56 (3-32)</td>
<td>Day 14</td>
<td>Day 14</td>
</tr>
<tr>
<td>751-1000 g</td>
<td>873</td>
<td>27 wk</td>
<td>Day 5.8 (2.30)</td>
<td>Day 10 (9-41)</td>
<td>Day 11</td>
<td>Day 11</td>
</tr>
<tr>
<td>1001-1250 g</td>
<td>1240</td>
<td>32.5 wk</td>
<td>Day 4.3 (1-13)</td>
<td>Day 14.3 (4-26)</td>
<td>Day 9</td>
<td>Day 9</td>
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<tr>
<td>N=34</td>
<td></td>
<td></td>
<td></td>
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</tr>
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<tr>
<td>N=41</td>
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<tr>
<td>N=66</td>
<td></td>
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</table>

Barriers to feeding

- Infant centered barriers
  - Poor Motility
    - Paradoxical and decreased upper intestinal motility results in delayed gastric emptying (residuals) and reflux of duodenal contents into stomach (green residuals)
    - Immature motility also responsible for delayed passage of meconium or "constipation"
  - Caretaker barriers
    - Fear of NEC
      - Most infants who develop NEC have been fed although there is no evidence that feeding causes NEC
    - Inconsistent practices among physicians
Rationale for Standardized Protocol

- Multiple studies have demonstrated that the introduction of standard feeding protocols have improved growth, led to earlier initiation of feeds and fewer days to achieve adequate enteral nutrition without increasing the rate of NEC.
- Initiating the protocol led to more standard advances in feedings that are tailored to each birth weight group.
- Clear guidelines for when to hold feedings, restart feedings and troubleshoot makes care more uniform and results in fewer long periods of “NPO”

Goals

- “Postnatal growth should approximate fetal growth”
  - Minimize extra-uterine growth failure
  - Provide adequate protein in addition to total calories to mimic in utero growth.
- Ideally, infants will achieve weight, length and head circumferences that follow the intrauterine growth curve.
- SGA infants should achieve some catch-up growth

Nutrient needs to achieve fetal growth rates

<table>
<thead>
<tr>
<th>Fetal growth (g/day)</th>
<th>500-700</th>
<th>700-900</th>
<th>900-1200</th>
<th>1250-1500</th>
<th>1500-1800</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein accretion (g)</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.4</td>
<td>2.2</td>
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<tr>
<td>Required enteral protein</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3.9</td>
<td>3.6</td>
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<tr>
<td>Energy needs Enteral</td>
<td>105</td>
<td>108</td>
<td>119</td>
<td>127</td>
<td>128</td>
</tr>
</tbody>
</table>

Human Milk

- Maternal milk is food of choice for premature infants
- More easily tolerated
- Appears to be protective against NEC when compared with infant formulas
- May be associated with lower rate of late onset sepsis
- It is unclear if pasteurized human milk has same protective properties but is better tolerated than formula

However, maternal milk—

- Does not have adequate protein/mineral/caloric density for preterm
- Needs fortification to meet the nutritional needs of the preterm infant

Suggested Protocol for CPMC

- Use human milk for all infants <1500 g. If maternal milk is not available, use pasteurized bank breast milk.
- Start trophic feedings early
  - Begin feedings for all babies within first 48 hours of life if hemodynamically stable (including DOL 1)
  - Umbilical lines and indocin are not contraindications to beginning feedings
- Advance feedings routinely per protocol (defined by BW category; goal is to be on substantial enteral feedings by 14 days of life in all weight groups

<750 g

Maternal Milk or Bank Milk only

- Trophic feeds only (1 ml q 6 h) x 3 days; advance to q 4 h on day 4, then q 2 hours on day 5.
- Begin routine advance of 10-15 ml/kg/day on day 4 with full feed=150 ml/kg/day fully fortified milk
- Fortify when at 80 ml/kg/day to 22 cal, then 24 cal at 100 ml/kg/day
- Add protein (1 ml/50 ml milk) when at 200 ml/kg/day

- If not tolerating bolus feeds (residuals requiring stopping feedings or not advancing x 24 hours), place on continuous drip feedings
- Keep bolus feedings at q 2 hours until >1250 gm.

For combined parenteral and enteral nutrition, keep protein intake at 3.5 g/kg/day combined intake. Wean TPN volume/glucose but maintain higher amino acid content until on full feedings.
**751-1000**

Maternal or Bank Milk only

- Trophic feeds of 1 ml q 6 x 3 days, then 1 ml q 3 h x 1 day then increase by 10 ml/kg/day feeding every 2 hours beginning day 4 and by 20 ml/kg/day on day 8
- Fortify to 22 cal when at 80 ml/kg/day and 24 cal at 100 ml/kg/day
- Add protein 1 ml/50 ml at 100 ml/kg/day
- Change to continuous drip if having residuals with every feeding and unable to advance per protocol
- Keep bolus feedings at q 2 hours until >1250 gm.
- For combined parenteral and enteral nutrition, keep protein intake at 3.5 gm/day combined intake. Wean TPN volume/glucose but maintain higher amino acid content until on full feedings.

**1001-1500**

- 1001-1250
  - Begin feedings on DOL 1 unless specific contraindications. Trophic feeds of 1 ml q 4 x 3 days, then 1 ml q 2 h x 1 day then increase by 10 ml/kg/day feeding every 2 hours beginning day 4 and by 20 ml/kg/day on day 8
- 1251-1500
  - Begin feedings on DOL 1 unless specific contraindications
  - Feed q 3 hours. No need for prolonged “trophic” feeding period

**<750 grams**

- Trophic feeds of 1 ml q 6 x 3 days, then 1 ml q 3 h x 1 day, then increase by 10 ml/kg/day feeding every 2 hours beginning day 4 and by 20 ml/kg/day on day 8
- Fortify to 22 cal when at 80 ml/kg/day and 24 cal at 100 ml/kg/day
- Add protein 1 ml/50 ml at 100 ml/kg/day
- Change to continuous drip if having residuals with every feeding and unable to advance per protocol
- Keep bolus feedings at q 2 hours until >1250 gm.
- For combined parenteral and enteral nutrition, keep protein intake at 3.5 gm/day combined intake. Wean TPN volume/glucose but maintain higher amino acid content until on full feedings.
Other issues

- Frequency of feedings
  - <1250 g: Feed q 2 hours after trophic period
  - >1250 g: Feed q 3 hours
- Continuous drip
  - Consider for any infant with persistent residuals of ≥50% of previous feeding volume or any infant who has failed multiple attempts at bolus feeding
- Stooling
  - Use suppositories early in the ELBW baby
  - Goal is minimum of one stool/24 hour period
  - May give as frequently as q 8 – 12 hours

Residuals

- Residuals are usually related to immaturity of gut motility
  - Green residuals may be sign of paradoxical contractions of upper GI tract and are not necessarily associated with NEC
  - The sudden appearance of large residuals in an infant previously tolerating feedings may be more ominous than frequent residuals

Stop feedings

- Hold feeding and ask attending M.D./N.N.P to evaluate if:
  - Distended abdomen
    - Tensely distended
    - Persistent visible loops
    - Tender abdomen
  - Vomiting
  - Bloody stools
  - New onset of large/dark green or persistent residuals
Holding feedings and restarting

- Residuals
  - Isolated large residual
    - Refeed and wait for next scheduled feeding
    - If improved, resume with normal feedings
  - Persistent residuals >50% of feedings
    - Hold feeding x 2 feedings, then restart at 50% of previous volume. Advance back to previous full volume if next feeding tolerated
    - Consider using continuous drip. Accepted residual is 50% of previous hours of feeding. Check q 4 h for continuous drip

Goals:

- Postnatal weight gain as close to expected fetal weight gain as possible. We want well grown babies, not just short fat babies
- Early initiation of enteral feeding with no increase in NEC
  - Exclusive use of human milk
  - Earlier fortification with both HMF and protein supplement
- Consistency of feeding practices

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