Infant Nutrition & Growth to Optimize Outcome

Fauzia Shakeel, MD
Neonatologist
All Children’s Hospital / Johns Hopkins Medicine
Affiliate Assistant Professor, University of South Florida
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Partnering to Improve Health Care Quality
for Mothers and Babies
Objectives

- Developing a standardized nutritional toolkit
- Early IV protein, lipid, & energy requirements
- Early initiation of enteral feeds
- Human milk diet
Rationale for Aggressive Nutrition

Last Trimester $\rightarrow$ Active amino acid transport
Glucose, facilitated diffusion

Calcium, phos, Mg, Iron, Lipid transfer

Delivery of premature Infant $\rightarrow$ High energy expenditure & inadequate protein and energy intake

Amino acids lower than in utero
Negative nitrogen balance and protein deficit

Catabolic Shock
Prevent Extrauterine Growth Restriction

Postnatal growth = Intrauterine growth

Ehrenkranz RA. NICHD Growth Observational Study. Pediatrics 1999
Components of Neonatal Nutrition

- Early Parenteral Nutrition
- Early Enteral Nutrition
- Post-discharge Nutrition & Follow up
- Transition to oral feeds & Monitor Growth

- Reduce time to regain BW
- MOM and DM fortification
- Reducing NEC
- Improve ND Outcome

Adopted from Bhatia, 2013
Early Neonatal Nutrition is Important

- Better postnatal growth & less likelihood of length and head circumference <10%ile
- Neurodevelopment
- NEC
- Sepsis
- ROP
- Impacts long term morbidity
Develop a Standardized Nutritional Toolkit

Partnering to Improve Health Care Quality for Mothers and Babies
Does your NICU have a standardized nutrition guideline for VLBW?

A. Yes
B. No
C. Unknown

- Yes: 84%
- No: 14%
- Unknown: 2%
Standardized Guidelines Improve Clinical Outcomes

- 0 day of life
- Lowers morbidity & improves outcomes ¹
- Improves feeding tolerance & decreases TPN days²
- Less discharge weight <3rd%ile ²,³
- Decreases variability of nutrition related outcomes²,³
  - NEC, late onset sepsis

¹Patole SK. Systemic reviews and meta-analyasis, 2005.
²McCallie KR. Improved outcomes with standardized feeding protocol in VLBW. Journal of Perinatology 2011.
³Street JL. Implementing feeding guidelines in NICU results in less variability in nutrition outcomes, 2006
Early IV Protein, Lipid, & Energy Requirements
In your NICU, when are IV protein initially started in VLBW infants?

A. 0 days of life
B. 1 day of life
C. 2 days of life
D. ≥3 day of life
E. Unknown
In your NICU, what is the initial IV protein administration for VLBW infants?

A. 0.5 g/kg/day
B. 1 g/kg/day
C. 2 g/kg/day
D. 3 g/kg/day
E. 4 g/kg/day
F. Unknown
In your NICU, when are lipids initially started in VLBW Infants?

A. 0 days of life
B. 1 day of life
C. 2 days of life
D. ≥3 day of life
E. Unknown

![Bar chart showing the distribution of initial lipid start days.]

- 68% start on 1 day of life
- 26% start on 0 days of life
- 6% start on 2 days of life
- 0% start on ≥3 days of life
- 0% start on unknown day
In your NICU, what is the initial IV lipids administration for VLBWs?

A. 0.5 g/kg/day
B. 1 g/kg/day
C. 2 g/kg/day
D. 3 g/kg/day
E. 4 g/kg/day
F. Unknown
Nutrition Challenges in VLBW Infants

- Inadequate PROTEIN (80%)
- Inadequate ENERGY (20%)

- Born w/minimal nutritional reserves
- Quickly develop catabolic state

Extrauterine growth restriction (EUGR)

Neurodevelopmental outcomes

Nutrition & Neurodevelopmental outcomes

Bayley II at 18 mo. CGA \(^1\)  

<table>
<thead>
<tr>
<th>Protein Intake</th>
<th>MDI Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every 1 g/kg/day</td>
<td>Increase by 8.2 points</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Energy Intake</th>
<th>MDI Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every 10 kcal/kg/day</td>
<td>Increase by 4.6 points</td>
</tr>
</tbody>
</table>


Outcomes at 18 to 22 Months’ Corrected Age According to Head Circumference Growth Quartile

Early IV Protein Intake Associations

- Less hyperglycemia & hyperkalemia and ↑ Nitrogen retention
  
- Less ROP

- Better postnatal growth
  - lean tissue growth
  - organ development

- Less discharge length < 10th % ile & better 18-month developmental outcomes

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Early IV lipid Intake

- Positive effect on nitrogen balance & improves energy intake\(^1\)
- Growth\(^2\)
  - Less discharge weight for age <10\(^{th}\)%ile\(^1,2\)
  - Less EUGR\(^2\)

- Neurodevelopmental outcomes
- Less ROP\(^1\)
- Less NEC\(^1\)

Safe & tolerated in VLBWs

(2 g/kg/day on day 1)

# Early, aggressive Nutritional Strategy in VLBW

<table>
<thead>
<tr>
<th></th>
<th>Aggressive (n = 117)</th>
<th>Conventional (n = 65)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>EUGR at 40 wks PMA, number (%)</td>
<td>62 (53)</td>
<td>50 (77)</td>
<td>0.005</td>
</tr>
<tr>
<td>Wt (kg) at 40 wks PMA, median (range)</td>
<td>2.95 (2.08-4.83)</td>
<td>2.7 (1.68-3.66)</td>
<td>0.002</td>
</tr>
<tr>
<td>Length (cm) at 40 wks PMA, mean (SD)</td>
<td>46.6 (2.6)</td>
<td>45.6 (2.7)</td>
<td>0.009</td>
</tr>
<tr>
<td>Head circumference(cm) at 40 wks PMA, mean (SD)</td>
<td>35.2 (0.17)</td>
<td>34.3 (0.21)</td>
<td>0.002</td>
</tr>
<tr>
<td>Days to regain birth weight, median (range)</td>
<td>10 (1–21)</td>
<td>16 (1–29)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Maximum weight loss, mean (SD)</td>
<td>9 (4.9)</td>
<td>13.3 (6.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Day of life at max weight loss, mean (SD)</td>
<td>4.7 (2.1)</td>
<td>12.7 (2.3)</td>
<td>0.005</td>
</tr>
</tbody>
</table>

### Recommended Early IV Nutrition in first week

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Day 0(^a)</th>
<th>Day 1-2</th>
<th>Day 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amino acids</td>
<td>≥2</td>
<td>≥3.5</td>
<td>3.5-4</td>
</tr>
<tr>
<td>g/kg/day*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lipid</td>
<td>≥2</td>
<td>3-4</td>
<td>3-4</td>
</tr>
<tr>
<td>g/kg/day</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Energy</td>
<td>60-80</td>
<td>80-100</td>
<td>≥100</td>
</tr>
<tr>
<td>Kcal/kg/day</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*For optimal lean tissue growth: 3-3.3 g protein per 100 kcal

\(^a\) First 24 hours of life
# FPQC vs. VON (2013)

## Weight Gain at Discharge

<table>
<thead>
<tr>
<th></th>
<th>FPQC</th>
<th>VON</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Discharge weight gain &lt;10th%ile, mean (IQR)</td>
<td>48.6 (41.7-54.4)</td>
<td>1,851</td>
</tr>
<tr>
<td>Discharge head growth &lt;10th%ile, mean (IQR)</td>
<td>23.3 (16.7-30.7)</td>
<td>1,837</td>
</tr>
</tbody>
</table>
Early Initiation of Feeds
(≤ 5 days of life)
In your NICU, when are first enteral feeds initiated in clinically stable VLBW infants?

A. 0 days of life
B. 1 day of life
C. 2 days of life
D. 3-5 days of life
E. > 5 days
Early Initiation of Enteral Feeds

- Hormonal stimulation of intestine growth\(^1\)
- Improves feeding tolerance\(^1\)
- Decreases TPN days → Decreases cholestasis\(^1\)
- Decreases NEC\(^1,2\)

**ASPEN clinical guidelines (2012)**

<table>
<thead>
<tr>
<th>Initiate feeds</th>
<th>≤ 2 days of life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advance feeds</td>
<td>~30 ml/kg/day*</td>
</tr>
<tr>
<td>Type of feed</td>
<td>Exclusive human milk</td>
</tr>
</tbody>
</table>

*For infants >1 kg

\(^1\) Evidence based guidelines for optimization of Nutrition for VLBW, NeoReviews, 2013

\(^2\) Fallon et al; ASPEN clinical guidelines: nutrition support of neonatal patients, JPEN 2012
Does your NICU use an exclusive human milk (mother’s own milk or donor breast milk) in VLBW infants during the first month of life?

A. Yes
B. No
C. Unknown

- **Yes**: 75%
- **No**: 22%
- **Unknown**: 3%
Does your NICU support the use of donor human milk?

A. Yes
B. No
C. Unknown

- Yes: 93%
- No: 7%
- Unknown: 0%
AAP recommends breastfeeding for all infants regardless of birth weight\(^1\)

Premature: mothers own milk or donor human milk

Improved neurodevelopmental outcomes\(^2,3\)

Decreased NEC\(^2,3\)

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\(^1\)AAP section on breastfeeding and the use of human milk. Pediatrics 2012

\(^2\)Vohr BR, Poindexter BB, Beneficial effects of breast milk in the neonatal intensive care unit on developmental outcomes of extremely low birth weight infants at 18 months of age. Pediatrics. 2006

Neurodevelopmental Outcomes Associated with Human milk use

Mean MDI and PDI scores at 18 and 30 months according to any BM feeding. NICHD data n=773

Donor Human Milk

- Similar to term milk (energy, fat, & lactose)\(^1\)
- Insufficient protein for preterm infant\(^1\)
- Effects of pasteurization (IgA, lactoferrin, lipase)\(^1\)
- Slower postnatal growth in early neonatal period (vs. formula)

### POTENTIAL BENEFITS\(^2\)

<p>| | |</p>
<table>
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<tbody>
<tr>
<td>NEC</td>
<td>(^2,^3)</td>
</tr>
<tr>
<td>Feeding tolerance</td>
<td>(^2)</td>
</tr>
<tr>
<td>Long term health outcomes, ↓BP &amp; LDH:HDL</td>
<td>(^2)</td>
</tr>
<tr>
<td>Enhanced Immunity (short &amp; long term)</td>
<td>(^2)</td>
</tr>
</tbody>
</table>

\(^1\) May J. Human Milk- Tables of the antimicrobial factors and microbiological contaminants relevant to human milk banking. La Trobe University. Available at:http://www.latrobe.edu.au/microbiology/milk.html.2013


\(^3\) Boyd CA. Donor breast milk versus formula for preterm infants: Systemic review and meta-analysis. Arch Dis Child Fetal Neonatal.2007
FPQC vs. VON (2013)

- Infants at Discharge on any Human Milk
- NEC
- Late onset sepsis
## FPQC vs. VON (2013)

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<thead>
<tr>
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<th>FPQC</th>
<th>VON</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>All infants: Any human milk, mean (IQR)</td>
<td>41.8 (33.3-48.7)</td>
<td>2,252</td>
</tr>
<tr>
<td>All infants: Human milk only, mean (IQR)</td>
<td>9.7 (3.9-18.4)</td>
<td>2,252</td>
</tr>
<tr>
<td>All infants: Formula only, mean (IQR)</td>
<td>47.1 (41.7-55.6)</td>
<td>2,252</td>
</tr>
<tr>
<td>NEC</td>
<td>4.4 (2-5.5)</td>
<td>2,251</td>
</tr>
<tr>
<td>Any late Infection</td>
<td>14.5 (10.8-18.3)</td>
<td>2,165</td>
</tr>
</tbody>
</table>
Are we interested in pursuing a nutrition project?
What should our project scope include?
What evidence-based measures do we want to address?
What measures should be evaluated for each of the goals?
THANK YOU

FPQC leadership
Dr. Tony Napolitano
Dr. Maya Balakrishnan