Prematurity:
Optimizing Growth in the NICU for Later Metabolic Outcomes

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Disclosures

There are no financial relationships to disclose.
NICU Nutrition: Goal

To achieve postnatal growth velocity that mimics intrauterine growth rates (AAP)

Prematurity/Catch-up growth

Embleton et al. 2001
Postnatal Growth → Neurocognitive Outcomes

Better NICU weight gain in preterm infants →

- Higher MDI/PDI developmental scores at 18M
- Lower rates of CP
- Lower rates of neurodevelopmental impairment
- Higher developmental scores at 5yr

SGA → Metabolic Outcomes: Barker’s Hypothesis

LBW →
- Higher rates of obesity
- Insulin resistance/DM2
- HTN
- High TG/low HDL
SGA $\rightarrow$ Metabolic Outcomes: Barker's Hypothesis

Rapid ‘catch-up’ growth $\rightarrow$ increased adiposity; linked with adult obesity

Prematurity $\rightarrow$ Metabolic Outcomes

Prematurity $\rightarrow$
- Higher visceral adiposity
- Decreased insulin sensitivity
- Higher blood pressure

?? related to rapid catch-up growth
Prematurity/SGA → Metabolic Outcomes: Summary

- SGA → early signs of metabolic syndrome
- SGA/rapid catch-up growth → early signs of metabolic syndrome
- Prematurity → early signs of metabolic syndrome, ?? related to catch-up growth

Prematurity = nutrient-restricted fetus

Preterm babies: ??high IUGR rates
NICU nutrition inadequate?
[fetal/NICU environmental stressors]

Catch-Up Growth:
Neurocognitive Development vs. Metabolic Syndrome?
I’m a NICU Nutritionist.

What’s the Bottom Line?

Nutritional Management in NICU

- NICU Nutrition: Crash Course
- Nutritional strategies: Then vs. Now
- Optimizing Kcal vs. Protein; protein-energy ratios
- Our NICU research
NICU Nutrition Crash Course: Nutrition Timeline

Parenteral Nutrition

Transitional Period

Enteral Nutrition

BIRTH

Start TPN

Trophic feeds

1EN, ↓PN
TF 140-150 ml/k/d

Advancing EN 100-160 ml/k/d

TPN d/c’ed; human milk fortifier added to breastmilk

Goal EN 160-180 ml/k/d

DISCHARGE

Enteral Feeds: breastmilk/donor breastmilk (with HMF), preterm infant formula
GOAL:
Optimize Nutrition at each step to:

(1) MAINTAIN TARGETED NUTRIENT INTAKES →
MAINTAIN TARGETED GROWTH RATES

(2) AVOID NEED FOR CATCH-UP GROWTH

NICU Nutrition Timeline: Old vs. New Trends

Old Guidelines:
Metabolic immaturity →
Slow dextrose, IL advancement
Lower protein – renal function??

New Guidelines:
more aggressive nutrient provision
“Starter TPN” – higher protein, promotes anabolism
Old Guidelines:
- Breastmilk with HMF
- High kcal formulas
- Fat/CHO modulars
- Replacing EBM with higher kcal formulas

New Guidelines:
- Breastmilk – encourage
- High protein HMF added to EBM
- Protein modulars – added to EBM
- Higher-protein formulas
- Protein-energy ratios
- Linear growth, HC growth
- BMI curves

NICU Nutrition Timeline: Old vs. New Trends

- Poor growth
- decreased kcal/protein provision
- decreased BUN
- Growth failure at discharge: 4x more likely

JPEN J Parenter Enter Nutr; 2013
## NICU Nutrition Timeline: Old vs. New Trends

<table>
<thead>
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## Nutritional Guidelines during Transition

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<td>1331 ± 339.8</td>
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<td>z-score at birth ± SD</td>
<td>-0.16 ± 0.59</td>
<td>-0.29 ± 0.52</td>
<td>0.117</td>
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<tr>
<td>z-score at DOL 7 ± SD</td>
<td>-0.97 ± 0.48</td>
<td>-1.03 ± 0.46</td>
<td>0.401</td>
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<td>z-score at start of transition ± SD</td>
<td>-1.02 ± 0.52</td>
<td>-1.1 ± 0.47</td>
<td>0.254</td>
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<td>z-score at end of transition ± SD</td>
<td>-1.1 ± 0.55</td>
<td>-1.3 ± 0.52</td>
<td>0.0078</td>
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<tr>
<td>z-score at CGA 35 wk ± SD</td>
<td>-1.2 ± 0.73</td>
<td>-1.5 ± 0.85</td>
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#### Results: Trends in z-score

- Weight gain: 16.1 ± 4.6 gm/kg/day *
- Weight gain: 13 ± 5.6 gm/kg/day

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* p<0.01
Results: Protein-Energy Ratio

EN volume (ml/kg)

Protein-Energy Ratio (gm/100kcal)

- Controls
- Study Group
NICU Nutrition: Summary of Newer Trends

**Parenteral Nutrition**
- Start TPN
- Trophic feeds
- Aggressive TPN; protein from birth
- Avoid nutritional deficits/need for catch-up growth

**Transitional Period**
- Start EN, ↓PN TF 140-150 ml/kg/d
- Advancing EN 100-160 ml/kg/d
- TPN d/c’ed; human milk fortifier added to breastmilk
- Concentrated TPN

**Enteral Nutrition**
- Goal EN 160-180 ml/kg/d
- High protein HMF
- Protein modulars; PER
- Breastmilk
- Avoiding rapid wt gain

NICU Nutrition Growth Goals: Old vs. New Trends

**Old Guidelines:**
- Get them to 10th percentile!!

**New Guidelines:**
- Maintain their growth curve
- Prevent ‘nutrition lags’ at each step of nutrition timeline
- Avoid rapid catch-up growth
Case Study

TPN: cautious advancement of AA, dextrose, IL

MCT oil/rice cereal
Switch EBM to higher kcal formula
Increase volumes of fortified EBM
Goal: catch up to 10th percentile

Weaning TPN

Aggressive TPN; protein from birth

High protein HMF
Protein modulars; PER avoiding rapid wt gain

Concentrated TPN to maintain kcal/pro
Questions?