Nutrition in the preterm - current menu

Dr Heena Hooker
Consulting Neonatal Paediatrician
Aga Khan University Hospital, Nairobi
Outline

- Background
- Challenges in preterm nutrition
- Parenteral Nutrition
- Enteral nutrition
- Role of supplements
- Nutritional monitoring
- New developments
- Summary
Introduction

- Nutrition is an essential component for growth, metabolism, immunity and neurodevelopment in a preterm.

- Poor nutrition
  - Poor head growth – poor psychomotor and mental skills
  - Adverse neurodevelopmental outcomes

- Barker hypothesis
  - Low birth weight infants at high risk of
    - Coronary heart disease
    - Hypertension
    - Type 2 diabetes in adulthood

- Current nutritional strategies unable to prevent postnatal growth restriction
Nutritional challenges

- Born at a time of otherwise rapid growth in utero
- Phenomenal growth demands a much higher intake of energy, protein and other nutrients
- Structural and functional immaturity of the gut
- Immature coordination of sucking, swallowing and breathing making suckling difficult
- Low stores of key micronutrients (iron, zinc, calcium, vitamins) + low subcutaneous stores of fat and glycogen – most placental transfer occurs in third trimester
- Medical conditions increase metabolic energy requirements
Nutritional goal

- Achieve rates of growth and nutrient accretion that match those achieved by infants of similar gestational age in utero
- Rate of growth
  - INTERGROWTH 21st century 2014
- Nutrient accretion
  - Chemical analysis of fetal cadavers
  - Contemporary non-invasive neutron activation techniques
Energy Requirements

- Parenterally fed: 80–100 kcal/kg/day
- Enterally fed: 120 kcal/kg/day
- Chronic illness: 150 kcal/kg/day
Recommended enteral nutrient intakes for preterm infants.

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Parenteral nutrition
**Parenteral feeding: Rationale**

- First weeks of life in the VLBW (<1500 g) as enteral nutrition is established
- Helps treat in utero growth restriction and postnatal growth failure
- Initiated as early as possible, even on the first day of life
- Administered through a central line mostly (can be given peripherally)
- Laboratory monitoring required
  - Adjust contents of the solution
  - Avoid excesses and deficiencies
- Monitor for complications
Parenteral feeding: Challenges

- Appropriate administration of intravenous nutrition can be difficult in the first few days
  - Infusion of drugs, volume boluses to maintain BP
  - Maintenance of vascular access
- Preterms barely receiving 30-50% of estimated nutritional intake (surveys in Europe and USA)
- Undernutrition
  - Significantly affects early postnatal growth
  - Causes electrolyte imbalances due to cellular catabolism
- Suboptimal nutrition attributed to
  - Lack of confidence in consensus guidelines
  - Fear of adverse metabolic outcomes
Parenteral nutrition: Requirements

- Glucose 3.5 mg/kg/min to a maximum of 12 mg/kg/min (close blood glucose monitoring)
- Amino acids 3.5 g/kg/day to a maximum of 4 g/kg/day (essential and nonessential)
- Lipids 1g/kg/day to a maximum of 3g/kg/day (20% solution)
- Other nutrients
  - trace elements
  - minerals,
  - vitamins
  - electrolytes
Parenteral feeding: Issues

- Restricted vs. liberal fluid intake?
  - ↓ risk of PDA and NEC with fluid restriction *(Cochrane Database 2014)*
- Many uncertainties
  - Ideal quantity and balance of amino acids
  - Optimal content of lipid emulsions
  - Optimal intake of macronutrients and how rapidly they can be increased *(Harding et al, Lancet 2017)*
Parenteral nutrition: problems

- Complications
  - Cholestasis
  - Line infection and sepsis
  - Air embolus
  - Infiltration and skin sloughing
Enteral nutrition
Enteral feeding: Issues

- Breast milk or formula?
- Early or late?
- Continuous vs. bolus?
- Rapid vs. slow?
- Nasogastric or orogastric?
- Does enteral feeding increase the risk for NEC?
Milk – which milk?

- Mother’s own breast milk
- Donor breast milk
- Fortified breast milk
- Preterm formula

(ESPHGAN guidelines)
Intakes of key nutrients from various enteral nutrition feedings for preterm infants in the United States, assuming milk intake of 160 mL/kg per day

<table>
<thead>
<tr>
<th></th>
<th>Target Intake*</th>
<th>Unfortified human milk $^\Delta$ (≈20 kcal/oz)</th>
<th>Fortified human milk $^\bowtie$ (≈24 kcal/oz)</th>
<th>Preterm formula (24 kcal/oz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kcal/kg/day)</td>
<td>128</td>
<td>104</td>
<td>128</td>
<td>129</td>
</tr>
<tr>
<td>Protein (g/kg/day)</td>
<td>3.5 to 4</td>
<td>1.6</td>
<td>4.1 to 4.3</td>
<td>4.3 to 4.6</td>
</tr>
<tr>
<td>Fat (g/kg/day)</td>
<td>5 to 7</td>
<td>5.6</td>
<td>6.3 to 8.3</td>
<td>5.6 to 7.0</td>
</tr>
<tr>
<td>Carbohydrate (g/kg/day)</td>
<td>12 to 14</td>
<td>11.2</td>
<td>11.2 to 13.6</td>
<td>12.9 to 13.6</td>
</tr>
<tr>
<td>Calcium (g/kg/day)</td>
<td>150 to 120</td>
<td>40</td>
<td>192 to 197</td>
<td>210 to 234</td>
</tr>
<tr>
<td>Phosphorus (mg/kg)</td>
<td>75 to 140</td>
<td>22</td>
<td>103 to 110</td>
<td>117 to 129</td>
</tr>
<tr>
<td>Vitamin D (IU/day)</td>
<td>400</td>
<td>0.3</td>
<td>189 to 253</td>
<td>194 to 384</td>
</tr>
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</table>
Milk fortification

- Principle of increasing the concentration of nutrients to meet the infant’s needs within customary feeding volume
- Monocomponent vs. multicomponent
- Minimum volume of feed 100mls/kg/day
- Standard fortification may not meet the recommended protein intake in preterm infants
- Concept of individualized fortification
  - Targeted vs. Adjustable
Donor pasteurized breast milk

- Available in countries with human milk banks
- Milk should be pasteurized
- Screened for HIV, HCV, HBsAg and venereal disease
- Donor mother should also be screened for the same (6 months)
- Pooled milk may be used if proper consent obtained
- Donor milk can be stored at -20 degrees for six months
Early vs. Late Enteral Feeds

- Early initiation of low volume feed shown to have many clinical benefits
- Delaying enteral feeds does not reduce the risk of NEC
  *Cochrane Database Systemic Review 2014*
Benefits of Early Trophic feeds

- Better feed tolerance
- Rapid maturation of intestinal motility patterns
- Higher serum GIT hormones
- Lowered risk of late onset sepsis
- Lower incidence of conjugated hyperbilirubinemia
- Better absorption of calcium and phosphorous and less osteopenia of prematurity
Rapid vs. slow advancement of feeds

- Optimal rate not been established
- Protocols vary from centre to centre
- Mostly advance feeds at 15-25 ml/kg/day
- More rapid advancement of feeds (30 to 40 ml/kg/day) could be successful when used with a carefully managed protocol and does not increase the risk of NEC

(Cochrane Systematic Review 2015)
Continuouos vs. bolus

- No nutritional advantage with either, in the absence of GIT disease
- Most protocols provide enteral feeds every three hours
- More frequent feeds or continuouos feeds
  - Improve feed tolerance
  - Reduce time to attain full feeds
  - Greater weight gain
  - Fewer days on TPN (Demauro et al, 2011)
- Continuouos feeds are useful in infants with GIT disease, post-intestinal surgery and infants being fed via the transpyloric route
How to feed?
Nasogastric vs. Orogastric

- All preterms <1800 g

- Nasogastric tubes
  - Increase airway resistance
  - ↑ periodic breathing and central apnoea

- Orogastric tube feeds are the preferred option

(Van Someran et al, Pediatrics 1984)
Breastfeeding the preterm

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<th>Inadequate milk production</th>
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<td>Incomplete mammary development</td>
<td>Poor milk transfer due to sucking immaturity</td>
</tr>
<tr>
<td>Stress</td>
<td>Poor suck, swallow, and breath reflex</td>
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Breastfeeding the preterm

- Steps to successful implementation of full breastfeeding in preterm below 34 weeks
  - Demonstration of oral skills indicating readiness to feed (non-nutritive sucking and rooting)
  - Initiation and advancement of breast feeding
    - Closely monitoring milk production and milk transfer
  - Transition to full breastfeeding
    - Encouraging mother to participate in care of the infant and kangaroo care
Late Preterm

- Preterms 34 to 36+ weeks
- Look and behave superficially like term infants
- Tendency to avoid medicalization of this group who are otherwise well
- More likely to experience difficulty in establishing breastfeeding
- Infants may not fully empty the breasts because of increased sleepiness, fatigue and difficulty maintaining the latch
- These infants will require close monitoring and possibly supplemental feeds
- Very little evidence-based data on early nutritional support of these infants
Nutritional supplementation
Nutritional supplements

- Iron
- Sodium and potassium
- Calcium and Phosphorous
- Vitamins
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Iron

- Low iron stores
- Often depleted by 2-3 months of age
- Breast milk is low in iron
- Iron supplementation 2-4mg/kg/day for all preterms on exclusive breast milk for the first year of life
- Infants on iron fortified formula may not require supplementation
Sodium and Potassium

- Regular monitoring
  - Daily in infants on parenteral fluids
  - Weekly in infants on enteral feeds
- Requirements
  - Na+ 2 to 4 mmol/kg/day
  - K+ 1 to 2 mmol/kg/day
- Supplementation may not be required in infants on fortified feeds and preterm formula
Calcium and Phosphorous

- Low skeletal stores of calcium and phosphorous
- Needed for healthy bones and growth
- Preterm human milk content insufficient for the needs of the preterm infant
- Insufficient evidence as to whether supplementation of calcium and phosphorous improves bone health and growth (Cochrane Database 2017)
- No longer common practice to give supplements with the use of human milk fortifiers and preterm formula
- More randomized studies required looking at outcomes with the use of fortifiers
Multivitamins

All breastfed and formula fed (taking <500 ml in 24 hr) require multivitamins
Nutritional monitoring

Growth parameters

- Weight
  - Daily
  - 18 g/kg/day (<2 kg)
  - 20-30 g/kg/day
- Length
  - Weekly
  - 1 cm/week
- Head circumference
  - Weekly
  - 0.5 cm/week
- Rate of growth

Laboratory markers

- Protein status
  - BUN Urea >3.5 mmol/l
- Haemoglobin
- Bone mineral status
  - Ca, P04, ALP
- Serum electrolytes
  - Na, K, HCO3
- Serum prealbumin (transthyretin)
Fenton preterm growth chart
Post discharge nutrition

- Sucking/swallowing ability of the infant should be good at discharge
- Ideal discharge weight may vary from centre to centre and depend on local services available to take care of the infant after discharge
- Standard formula may be initiated once the infant has reached the birth centile
- Complementary feeding may be initiated at a corrected age of four months
- Monitored for up to a minimum of two years and preferably till adolescence
New developments

- Use of standardized parenteral nutrition formulation -
  - Easy to use, stable, long shelf life
  - Reduce prescription errors

- Early oropharyngeal administration of colostrum
  - Improve early immune development
  - Promote early commencement of breastmilk

- Emerging data highlighting the importance of Vitamin D for immune regulation

- Ongoing trials
  - Role of insulin like growth factor in early nutrition
  - Immunonutrients (Bilesalt stimulated lipase and bioactive peptides)
Summary

- Enteral feeding is the safe and preferred option for preterms.
- Parenteral nutrition is a useful adjunct in VLBW infants.
- Early, fast and continuous feeding yield better outcomes compared to late, slow or intermittent feeds.
- Human breast milk remains the first choice.
Summary

- Fortification is safe and effective but does not fulfill high protein needs.
- Checking for optimal weight gain and sucking/swallowing ability essential prior to discharge.
- Regular follow up and monitoring will help achieve better long term outcomes.
Asante Sana!!