Advances in Human Milk Feeding

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Session Summary
This presentation will discuss the benefits of human milk for low birthweight infants, focusing on exclusive human milk diet and future direction for human milk research.

Session Objectives
Upon completion of this presentation, the participant will be able to:
▪ discuss the benefits of an exclusive human milk diet;
▪ identify the effects of pasteurization of donor breast milk.

References


Neu, J. (2007). Myths and dogmas in neonatal gastroenterology and nutrition. *NeoReviews, 8*(11), e485-e489


Tuttle, D.J., Williams, M.A, Moore, G., et al. Reduction in NEC associated with human milk based fortifier as a value added strategy. PAS 3838.657,

Advances in Human Milk Feeding

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Importance of Human Milk

AAP Policy Statements

- "All preterm infants should receive human milk."
  - There are significant short and long-term beneficial effects of feeding preterm infants human milk
- Current U.S. supply of donor milk not sufficient to supplement all infants
  - Should be prioritized for use in infants born at <1500 gms
- Human milk should be fortified to ensure optimal nutrient intake for infants weighing <1500 grams at birth
- Pasteurized donor human milk (DHM) should be used if mother’s own milk is unavailable
- No clear guidelines for when to discontinue use
  - Ranges from 32-36 WGA at various institutions
- May have direct effect on intestinal growth and feeding tolerance in high risk intestinal disorders
  - i.e. gastroschisis or omphalocele

Safety of Donor Milk

Screening

- Screening practices of mothers vary between milk banks
- Health screening questionnaire
- Blood serologic testing
- Instructions for collecting, storing, and shipping milk
- Some perform DNA matching
- Screening for drugs of abuse
- Bovine protein testing

Pasteurization

- Pasteurization process effective in removing viral components
- Each milk bank varies in its approach to screening
  - Post-pasteurization bacterial cultures performed routinely
- There has been no report of pasteurized donor milk causing a case of infection with hepatitis viruses or HIV
Pasteurized Donor Human Milk

- Human Milk Banking Association of North America
- ~30 individual banks
- Prolacta Bioscience
- Hospital Based Milk Banks
- Medolac/Mother’s Milk Cooperative
- Ni-Q

Effects of Pasteurization on Human Milk Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Untreated Human Milk</th>
<th>Pasteurized Human Milk</th>
<th>% Remaining</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactoferrin (g/100mL)</td>
<td>0.24</td>
<td>0.033</td>
<td>14*</td>
</tr>
<tr>
<td>Lysozyme (Units/mL)</td>
<td>39,000</td>
<td>22,000</td>
<td>57*</td>
</tr>
<tr>
<td>Immunoglobulin A (mg/mL)</td>
<td>315</td>
<td>230</td>
<td>73*</td>
</tr>
<tr>
<td>Secretory IgA</td>
<td>462</td>
<td>379</td>
<td>83*</td>
</tr>
<tr>
<td>Vitamin B6 (mcg/100mL)</td>
<td>8.8</td>
<td>7.4</td>
<td>89</td>
</tr>
</tbody>
</table>

* Variable effects

Effects of Pasteurization

- Significant Impact
  - IgG 4
  - Enzymes: alkaline phosphatase, amylase, lipase
  - Growth Factors: IGF 1 and 2, EGF, GM-CSF
  - Amino Acids:
    - Increased: arginine, leucine, glutamine
    - Decreased: aspartate
- Minimal Impact
  - Fatty acids
  - Saccharides
  - Vitamins: D, E, B2, B5, Biotin, B3, B12
  - Amino Acids: taurine, methionine, cysteine, glutamate
  - Cytokines: IL 2, IL 4, IL 5, IL 7, IL 13
  - Growth Factors: EGF, TGF Beta 1 and 2, MCP-1

- Variable Impact
  - Protein
  - Immunoglobulins A, sA, M, G
  - Lactoferrin
  - Lysozyme
  - Fatty acids
  - Cytokines (decreased) IL 1β, IL 6, IL 10, TNF α, INF γ

Benefits of EHM

- Associated with decreases in the following
  - NEC rates
  - Days to full feeds
  - TPN days
  - Central line days
  - Length of stay
  - Ventilator days
Decreasing NEC

- Cost of one case of medical NEC ~$75,000
- Cost of one case of surgical NEC ~$200,000

Decreasing TPN

- Cristofalo et al.: 9 day reduction in total TPN days
  - EHM versus all formula diet
- Ghandehari et al.: 11-14% decrease in risk of being on TPN any given day
  - Compared EHM to EBM with bovine fortifier
- Based on SJWH cost of TPN ($500 per day) and population, a 9 day reduction would translate to over $200,000 per year savings

Implementation of Exclusive Human Milk Diet: A Shared Experience

St. Joseph’s Women’s Hospital

- 64 bed Level 3 NICU
- 7-8,000 deliveries per year
- 1,200 NICU admissions per year
- ~150 <1500 gram birthweight NICU admissions per year
- 60-100 <1000 gram birthweight NICU admissions per year

Recommendations when implementing human milk

- Programs to support increasing maternal production rates
- Standardize feeding protocols
- Implement guideline for donor milk use
- Scripting for family education/consent process
- Implement consent and/or opt out process
- Establish relationship with one or multiple banks

SJWH Timeframe of Implementation

- 10/2013: Began use of Prolacta Donor Human Milk
- 3/2014: Began use of Prolact+ Fortifier for exclusive human milk diet
- 6/2015: Began use of human cream (CR)
- 9/2016: Began enrollment for human cream study (Prolacta)
- 2/2016: Began use of HMBANA donor human milk for normal newborns
- 7/2016: Expanded use of HMBANA donor human milk to NICU
Considerations Beyond Human Milk Cost

- Establish feeding guidelines and milk protocols
- Train hospital staff
- Equipment for storing
- Location for storage and preparation
- Thawing machine
- Tracking system
- Ordering system

Donor Milk Eligibility

- <32 WGA OR <1500 grams
  - Continue until >35 WGA AND >1700gm
- Other potential indications
  - Gastroschisis or omphalocele
  - Major congenital heart disease
  - During cooling for HIE
- Also used for moms who wish to exclusively breastfeed
  - For the first 5-7 days
  - Use longer if mom providing >50% of infant’s daily needs

Exclusive Human Milk Eligibility

- <1000 gm birthweight
- Continue until >32 WGA AND >1500gm

Feeding Guidelines for VLBW Infants

<table>
<thead>
<tr>
<th>Feeding Day</th>
<th>BW&lt;750gms or IUGR</th>
<th>BW 751-1000gms</th>
<th>BW 1001-1500gms or &gt;32 WGA</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>1mL q12</td>
<td>1mL q6</td>
<td>1mL q6</td>
</tr>
<tr>
<td>2</td>
<td>1mL q12</td>
<td>1mL q6</td>
<td>Increase by 20mL/kg/day</td>
</tr>
<tr>
<td>3</td>
<td>1mL q6</td>
<td>1mL q6</td>
<td>Increase by 20mL/kg/day</td>
</tr>
<tr>
<td>4</td>
<td>1mL q6</td>
<td>Increase by 20mL/kg/day</td>
<td>Increase by 20mL/kg/day</td>
</tr>
<tr>
<td>5</td>
<td>1mL q3</td>
<td>Increase by 20mL/kg/day</td>
<td>Increase by 20mL/kg/day</td>
</tr>
<tr>
<td>6</td>
<td>2mL q3</td>
<td>Increase by 20mL/kg/day</td>
<td>Increase by 20mL/kg/day</td>
</tr>
<tr>
<td>7</td>
<td>Increase by 20mL/kg/day</td>
<td>Increase by 20mL/kg/day</td>
<td>Increase by 20mL/kg/day</td>
</tr>
</tbody>
</table>

EHM Diet Fortification

- 24 kcal/oz (Prolact+4) at 40mL/kg/day
- 26 kcal/oz (Prolact +6) at 80mL/kg/day
- Cream (CR) at 80 mL/kg/day
- Inc to 28 kcal/oz (Prolact +8) if growth <15gm/day average over a week

Transitioning off of EHM

- Transition from donor derived fortifier to HPCL fortification over 4 days
  - Day 1: 2 feeds with HPCL
  - Day 2: alternate feeds of donor derived fortifier and HPCL
  - Day 3: 2 feeds with donor derived fortifier
  - Day 4: all feeds with HPCL
Milk Storage

Milk Preparation

- All NICU Human Milk feedings prepared in a central milk lab
- Donor and mom's milk for infants who qualify for DHM
- Prepared by milk technicians
- Standardized milk preparation process
- Controlled environment separate from patient care areas
- Preparation of 24 hr of milk feedings
  - Divided into syringes for each feeding

Outcomes

Optimizing Growth

- Problem: Initially we saw a decrease in average weight gain
  - Required use of increased fortification to +8 and +10
- Solutions:
  - Wait min 72 hrs after a feeding change to observe a result
  - Changes in feeding practice to optimize enteral nutrition and fat delivery
    - Feeds over 30 min
  - No NPO during Indocin, instead dec to trophic volumes, then restart at previous
  - Support growth by decreasing respiratory metabolic demand
    - Keep CPAP to 1,200-1,400 grams

SJWH Outcomes After 1 Year*

- Increased human milk use
  - From 60% to 92%
- Increased breastfeeding at discharge
  - From 41% to 77%
- Decreased LOS
  - From 41.7 to 41.7
  - 201 total fewer days in first year, at -$1,000/day = $200,000
- Decreased central line days
  - From 18 to 14 with donor milk, then to 12 with DHM
- Decreased average days to full feeds
  - From 21.2 to 15.2
- Decreased TPN Days
  - From 28 to 15 with donor milk, then to 15.5 with DHM

NEC in Infants Born at <1000 gms

- 2012: Prior to implementation of donor milk or EHM Diet
  - Overall NEC rate 9%, surgical NEC rate 5.5%
  - 5 cases of NEC
  - 3 cases of surgical NEC
- 2016: 3 years after donor milk and 2 years after EHM Diet
  - Overall NEC rate 1% (inborn)
  - Zero cases of NEC

* In infants <1000 gms