Nutritional management post Necrotising Enterocolitis – a practical approach

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Topics covered

- Who gets necrotising enterocolitis?
- The challenge of feeding post NEC
- Evidence for feeding post NEC
- Medical NEC – nutritional management
- Surgical NEC – nutritional management – case study

**Deal with preterm infants**
**Deal with enteral feeding**
Who gets NEC?
Necrotising enterocolitis

- Nutritionally vulnerable preterm infant
  - Mucosal inflammation and gut tissue necrosis
    - Destruction of integrity of the gut
  - Catabolic state
    - Reduced capacity of the gut to effectively absorb enteral nutrients
  - Deteriorating nutritional status
Nutritional management of NEC - overview

Parenteral nutrition

Support breast milk expression

Nil by mouth
7-10 days

Gastric decompression

KEEP CALM
NIL BY MOUTH
Nutritional management of NEC - overview

• Goals:
  – Gut rest
  – Preserve/support nutritional status
  – Avoid toxicity – protect liver
  – Prevent biochemical abnormalities
  – Support family
What is the evidence about enteral feeding post NEC?
Benefits of enteral feeding

• Enteral feeding promotes
  – cellular hyperplasia
  – regeneration of brush border
  – bile flow
  – gut motility

• Trophic volumes prepare the gut for full feeding

• Longer term, enteral feeding is key to gut repair
When should enteral feeding restart in medical NEC?

- Little evidence or consensus
- Depends on disease severity
- 7-10 days post onset of NEC??
- Likely some infants can tolerate earlier if clinically improving and inflammatory markers reducing
Evidence

Early enteral feeding (day 4-5) post medical NEC stage II or above in clinically improving infants may be beneficial:

- shorter time to full enteral feeds (Bohnhorst et al 2003)
- reduced catheter related septicaemia (Bohnhorst et al 2003, Brotschi et al, 2009)
- shorter hospital stay (Bohnhorst et al 2003)
How to progress with feeds?

• No evidence

• Pragmatic and practical approach
  – Slowly! 10-20 ml/kg/day
  – Be guided by NG aspirates, abdomen, clinical condition
  – Wean PN as feeds increase, consider growth
What to feed post medical NEC?

First choice - HUMAN MILK
  – Freshly expressed MEBM
  – Pasteurised donor milk

• Benefits to the infant post NEC:
  – Readily absorbable
  – Epidermal growth factor – mucosal growth
  – Hormones – modulates growth effects
  – Oligosaccharides – microbial protection
  – Glutamine – fuel for enterocytes
  – Enzymes – aid digestion and absorption
What to feed post medical NEC?

No human milk available ???

Very little evidence available
Conflict for enteral feeding post NEC

Prematurity
Growth
Bone health

Feed tolerance
Nutrient malabsorption
Gut inflammation
Formula choice

- Peptides Lactose
  - Hydrolysed preterm formula
- Whole protein Lactose
  - Standard preterm formula
- Amino acids Lactose free
  - Amino acid based term formula
- Peptides Lactose free
  - Peptide based term formula
Formula choice - straw poll

- Hydrolysed preterm formula: 3 units
- Standard preterm formula: 3 units
- Amino acid based term formula: 3 units
- Peptide based term formula: 3 units
Benefits/risks of hydrolysed feeds for the preterm infant

• Potential benefits
  – Better tolerance
  – Less malabsoprtion
  – ? Effects on remission

• Potential risks
  – Poorer growth
  – Lower lean body mass
    • Increased urinary nitrogen excretion
    • Plasma amino acid imbalance
  – Poorer bone mineralisation
    • Reduced absorption of calcium and phosphorus
Feeding post surgical NEC

- Management depends on:
  - extent and site of resection (less adaptive capacity with significant ileal resection)
  - quality of remaining bowel
  - whether stoma present

The relative locations of digestion and absorption of nutrients in the healthy gastrointestinal tract. Jeejeebhoy K N CMAJ 2002;166:1297-1302
Consequences of extensive resection

• ‘Intestinal failure’ or ‘short bowel syndrome’
  – Critical reduction in gut mass or function below the minimum needed to absorb nutrients and fluids required for adequate growth

• Leads to:
  – Malabsorption of macro and micronutrients
  – Growth failure
  – Fluid balance disturbances
  – Electrolyte disturbances
Nutritional management post surgical NEC

• Phases of management – can be protracted
  • Recovery + PN
  • Trophic enteral feeding
  • Increasing enteral feeds
  • Weaning of PN

• Aim to support normal growth and development & promote intestinal recovery and adaptation whilst minimising complications

Enteral feeds are the single most important factor in promoting adaptation
What can we feed post surgical NEC?

- First choice = human milk
- Beneficial effect on gut adaptation

BUT infants post gut resection may have poorer tolerance to whole protein fat and lactose
Formula selection post surgical NEC

• What do we consider when choosing a formula feed post gut resection?
  – Nutritional requirements – premature?
  – Bowel length and integrity – lactose tolerance?
  – Stoma output – volume and quality
  – Complications eg liver impairment
  – Time since GI surgery
  – Weight and growth history
## Formulas available

<table>
<thead>
<tr>
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<th>Protein (g/100ml)</th>
<th>MCT (%)</th>
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<th>Meet preterm nutritional need</th>
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<tbody>
<tr>
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<td>1.3 (whole)</td>
<td>?</td>
<td>284</td>
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<td>Nutriprem 1</td>
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<td>375</td>
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<td>SMA GoldPrem Pro</td>
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Monitoring

- Enteral feed increase can be slow
- Need a consistent approach
  - Gastric aspirates - volume and quality
  - Stoma output - volume and consistency
  - Malabsorption signs
  - Growth/weight gain
  - Feeding method – continuous vs bolus
  - Urine sodium
How do we feed after surgical NEC?

• Orally – if gestationally appropriate
  – Important in avoiding aversive behaviours later on
  – Aids in gut adaption (epidermal growth factor produced in salivary glands)

• Enteral (bolus vs continuous)
  – Boluses more physiological
  – Continuous encourages feed absorption and recommended if boluses fail
Nutritional outcomes

- Medical NEC
  - Majority off PN within 2-3 weeks

- Surgical NEC - much poorer
  - Short bowel in 20-25% infants (Murthy et al, 2014)

[Diagram showing Kaplan-Meier Estimates of PN duration]
Summary of management

- Parenteral nutrition from time of onset
- Nil enterally for a maximum of 7-10 days
- Consider introducing feeds earlier if clinically improving and breast milk available
- Use human milk as first choice post NEC
- If no human milk available
  - Medical NEC - consider hydrolysed preterm/term feeds depending on gestation and severity of NEC
  - Surgical NEC – likely to require peptide/amino acid feed and proceed slowly depending on extent of surgery
Case study

• 35 yr old supported mother
• Mum – preterm, NEC and ileostomy as an infant
• First pregnancy
• IVF identical twin pregnancy
• Intrauterine growth restriction
• Twin to twin transfusion
• Normal ante-natal dopplers
Birth

• Emergency caesarean at 28+6 weeks
• Male infant
• Born in poor condition
• 630g (0.4\textsuperscript{th} centile)
Medical management

- Ventilated for 5 weeks before extubation to CPAP and eventually nasal cannula oxygen
- PDA – medically managed
- Grade I IVH on right on head scans
Early nutritional management - overview

Parenteral nutrition

Breast milk expression

Colostrum for mouth cares

Early minimal enteral nutrition
Progress

• Slow progress with milk feeds - on/off
• Day 22 – full feeds of MEBM at 165 ml/kg/d
• Day 25 – limited MEBM, commenced on preterm formula – graded over 10 days
• Day 34 (34 weeks CGA) - abdominal distension, vomiting, desaturations, bradycardia, lactic acidosis, profound sepsis
Multifocal gangrenous NEC

- AXR – pneumatosis, distended loops of bowel
- Laparotomy x 2
Surgery

• Surgery 1 - ‘clip and drop’ – 4 segments small bowel remaining

• Surgery 2 – anastomosis of remaining segments, ileostomy and mucous fistula

• Remaining bowel:
  – 42cm proximal bowel from DJ flexure to stoma
  – 10cm distal bowel from mucous fistula to ileo-caecal valve
  – Full colon preserved
Early nutritional management

• Long line
• Parenteral nutrition
  – liver protection with SMOF lipid
• Aim – growth?
  – Maintain centiles
  – Do not overfeed PN
• Advice to family?
  – Cautious optimism
  – Protracted recovery and time to full feeding
Progress

• Protracted recovery post surgery

• When to start feeds?
  – Feeds restarted once NG aspirates settled, 21 days post second surgery
  – Increase slowly at 10 ml/kg/d monitoring stoma output to guide progress

• What to start?
  – No MEBM so start donor EBM
  – Graded to Pepti-Junior once tolerating 40 ml/kg/d
Why Pepti-Junior?

Medium chain fats absorbed independently of bile flow
Close to term corrected age
## Feed properties

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Problems

• Slow progress
• Stoma output high and watery
  – Feeds changed to Neocate LCP (amino acid)
  – Some improvement but still high stoma output
  – Feeds maintained at 80ml/kg PN, 80 ml/kg Neocate as hourly bolus feeds
  – Start refeeding into mucous fistula
• PN dependant until stoma closure
• Other considerations? - oral feeding?
Refeeding

• Stoma effluent
• Gathered at intervals
• Fed into mucus fistula
• Why?
  – Induce colonic absorption
  – Optimise absorption
  – Water absorption
• Plan for closure?
Bloods and monitoring

- Input and output
- Regular FBC, U&E, LFTs, Transaminases
- Bilirubin & conjugated fraction
- Urine sodium
- Growth
- Length for long-term
Progress

- Stoma closure day 101 (term plus 3 weeks CGA)
- Off PN day 121 (term plus 6 weeks CGA)
- Full feeds Neocate 165 ml/kg/d by bottle
- Poor weight gain
  - Feeds concentrated
  - Additional vitamins
Weight gain

Weight (Kg)

WHO-UK growth chart
Gestational Age 28 weeks and 6 days. Age has been adjusted for the first two years
Planning for discharge

• Parental expectations
• Short term follow up
  – Nurse led clinic
  – Dietitian
• Longer term follow up
  – Neonatal clinic
  – Surgical clinic
  – Short gut clinic
• Support for family at home
Follow up – 9 months corrected age

WHO-UK growth chart
Gestational Age 28 weeks and 6 days. Age has been adjusted for the first two years.
Follow up – 9 months corrected age

- Excellent nutritional status
- Neurodevelopmentally excellent
- Diet:
  - 2 bottles/day follow on formula
  - 3 age appropriate meals per day
  - Full varied diet including dairy plus finger foods
  - BO x 2 per day – constipated!
Learning Points

• Limited evidence base for feeding post NEC
• More research needed
• Feed choice depends on many competing factors
• Keep feed choice under regular review
• Patience and close monitoring!
• Full nutrition team with specialist expertise required for complex cases
Nutrition Team

- Family
- Neonatologist
- Surgeon
- Dietitian
- Gastroenterologist
- Neonatal Nurse
- Pharmacist
References


