LLL Session - Nutrition in paediatric patients

Enteral nutrition in paediatric patients

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Enteral Nutrition (EN) in Paediatric Patients

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EN in PAEDIATRICS
Lecture objectives

Nutritional support in children

EN: Indications & contraindications

Selection of formula

How to choose site & route & mode

Complications
Nutritional Support in Sick Children

**GOALS**

- optimal growth
- neuromotor development
- minimize gastrointestinal symptoms
- promote normal feeding habits & skills

To provide energy & nutrients to support:

To treat a disease
(food allergy in infants, Crohn’s disease......)
Nutritional Interventions in Sick Children

Depend on:

- Age
- Clinical picture
- Possibility of oral intake
- Absorptive & digestive capacity
- Dietary habits
- Costs
Chosen approach should increase stepwise in respect to underlying condition & impairment of nutritional status.
Management strategy: nutritional counselling & sip feeds

Get children eat more without unnecessary restrictions

simplest, cheapest & safest nutritional support

if not enough than

Provide oral nutritional supplement - sip feeds

- whole protein based, pediatric formula, nicely flavored, with fibers
- energy enriched (1.3-1.5 kcal/ml) if more energy required, or if amount ingested is limited

Enteral Nutrition

DEFINITION

Feeding directly into stomach or duodenum / jejunum over tube or stoma

or / and

Oral provision of dietary foods for special medical purposes

ESPEN Guidelines in EN, Clin Nutr 2006
ESPGHAN CoN Comment, JPGN 2010
EN vs. PN: Rule of Thumb

ENTERAL INTAKE
- improves GUT function & morphology
- limits bacterial translocation & sepsis
- decreases incidence of multiorgan failure
- 3x less expensive

THEREFORE

Use GUT whenever possible & as much as possible
Paediatric EN: Evidence based guidelines

Invited Review

Practical Approach to Paediatric Enteral Nutrition: A Comment by the ESPGHAN Committee on Nutrition

ESPGHAN Committee on Nutrition: *Christian Braegger, †Tamas Decsi, ‡Jorge Amil Dias, §3 Corina Hartman, ¶Sanja Kolaček, ‡‡Berthold Koletzko, §§¶Sibylle Koletzko, #Walter Mihatsch, **Luis Moreno, ††John Puntis, §1Raanan Shamir, ‡‡‡Hania Szajewska, §§§Dominique Turck, and ‡‡‡‡Johannes van Goudoever
EN in Paediatrics

WHEN??

A. Not growing well on oral intake + GIT function sufficiently preserved

Not growing well ???

- Growth failure >1 months in child <2 y
- Growth failure >3 months in child >2 y
- Change on centile charts >2 growth channels
- Triceps skinfolds <5th percentile / age

B. EN used as treatment of the disease (allergy, Crohn,

C. Total feeding time >4 h/day in disabled child

ESPGHAN Commitee on Nutrition Comment, JPGN 2010;51
EN: Clinical Indications

Inability to take enough food:
Suck-swallow disfunction, acquired condition (facial trauma, coma...), anorexia, muscle weakness & fatigue

Maldigestion & malabsorption — increased nutritional losses
Enteropathies, pancreatic insufficiencies (CF...), short bowel syndrome

Increased nutritional requirements
Burns, trauma, cystic fibrosis, congenital heart disease...

Altered metabolism
Inborn errors, impaired organ function (renal, liver, pulmonary)

Primary disease management
Chronic diarrhoea of infancy, Crohn’s
EN: Contraindications

- Intestinal perforation & obstruction
- Mechanical & paralytical ileus
- Major intra-abdominal sepsis
- Necrotizing enterocolitis
Selection of Formulae for EN

Age specific nutritional requirements
- infants
- small children
- >8 to 10 y adult formulae

Intestinal, liver & pancreatic function

Food intolerances or allergy
- allergens, gluten, lactose, phenil-alanin...

Formula features:
- osmolality, viscosity, costs, taste

Site & route & mode of delivery
## Selection of EN Formulae in Respect to Nitrogen Source

<table>
<thead>
<tr>
<th></th>
<th>POLYMERIC</th>
<th>SEMI-ELEMENTAL</th>
<th>ELEMENTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>whole proteins</td>
<td>small peptides</td>
<td>amino-acids</td>
</tr>
<tr>
<td>(casein, lactalb., soy)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>glucosae polymers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fats</td>
<td>LCT or LCT &amp; MCT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Osmolarity</td>
<td>300</td>
<td>300 - 450</td>
<td>300 - 600</td>
</tr>
<tr>
<td>Indications</td>
<td>multiple</td>
<td>allergy, malabsorption</td>
<td>multiple allergies, severe malabs.</td>
</tr>
<tr>
<td>Advantages</td>
<td>palatable, cheap</td>
<td>hypoallergenic rapid absorption</td>
<td>non-allergenic immunomodulatory</td>
</tr>
<tr>
<td>Disadvantages</td>
<td>intact GIT</td>
<td>bitter, expensive</td>
<td>expensive, bad taste, hyperosmolar</td>
</tr>
</tbody>
</table>
Selection of disease specific EN formulae

<table>
<thead>
<tr>
<th>Formula Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCT based</td>
<td>• requires no lipase &amp; bile</td>
</tr>
<tr>
<td></td>
<td>• absorbed to portal blood (not lymph)</td>
</tr>
<tr>
<td>High energy (1.3 - 2.0 kcal/ml)</td>
<td>• fluid restriction</td>
</tr>
<tr>
<td></td>
<td>• increased energy requirements</td>
</tr>
<tr>
<td>High nitrogen (&gt;15%)</td>
<td>• catabolic patients</td>
</tr>
<tr>
<td></td>
<td>• wound healing</td>
</tr>
<tr>
<td>High lipids (&gt;35%)</td>
<td>• respiratory problems, high energy requir.</td>
</tr>
<tr>
<td>Addition of immunonutrients</td>
<td>• glutamin, arginin, n-3 FA, nucleotides, TGF-beta &amp; probiotics, prebiotics</td>
</tr>
<tr>
<td>Other disease specific</td>
<td>• liver, renal, lung, diabetes</td>
</tr>
</tbody>
</table>
Enteral Formulae Selection

role of disease-specific formulations

- Could be beneficial in certain clinical conditions
- Good controlled studies in children are lacking

CLAIMS SHOULD BE EVALUATED CRITICALLY
Selection of EN formulae

**Standard paediatric formula**

- **Age adapted nutritional composition**
  - Use adult formula only after 8-10 y

- **Isocaloric** (1 kcal/ml), **iso-osmolar** (300-350), mostly gluten & lactosa free

- **Polymeric formula**

- **Addition of fibres??**
Enteral Formula Selection: addition of fibres


• Significant benefit of fibre supplemented versus unsupplemented EN formula in:
  a. patients and healthy controls
  b. predominant symptom diarrhoea & constipation
Enteral Formulae Selection: take home message

Standard polymeric formula can be safely used in >90% patients, irrespective of their basic clinical condition, but with functioning GUT. Fibres considered as a useful addition

BEST COST-BENEFIT RATIO
EN in CHILDREN: Sites for delivery

STOMACH

- physiologic
- antimicrobial effect
- reservoir - gradual release
- tubes easily placed
- less diarrhoea, better osmotic tolerance

JEJUNUM

- in patients with high risk of aspiration
- gastric outlet obstruction, pancreatitis

ESPGHAN Committee on Nutrition. Practical approach to paediatric EN JPGN 2010;51:110-122.
Gastric vs. Postpyloric
EN Application

Evidence - based

**Metheny NA et al. JPEN 2011** (critically ill adults)
- Compared to stomach, % of aspiration decreased when tubes in 1st portion of duodenum by 11%, 13% in 3rd, 18% in 4rd portion
- Pneumonia decreased only when tube beyond 2nd portion (p=0.02)

**Rosen R et al. JPGN 2011**
- GER episodes increased also in transpyloric feedings: fasting 24.9 vs nonfeed period 3.3; p=0.001
- Hospitalization for aspiration possible after transpyloric feeds initiated

**McGuire W, et al. Cochrane Database 2007**
- 8 RTC in prematures
- Increased GIT complications (RR 1.45) & increased mortality (RR 2.46) in postpylorically fed
EN in CHILDREN: Routes of delivery

TUBES (NG/NJ) if expected EN <6-12 wks

<table>
<thead>
<tr>
<th>PVC</th>
<th>Silicon or polyurethan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stiff, release phalate</td>
<td>Soft, flexible</td>
</tr>
<tr>
<td>Traumatic</td>
<td>Atraumatic</td>
</tr>
<tr>
<td>Cheap</td>
<td>Expensive</td>
</tr>
<tr>
<td>Short duration (4-6 d)</td>
<td>Long duration (4-6 weeks)</td>
</tr>
</tbody>
</table>
Positioning of the NG tube

Measuring tube for children

Measuring tube for infants and newborns

Cirgin Ellett ML et al. Predicting insertion length for gastric tube placement in neonates. JOGNN 2011;40:412-421
Positioning of NG Tubes

Suggested by

- acid pH (≤5) of the aspirate
- epigastric auscultation of injected air
- correct external length of tube

If necessary check by abdominal x-ray

- no aspiration of gastric content
- pH >5
- patient’s condition suggests aspiration

ESPGHAN Committee on Nutrition. Practical approach to paediatric EN. JPGN 2010
Gilberson HR et al. Determination of practical pH cutoff level..............JPEN 2011;35
EN in CHILDREN: **route**

PEG / PEJ

| Method of placement | • endoscopically  
|                     | • surgically  
|                     | • radiologically  

| Endoscopy preferred | • cheapest & quickest  
|                     | • low rate of complications  

| Surgery preferred in | • neurologically impaired  
|                     | • combined with Nissen  

PEG & PEJ indicated if expected EN duration longer than 6-12 wks

ESPEN Guidelines/PEG. Clin Nutr 2005;24
ESPGHAN CoN Comment. JPGN 2010;51:110-122
<table>
<thead>
<tr>
<th>PRE-PROCEDURE</th>
<th>PROCEDURE</th>
<th>POST-PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discuss with parents/child</td>
<td>In children general anesthesia</td>
<td>Start feeding after 6 h (even 3h safe**), resume full feeds after 24 h</td>
</tr>
<tr>
<td>Laboratory tests (Hgb, platelets, coagulation)</td>
<td>Pull method most common</td>
<td>Train parents</td>
</tr>
<tr>
<td>Antibiotic prophylaxis useful* (cefazolin 30 min before procedure)</td>
<td>Sufficient incision + application of povidone iodine useful for prevention of infection</td>
<td>Early complications in 8-30%, most common wound infection Late complications up to 40% (stoma related)</td>
</tr>
</tbody>
</table>

*Lipp A et al. Systemic antimicrobial prophylaxis for PEG. Cochrane Database 2006 (4)
** Corkins MR et al. Feeding after PEG in children... JPGN 2010
Management strategy: site & route

Expected Duration of Nutritional Support

More than 6-12 weeks

Risk of Aspiration

- NO: NG tube
- YES: Postpyloric tube

Risk of Aspiration

- NO: Gastrostomy
- YES: Jejunostomy
## EN in CHILDREN: Modes of delivery

<table>
<thead>
<tr>
<th>BOLUS FEEDING</th>
<th>CONTINUOUS</th>
<th>COMBINED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physiologic</strong></td>
<td>Utilization better</td>
<td>Continuous over night</td>
</tr>
<tr>
<td><strong>Cyclical hormon surge</strong></td>
<td>Less termogenic</td>
<td>Bolus over day</td>
</tr>
<tr>
<td><strong>Non-restrictive</strong></td>
<td>Look after:</td>
<td>Preserved oral motor function</td>
</tr>
<tr>
<td>a. gastric emptying rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. gallbladder emptying!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## EN in CHILDREN:

### Delivery sets

**Bankhead R et al. ASPEN enteral nutrition practice recommendation. JPEN 2009**

<table>
<thead>
<tr>
<th>Closed system</th>
<th>Open set, sterile feed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expensive, sterile inside</td>
<td>Cheaper</td>
</tr>
<tr>
<td>Can hang un-opened for 24 - 48 hours</td>
<td>Sterile formula* content to be changed:</td>
</tr>
<tr>
<td></td>
<td>- every 8h in hospital</td>
</tr>
<tr>
<td></td>
<td>- every 12 h at home</td>
</tr>
<tr>
<td></td>
<td>- aseptic approach required</td>
</tr>
</tbody>
</table>

*In case of non-sterile powder formula, content should changed every 4-6 hours*
<table>
<thead>
<tr>
<th>COMPLICATIONS - look for -</th>
<th>PREVENTION &amp; THERAPY - take care on -</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gastrointestinal</strong></td>
<td><strong>Formula selection &amp; delivery</strong></td>
</tr>
<tr>
<td>Diarrhoea, nausea, vomiting, bloating, abd. distension</td>
<td><strong>Osmolality, viscosity...</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Disease specific</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Stepwise introduction</strong></td>
</tr>
<tr>
<td><strong>Aspiration!!</strong></td>
<td><strong>Monitoring gast. residuals</strong></td>
</tr>
<tr>
<td><strong>Technical</strong></td>
<td><strong>Tube, stoma selection &amp; placement</strong></td>
</tr>
<tr>
<td>Occlusion, migration, GIT lesion</td>
<td><strong>PVC vs. silicon</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Endoscopy vs. surgery</strong></td>
</tr>
<tr>
<td><strong>Infective</strong>*</td>
<td><strong>Quality control &amp; protocols</strong></td>
</tr>
<tr>
<td>Gastroenteritis, septicaemia</td>
<td><strong>Hanging time, hygiene...</strong></td>
</tr>
<tr>
<td><strong>Metabolic</strong></td>
<td><strong>Monitoring</strong></td>
</tr>
<tr>
<td>Fluid, glucose, electrolytes</td>
<td><strong>Growth (weight, height/length, skinfolds)</strong></td>
</tr>
<tr>
<td>Trace elements, vitamins</td>
<td><strong>Hematology, biochemistry</strong></td>
</tr>
<tr>
<td><strong>Psychological</strong></td>
<td><strong>TEAM APPROACH!!!</strong></td>
</tr>
<tr>
<td>Oral aversion, altered taste</td>
<td></td>
</tr>
</tbody>
</table>

*Roy S, et al. Bacterial contamination...J Hosp Infection 2005; 59*
EN Initiation

Gradual increase in rate and concentration

Depends on:
- age
- clinical condition (GUT !)
- formula (osmolality !)
- delivery route (jejenum !)

Weaning from Enteral Nutrition

Stable condition + appropriate nutritional status

May take days to many months

EN to be stopped when:
- oral intake sufficient
- growth appropriate
Enteral Nutrition in Children

Take Home Messages

1. **Use** GUT whenever possible & as much as possible

2. **Standard polymeric formulas** useful in >90% patients with best cost / benefit ratio

3. EN is **safe & effective** method of nutr. therapy

   IF

4. Close **monitoring & following protocols** & supervised by dedicated Nutrition Care Team