Tube Feeding in Children

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Objectives

- Describe the indications and delivery methods of tube feeding in children

- Summarize the components of enteral feeding and monitoring strategies

- Discuss safety measures of tube feeding in children
Poll Question

5. A 14-month-old girl has severe oropharyngeal dysphagia related to hypoxic-ischemic brain injury secondary to abruptio placentae. She now requires enteral feeding to provide adequate nutrition. Assuming the gut works normally, the child is exposed to the family mealtime environment, and the child is encouraged to touch food without regard to intake, optimal management would include:

A. Continuous gastrostomy tube feeding.
B. Continuous gastrojejunostomy tube feeding.
C. Continuous nasogastric tube feeding.
D. Intermittent bolus gastrostomy tube feeding.
E. Intermittent bolus nasogastric tube feeding.
Child needs long term enteral feeding via G tube as intermittent boluses to be more physiological
NUTRITIONAL INTERVENTIONS

- Parenteral nutrition
- Enteral feeding
- Oral nutritional supplements
- Nutritional counseling

Chosen approach should increase stepwise in respect to underlying condition & impairment of nutritional status
Indications
Pediatric Enteral Nutrition

- Enteral nutrition is the provision of nutrients via the gastrointestinal tract
- Enteral nutrition maintains the integrity of the GI tract and is associated with fewer infections than parenteral nutrition
- Children who require EN support are those that
  - Eat less than 80% of needs by mouth
  - Require an extended period of time to eat

Progressive Intervention

- Attempt oral feeding first. If the gut works, use it
  - There are no trials comparing enteral versus parenteral nutrition
  - EN is physiologic, has reduced, or less severe, incidence of infection as compared to parenteral EN, and is cost effective

- If the patient cannot take enough nutrition orally or has intolerance, then begin NG feedings
  - Bolus usually first
  - Drip next

- If intolerant of NG feedings then transpyloric
  - Must be continuous feedings

Delivery Modes/Tubes
Nasogastric (NG), Nasoduodenal (ND) and Nasojejunal (NJ) Tubes

NG tubes are temporary feeding tubes placed manually via the nose and esophagus into the stomach.

When feedings are not tolerated in the stomach, the tube may be placed into the duodenum (ND) or jejunum (NJ).


www.cincinnatichildrens.org/health/n/nasojejunal-kangaroo
What is a G Tube?

- A G tube is a tube placed into the stomach through an opening called a stoma
Gastrojejunostomy Tube (G-J Tube)

A G-J tube is a tube that is placed via the opening into the stomach (stoma) and passes through the pylorus into the mid section of the small intestine (the jejunum). It has a G port which can be used for gastric decompression with jejunal feeds, gastric med delivery or bolus feeds. The J port can be used for continuous feeds.
Why Use a G or J Tube?

- A G tube allows need for EN to be met by feeding into the stomach

- A J tube can be used when needs for EN may not be met by feeding into the stomach, allowing EN feeding to occur past the stomach, i.e. in the jejunum
  - Cannot use bolus feeding technique beyond the pylorus due to dumping syndrome
Bolus vs. Continuous Feedings

Bolus
- Can mimic or supplement meals
- More physiologic
- May not require a pump
- Freedom of movement between feedings
- Only GT feeding
- Can promote osmotic diarrhea

Continuous
- Slow infusion may improve tolerance and absorption
- Can be given overnight to avoid disruption of daytime schedule and oral intake
- Encourages intestinal adaption by constant mucosal stimulation
- Reduces need for parenteral calories

Review of EN Components

Protein
Infant Formulas: Protein Content

- Divided into 4 classes of formulas:
  - Cow’s milk–based formulas
    - Preterm and follow-up preterm formulas as well
    - Partially hydrolyzed whey; not considered hypoallergenic but less allergic diseases
  - Soy formulas
  - Casein hydrolysate formulas
  - Amino acid–based formulas
Review of EN Components

Carbohydrates
Infant Formulas – CHO

- Main types of carbohydrate in formulas:
  - Lactose
  - Sucrose
  - Glucose polymers

- Galactosemia: soy formulas, because they do not contain lactose
  - Isomil®

- Which formulas contain sucrose?
  - Alimentum® and soy formulas, except Prosobee®

Perlstein D. Infant Formulas. MedicineNet.com
Review of EN Components

Fat
DHA and ARA

- Docosahexaenoic acid (DHA) and arachidonic acid (ARA), both long-chain polyunsaturated fatty acids
- Present in breast milk; were not in formulas
- Animal models showed increased visual acuity and neurologic development; some infant studies agree
- No harmful effects found
- Now in most infant formulas
- A recent meta-analysis found no effect of DHA/ARA on cognitive development

Review of EN Components

Additives
Immune Input

- Probiotics
  - Evidence of decreased infectious illnesses, especially diarrheal illnesses
  - Now present in some infant formulas

- Prebiotics
  - Growth factors that foster the growth of “good bacteria” in the gut e.g., inulin, fructooligosaccharides (FOS)
Enteral Feeding Questions

- Fiber? Helps with stooling issues
  - Soluble versus insoluble

- Transpyloric feeds - Elemental?
  - Tolerance okay
  - Animal studies; absorption better

- When are adult EN formulas suitable?
  - Adolescent? Ca and Phos needs to be higher
  - Do contain higher protein content
Principles of Designing/Monitoring Pediatric EN Support

Age / Medical Condition
Administration

- The route of and duration (bolus vs. continuous) of enteral administration depends on:
  - Indication for EN, the duration of need
  - Anatomical integrity of the GI tract
  - Functional integrity of the GI tract
  - Risk of aspiration
# Enteral Feeding Methods

## Gastric Vs. Post-pyloric - I

<table>
<thead>
<tr>
<th>Site</th>
<th>Delivery Route</th>
<th>Indications</th>
<th>Potential Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stomach</td>
<td>Orogastric (infants)</td>
<td>• Short-term nutrition support (6-8 wks)</td>
<td>• Aspiration</td>
</tr>
<tr>
<td>Nasogastric</td>
<td></td>
<td>• Inadequate oral intake due to increased needs or anorexia of chronic disease</td>
<td>• Nasal mucosal ulceration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Refusal to eat</td>
<td>• Tube occlusion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Nocturnal feeds</td>
<td>• Pneumothorax</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Inability to suck or swallow</td>
<td>• Bleeding</td>
</tr>
<tr>
<td>Gastrostomy</td>
<td></td>
<td>• Long term tube feeding</td>
<td>• Epistaxis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Congenital anomalies, such as tracheoesophageal fistula, esophageal atresia</td>
<td>• Sinusitis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Esophageal injury/obstruction</td>
<td>• Otitis Media</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Failure to thrive</td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
## Enteral Feeding Methods
### Gastric Vs. Post-pyloric - II

<table>
<thead>
<tr>
<th>Site</th>
<th>Delivery Route</th>
<th>Indications</th>
<th>Potential Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transpyloric</td>
<td>• Nasoduodenal</td>
<td>• Congenital upper GI anomalies</td>
<td>• Pneumatosis intestinalis</td>
</tr>
<tr>
<td>Postpyloric</td>
<td>• Nasojejunal</td>
<td>• Inadequate gastric motility</td>
<td>• Bleeding</td>
</tr>
<tr>
<td></td>
<td>• Gastrojejunal</td>
<td>• High aspiration risk</td>
<td>• Dislodgement</td>
</tr>
<tr>
<td></td>
<td>• Jejunostomy</td>
<td>• Severe GER</td>
<td>• Tube deterioration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Functioning intestinal tract with obstruction above it</td>
<td>• Tube occlusion</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Bowel obstruction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Stomal leakage</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Wound infection</td>
</tr>
</tbody>
</table>
Bolus vs. Continuous Feeds

- Enteral feeds may be given as bolus (intermittent), continuous, or a combination

**Bolus Feedings**

<table>
<thead>
<tr>
<th>Age</th>
<th>Initiation</th>
<th>Advance</th>
<th>Suggested Tolerance Volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 12 months</td>
<td>10 – 15 mL/kg every 2 to 3 hours</td>
<td>10 to 30 mL per feed</td>
<td>20 to 30 mL/kg every 4 to 5 hours</td>
</tr>
<tr>
<td>1 - 6 years</td>
<td>5 – 10 mL/kg every 2 to 3 hours</td>
<td>30 to 45 mL per feed</td>
<td>15 to 20 mL/kg every 4 to 5 hours</td>
</tr>
<tr>
<td>&gt; 7 years</td>
<td>90 to 120 mL every 3 to 4 hours</td>
<td>60 to 90 mL per feed</td>
<td>330 to 480 mL every 4 to 5 hours</td>
</tr>
</tbody>
</table>

**Continuous Feedings**

<table>
<thead>
<tr>
<th>Age</th>
<th>Initiation</th>
<th>Advance</th>
<th>Suggested Tolerance Volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 12 months</td>
<td>1 to 2 mL/kg/hour</td>
<td>1 to 2 mL/kg every 2 to 8 hours</td>
<td>6 mL/kg/hour</td>
</tr>
<tr>
<td>1 - 6 years</td>
<td>1 mL/kg/hour</td>
<td>1 mL/kg every 2 to 8 hours</td>
<td>1 to 5 mL/kg/hour</td>
</tr>
<tr>
<td>&gt; 7 years</td>
<td>25 mL/hour</td>
<td>25 mL every 2 to 8 hours</td>
<td>100 to 150 mL/hour</td>
</tr>
</tbody>
</table>
## Monitoring / Evaluation

<table>
<thead>
<tr>
<th>Category</th>
<th>Initial</th>
<th>Hospital</th>
<th>Outpatient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthropometrics</td>
<td>Daily Baseline</td>
<td>Daily Monthly</td>
<td>Weekly-monthly Monthly or at clinic</td>
</tr>
<tr>
<td>Intake</td>
<td>Daily</td>
<td>Weekly</td>
<td>Monthly</td>
</tr>
<tr>
<td>GI Tolerance</td>
<td>As ordered, reported</td>
<td>As ordered, reported</td>
<td>As reported</td>
</tr>
<tr>
<td>Stool/Ostomy</td>
<td>Daily</td>
<td>Daily</td>
<td>Report changes in stool pattern</td>
</tr>
<tr>
<td>Tube Placement</td>
<td>Prior to each feeding</td>
<td>Prior to each feeding</td>
<td>Prior to each feeding</td>
</tr>
<tr>
<td>Tube Site</td>
<td>Daily</td>
<td>Daily</td>
<td>Daily</td>
</tr>
</tbody>
</table>
## Monitoring/ Evaluation - I

<table>
<thead>
<tr>
<th>Problem</th>
<th>Prevention/Intervention</th>
</tr>
</thead>
</table>
| Diarrhea/ Abdominal Cramping | • Decrease delivery rate  
                               | • Recognize or avoid drugs that result in diarrhea  
                               | • Consider fiber containing products  
                               | • Consider osmolarity and addition of modular additives  
                               | • Semi-elemental or elemental formula if indicated |
| Vomiting/ Nausea          | • Ensure formula is always at room temperature prior to tube feedings  
                               | • Elevate head of bed  
                               | • Consider postpyloric or continuous feeding |
| Hyperglycemia             | • Reduce flow rate  
                               | • Use formulas with minimal simple sugars  
<pre><code>                           | • Consider insulin if clinically indicated |
</code></pre>
<table>
<thead>
<tr>
<th>Problem</th>
<th>Prevention/Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constipation</td>
<td>• Ensure optimal fluid intake</td>
</tr>
<tr>
<td></td>
<td>• Increase free water intake</td>
</tr>
<tr>
<td></td>
<td>• Change to a product containing fiber</td>
</tr>
<tr>
<td>Gastric Retention of Formula</td>
<td>• Monitor for correct tube placement</td>
</tr>
<tr>
<td></td>
<td>• If residuals are high (&gt;2 hour volume of feeds), hold feeds; recheck residuals in 1 hour</td>
</tr>
<tr>
<td></td>
<td>• Consider continuous or postpyloric feeding</td>
</tr>
<tr>
<td></td>
<td>• Position patient on right side</td>
</tr>
<tr>
<td>Clogged Feeding Tube</td>
<td>• Ensure tube is flushed after checking residuals, boluses and every 4 – 8 hours with continuous feeds</td>
</tr>
<tr>
<td></td>
<td>• Check tubing size for appropriateness for some formulas</td>
</tr>
<tr>
<td></td>
<td>• Infuse formula past pylorus</td>
</tr>
<tr>
<td></td>
<td>• Consider continuous infusion</td>
</tr>
</tbody>
</table>
Outline of Products

- Infant Formulas
  - 0 to 1 year of age
- Pediatric Formulas
  - 1 to 13 years of age
- Specialized formulas/supplements
- Modular Additives
Specialty Infant Formulas

- Protein allergy/malabsorption
  - Cow milk allergy, multiple food allergies
  - Short bowel syndrome
- Fat malabsorption
  - Liver disease
  - Cystic fibrosis
  - Steatorrhea
  - Short bowel syndrome
  - Persistent diarrhea
Specialty Pediatric Formulas

Elemental

- Broken down even more = Free AA
- Decreased palatability
- Indications:
  - Severe multiple food protein allergy/intolerance
  - Eosinophilic esophagitis
  - Gastrointestinal tract impairment/malabsorption
  - Severe GERD
- Costly: $$$
Gastric Residual Volumes (GRV)

- No standard practices on how, when and what is a high value gastric residual volume (GRV)
- Difficult to withdraw well with small tube
- No studies that prove correlation of GRV with intolerance
- GRVs result in holding feedings despite no other signs of intolerance

Intolerance Interventions

- Drip feedings-continuous
- Consider trial of promotility agents either to advance tube or enhance emptying/feeding tolerance
  - Several promotility agents have side effects
- Trans-pyloric feedings
  - Previous adult studies show it ends up delaying feeding initiation
  - Consider if aspiration risk or intolerance to gastric

Principles of Designing/Monitoring Pediatric EN Support

Safety
Refeeding Syndrome (RFS)

- RFS is a term used to describe the metabolic and clinical changes that can occur during nutritional support of a malnourished patient.
  - Normally occurs within 3-4 days after initiating feeds.
  - Signs/symptoms include weakness, muscle pain, ataxia, paresthesia, confusion, arrhythmia, seizures.
  - Phos depletion is the hallmark and cause of the majority of symptoms.

Serum Abnormalities During Refeeding

Serum abnormalities are often seen in patients during refeeding and may include:

- Hypophosphatemia
- Hypokalemia
- Hypomagnesemia
- Glucose abnormalities
- Thiamine deficiency
- Derangements of sodium, nitrogen, and fluid balance

Management Guidelines for RFS

- Identify patients at risk of RFS
  - Check electrolytes (including K, Ca, Phos, Mg, blood urea nitrogen, and creatinine) prior to start of feeding
  - Start refeeding at 50-75% of goal calories and increase to goal over 3-5 days

- Protein does not need to be restricted

- Rehydrate carefully, being careful not to fluid overload

- Monitor K, Ca, Phos, and Mg levels frequently during first four days and replace appropriately

Summary

• Consider EN in patients who cannot take enough nutrition orally or have intolerance to oral feeding
• A variety of enteral tubes, feeding modalities and formulas are available
  – Each should be tailored to the individual patient
• Patients should be monitored to ensure tolerance of EN
• RFS should be anticipated in malnourished patients who are begun on EN and should be prevented / managed
Practical Approach to Paediatric Enteral Nutrition: A Comment by the ESPGHAN Committee on Nutrition

ESPGHAN Committee on Nutrition: *Christian Braegger, †Tamas Decsi, ¶4 Jorge Amil Dias, §3 Corina Hartman, || Sanja Kolaček, †† Berthold Koletzko, †‡ Sibylle Koletzko, †# Walter Mihatsch, ** Luis Moreno, ††† John Puntis, §§1 Raanan Shamir, ††‡ Hania Szajewska, §§2 Dominique Turck, and |||| Johannes van Goudoever


Thanks
Questions!