NUTRITION IN THE CRITICALLY ILL CHILDREN

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When you can use the gut please use it?
Case Scenario

- A 4 years old male child admitted to PICU with septic shock.
- Patient started on Vasopressors
- Resident: can we start feeding?
- You: Lets wait, patient just admitted to PICU (Sunday)
Next day patient is stable, can we start feeding?

You: Patient just got stable now let's wait to see how he does. (Monday)

Resident: can we start feeding today?

You: we just started to wean vasopressors. Let's make sure BP will not drop. (Tuesday)
Case Scenario

- What about today Doctor?

- You: today is my anniversary so I feel very bad, I don’t want to change anything. (Wednesday)

- Okay Sir, today will start feeding right?

- Today we are coming into weekend and I don’t like to change management plans on a weekend. (Thursday)
Case Scenario

- Sunday morning can we start feeding

- You: yes it is safe to do so now.

- Resident: Mom you can feed him now

- Mom: I have been feeding him since we came to PICU
Overview

- Nutrition is essential for survival.

- It is essential for critically ill child to support anabolism, ameliorate uncontrolled catabolism.

- Nutrition maintain competent immune system and improve patient outcome.

- There is a strong association between reduced provision of energy and protein and worse outcome.
Overview

- There is no known illness or disease that can benefit from starvation.

- It is not uncommon for critically ill children to be starved.
A.S.P.E.N. Clinical Guidelines: Nutrition Support of the Critically Ill Child

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## Table 2

**Nutrition Support Guideline Recommendations in the Critically Ill Child**

<table>
<thead>
<tr>
<th>#</th>
<th>Guideline Recommendations</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Children admitted with critical illnesses should undergo nutrition screening to identify those with existing malnutrition and those who are nutritionally-at-risk.</td>
<td>D</td>
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<tr>
<td>1B</td>
<td>A formal nutrition assessment with the development of a nutrition care plan should be required, especially in those children with premorbid malnutrition.</td>
<td>E</td>
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<tr>
<td>2A</td>
<td>Energy expenditure should be assessed throughout the course of illness to determine the energy needs of critically ill children. Estimates of energy expenditure using available standard equations are often unreliable.</td>
<td>D</td>
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<tr>
<td>2B</td>
<td>In a subgroup of patients with suspected metabolic alterations or malnutrition, accurate measurement of energy expenditure using indirect calorimetry (IC) is desirable. If IC is not feasible or available, initial energy provision may be based on published formulas or nomograms. Attention to imbalance between energy intake and expenditure will help to prevent overfeeding and underfeeding in this population.</td>
<td>E</td>
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<td>3</td>
<td>There are insufficient data to make evidence-based recommendations for macronutrient intake in critically ill children. After determination of energy needs for the critically ill child, the rational partitioning of the major substrates should be based upon understanding of protein metabolism and carbohydrate- and lipid-handling during critical illness.</td>
<td>E</td>
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<tr>
<td>4A</td>
<td>In critically ill children with a functioning gastrointestinal tract, enteral nutrition (EN) should be the preferred mode of nutrient provision, if tolerated.</td>
<td>C</td>
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<tr>
<td>4B</td>
<td>A variety of barriers to EN exist in the pediatric intensive care unit (PICU) Clinicians must identify and prevent avoidable interruptions to EN in critically ill children.</td>
<td>D</td>
</tr>
<tr>
<td>4C</td>
<td>There are insufficient data to recommend the appropriate site (gastric vs post-pyloric/transpyloric) for enteral feeding in critically ill children. Post-pyloric or transpyloric feeding may improve caloric intake when compared to gastric feeds. Post-pyloric feeding may be considered in children at high risk of aspiration or those who have failed a trial of gastric feeding.</td>
<td>C</td>
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<tr>
<td>5</td>
<td>Based on the available pediatric data, the routine use of immunonutrition or immune-enhancing diets/nutrients in critically ill children is not recommended.</td>
<td>D</td>
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<td>6</td>
<td>A specialized nutrition support team in the PICU and aggressive feeding protocols may enhance the overall delivery of nutrition, with shorter time to goal nutrition, increased delivery of EN, and decreased use of parenteral nutrition. The affect of these strategies on patient outcomes has not been demonstrated.</td>
<td>E</td>
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</tbody>
</table>
Nutrition Assessment

- Children should undergo nutrition screening, to identify at risk patients.
- Formal assessment with development of nutrition plan.
- Assessment with Anthropometric measurements:
  - Height, weight, mid arm circumference

Nutrition Assessment

- **Albumin:**
  - long half life (14-20d)
  - Affected by sepsis, dehydration, trauma, liver disease

- **Prealbumin:**
  - Glycoprotein synthesis in liver
  - Short half life (24-48h)
  - Easily measured in hospitals

- **Ca, Phosphorous, Mg, Urea, Creatinine**
Energy Requirements

- In general energy requirements are:
  - Resting Energy Expenditure (REE) 70%
  - Activity 20%
  - Thermogenesis 10%

- In critically ill children REE is 37% higher than in healthy children.

- REE could be dramatically decreased in sedated and mechanically ventilated children.

- Overfeeding can lead to increased CO2 production, hepatic steatosis, difficult ventilator weaning.

Energy Requirements

- Protein requirements range 1.5- 3 gm/kg/day depending on age and disease state as acute or recovering.
- Till stress over, can still be in –ve Nitrogen balance.
- Excessive protein intake will lead to rise in BUN, metabolic acidosis and neurodevelopmental problems.
- Large CHO administration does not prevent protein breakdown.
- Glycemic control is important but not too tight.
- Lipid is important, essential FA if not administered leads to thrombocytopenia, dermatitis and susceptibility to infection.

Energy Requirements

- Fat ~ starting 1gm/kg/day and advancing to 2-4gm/kg/day
- TG levels should be monitored.
- Typically 20-30% of Caloric intake should be from fat.
- Essential FAs need to be provided: linolenic and linoleic acid.
- MCT are better tolerated with shortgut, and RT side heart failure.

When to Feed

- As early as possible within 48 hours of ICU admission or when pathophysiology reverses.
- Early enteral nutrition supports functional integrity of the gut.
- Maintains tight junctions between intraepithelial cells.
- Stimulates blood flow.
- Maintains villous integrity.
- Induces release of trophic endogenous agents (gastrin, CCK, Bile salts).

Route of Delivery

- Enteral is always preferred, if tolerated over parenteral
- EN stimulates the release of wide variety of enterohormones
- It is essential for hepatic functions
- Lack of EN results into mucosal atrophy, bacterial overgrowth, increased intestinal permeability
- EN has a major effect on GALT

Route of Delivery

- PN results into liver dysfunction.
- PN impairs humoral and cellular immunological defenses.
- It also inhibit bacterial and fungal killing.
- PN is also associated with increased free radical formation.

Enteral Feeding

- Enteral is always preferred, if tolerated over parenteral.
- Insufficient data to recommend gastric versus transpyloric.
- Transpyloric best for children at high risk for aspiration.
- Combination of both enteral and parenteral if unable to meet nutritional goals.
- Continuous versus intermittent no difference in tolerance
  but potential less risk of aspiration in continuous feeds.
Route of delivery

- Important in transpyloric feeds you can’t give boluses for fear of dumping syndrome.

- Don’t wait for bowel sound to start feeding.

- Neither the presence or absence of bowel sounds, nor the evidence of passage of flatus or stool is required for feeding initiation.
Basic principles of optimal EN delivery

- Early initiation
- Selection of an appropriate route (gastric versus small intestine)
- Use of a stepwise algorithmic approach to increasing feedings
- Application of a uniform definition and monitoring for feeding intolerance
- Use of a reasonable and practical approach to EN intolerance
- Maintenance of EN during the PICU course by addressing the barriers that impede feeding
- Sustained efforts to audit practice, identify gaps, and modify and re-evaluate feeding practices in the PICU
<table>
<thead>
<tr>
<th>Barrier</th>
<th>Reason</th>
<th>Suggested Approach</th>
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<tbody>
<tr>
<td>Interruptions to EN</td>
<td>Intolerance</td>
<td>Apply uniform definition, algorithmic guideline</td>
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<tr>
<td></td>
<td>Procedures</td>
<td>Review fasting guidelines for procedures, Resume feeding if procedure delayed, canceled or complete</td>
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<td></td>
<td>Enteral access issues</td>
<td>Request specialized team for enteral access, radiology collaboration, prompt replacement of displaced enteral tubes</td>
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<tr>
<td>Fluid restriction</td>
<td>Patients with cardiac or renal conditions</td>
<td>Consider concentrated formulae, Review other fluids, Anticipate and plan with dietitian</td>
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<tr>
<td>Patient on vasoactive drug(s)</td>
<td>Concerns for gut ischemia</td>
<td>Prudent to hold EN when actively resuscitating with fluid, hemodynamics worsening or multiple vasoactive drugs required, Consider EN if no fluid resuscitation for over 12 hours and on single or stable vasoactive support, Monitor closely while advancing feedings</td>
</tr>
<tr>
<td>Delayed EN initiation</td>
<td>Failure to prioritize</td>
<td>Educate, develop institution-specific, uniform guidelines for nutrition delivery</td>
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<td>General reluctance to address nutrition delivery</td>
<td>Failure to prioritize nutrition support</td>
<td>Create nutrition support teams, Request dietitian dedicated to the ICU, Involve key stakeholders and develop multiprofessional consensus for nutritional therapy goals</td>
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Myths and Misconceptions of EF

- Enteral feeding is contraindicated with Vasopressors
- Early feeding is not important in patients receiving MV
- EN is contraindicated with high gastric residual volume
- Postpyloric feeding reduces the risk of aspiration
Myths and Misconceptions of EF

- EN is contraindicated in patients without bowel sound
- EN is contraindicated following GI surgery
- EN is contraindicated in patients with pancreatitis
Parenteral nutrition

- If it is not possible to initiate EN.
- It is appropriate to initiate PN as soon as possible following admission.
- Some study showed that PN increase mortality in Critically ill patients.
Final Thoughts

- Stress leads to negative nitrogen balance.
- Assessment of nutrition in children is very important.
- Need to avoid both excessive feeding or under feeding.
- Enteral route is preferable.
- Precautions for aspiration.
- Limit interruptions.
Please NO questions