Nutrition Support for the Critically Ill: Considerations for the ICU Nurse

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Disclosure Information
The content within has met continuing education criteria by being evidence based, fair and non-promotional.

Disclosure Information

Relationship with companies who manufacture products used in the treatment of the subjects under discussion:

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Manufacturer(s)</th>
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<tbody>
<tr>
<td>Research Support</td>
<td>Abbott Nutrition</td>
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<tr>
<td>Speaker's Bureau</td>
<td></td>
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<tr>
<td>Consultant</td>
<td>Bali Medical</td>
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<td>Share Holder</td>
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<td>Other Financial Support</td>
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<td>Large Gift(s)</td>
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Relationships with any of the commercial supporters of this CE activity:
Abbott Nutrition as above

Discussion of unlabeled uses: Yes _ No ___

Myths...

- Gastric residuals should be less than:
  - 50 ml
  - Double the feed rate

- Hold feeds for:
  - High residuals
  - Procedures at midnight
  - All medications

- Gastric feeds are not tolerated and patient should have post-pyloric feeding tube
- Diabetic formulas improve glucose control
- Protein restriction is required in patients with renal failure
- Tube feeds should be held for diarrhea
- Predigested (expensive) feeds should be used for diarrhea
- Bowel sounds must be present for enteral feeding

Changing The Dogma

Objectives

- Review new thinking about malnutrition
- Discuss the importance of how and when nourishment occurs in the critically ill
- Reevaluate the concerns that often lead to chronic starvation of the critically ill
**“Nutritional” Markers**

- Serum proteins, immune function markers, anthropometrics
  - Predict outcome
  - Correlate with intake in individual studies
  - No concordance between studies between intake, markers, and improvement in outcome

Seres, *Nutrition in Clinical Practice*, 2005

**Nutrition Support Does Not Treat Malnutrition**

- Nutrition support raises albumin 0.2-0.3 g/dl
  - Statistically significant
  - Clinically irrelevant

Albumin is *not* a marker for adequacy of nourishment

Seres, *Nutrition in Clinical Practice*, 2005

**Nutritional Markers**

- Nutritional markers are markers of severity of illness
- Nutritional markers are extremely important prognostically
  - Albumin < 2.0 = 50-70% surgical mortality

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**Edema Causes Hypoalbuminemia**

- Hydrostatic pressure
- Protein-related oncotic pressure

**Systemic Inflammatory Response**

- Antianabolic/Catabolic
  - Wound healing
  - Muscle wasting/deconditioning
  - Immunosuppressive
  - Hypoalbuminemia (and others)
  - Acute phase reaction

**Catabolism**

- Metabolic derangements
  - Insulin resistance
    - Increased gluconeogenesis
    - May drive muscle breakdown
  - Fat
    - Futilic cycling – less available as energy source
    - Lipase dysfunction

**Catabolic Hypoalbuminemia**

**Route of Nourishment**

- Parenteral Nutrition vs Nothing
  - No difference in positive outcomes even when carried out over 2 weeks (severe malnourished excluded)
  - Starving healthy develop morbidity at 6 weeks
  - Period for tolerance
    - Unknown
    - Weeks not days – Likely in excess of 2 weeks

**Concept:** Kim Dong Wook, MD

**Korets, Gastroenterology, 2001**
Parenteral Nutrition and Risk of Line-Related Infection

PN vs Nothing

Early vs Late TPN in ICU

Enteral vs Parenteral Nutrition

Enteral feeding attenuates the acute phase response and improves disease severity in acute pancreatitis vs parenteral nutrition

Table 1: Clinical Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parenteral</th>
<th>Enteral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>50±10</td>
<td>55±15</td>
</tr>
<tr>
<td>Gender</td>
<td>60% Male</td>
<td>50% Male</td>
</tr>
<tr>
<td>Comorbidities</td>
<td>20%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Results

1. In the parenteral group, the acute phase response was suppressed compared to the enteral group.
2. Enteral feeding resulted in a significant reduction in hospital stay compared to parenteral feeding.

Table 2: Nutrient Intake Comparison

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Parenteral</th>
<th>Enteral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>1.0 g/kg</td>
<td>1.2 g/kg</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>1.5 g/kg</td>
<td>1.7 g/kg</td>
</tr>
</tbody>
</table>

References

1. Beghetto, et al., JPEN 2005
2. Koret, Gastroenterology 2001
3. Caesar, et al., NEJM 2011
Enteral vs Parenteral

Fewer infectious complications with enteral in acute pancreatitis

- McClave, et al, JPEN 2006

Enteral vs Parenteral

Shorter LOS with enteral in pancreatitis

- McClave, et al, JPEN 2006

Enteral Route in Pancreatitis

- EN at a slow infusion is well tolerated by both NJ and NG routes in patients with severe acute pancreatitis.
- Neither NJ nor NG feeding leads to recurrence or worsening of pain in severe acute pancreatitis.

Timing

Ileus

Tripartite

- Foregut
  - Stomach and proximal duodenum
  - 1-2 days post-op
  - Gastroparesis
- Hindgut
  - Mid-ascending colon to rectum
  - 3-7 days post-op (sooner with feeding)
- Midgut
  - Is it real? Peristalsis occurs during surgery
  - Appearance may be due to colonic dysfunction

Normal Gut in Fed State
Nutrition Support for the Critically Ill: Considerations for the ICU Nurse

Unfed Gut in Stressed Patient

Unfed Gut in Stressed Patient

Morrell et al., Infectious Disease Clinics of North America, 2009
Dietch, The Surgeon, 2012

TPN Reduces Peyer Patch and Lung Associated Lymphoid Tissue IgA Production

TPN Reduces Peyer Patch and Lung Associated Lymphoid Tissue IgA Production

King, et al., Arch Surg, 1997

Unfed Gut in Stressed Patient

Unfed Gut in Stressed Patient

TPN Induces Respiratory Immunosupression (Viremia in Immune Mice)

Table 4. VIRAL SHEDDING

<table>
<thead>
<tr>
<th>Group</th>
<th>TPN+</th>
<th>TPN-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viremia</td>
<td>17%</td>
<td>5%</td>
</tr>
<tr>
<td>Infection Rate</td>
<td>2%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

TPN = total parenteral nutrition; TPN+ = animals that received TPN contained within the study; TPN- = animals that received no TPN.


Early Enteral Nutrition Decreases Infectious Complications

Early Enteral Nutrition Decreases Infectious Complications

Marik, et al., CCM, 2001

Early Enteral Nutrition Significantly Reduces Mortality

Early Enteral Nutrition Significantly Reduces Mortality

Marik, et al., CCM, 2001

Early Enteral Feeds vs NPO

Early Enteral Feeds vs NPO

Lewis, BMJ, 2001

Critical III Patients

Infectious complications

Infectious complications

Infectious complications

Infectious complications

Marik, et al., CCM, 2001
**Gastric Feeds in ICU**

- Pancreatitis – 100% tolerated
- Traumatic brain injury – 97% tolerated
- Critically ill – NG+erythro = small bowel feed
- Sepsis – UGI intolerance in 79%; 95.5% continued feeds

**Early postoperative feeding tolerated**

Post op day one oral intake tolerated in most colorectal surgery patients.

**Early postoperative feeding hastens return to regular diet**

Early post op vs start diet after bowel sounds

- Liquid diet tolerated POD 1
- Pts were advanced to regular diet within the next 24 to 48 hours in 79%
- No differences in complications
- Early feeding group tolerated a regular diet sooner (2.6 +/- 0.1 days vs. 5 +/- 0.1 days; p < 0.001).

**Ileus resolves faster with fewer complications with early post-op enteral nutrition for perforation peritonitis**

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Study</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return of bowel fxn (days)</td>
<td>4.4</td>
<td>3.36</td>
<td>&lt;0.0005</td>
</tr>
<tr>
<td>Complications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wound infxn dehiscence</td>
<td>8</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Complete dehiscence</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Chest infection</td>
<td>14</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Pneumonia/effusion</td>
<td>13</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Septicemia, septic shock</td>
<td>8</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total Complications</td>
<td>47</td>
<td>39</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

**Rule of Thumb**

If the gut works, use it
Rule of Thumb
If there is a gut, use it

The New ABC(DEF)’s
- Airway
- Breathing
- Circulation
- Diet or
- Enteral Feeding

Parenteral Nutrition
- Use limited to prolonged gut failure
  - Greater than 2 weeks anticipated or
  - Preexisting starvation for ≥ 2 weeks
- Never short term
- NO PPN except to resolve refeeding abnormalities when central line delayed

Gastroparesis
- Common
  - Diabetes
  - Pressors
  - Narcotics
- Approach
  - Prokinetics – metoclopramide/erythromycin
  - Postpyloric tubes (nasoenteric)
    - Endoscopy
    - Radio-emitting guidewire
    - Blind at bedside
  - Opiate receptor antagonists

Intolerance

Parenteral Nutrition
**Elevated Gastric Residual**

- **Mythology**
  - Increased residual = increased vomiting = increased pneumonia
  - 2x rate or 50 ml hold feed
- **Data**
  - 350 – 500 ml residual not associated with increase in pneumonia
  - Intragastric pressure may be more important determinate of reflux/vomiting
  - Vomiting may not predispose to pneumonia

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**Diarrhea**

- Meds – Antibiotic-related (+/- c diff)
- Meds – Side effect (PPIs & many others)
- Meds – Liquid meds are in 70% sorbitol
- Feeds

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**Diarrhea and “Hyperosmolar” feeds**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Osmolarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum</td>
<td>275-299</td>
</tr>
<tr>
<td>Tube feeds</td>
<td>250-710</td>
</tr>
<tr>
<td>Soda</td>
<td>695</td>
</tr>
<tr>
<td>Fruit juice</td>
<td>990</td>
</tr>
<tr>
<td>Acetaminophen elixir</td>
<td>5400</td>
</tr>
<tr>
<td>Na Phosphate</td>
<td>7250</td>
</tr>
</tbody>
</table>

Adapted from Parrish & McCray, *Pract Gastro*, 2003

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**Aspiration**

- The data:
  - Does not equal pneumonia
  - Incidence 100% in all of us
  - Collection of sputum for evidence of markers for gastric contents not appropriate (dye in feed, pH, glucose, etc)
- Approaches (to avoid pneumonia)
  - Head of the bed up
  - Examine patient for distention
  - Attention to dysphagia

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**Calorie Delivery**

- The data: 50% of prescribed calories are delivered to patients in ICUs in North America
- Approaches:
  - Improved with volume-based feed protocols (vs. rate based)
  - Make up for held periods
  - Rates up to or above twice the rate needed for 24 hour feed
  - Caution about overly aggressive feeding full volume too early (approx the first week)

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**Summary**

- “Malnutrition” includes imbalance as well as impact of disease
- Early enteral feeding is beneficial to critically ill
- Iatrogenic starvation is often unnecessary
We can't solve problems by using the same kind of thinking we used when we created them.

Albert Einstein

References


