ENTERAL AND PARENTERAL NUTRITION

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Objectives
- Recognize when nutritional support is warranted
- Choose route of nutrition (enteral vs parenteral)
- Plan nutrient prescription
- Discuss benefits vs complications of enteral and parenteral nutrition
- Describe how to monitor patients receiving nutrition support

Why Is Nutrition Important?

Importance of Nutrition
- Hippocrates - "Let food be your medicine and medicine be your food."
- Wound healing/recovery from illness
- Prevention/resistance to infection
- Maintenance of vital functions
  - Respiratory muscle function
  - Cardiac function
  - Coagulation cascade
  - Electrolyte and hormonal balance
  - Renal function.

Effects of Injury and Critical Illness
- Insulin resistance
- Reduction in insulin-like growth factor, growth hormone
- Release of catecholamines, glucagon, cortisol
- Release of inflammatory cytokines, oxygen radicals

When Is Nutritional Support Warranted?
- Well nourished patients who will be unable to eat for > than 5-7 days
- Surgery, stroke, ventilator
- Malnourished patients
- High risk patients
- Trauma, burns, sepsis
**Malnutrition**

- Marasmus
  - Inadequate protein and calories
  - Wasting of fat and muscle
  - Aids, advanced renal failure, elderly
- Kwashiorkor
  - Inadequate protein
  - Edema and fatty infiltration of liver
  - Fad diets, ETOH abuse

If NS warranted, if so, when, what route, what access, what type?

- 77 year old previously healthy female with severe dysphagia following a CVA
- 59 year male with COPD and esophageal cancer who has lost 20 pounds
- 18 year male s/p SGW to abdomen with stomach, pancreas, duodenal and colon injury

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- High risk patient - Trauma

**CAVEAT**

*Nutrition support should maintain or improve quality of life*
**Enteral vs Parenteral?**
- When the gut works use it!
- Using the gut can be a pain in the butt

**Benefits of Enteral vs Parenteral Nutrition**
- Maintains morphologic, functional integrity of GI tract
- Avoid mechanical, metabolic complications of TPN
- Decreased cost
- “Easier”

**Morphologic Benefits of Enteral vs Parenteral Nutrition**
- Maintenance of gut permeability
- Prevention of gut stasis
- Maintenance of gut mass
- Maintenance of gut-associated lymphoid tissue - GALT

**Clinical Benefits of Enteral vs Parenteral Nutrition**
- Decreased length of ICU and hospital stay
- Decreased infectious complications
- Decreased hypermetabolism

**Enteral Contraindications**
- Hemodynamic instability
- Pressors
- Peritonitis
- Bowel obstruction
- Proximal fistula
- High output fistula
- Bowel ischemia

**Enteral Access**
- Nasogastric/nasojugal tube
- Gastrostomy
  - PEG, radiologic, operative
- Jejunostomy
  - PEG, radiologic, operative
Complications of Any Enteral Access

- Aspiration
- Infection
- Bleeding
- Occlusion
- Displacement

Even Worse Complications of Enteral Access

- Bowel obstruction
- Perforation
- Bowel infarction

More Complications of Enteral Feeding

- Diarrhea/constipation
- Abdominal distention
- Nausea/vomiting

BUT!!!!
TPN Has Some Pretty Sporty Complications, Too

- Line related
  - Infection
  - Arrhythmia's
  - Thrombosis
  - Adjacent organ perforation
- Metabolic
  - Hyperglycemia

Where to Start

- Determine enteral vs parenteral
- Determine calories required
- Determine protein required

Caloric Requirements

- Formulas such as Harris-Benedict
- Kcal/KG method
- Indirect calorimetry
Caloric Requirements

- Harris-Benedict for women
  \[ \text{BEE} = 655.1 + (9.563 \times \text{kg}) + (1.85 \times \text{cm}) - (4.676 \times \text{age}) \]
- Harris-Benedict for men
  \[ \text{BEE} = 66.5 + (13.75 \times \text{kg}) + (5.003 \times \text{cm}) - (6.7756 \times \text{age}) \]
- Multiply by a stress factor

**Table: KCAL/KG METHOD**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance</td>
<td>25</td>
</tr>
<tr>
<td>Minor infection, surgery</td>
<td>25-30</td>
</tr>
<tr>
<td>Trauma, Major surgery, sepsis</td>
<td>30-35</td>
</tr>
<tr>
<td>Burns</td>
<td>Xie</td>
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</tbody>
</table>

Protein Requirements

<table>
<thead>
<tr>
<th>G/KG/DAY</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance</td>
<td>1.0</td>
</tr>
<tr>
<td>Moderate stress or repletion</td>
<td>1.5</td>
</tr>
<tr>
<td>Severe stress</td>
<td>2.5</td>
</tr>
<tr>
<td>Renal failure without dialysis</td>
<td>0.3-0.5</td>
</tr>
<tr>
<td>Renal failure with dialysis</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Putting It Together - Enteral -

- Figure out the calories/day you want to give
- Calculate volume per day to deliver calories
- Calculate amount of protein that will be delivered
- Add protein to the feeding to make up the difference

Example - Enteral

- 27 year old, 55 kg, 5'4" female involved in MVA with spleen and liver lacerations, pelvic fracture and bilateral pulmonary contusions
  - Kcal/day = 55 Kg x 30-35 kcal/kg/day = 1650 - 1925 Kcal/day
  - BEE = 1356 kcal/day x 1.5 - 2 stress factor = 2034 - 2712 kcal/day
  - Protein = 2 - 2.5 gram protein x 55 kg = 110 - 140 grams

Important Numbers That You Forgot a Long Time Ago

- Carbohydrates - 3.4 kcal/gram
- Lipids - 9 kcal/gram
- Protein - 4 kcal/gram
- Minimum of 75-100 grams carbs/day necessary (1 liter of D5W has 50)
- Minimum of 1-1.5 grams fat/day necessary (Big Mac at least 31)
**Example - Enteral**

- Ensure Plus HN
  - 1.5 kcal/cc
  - 44.4 grams protein/liter
- Goal 1650-1925 kcal/day
  - 1650 kcal + 1.5 kcal/cc = 1100 cc/day (≈ 45 cc/hr)
  - 1925 kcal + 1.5 kcal/cc = 1283 cc/day (≈ 55 cc/hr)

- 1100 cc/d x 44.4 gm protein/liter = 49 gm protein/d
- 1283 cc/d x 44.4 gm protein/liter = 57 gm protein/d
- Goal Protein = 110 - 140 gm/d
- Add protein – pain for the nurses
- OR use a higher nitrogen formula

**Example - Enteral**

- Replete with Fiber
  - 1.0 kcal/cc
  - 64 grams protein/liter
- Goal 1650-1925 kcal/day
  - 1650 kcal + 1 kcal/cc = 1650 cc/day (≈ 70 cc/hr)
  - 1925 kcal + 1 kcal/cc = 1925 cc/day (≈ 80 cc/hr)

- 1650 cc/d x 64 gm protein/liter = 106 gm protein/d
- 1925 cc/d x 64 gm protein/liter = 123 gm protein/d
- Goal Protein = 110 - 140 gm/d

**Overfeeding**

- Steatosis
- Cholestasis
- Intrahepatic triglyceride accumulation
- Excessive CO₂ production

**Special Considerations**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renal failure</td>
<td>Reduce protein, Mg, Phos, K</td>
</tr>
<tr>
<td>Lung disease</td>
<td>Decrease carbs, increase lipids</td>
</tr>
<tr>
<td>Diabetes</td>
<td>Decrease carbs, increase lipids</td>
</tr>
<tr>
<td>Liver disease</td>
<td>Consider branched chain amino acids</td>
</tr>
<tr>
<td>Aspiration risk</td>
<td>Use concentrated formulas</td>
</tr>
<tr>
<td>CHF</td>
<td>Use concentrated formulas</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>Don't ask me</td>
</tr>
</tbody>
</table>
Things to Watch Out For

- Overfeeding/underfeeding
  - Follow nitrogen balance
  - Follow BUN, CO₂
  - Follow albumin, prealbumin

Things to Watch Out For

- Refeeding
  - Hypokalemia
  - Hypomagnesemia
  - Hypophosphatemia
  - Hyperglycemia
  - Thiamine deficiency

Things to Watch Out For

- Any and all electrolyte abnormalities
- Hypo/hyperglycemia
- Acidosis
- Fluid overload

How and What Would We Feed Our Original Patients?

- 77 year old previously healthy female with severe dysphagia following a CVA
  - Enteral vs Parenteral?
  - Access route?
  - Type of formula?

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Summary

- Recognize when nutritional support is warranted
  - Malnourished
  - Expected to be without oral intake for 5 - 7 days
  - High risk patients

Summary

- Choose route of nutrition (enteral vs parenteral)
  - When the gut works use it
  - MUST BE closely monitored
  - TPN is significantly better than starving to death

Summary

- Plan nutrient prescription
  - Calculate caloric requirements
  - Calculate protein requirements
  - Determine amount of ENTERAL feeds based on CALORIC requirements, adjust PROTEIN

Summary

- Discuss benefits vs complications of enteral and parenteral nutrition
  - Physiologic and clinical benefits to enteral compared with parenteral
  - Both can be associated with SIGNIFICANT COMPLICATIONS so patients must be monitored

Summary

- Describe how to monitor patients receiving nutrition support
  - Examine abdomen and TALK TO PATIENT!
  - Follow electrolytes, glucose, LFT' S
  - Monitor nitrogen balance, albumin, prealbumin
Parting Thoughts

- My personal goal for each patient followed by the Nutrition Support Service is to sign off

- That means that the patient is taking an adequate enteral or even better, an ORAL diet