Enteral Feeding: It’s the natural way....It’s the Colorado way.

Grand Rounds
July 27th, 2009
Presented By: Jeffrey Harr
Objectives

- Nutrition / Malnutrition
- Abnormal Physiology with Lack of Enteral Nutrition / Use of Parenteral Nutrition
- Guidelines for Enteral Nutrition
- Debunking the Argument(s) Against Enteral Nutrition
- Conclusion
Who Needs Nutritional Support?

- Well-nourished person who has been without nutrition for 7-10 days
  - Adequate stores to provide nutrients without compromising physiologic functions, altering resistance to infection, or impairing wound healing

- Duration of illness is anticipated to be more than 10 days
  - Severe peritonitis or pancreatitis
  - Injury severity score > 15
  - Extensive Burns (> 20% BSA)

- Malnourished (loss of > 10% of usual body weight over 3 months)
  - % Weight loss = (Usual weight - present weight) x 100/ Usual Weight
Caloric Requirements

- **General**: 25 kcal/ kg/ day
- **Harris-Benedict Formula**
  - Male: BMR = 66 + (13.7 \times \text{weight [kg]}) + (5 \times \text{height [cm]}) - (6.8 \times \text{age [yr]})
  - Female: BMR = 65 + (9.6 \times \text{weight [kg]}) + (1.7 \times \text{height [cm]}) - (4.7 \times \text{age [yr]})

<table>
<thead>
<tr>
<th>Patient Condition</th>
<th>Basal Metabolic Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>No postoperative complications</td>
<td>Normal</td>
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<tr>
<td>Fistula without infection</td>
<td></td>
</tr>
<tr>
<td>Mild peritonitis</td>
<td>25% above normal</td>
</tr>
<tr>
<td>Long-bone fracture or mild to moderate injury</td>
<td></td>
</tr>
<tr>
<td>Severe Injury of infection in ICU patient</td>
<td>50% above normal</td>
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<tr>
<td>Multiorgan Failure</td>
<td></td>
</tr>
<tr>
<td>Burn of 40-100% of BSA</td>
<td>100% above normal</td>
</tr>
</tbody>
</table>
Malnutrition in Hospitalized Patients

- Estimated that as many as 50% of hospitalized patients may be malnourished\(^1\)
  - anorexia (cancer, sepsis, liver disease), GI Obstruction, Motility disorders, GI Surgery, Inadequate Absorption

- Risk of Malnutrition in hospitalized patients is a world wide problem
  - Other studies conducted in England, Germany, and Australia report malnutrition in 25 – 70% of their patients

- Effects of Malnutrition
  - Increased morbidity and mortality
  - Increase in length of hospital stays
  - Increase in hospital costs
  - Increase risk of readmission

- Largely undiagnosed problem
  - Lack of simple lab tests (difficult to interpret) or monitoring
  - Poor documentation
  - Patients leave hospital without action to treat malnutrition
  - Screening tools are underused and not enforced

Some adverse effects of malnutrition include:

- Impaired immune responses - increasing risks of infection
- Reduced muscle strength and fatigue
- Reduced respiratory muscle function - resulting in increased difficulties in breathing and expectoration, in turn increasing the risk of chest infection and respiratory failure
- Impaired thermoregulation - predisposition to hypothermia
- Impaired wound healing and delayed recovery from illness
- Apathy, depression and self neglect
- Increased risk of admission to hospital and length of stay
- Poor libido, fertility, pregnancy outcome and mother child interactions
Malnutrition

- **Protein Deficient**
  - Serum Albumin < 2.5 g/ dL
  - Weight maintained
  - Peripheral edema

- **Calorie Deficient**
  - 20% below usual weight or hx of weight loss
  - Overt muscle wasting
  - Serum proteins maintained: Albumin > 2.9 g/ dL

- **Protein-Calorie Deficient**
  - 20% below usual weight or hx of weight loss
  - Serum albumin < 2.9 g/ dL
    - Moderate: 2.5 - 2.9 g/ dL
    - Severe: < 2.5 g/ dL
  - Overt signs of muscle wasting
Risks of TPN / Lack of EN

- Loss of intestinal integrity
  - Mucosal Atrophy
  - Increase in IFN-gamma
    - Increase apoptosis and decreased IgA secretion
    - Impaired GALT
  - Decrease in IL-10
    - Decrease expression of tight junction and adheren junction proteins
  - Increase in serum intestinal fatty acid binding protein (i-FABP) in trauma patients
    - Early presence of intestinal epithelial cell damage associated with shock and injury severity within first day
- Bacterial Translocation
Risks of TPN / Lack of EN

- Decompensated Liver Disease\(^4\)
  - Steatohepatitis, cholestasis, cholelithiasis
  - Decrease in liver mononuclear cells and LPS receptors
    - Impaired hepatic immunity

- Impaired Respiratory Tract Immunity\(^5\)
  - Decreased IgA-dependent upper respiratory tract immunity with TPN
    - Preserved with EN
    - Independent of GALT
  - Associated with late-onset ARDS (Retrospective 6 year Review N =2346)\(^6\)
    - 28.7% of those exposed to TPN met criteria for late-onset ARDS
    - 3.9% of those not exposed to TPN developed late-onset ARDS

- Impaired peritoneal host defense system\(^7\)
  - Parenteral nutrition decreased the number of intraperitoneal macrophages and had a blunted nuclear factor kappaB activation
American Society for Parenteral and Enteral Nutrition (ASPEN) Guidelines

- **Initiate Enteral Feeding**: Traditional nutritional assessment tools are not validated in critical care. Albumin, prealbumin, transferrin, and retinol binding protein are a reflection of the acute phase response.

- **Critically ill patients who are unable to maintain volitional intake should receive enteral nutrition**: Maintains tight junctions between intraepithelial cells, stimulates blood flow, induces the release of trophic endogenous agents (CCK, Gastrin, Bombesin, Bile Salts), maintains villous height, supports secretory IgA-producing immunocytes, contributes to distant site mucosal-associated lymphoid tissue (lungs, liver, kidneys).
<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Study Groups</th>
<th>Infectiona</th>
<th>Hospital LOS Days, Mean ± SD (or Range)</th>
<th>Hospital Mortality</th>
<th>Other Outcomes</th>
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<tr>
<td>Sagar et al, 197912</td>
<td>GI surgery (n = 30)</td>
<td>EN</td>
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<td>14 (10-26)</td>
<td>0/15 (0%)</td>
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<td>Schroeder et al, 199111</td>
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<td>EN</td>
<td>1/16 (6%)</td>
<td>0 ± 4</td>
<td>0/16 (0%)</td>
<td>Anastomotic dehiscence 0/16 (0%)</td>
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<td>Carr et al, 199613</td>
<td>GI surgery (n = 28)</td>
<td>EN</td>
<td>0/14 (0%)</td>
<td>9.8 ± 6.6</td>
<td>0/14 (0%)</td>
<td>Lactulose:mannitol ratio 0.1 ± 0.03b</td>
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<td>Beier-Holgersen et al, 199614</td>
<td>GI surgery (n = 60)</td>
<td>EN</td>
<td>2/30b (7%)</td>
<td>8.0c</td>
<td>2/30 (7%)</td>
<td>Anastomotic leak 2/30 (7%)</td>
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<td>Heslin et al, 199715</td>
<td>GI surgery (n = 195)</td>
<td>EN</td>
<td>20/97 (21%)</td>
<td>11 (4-41)</td>
<td>2/97 (2%)</td>
<td>Major complication 27/97 (28%)</td>
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<td>Watters et al, 199716</td>
<td>GI surgery (n = 28)</td>
<td>EN</td>
<td>NR</td>
<td>17 ± 9</td>
<td>0 (0%)</td>
<td>Anastomotic leak 1/13 (8%)</td>
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<tr>
<td>Pupelis et al, 200018</td>
<td>Acute pancreatitis  (n = 29)</td>
<td>EN</td>
<td>3/11 (27%)</td>
<td>45 ± 96</td>
<td>1/11 (9%)</td>
<td>MOF 18/30 (60%)</td>
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<tr>
<td>Pupelis et al, 200119</td>
<td>Acute pancreatitis, peritonitis (n = 60)</td>
<td>EN</td>
<td>10/30 (33%)</td>
<td>35.3 ± 22.9</td>
<td>1/30 (3%)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>STD</td>
<td>8/30 (27%)</td>
<td>35.8 ± 32.5</td>
<td>7/30 (23%)</td>
<td></td>
</tr>
</tbody>
</table>

SD, standard deviation; NR, not reported; LOS, length of stay; GI, gastrointestinal; MOF, multiple organ failure.

a All infections represent number of patients per group with infection unless otherwise stated.

b P ≤ .05.
c P = .08.
d Wound sepsis.
• Enteral feeding should be started within 24-48 hrs following admission and advanced to goal over next 48-72 hrs.

• Early feeding associated with less gut permeability, diminished activation and release of inflammatory cytokines\(^\text{13}\)

• Decreased ICU Mortality and Infections compared to delayed enteral feeding
<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>ICU Groups</th>
<th>ICU Mortality</th>
<th>Infectionsa</th>
<th>LOS Days, Mean ± SD</th>
<th>Ventilator Days, Mean ± SD</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Moore et al, 1986</td>
<td>Trauma (n = 43)</td>
<td>Early</td>
<td>1/32 (3%)</td>
<td>3/32 (9%)</td>
<td>NR</td>
<td>NR</td>
<td>$16,280 ± 2146</td>
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<td></td>
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<td>Delayed</td>
<td>2/31 (6%)</td>
<td>9/31 (29%)</td>
<td></td>
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<td>$19,636 ± 3396</td>
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<td>Chiarelli et al, 1990</td>
<td>Burn (n = 20)</td>
<td>Early</td>
<td>0/10 (0%)</td>
<td>3/10 (30%)b</td>
<td>69.2 ± 10.4° Hosp</td>
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<td>Delayed</td>
<td>0/10 (0%)</td>
<td>7/10 (70%)</td>
<td>89.0 ± 18.9 Hosp</td>
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<td>Eyer et al, 1993</td>
<td>SICU trauma (n = 52)</td>
<td>Early</td>
<td>2/19 (11%)</td>
<td>29 per group</td>
<td>11.8 ± 7.9 ICU</td>
<td>10.2 ± 8.1</td>
<td>NR</td>
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<tr>
<td>Level II</td>
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<td>Delayed</td>
<td>2/19 (11%)</td>
<td>14 per group</td>
<td>9.9 ± 6.7 ICU</td>
<td>8.1 ± 6.8</td>
<td>NR</td>
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<tr>
<td>Chuntratasakul et al, 1996</td>
<td>SICU trauma (n = 38)</td>
<td>Early</td>
<td>1/21 (5%)</td>
<td>NR</td>
<td>8.1 ± 6.3 ICU</td>
<td>5.29 ± 6.3</td>
<td>NR</td>
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<tr>
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<td>Delayed</td>
<td>3/17 (18%)</td>
<td></td>
<td>8.4 ± 4.8 ICU</td>
<td>6.12 ± 5.3</td>
<td>NR</td>
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<tr>
<td>Singh et al, 1998</td>
<td>Peritonitis (n = 43)</td>
<td>Early</td>
<td>4/21 (19%)</td>
<td>7/21 (33%)</td>
<td>14 ± 6.9 Hosp</td>
<td>NR</td>
<td>NR</td>
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<tr>
<td>Level II</td>
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<td>Delayed</td>
<td>4/22 (18%)</td>
<td>12/22 (55%)</td>
<td>13 ± 7.0 Hosp</td>
<td></td>
<td>NR</td>
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<tr>
<td>Minard et al, 2000</td>
<td>Closed head injury (n = 27)</td>
<td>Early</td>
<td>1/12 (8%)</td>
<td>6/12 (50%)</td>
<td>30 ± 14.7 Hosp</td>
<td>15.1 ± 7.5</td>
<td>NR</td>
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<tr>
<td></td>
<td></td>
<td>Delayed</td>
<td>4/15 (27%)</td>
<td>7/15 (47%)</td>
<td>21.3 ± 13.7 Hosp</td>
<td>10.4 ± 6.1</td>
<td>NR</td>
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<td>Kompan et al, 2004</td>
<td>SICU trauma (n = 52)</td>
<td>Early</td>
<td>0/27 (0%)</td>
<td>9/27 (33%)</td>
<td>15.9 ± 9.7 ICU</td>
<td>12.9 ± 8.1</td>
<td>NR</td>
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<tr>
<td></td>
<td></td>
<td>Delayed</td>
<td>1/25 (4%)</td>
<td>16/25 (64%)</td>
<td>20.6 ± 18.5 ICU</td>
<td>15.6 ± 16.1</td>
<td>NR</td>
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<tr>
<td>Malhotra et al, 2004</td>
<td>Postop peritonitis (n = 200)</td>
<td>Early</td>
<td>12/100 (12%)</td>
<td>54/100 (54%)</td>
<td>10.6 Hosp</td>
<td>NR</td>
<td>NR</td>
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<tr>
<td></td>
<td></td>
<td>Delayed</td>
<td>16/100 (16%)</td>
<td>67/100 (67%)</td>
<td>10.7 Hosp</td>
<td></td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Early</td>
<td>1.6 ICU</td>
<td></td>
<td></td>
<td></td>
<td>NR</td>
</tr>
<tr>
<td>Peck et al, 2004</td>
<td>Burn (n = 27)</td>
<td>Early</td>
<td>4/14 (29%)</td>
<td>12/14 (86%)</td>
<td>60 ± 44 Hosp</td>
<td>32 ± 27</td>
<td>NR</td>
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<tr>
<td>Level II</td>
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<td>Delayed</td>
<td>5/13 (38%)</td>
<td>11/13 (85%)</td>
<td>60 ± 38 Hosp</td>
<td>23 ± 26</td>
<td>NR</td>
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<tr>
<td></td>
<td></td>
<td>Early</td>
<td>40 ± 32 ICU</td>
<td></td>
<td></td>
<td></td>
<td>NR</td>
</tr>
<tr>
<td>Dvorak et al, 2004</td>
<td>Spinal cord injury (n = 17)</td>
<td>Early</td>
<td>0/7 (0%)</td>
<td>2.4 ± 1.5 per pt</td>
<td>53 ± 34.4 Hosp</td>
<td>31.8 ± 35.0</td>
<td>NR</td>
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<tr>
<td></td>
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<td>Delayed</td>
<td>0/10 (0%)</td>
<td>1.7 ± 1.1 per pt</td>
<td>37.9 ± 14.6 Hosp</td>
<td></td>
<td>NR</td>
</tr>
</tbody>
</table>

SD, standard deviation; NR, not reported; ICU, intensive care unit; LOS, length of stay; Hosp, hospital; SICU, surgical ICU; pt, patient.

a All infections represent number of patients per group with infection unless otherwise stated.
b Bacteremia.
c P ≤ .05.

Adapted from the Canadian Clinical Practice Guidelines.21
ASPEN Guidelines

- If early EN is not feasible or available the first 7 days following admission to the ICU, **NO** nutrition support therapy should be provided
  - If patient was previously healthy
  - No evidence of protein-calorie malnutrition

- Meta-analyses comparing PN with EN/STD therapy in critically ill patients\textsuperscript{14,15}
  - reduced infectious morbidity with EN/STD therapy (RR = 0.77; p < 0.05)
  - Increased mortality with PN (RR = 1.78; p < 0.05) and trend toward greater rate of complications
### TABLE 3
Prospective randomized clinical trials of enteral nutrition (EN; tube feeding or standard care) compared with parenteral nutrition (PN)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Number of subjects</th>
<th>Study-quality score</th>
<th>PEM&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Cancer&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Infection EN (%)</th>
<th>Infection PN (%)</th>
<th>Nutrition support complications EN (%)</th>
<th>Nutrition support complications PN (%)</th>
<th>Other complications EN (%)</th>
<th>Other complications PN (%)</th>
<th>Mortality EN (%)</th>
<th>Mortality PN (%)</th>
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<td>Tube feeding</td>
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<tr>
<td>Adams et al, 1986 (32)</td>
<td>23</td>
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<td>15 (30)</td>
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<td>Bower et al, 1986 (20)</td>
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<td>3</td>
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<td>9 (45)</td>
<td>2 (11)</td>
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<td>7 (58)</td>
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<sup>1</sup> PEM, protein-energy malnutrition ≥50%.

<sup>2</sup> Studies in which ≥50% of the study population had cancer.
• Effort to provide > 50% - 65% of goal calories should be made\textsuperscript{10,16-18}
• Trophic feeds are sufficient to prevent mucosal atrophy, but insufficient in other endpoints
• Achieving > 50% - 65% of goal calories is required for:
  • Preventing increase in intestinal permeability in burn and bone-marrow transplant patients
  • Promoting faster return of cognitive function in head injury patients
  • Improving outcomes in immune-modulating enteral formulations in critically ill patients
Nutrition Protocols

- Implementation of an evidenced-based nutritional support algorithm improved the proportion of patients meeting > 80% of caloric goals\textsuperscript{19,20}
  - Proportion of goal caloric intake improved from 56% to 83%
- 50% Reduction in Days to Feeding
- Decrease of clinically non-indicated use of parenteral nutrition.
ICU admission
Follow GI prophylaxis protocol until EN commenced
Evaluate initiation nutrition support within and q12h

Risk factors for early EN?
Absolute: mechanical bowel obstruction, massive upper GI bleed, high out-put fistula >500mL/24h, short gut <60cm bowel left
Relative: risk of gut ischemia (cardiogenic/septic/hypovolemic shock), distension/ileus, OG output >1L/24h, malabsorption, high output fistula, impending extubation/endoscopy/OR; post-op patients: discuss feeding access and plans with surgeon.

High Risk pathway (2)

Nutritional assessment:
Indicators of malnutrition: ETOH abuse, unintentional wt loss >10lb x 3 months, NPO >7 day in the ICU, cachexia. These patients are at risk of refeeding syndrome - Avoid over-feeding. Monitor K, PO4, Mg closely.
If malnutrition present consider TPN if EN contraindicated (see Appendix 2)

Formula selection and rate advance guidelines:
Standard formula: Nutren VHP Fibre
Renal Failure on hemodialysis: Nepro
Fluid Restricted - Nutren 2.0
Malabsorption - Peptinex DT
Other - Consult RD

Rate advance guideline:
Initiate orogastric infusion @ 25mL/h. Increase by 25mL/h q4h to goal 1mL/kg/h. For Nepro/Nutren 2.0 goal = 0.5 mL/kg/h.
Use actual or IBW, whichever is less.

Initiate gastric residual protocol (3)
See Appendices for other Recommended Practices

Special Circumstances?
Pancreatitis (4)
Emergency GI Surgery (5)
Elective GI Surgery (6)
-dialect with surgeon
-dialect with surgeon
An economic analysis of a multicenter Department of Veterans Affairs randomized, controlled trial of perioperative total parenteral nutrition (TPN)\textsuperscript{21}

- The cost of providing TPN for an average of 16.15 days before and after surgery was $2405
- Perioperative TPN did not result in decreased costs for any subgroup of patients.

A prospective, randomized clinically controlled trial evaluated the potential clinical, metabolic, and economic advantages of enteral nutrition over total parenteral nutrition\textsuperscript{22}

- Enteral nutrition was four-fold less expensive than TPN ($25 vs. $90.60/ day, respectively)
Conclusion

- Enteral Nutrition is superior to STD nutrition for reducing risk of infection and hospital mortality.
- Enteral Nutrition is superior to Parenteral nutrition for reducing risk of infection and hospital mortality.
- STD nutrition is superior to Parenteral nutrition if no evidence of malnourishment.
- Enforced protocols can ensure adequate nutrition to maintain protective physiology.
- Enteral Nutrition is less expensive than parenteral nutrition.
And Finally...

Do you think this guy has ever seen a drop of TPN?
References


