Intensive Care Nutrition

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Objectives

1. What examiners say
2. Definition
3. Assessment
4. Requirements
5. Types of delivery
6. CALORIES Trial
7. Timing
8. Immunomodulation
9. Refeeding
Enteral nutrition in critically ill. 44.9% pass rate.

- Answered poorly.
- Very important – detailed knowledge of the specific components
- Required knowledge:
  - Water (ml/kg/day)
  - Calories (kCal/kg/day)
  - Protein, fat and carbohydrate (g/day) Na/K (mmol/kg/day) and minerals
  - Vitamins
  - Immunonutrition
- Failed to be specific enough. No okay: “nutrition team” or “Intensive Care dietician”
Nutrition

• Key aspect of care but little evidence

• Important because
  • Increased energy requirements
  • Failure to meet energy needs
    • Catabolism – wound healing, immune function, coagulation, muscle strength and respiratory function
    • Hypoglycaemia
    • Loss of mean body mass
    • Hypoalbuminaemia

• Malnutrition may lead to worse outcomes

• Overfeeding dangerous too
Assessment

- Biochemical markers
  - albumin, pre-albumin, transferrin

- In critical illness they are acute phase markers

- The involvement of a critical care dietician is imperative in clinical practice
Assessment

• It is difficult to estimate nutritional requirements

• Energy
  • Indirect calorimetry
    • The gold standard
    • Calorific requirements calculated on the basis of oxygen consumption
    • Not really available on the majority of units
  • Measurement of CO₂ production
    • Good estimate of energy requirement under stable conditions; however, overfeeding will lead to an overestimate of energy expenditure
Assessment

• Estimation
  • For the majority of units, energy requirements are based upon population derived formulae +/- correction for disease state
    • **Scholfield Formula**
      • Age under 65 years: 25 kilocalories per day
      • Age over 65 years: 20 kilocalories per day
    • Some patient groups present particular problems in determining energy requirements
      • Obese
      • Malnurished
      • Patients with hypermetabolic states (major trauma, burns)
  • It was postulated that patients with ARDS may benefit from a lower calorific intake at the beginning of their admission; this however was not borne out in the recent EDEN study
<table>
<thead>
<tr>
<th>Gender</th>
<th>Equation</th>
<th>Descriptive equation for BMR (MJ/24 h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Henry(^{[10]})</td>
<td>BMR = 0.0669 \times \text{(Weight)} + 2.28</td>
</tr>
<tr>
<td></td>
<td>Schofield(^{[10,11]})</td>
<td>BMR = 0.063 \times \text{(Weight)} + 2.896</td>
</tr>
</tbody>
</table>
|         | Cole\(^{[11]}\)   | \[
BMR = \exp\left( -0.263 - 0.00277 \times \text{Age} + 0.4877 \ln \text{(Weight)} + 0.3367 \ln \text{(Height)} \right)
\] |
| Female  | Henry\(^{[10]}\) | BMR = 0.0546 \times \text{(Weight)} + 2.33                                |
|         | Schofield\(^{[10,11]}\) | BMR = 0.062 \times \text{(Weight)} + 2.036                                |
|         | Cole\(^{[11]}\)   | \[
BMR = \exp\left( -0.1934 - 0.00199 \times \text{Age} + 0.4764 \ln \text{(Weight)} + 0.0194 \ln \text{(Height)} \right)
\] |

W – Weight (kg); H – Height (cm); A – Age (years)
### Daily requirements

<table>
<thead>
<tr>
<th></th>
<th>/ kg / day</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy</strong></td>
<td>Under 65 years – 25 kilocalories</td>
</tr>
<tr>
<td></td>
<td>Over 65 years – 20 kilocalories</td>
</tr>
<tr>
<td><strong>Carbohydrates</strong></td>
<td>Should provide ~ 60% non-protein calories</td>
</tr>
<tr>
<td></td>
<td>3-4 g (4 calories / g)</td>
</tr>
<tr>
<td><strong>Protein</strong></td>
<td>Normally 1-1.5 g</td>
</tr>
<tr>
<td></td>
<td>Increase to 1.5 – 2.0 g for burns, major trauma and hypercatabolic states</td>
</tr>
<tr>
<td></td>
<td>A mixture of essential and non-essential amino acids</td>
</tr>
<tr>
<td></td>
<td>(4 calories / g)</td>
</tr>
<tr>
<td><strong>Lipids</strong></td>
<td>Should provide ~ 40% of non-protein</td>
</tr>
<tr>
<td></td>
<td>0.7 – 1.5 g (9 calories / g)</td>
</tr>
</tbody>
</table>
## Daily requirements

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<th>/ kg / day</th>
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</thead>
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<tr>
<td><strong>Water</strong></td>
<td>30 mls</td>
</tr>
</tbody>
</table>
| **Electrolytes**     | Sodium 1-2 mmol  
|                      | Potassium 0.7 – 1 mmol  
|                      | Calcium 0.1 mmol  
|                      | Magnesium 0.1 mmol  
|                      | Phosphate 0.4 mmol  |
| **Trace elements**   | Role unclear  
|                      | Selenium may have mortality benefit  |
Route of nutrition

• Volitional intake preferred route

• Those unable to meet nutritional requirements will require enteral nutrition (ER) or parenteral nutrition (PN)
Enteral Nutrition

- Administered via enteral tube, which is gastric or jejunal
  - Jejunal tubes – expensive and difficult to site
  - Jejunal tubes may reduce VAPs – not borne out in trials
  - Jejunal tubes – where gastric tubes are not tolerated

<table>
<thead>
<tr>
<th>Advantages over PN</th>
<th>Disadvantages over PN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheaper</td>
<td>Requires gut function</td>
</tr>
<tr>
<td>Easy administration</td>
<td>VAP association</td>
</tr>
<tr>
<td>Lower risk of infection</td>
<td>Less reliable delivery of energy</td>
</tr>
<tr>
<td>“Gut protection”</td>
<td></td>
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</tbody>
</table>
Enteral Nutrition

• Bowel sounds/flatus/stool – poor indicator of readiness for EN in ICU
• Volume aspirated from the feeding tube every 4 hours
  • Aspirates > 500 ml – hold feeds
  • High aspirates – look for gut failure (constipation, acute abdomen or ACS)
• Prokinetics
• Avoid opiates
• Jejunal feeding and PN are alternative options
Parenteral nutrition

• Enteral route is not available, or who fail to tolerate enteral feed

• Complications of PN include:
  • Access-related
    • Central venous line insertion
  • Liver-related
    • Hepatic steatosis
    • Cholestasis
    • Liver failure
  • Increased risk of sepsis with PN
  • Increased risk of hyperglycaemia
Enteral vs parenteral (CALORIES trial)

- Large pragmatic multi-centre trial – early PN vs EN,
  - No difference in mortality at 30 days
  - EN higher risk of vomiting and hypoglycaemia
- The authors concluded that
  - “Early nutritional support through parenteral route is neither more harmful nor more beneficial than such support through the enteral route”
- Neither group achieved energy targets in the trial and there was no significant difference in energy delivery in both groups: this challenges the idea that PN is more effective at delivering nutrition
Timing of nutrition

• Early vs Late
  • Timing of nutrition (either EN or PN)
    • ‘early’ or ‘late’.
  • No absolute consensus on timings
    • “Early” < 48 hrs after ICU admission
    • “Late” > 7 days
Timing of nutrition

- Evidence and practice
  - No high-grade evidence
  - Consensus: early EN - reduced mortality
  - Controversial: early PN in gut failure – good
    - CALORIES study
  - Cancer and pre-existing malnutrition – stronger evidence for early feeds
Immuno-nutrition

- Glutamine
  - Most abundant circulating AA
  - Leukocytes and enterocyte energy
  - Inflammation, oxidating stress, gut integrity and function
  - Trauma and burns
Immuno-nutrition

• L-Arginine
  • Essential during metabolic stress
  • Upregulates macrophage activity
  • High-doses – enhanced wound healing and reduce infections in elective surgery
  • Increases mortality in other groups
Omega 3

• Immuno-modulator
• Arachidonic acid inhibitor
• ?ARDS modulation
Refeeding Syndrome

• Develops when CHO load is delivered following prolonged starving
• Hypoinsulinaemia is common during fasting – the sudden increase in insulin leads to intracellular uptake:
  • K+
  • Mg++
  • PO4-
  • Ca++
• Arrhythmias and cardiac failure
Refeeding Syndrome

• Avoidance and management
  • Risk assess
  • THIAMINE replacement
  • Electrolyte replacement prior to feeding
  • EN withing 24-72 hrs
  • 10 kcal/kg initially
Hope we covered

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