**Nutritional requirements**

**Non-stressed, non-depleted patient**

- Energy: REE x 1.2  
  25-30 kcal/kg/day

- Proteins: 1 g/kg/day
Nutritional requirements

Non-stressed, depleted patient

- Energy: REE x 1.3-1.5
  35 kcal/kg/day

- Proteins: 1.2 g/kg/day

Gain of 1 kg LBM: 9,000-12,000 kcal above the maintenance needs

Nutritional requirements

Stressed patient: Energy

**Aim:** Energy load = Energy expenditure
Supply > EE - does not improve nitrogen retention
- may have deleterious effects

**Usual practice:** Basal metabolism (H&B) x correcting factor
Postoperative phase: 1-1.1  Trauma: 1.1-1.3
Severe sepsis: 1,3-1,6  burns: 1,5-2,1
↑ EE: fever (10%/degree C)
[] EE: sedation (profound sedation: EE = BM)

CHO: 70%  Fat: 30%

Consensus conference SFNEP 1997
### Nutritional requirements

**Stressed patient: Proteins**

Non-depleted patients:

- 0.2-0.25 g/kg/jour

Depleted patients or severe injury:

- 0.25-0.35 g/kg/jour

Supply > 0.35 g/kg/day: no documented interest

*Consensus conference SFNEP 1997*

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### Digestive water and nutrient absorption

<table>
<thead>
<tr>
<th>Location</th>
<th>Nutrients Absorbed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stomach</td>
<td>Intrinsic factor secretion</td>
</tr>
<tr>
<td></td>
<td>Regulation of nutrient delivery in the gut</td>
</tr>
<tr>
<td>Duodenum</td>
<td>Water, CHO, fat, protein, folate, hydrosolubles vitamins, Fe, Cu</td>
</tr>
<tr>
<td>Jejunum</td>
<td><strong>High permeability and absorption:</strong></td>
</tr>
<tr>
<td></td>
<td>Water, CHO, fat, protein, folate, hydrosolubles vitamins, P, Mg, Ca</td>
</tr>
<tr>
<td>Ileon</td>
<td>Water, CHO, biliary salts, vitamin B12</td>
</tr>
<tr>
<td>Ileocaecal valve</td>
<td>Protects small bowel from infection</td>
</tr>
<tr>
<td></td>
<td>Controls small bowel emptying</td>
</tr>
<tr>
<td>Colon</td>
<td>Water and Na absorption, K and bicarbonate secretion</td>
</tr>
</tbody>
</table>
**Enteral nutrition & Jejunum**

**Intraluminal hyperosmolarity ➞ water secretion**

During enteral infusion of a given nutritive mixture, jejunal output within the 70 first cms of jejunum mainly depends on caloric load and not on osmolarity:
- iso-osmolar mixtures do not induce water exchange
- hyperosmolar mixtures induces water secretion to equilibrate interstitial and intraluminal osmolarity

*Vidon N et al. Gastroenterol Clin Biol 1977:

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**Enteral Nutrition: nutritive mixtures**

**Industrial polymeric mixtures: composition**

**Carbohydrates: malto-dextrins**

**Fat:** Long chain triglycerides (LCT)
- MCT: 14%-50% fat supply
- Liposoluble vitamins A,D,E,K
  - Equilibrated FA composition (omega-3 content)

**Proteins:** caseine, lactalbumine, soja
Enteral Nutrition: nutritive mixtures

Polymeric mixtures: Quantitative aspects

Standard diets: iso-osmolar, 1 kcal/ml
- Protein 14-16%, fat 30-35%, CHO 49-55%
- Recommended supplies for micronutrients
- Phosphorus supply may be insufficient (severely depleted)

Low-energy diets: 0.5-0.9 kcal/ml
- Initial phase of renutrition

High-energy diets: 1.5 kcal/ml
- Fluid limitation

High-protein & High protein & energy : 20% proteins
- Stressed patients, old people

Enteral Nutrition: nutritive mixtures

Industrial mixtures: Qualitative aspects

Fiber-enriched diets: iso-osmolar, 1 kcal/ml
- Improve bowel transit
- Provide substrate for SCFA production

Liver-failure diets: BCAA enriched

Renal failure diets: low volume, low K, low phosphorus

Diabete specific diets:
- low glycemic index CHO
- fiber-enriched

Immune diets: enriched with glutamine, arginine, nucleotides, omega-3 FA
- Surgical patients, severe burns
**Enteral Nutrition: nutritive mixtures**

**Elemental & semi-elemental diets**

**Protein:** AAs (elemental) or small peptides (semi-elemental)

**Limited indications:** very short-bowel, severe Crohn’s disease, malabsorption syndrome

**No demonstrated interest of elemental over semi-elemental diets**

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**Administration of Enteral Nutrition**

**Starter regimen?**
- No improvement in digestive tolerance
- No indication in non-depleted patient

**Progressive increase in EN supply:**
- Recommended in depleted patients because of the **risk of refeeding syndrome**
- Start: 0.5 kcal/ml (about 1000 kcal/day)
- Progressive increase: 200-250 kcal/day
- Particular attention to plasma phosphorus
- Hypophosphoremia can induce severe energy depletion with cardiac, neurologic, respiratory failures
**Inhalation pneumonia**

- **Most severe complication**, 4 à 5%
  - Old people: 43%
  - Neurology patients: NGT 62%, PEG 15%
- **Symptomatology:**
  - Massive inhalation: respiratory distress
  - Mild inhalation: infectious pneumonia
- **Risk factors**
  - Abnormal position of the NGT
  - Decubitus
  - GO reflux
  - Residual gastric fluid > 150 ml
- **Prevention**
  - Semi-seating position
  - Prokinetics: metoclopramide, erythromycin

**Causes of diarrhea**

1/ **NE administration**
   - Bolus

2/ **Nutritive mixture:**
   - **Osmolality**
     - Hyperosmolality
     - Unlikely in the absence of bolus
   - **Nutritive mixture infection**

3/ **Underlying setting**
   - **Abnormal intestinal flora**
     - Bacterial pullulation
     - Due to antibiotics:
       - Clostridium difficile
       - Candida
   - **Stressed patients**
     - Role of gut ischemia
   - **Hypoalbuminemia**

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**Traitement of diarrhea**

1/ Traitement of the cause of diarrhea
   - Regular EN administration by pump
   - Adapt EN composition:
     - Steatorrhea: MCT, pancreatic enzymes
     - Intolerance: lactose, gluten

2/ Correction of water and electrolyte losses

3/ Drugs
   - Morphinomimetics:
     - lopramide, codeine
     - diphenoxylate
   - Probiotic: Saccharomycoses boulardii

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**Complications of NE**

Complications of EN are usually less severe than complications of parenteral nutrition

Inhalation pneumonia: severe, sometimes lethal event

→ Rules:

- Specialized care teams
- Written protocols
- Respect of contra-indications
- Application of EN administration and monitoring recommendations
**Goals of perioperative nutrition**

In surgical patients malnutrition induces delayed wound healing and increased morbidity & mortality

The main goal of perioperative nutrition is to reduce
- the incidence of postoperative complications,
- the length of postoperative hospitalization
- operative mortality

Additional goals are to decrease the effects of disease and surgery-related malnutrition on body composition, organ functions and subsequent patient performance.

**Routine preoperative assessment**

Nutrition Risk Index (NRI) [Buzby, VA, 1991]

\[ \text{NRI} = (1,519 \times \text{serum albumin g/L}) + 41.7 \times \left( \frac{\text{current weight}}{\text{usual weight}} \right) \]

Mild malnutrition: NRI < 97.5
Severe malnutrition, NRI < 83.5

These patients can also be identified by:
- weight loss >20% & serum albumin < 33 g/L
- weight loss > 10% & serum albumin < 28 g/L

[Bouletreau, 1998]
Preoperative nutritional assessment

Severely malnourished
Body weight loss ≥ 10% usual weight
Body weight loss ≥ 5 kg within 3 mo
NRI < 83.5

Non severely malnourished
Non eligible for preoperative nutritional support
Postoperative food intake
> 60% requirements within one week
Non eligible for postoperative nutritional support
Postoperative food intake
< 60% requirements within one week
Postoperative complication, stress prolonged starvation

Consensus conference SFNEP 1995

Randomised trial of glutamine-enriched enteral nutrition on infectious morbidity in patients with multiple trauma

Lancet 1998; 352: 777–78


80 pts with severe trauma
-39: glutamine-enriched diet
-41: standard diet

<table>
<thead>
<tr>
<th></th>
<th>Glutamine</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fed &gt;5 days (n=29)</td>
<td>Intention to treat (n=35)</td>
</tr>
<tr>
<td>Chest infection</td>
<td>5 (17%) * 6 (11%)</td>
<td>14 (41%) 16 (45%)</td>
</tr>
<tr>
<td>Esophagus</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Abdominal</td>
<td>1 (3%) 2 (6%)</td>
<td>4 (11%) 5 (14%)</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>5 (17%) 7 (20%)</td>
<td>9 (25%) 10 (27%)</td>
</tr>
<tr>
<td>Revert</td>
<td>2 (7%) 2 (6%)</td>
<td>1 (3%) 1 (3%)</td>
</tr>
<tr>
<td>Sheetrock</td>
<td>6 (21%) 7 (20%)</td>
<td>7 (20%) 8 (22%)</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>2 (7%) 3 (6%)</td>
<td>13 (42%) 14 (38%)</td>
</tr>
<tr>
<td>Sepsis</td>
<td>1 (3%) 1 (3%)</td>
<td>8 (20%) 8 (22%)</td>
</tr>
<tr>
<td>Central-line infection</td>
<td>0</td>
<td>6 (18%) 5 (14%)</td>
</tr>
<tr>
<td>Other</td>
<td>1 (3%) 1 (3%)</td>
<td>4 (12%) 4 (11%)</td>
</tr>
</tbody>
</table>

*p<0.05, †p<0.01 compared with control group.

Tab 2: Frequency of infections by protocol and by intention to treat.
Pharmaconutrition

Immuno-Nutrition

Braga M et al Arch surg 1999

206 digestive cancer patients
Pre and post operative EN

Impact® vs standard formula
⇒⇒ reduction of
- infection rates
- length of postoperative stay

% patients with complications
- Impact®
- Standard formula

Well nourished    Malnourished