Nutrition Support in Surgical Patients

"thy food shall be thy remedy"

Hippocrates c. 400 B.C.

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Objectives

1. Malnutrition: effects and definition
2. Steps in providing nutritional support: Enteral and Parenteral nutrition
3. Role of perioperative nutritional support
4. Immunonutrition
• 10 - 40% of hospitalised patients are malnourished
• Surgical diseases predispose to malnutrition
• Post-operative recovery period
• Post-operative complications
• Malnutrition a/w increased mortality / morbidity
Malnutrition: Post-op Complications

Preoperative malnutrition ↔ Post-op Complications

Weight Loss  Surgical mortality (Peptic Ulcer Dis)
≥ 20%          33% (6/18)
<20%           4% (1/28)

Studley H, JAMA 1936;106:458

Preoperative nutrition support ↔ Post-op Complications

N=1085 screened with NRS-2002

NRS-2002 score ≥ 5 (n=120)

Morbidity        25.6% vs 50.6% (p=0.008)
LOS              13.7 d vs 17.8 d (p=0.018)

Jie B, Nutrition 2012; 1022
Malnutrition: Consequences in Surgical Patients

- Increased susceptibility to infection
- Poor wound healing
- Increased frequency of decubitus ulcers
- Overgrowth of bacteria in the gastrointestinal tract
- Abnormal nutrient losses through the stool
- Immune system dysfunction
  - complement activation and production
  - bacterial opsonization
  - function of neutrophils, macrophages, lymphocytes
  - subnormal skin reactions to Candida
  - low levels of antibodies to various phytomitogens, suggesting that humoral and cell-mediated immunity are affected
- Increase mortality
- Increase LOS
- Increase treatment cost
Effect of Injury on REE and Nitrogen Excretion


Metabolic Response to Injury

Injury (wound/trauma/fracture)

Neuroendocrine Response
- Catecholamines
- Cortisol
- Glucagon

Inflammatory Response
- Cytokines
- Arachidonic acid metabolism
- Hepatic acute-phase proteins
- Oxidizing agents

Lactate

Liver
- Glycolysis
- Glycogenolysis
- Gluconeogenesis
- Lipid complexes
- Urea synthesis

Glucose

Muscle
- Proteolysis

Amino acids

Glucose

Heart/Brain

Fatty acids

Ketones

Kidney
- Nitrogen wasting

Adipose Tissue
- Lipolysis

Sabiston Textbook of Surgery, Chapter 6, 120-150
Fuel utilization in a 70-kg man during short-term fasting with an approximate basal energy expenditure of 1800 kcal. During starvation, muscle proteins and fat stores provide fuel for the host, with the latter being most abundant. RBC = red blood cell; WBC = white blood cell. (Adapted from Cahill GF: Starvation in man. N Engl J Med. 1970;282:668.)

Fuel utilization in extended starvation. Liver glycogen stores are depleted, and there is adaptive reduction in proteolysis as a source of fuel. The brain uses ketones for fuel. The kidneys become important participants in gluconeogenesis. RBC = red blood cell; WBC = white blood cell. (Adapted from Cahill GF: Starvation in man. N Engl J Med. 1970;282:668.)

Acute injury is associated with significant alterations in substrate utilization. There is enhanced nitrogen loss, indicative of catabolism. Fat remains the primary fuel source under these circumstances.
Malnutrition: Etiology-based Definitions

Nutrition Risk Identified
Compromised intake or loss of body mass.

Inflammation present? No / Yes

No

Starvation Related Malnutrition
(pure chronic starvation, anorexia nervosa)

Yes
Mild to Moderate Degree

Chronic Disease – Related Malnutrition
(organ failure, pancreatic cancer, rheumatoid arthritis, sarcopenic obesity)

Yes
Marked Inflammatory Response

Acute Disease or Injury-Related Malnutrition
(major infection, burns, trauma, closed head injury)

Steps in Providing Nutritional Support

- Nutritional Screening/Assessment
- Nutrition Support
  - Oral supplementation
  - Enteral / Parenteral feeding
- Monitoring and follow up
## Nutritional Screening and Nutritional Assessment

<table>
<thead>
<tr>
<th>Nutritional Screening</th>
<th>Nutritional Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Identify characteristics of nutritional problems</td>
<td>• Detailed evaluation by history, physical examination, labs</td>
</tr>
<tr>
<td>• Identify patient at risk</td>
<td>• Classify patient by nutritional state</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Malnutrition Universal Screening Tool (MUST) (community)</th>
<th>Subjective Global Assessment (SGA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutritional Risk Screening -2002 (NRS-2002) (adult, hospitalised)</td>
<td>(cancer, transplantation, geriatrics, chronic liver disease, stroke, pregnancy)</td>
</tr>
<tr>
<td>Mini Nutritional Assessment (MNA) (geriatrics)</td>
<td></td>
</tr>
</tbody>
</table>
Nutritional Risk Scoring - 2002

Table 1: Initial screening

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Is BMI &lt;20.5?</td>
</tr>
<tr>
<td>2</td>
<td>Has the patient lost weight within the last 3 months?</td>
</tr>
<tr>
<td>3</td>
<td>Has the patient had a reduced dietary intake in the last week?</td>
</tr>
<tr>
<td>4</td>
<td>Is the patient severely ill? (e.g. in intensive therapy)</td>
</tr>
</tbody>
</table>

Yes: If the answer is ‘Yes’ to any question, the screening in Table 2 is performed.
No: If the answer is ‘No’ to all questions, the patient is re-screened at weekly intervals. If the patient e.g. is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status.

Table 2: Final screening

<table>
<thead>
<tr>
<th>Impaired nutritional status</th>
<th>Severity of disease (≈ increase in requirements)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent Score 0</td>
<td>Normal nutritional status</td>
</tr>
<tr>
<td>Mild Score 1</td>
<td>Wt loss &gt;5% in 3 mths or Food intake below 50-75% of normal requirement in preceding week</td>
</tr>
<tr>
<td>Moderate Score 2</td>
<td>Wt loss &gt;5% in 2 mths or BMI 18.5 - 20.3 + impaired general condition or Food intake 25-60% of normal requirement in preceding week</td>
</tr>
<tr>
<td>Severe Score 3</td>
<td>Wt loss &gt;5% in 1 mth (&gt;15% in 3 mths) or BMI &lt;18.5 + impaired general condition or Food intake 0-25% of normal requirement in preceding week</td>
</tr>
</tbody>
</table>

Score: + Age if ≥70 years: add 1 to total score above = age-adjusted total score = Total score

Score <3: weekly rescreening of the patient. If the patient e.g. is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status.

Score ≥3: the patient is nutritionally at-risk and a nutritional care plan is initiated.

NRS-2002 is based on an interpretation of available randomized clinical trials. *indicates that a trial directly supports the categorization of patients with that diagnosis. Diagnoses shown in italics are based on the prototypes given below.

Nutritional risk is defined by the present nutritional status and risk of impairment of present status, due to increased requirements caused by stress metabolism of the clinical condition.

A nutritional care plan is indicated in all patients who are

(1) severely undernourished (score = 3), or (2) severely ill (score = 3), or (3) moderately undernourished + mildly ill (score 2 + 1), or (4) mildly undernourished + moderately ill (score 1 + 2).

Prototypes for severity of disease

Score = 1: a patient with chronic disease, admitted to hospital due to complications. The patient is weak but out of bed regularly. Protein requirement is increased, but can be covered by oral diet or supplements in most cases.

Score = 2: a patient confined to bed due to illness, e.g. following major abdominal surgery. Protein requirement is substantially increased, but can be covered, although artificial feeding is required in many cases.

Score = 3: a patient in intensive care with assisted ventilation etc. Protein requirement is increased and cannot be covered even by artificial feeding. Protein breakdown and nitrogen loss can be significantly attenuated.

Nutritional Risk Scoring -2002
NRS-2002
Nutrition Assessment Tool: Subjective Global Assessment

A. History
   1. Weight change
      Overall loss in past 6 months: amount = # __________ kg; % loss = # __________
      Change in past 2 weeks: __________ increase,
      __________ no change,
      __________ decrease.

   2. Dietary intake change (relative to normal)
      __________ No change.
      __________ Change __________ duration = # __________ weeks
      __________ type: __________ suboptimal liquid diet, __________ full liquid diet
      __________ hypocaloric liquids, __________ starvation.

   3. Gastrointestinal symptoms (that persisted for >2 weeks)
      __________ nausea, __________ vomiting, __________ diarrhea, __________ anorexia.

   4. Functional capacity
      __________ No dysfunction (e.g., full capacity).
      __________ Dysfunction __________ duration = # __________ weeks.
      __________ type: __________ working suboptimally.
      __________ ambulatory.
      __________ bedridden.

   5. Disease and its relation to nutritional requirements
      Primary diagnosis (specify) _______________________________________
      __________ moderate stress, __________ high stress.

B. Physical (for each trait specify: 0 = normal, 1+ = mild, 2+ = moderate, 3+ = severe).
   # __________ loss of subcutaneous fat (triceps, chest)
   # __________ muscle wasting (quadriceps, deltoids)
   # __________ ankle edema
   # __________ sacral edema
   # __________ ascites

C. SGA rating (select one)
   __________ A = Well nourished
   __________ B = Moderately (or suspected of being) malnourished
   __________ C = Severely malnourished
Nutrition Assessment Tool: Subjective Global Assessment

Well validated tool – cancer, transplantation, geriatrics, chronic liver disease, stroke, pregnancy

Scores subjectively based on
7 items on clinical history and
4 items on physical examination

A  Well Nourished
B  Moderately Malnourished
C  Severely Malnourished
A.1 – Weight change over 6 months
   A: Weight gain/No change/Mild weight loss
   B: Moderate weight loss
   C: Severe weight loss

A.2 – Weight change in past 2 weeks
   A: Weight is increasing
   B: No change in weight
   C: Weight is decreasing

A.3 – Change in dietary intake
   A: No change or slight change for short duration
   B: Intake borderline and decreasing; Intake poor and increasing; Intake poor, No change based on prior intake
   C: Intake poor and decreasing

A.4 – Duration and degree of change
   A: Less than 2 weeks, little or no change
   B: More than 2 weeks, mild to moderate suboptimal diet
   C: Unable to eat or starvation
A.5 – Presence of GI symptoms
A: Few or no symptoms intermittently
B: Some symptoms for >2 weeks; severe symptoms that are improving
C: Symptoms daily or frequently >2 weeks

A.6 – Functional status
A: No impairment in strength, stamina and full functional capacity; mild-moderate loss and improving
B: Mild to moderate loss of strength, stamina / some loss of daily activity or severe loss but now improving
C: Severe loss of function, stamina and strength

A.7 – Disease state and co-morbidity
A: No stress
B: Low or moderate stress
C: High stress
B.1 – Subcutaneous loss of fat
   A: Little or no loss
   B: Mild-moderate in all areas; severe loss in some areas
   C: Severe loss in most areas

B.2 – Muscle wasting
   A: Little or no loss
   B: Mild to moderate in all areas; severe loss in some areas
   C: Severe loss in most areas

B.3 – Edema
   A: Little or no edema
   B: Mild to moderate edema
   C: Severe edema

B.4 – Ascites
   A: No ascites or only on imaging
   B: Mild to moderate ascites or improving clinically
   C: Severe ascites or progressive ascites
Nutritional Assessment

- History
- Physical examination
- Anthropometric measurements
- Laboratory investigations
Nutritional Assessment: History

Dietary history

• 24 hour food recall
• Allergies, preferences, intolerance
• Food frequency
• Related medical history
• Usual eating pattern
**Nutritional Assessment: History**

Diagnosis of significant weight loss

<table>
<thead>
<tr>
<th>Time</th>
<th>Significant</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 week</td>
<td>1%</td>
<td>≥1%</td>
</tr>
<tr>
<td>1 month</td>
<td>5%</td>
<td>≥5%</td>
</tr>
<tr>
<td>3 month</td>
<td>7%</td>
<td>≥7%</td>
</tr>
<tr>
<td>6 month</td>
<td>10%</td>
<td>≥10%</td>
</tr>
</tbody>
</table>
Nutritional Assessment: P/E

Physical Examination
- Hair
- Skin
- Nails
- Eyes
- Oral
- Lips/mucous membranes
- Overall musculature/ fat stores
Anthropometry

- Body weight
- Body Mass Index (<18.5)
- Triceps skinfold thickness (TST)
- Mid arm circumference (MAC)
- Bioelectrical impedance
- Hand grip dynamometry
Table 2  The WHO classification of adults according to BMI\(^2\)

<table>
<thead>
<tr>
<th>Category</th>
<th>BMI (kg/m(^2))</th>
<th>Risk of co-morbidities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt;18.5</td>
<td>Low*</td>
</tr>
<tr>
<td>Normal range</td>
<td>18.5 to 24.9</td>
<td>Average</td>
</tr>
<tr>
<td>Overweight</td>
<td>≥25.0</td>
<td></td>
</tr>
<tr>
<td>Pre-Obese</td>
<td>25.0 to 29.9</td>
<td>Increased</td>
</tr>
<tr>
<td>Obese class I</td>
<td>30.0 to 34.9</td>
<td>Moderate</td>
</tr>
<tr>
<td>Obese class II</td>
<td>35.0 to 39.9</td>
<td>Severe</td>
</tr>
<tr>
<td>Obese class III</td>
<td>≥40.0</td>
<td>Very severe</td>
</tr>
</tbody>
</table>

* but increased risk of other clinical problems

Table 3  Proposed BMI cut-off points for public health action in Asians (adapted from a WHO report)\(^{57}\)

<table>
<thead>
<tr>
<th>Cardiovascular disease risk</th>
<th>Asian BMI cut-off points for action (kg/m(^2))</th>
<th>Current WHO BMI cut-off points (kg/m(^2))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;18.5</td>
<td>&lt;18.5</td>
</tr>
<tr>
<td>Low</td>
<td>18.5 to 22.9</td>
<td>18.5 to 24.9</td>
</tr>
<tr>
<td>Moderate</td>
<td>23.0 to 27.4</td>
<td>25.0 to 29.9</td>
</tr>
<tr>
<td>High</td>
<td>27.5 to 32.4</td>
<td>30.0 to 34.9</td>
</tr>
<tr>
<td>Very high</td>
<td>32.5 to 37.4</td>
<td>35.0 to 39.9</td>
</tr>
<tr>
<td></td>
<td>≥37.5</td>
<td>≥40.0</td>
</tr>
</tbody>
</table>
Nutritional Assessment: Labs

Lab investigations

- albumin < 30 mg/dl
- pre-albumin < 12 mg/dl
- transferrin < 150 mmol/l
- total lymphocyte count < 1800 / mm³
- creatinine / height index
- nitrogen balance study
- skin anergy testing
- specific nutritional deficits tests
Albumin and Postoperative Complications

Kudsk 2003

- combined sample;
- esophagus;
- pancreas;
- stomach;
- colon.
Albumin and Post-op days; ICU days & NPO days

Kudsk 2003
Nutritional Support

• **Who?** Malnourished / At risk of malnutrition
• **Where?** Oral / EN / PN
• **How much?** Calories / Protein
• **What?** Composition of Nutrients
• **Why?** Monitoring and Follow-up
Where?
Algorithm for Nutritional Support
Benefits of Enteral Feeding

- Physiologic
- Decrease infectious complications
- Maintains gut integrity
- Maintains immunological integrity
- Less bacterial translocation
- Attenuate catabolic response
- Immunonutrition
- Cheaper
Contraindications for Enteral Feeding

- Active GI bleed
- High output fistula (>500ml/day)
- Intractable vomiting
- Ileus or bowel obstruction
- Profuse diarrhea
- Severe enterocolitis
- Ischaemic bowel
- Aggressive support not warranted
Parenteral Nutrition

- Greater caloric intake
- More expensive
- Complications
- Technical expertise
Indication of Parenteral Nutrition

- Abnormal gut function
- Not able to be fed enterally by 5-7 days
- Prognosis warrants aggressive nutritional support
Where?
Route

Feeding regime
- 24-hour continuous
- Intermittent bolus
- Nocturnal, cyclic

Sabiston Textbook of Surgery, Chapter 6, 120-150
How much?
Estimating Energy Needs

Caloric Requirements

✧ *Harris-Benedict Equation*

- **Males** $BEE = 66 + (13.7Wt) + (5Ht) - 6.8A$
- **Females** $BEE= 655 + (9.6Wt) + (1.8Ht) - 4.7A$

Total requirement = $BEE \times \text{Injury Factor} \times \text{Activity Factor}$

✧ **25 to 30 kcal/kg/day**
<table>
<thead>
<tr>
<th>Injury Factor</th>
<th>Activity Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peritonitis</td>
<td>1.15</td>
</tr>
<tr>
<td>Soft tissue trauma</td>
<td>1.15</td>
</tr>
<tr>
<td>Fracture</td>
<td>1.20</td>
</tr>
<tr>
<td>Fever (per °c rise)</td>
<td>1.13</td>
</tr>
<tr>
<td>Moderate infection</td>
<td>1.20</td>
</tr>
<tr>
<td>Severe infection</td>
<td>1.40</td>
</tr>
<tr>
<td>&lt;20% BSA burns</td>
<td>1.50</td>
</tr>
<tr>
<td>20-40% BSA burns</td>
<td>1.80</td>
</tr>
<tr>
<td>&gt;40% BSA burns</td>
<td>2.00</td>
</tr>
<tr>
<td>Bed bound</td>
<td>1.20</td>
</tr>
<tr>
<td>Ambulatory</td>
<td>1.30</td>
</tr>
</tbody>
</table>
Energy expenditure must be calculated with actual weight.
Adjusted body weight

= Ideal Body Weight + 0.4(actual weight - ideal body weight)

Ideal body Weight
Man: 48kg for first 150cm, 2.7kg/2.5cm thereafter
Woman: 45.5kg for first 150 cm, 2.2kg/cm thereafter
Estimating Protein Requirements

- **Based on calorie : nitrogen ratio**
  - Normal ratio 150 cal : 1g N
  - Critically ill patients 85-100 cal : 1 g N

- **Based on degree of stress & body weight**
  - Non-stress patients 0.8 g / kg / day
  - Mild stress 1.0 to 1.2 g / kg / day
  - Moderate stress 1.3 to 1.75 g / kg / day
  - Severe stress 2 to 2.5 g / kg / day

- **Based on Nitrogen Balance**
  - Positive balance of 1.5 to 2g / kg / day
Types of Enteral Feeds

- Blenderised feeds
- Commercially prepared feeds
  - **Polymeric**
    - *e.g.* Isocal, Ensure, Jevity
  - **Modular/Disease specific**
    - *e.g.* Suplena, Nepro, Pulmocare, Hepaticaid, Glucerna
  - **Elemental/Semi-elemental/Monomeric**
    - *e.g.* Vivonex, Alitraq
Complications of Enteral Feeding

- **Gastrointestinal complications**
  - Distension
  - Nausea and vomiting
  - Diarrhoea / Constipation

- **Mechanical complications**
  - Malposition/ Blockage of feeding tube
  - Sinusitis
  - Ulcerations / erosions

- **Metabolic complications**

- **Infectious complications**
  - Aspiration pneumonia
  - Bacterial contamination
Parenteral Nutrition

- Peripheral (Partial/Total) Parenteral Nutrition
- Central (Total) Parenteral Nutrition
  - method of administration
  - composition of feed
  - primary caloric source
  - potential complications
What to Do Before Starting TPN

- Nutritional Assessment
- Baseline weight
- Venous access evaluation
- Baseline lab investigations
Baseline Investigations

- Full blood count
- Coagulation screen
- U/E/Cr
- Ca++, Mg++, PO$_4^{2-}$
- TG / Cholestrol
- Liver Panel
- Other tests when indicated
Steps to Ordering TPN

1. Volume
2. Calculate Caloric requirement
3. Calculate Protein requirement
4. Determine Dextrose requirement
5. Leftover calories as Lipids
6. Electrolytes
7. Micronutrient
8. Additives
Volume

- **Maintenance requirements**
  - Body weight
  - 30 to 50 ml/kg/day

- **On going losses + insensible fluid losses**
  - add 10% for every °C rise in temperature

- **Fluid restriction**
  - CCF, ESRF
2. Calculate Caloric requirement
   70 kg x 25 kcal/kg = **1,750 Cal**

3. Calculate Protein requirement
   70 kg X 1.2 g protein/kg = **84 g Protein**
   84 X 4 kcal/g protein = **336 Cal**

4. Determine Dextrose requirement
   55% calories from carbohydrate
   1,750 x 0.55 = **962 Cal**
   962 ÷ 3.4 (kcal/g dextrose) = **283 g Dextrose**

5. Leftover calories as Lipids
   1,750 – (336 prot cal + 962 dextrose cal) = **452 Cal**
   452 ÷ 10 (kcal/g lipid) = **45 g Lipid**
CHO usually form 50-70 % of calories

< 7 g/kg/day (max glucose oxidation: 4-5mg/kg/min)
Blood sugar 8-10 mmol/L

Fats usually form 20 to 40% of calories

• Not more than 50%
• < 1g/kg/day
• Increase usually in severe stress
• Aim for serum TG levels < 350 mg/dl or 4.2 mmol/L
Electrolyte Requirements

Maintenance + Replacement

<table>
<thead>
<tr>
<th>Electrolyte</th>
<th>Maintenance</th>
<th>Replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na⁺</td>
<td>1 to 2 mmol/kg/d</td>
<td>(60-120 mmol/d)</td>
</tr>
<tr>
<td>K⁺</td>
<td>0.5 to 1 mmol/kg/d</td>
<td>(30 - 60 mmol/d)</td>
</tr>
<tr>
<td>Mg²⁺</td>
<td>0.35 to 0.45 meq/kg/d</td>
<td>(10 to 20 meq/d)</td>
</tr>
<tr>
<td>Ca²⁺</td>
<td>0.2 to 0.3 meq/kg/d</td>
<td>(10 to 15 meq/d)</td>
</tr>
<tr>
<td>PO₄²⁻</td>
<td></td>
<td>(10 to 20 mmol/d)</td>
</tr>
</tbody>
</table>
Commercial Trace Element preparations provide RDA

- Zn  2-4 mg/day
- Cr  10-15 ug/day
- Cu  0.3 to 0.5 mg/day
- Mn  0.4 to 0.8 mg/day
- Se  20-40 mcg/day
- Mb  20-13

Vitamins

- 2-3x that recommended for oral intake
- 1 ampoule MultiVit per bag of TPN
- MultiVit does not include Vit K
- (1 mg/day or 5-10 mg/wk)
Monitoring of patient

Monitoring

- Clinical review
- Investigations
Complications Related to TPN

- Mechanical Complications
- Metabolic Complications
- Infectious Complications
Mechanical Complications

Related to vascular access technique

- pneumothorax
- air embolism
- arterial injury
- bleeding
- brachial plexus injury
- catheter malplacement
- catheter embolism
- thoracic duct injury

Related to catheter in situ

- Venous thrombosis
- Catheter occlusion
Metabolic Complications

Abnormalities related to excessive or inadequate administration
- hyper / hypoglycaemia
- electrolyte abnormalities
- acid-base disorders
- hyperlipidaemia

Hepatic complications
- Liver steatosis
- Cholestatic liver disease
- Cholelithiasis/Acalculous cholecystitis

Bone Disease
- Bone pain
- Fractures
- Increased SAP, hypercalciuria
Infectious Complications

Insertion site contamination
Catheter contamination
  • improper insertion technique
  • use of catheter for non-feeding purposes
  • contaminated TPN solution
  • contaminated tubing

Secondary contamination
  • septicaemia
Stopping PN

When?  Enteral feeding tolerated

How?  Wean to avoid hypoglycaemia

Monitor hypocount

Give IV Dextrose 10% solution at previous infusion rate for 4 h

Half TPN rate X 2 hours for patient
Role of Perioperative Nutrition

Grain versus Vein
Role of Post-operative PN

The effect of postop IV feeding (TPN) on outcome following major surgery evaluated in a randomised study


No diff in mortality, Major Cx increased

A PRT of TPN after major pancreatic resection for malignancy


Major Cx increase 2 X, Mortality increased 3.5 X

Table 2. Prospective, randomized trials of postoperative TPN.

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of patients</th>
<th>Nonprotein calories (kcal/kg/day)</th>
<th>TPN duration (days)</th>
<th>Complications (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brennan [22]</td>
<td>117</td>
<td>30–35</td>
<td>12</td>
<td>45.0</td>
</tr>
<tr>
<td>Collins [23]</td>
<td>20</td>
<td>37</td>
<td>13</td>
<td>20.0</td>
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<tr>
<td>Holter [24]</td>
<td>56</td>
<td>30</td>
<td>10</td>
<td>13.3</td>
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<tr>
<td>Jensen [25]</td>
<td>20</td>
<td>40–50</td>
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<td>Preshaw [26]</td>
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<td>40</td>
<td>5</td>
<td>33.0</td>
</tr>
<tr>
<td>Reilly [27]</td>
<td>28</td>
<td>35</td>
<td>7</td>
<td>NR</td>
</tr>
<tr>
<td>Sandstrom [28]</td>
<td>300</td>
<td>29</td>
<td>9</td>
<td>27.3</td>
</tr>
<tr>
<td>Woolfson [29]</td>
<td>122</td>
<td>35</td>
<td>≥6</td>
<td>9.7</td>
</tr>
</tbody>
</table>

Complications (%):
- Control: 22.8, 90.0, 19.2, 40.0, 17.4, NR, 16.0, 6.7
- TPN: 45.0, 20.0, 13.3, 10.0, 33.0, NR, 27.3, 9.7
- p-values: <0.02, <0.01, NS, NS, NS, NS, <0.05
# Role of Preoperative PN

## Table 1. Prospective, randomized trials of preoperative TPN.

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of patients</th>
<th>Nonprotein calories (kcal/kg/day)</th>
<th>TPN duration (days)</th>
<th>Complications (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bellantone [8]</td>
<td>100</td>
<td>30</td>
<td>≥7</td>
<td>14.8</td>
</tr>
<tr>
<td>Bellantone [9]</td>
<td>100</td>
<td>30</td>
<td>&gt;7</td>
<td>30.0</td>
</tr>
<tr>
<td>Fan [10]</td>
<td>124</td>
<td>30</td>
<td>7</td>
<td>34.0</td>
</tr>
<tr>
<td>Fan [11]</td>
<td>40</td>
<td>&gt;40</td>
<td>14</td>
<td>85.0</td>
</tr>
<tr>
<td>Heatley [12]</td>
<td>19</td>
<td>40</td>
<td>7–10</td>
<td>23.7</td>
</tr>
<tr>
<td>Meguid [13]</td>
<td>66</td>
<td>35</td>
<td>8</td>
<td>31.3</td>
</tr>
<tr>
<td>Muller [14]</td>
<td>105</td>
<td>32–46</td>
<td>7–14</td>
<td>37.0</td>
</tr>
<tr>
<td>Moghissi [16]</td>
<td>15</td>
<td>34–36</td>
<td>5–7</td>
<td>0.0</td>
</tr>
<tr>
<td>Smith [17]</td>
<td>34</td>
<td>50–60</td>
<td>8–15</td>
<td>17.6</td>
</tr>
<tr>
<td>Thompson [18]</td>
<td>21</td>
<td>40–50</td>
<td>6–14</td>
<td>16.7</td>
</tr>
</tbody>
</table>

*Note: NS denotes not significant.*
Role of Perioperative PN

Perioperative TPN in surgical patients. VATPNCSG

*NEJM 1991, 22;325:525*

RCT Preop + 3day post op PN vs No PN (7-15 days)

N=396
Follow up : 90 days
No difference in mortality

**Infective Cx:** TPN > Ctrl (14.1% vs 6.4%; p<0.01)

**Non-infective Cx:** Ctrl > TPN (22.2% vs 16.7%; p=0.2)

Severely malnourished:

**Infective Cx:** TPN = Ctrl

**Non-infective Cx:** TPN < Ctrl (5% vs 43%; p=0.03)

*Use of preop TPN should be limited to severely malnourished*
Early Enteral Nutrition

Definition: enteral feeding within 48 hour of injury (trauma/surgery) or admission to ICU

Physiology: Gastric/Colonic atony 24-48H
Small Bowel ileus 4-6 hours

Advantages
- preserve gut mucosa mass
- prevent mucosal atrophy
- maintains normal gut flora
- reduce bacterial translocation
- stimulates gut secretion of IgA

Disadvantages
- Abdominal distension, pain
- Vomiting, diarrhea
# Early Enteral Nutrition

<table>
<thead>
<tr>
<th>Author/Journal</th>
<th>Study Parameters</th>
<th>Study Design</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marik, <em>CCM</em> 2001 (medical ICU patients)</td>
<td>Feeding &lt; or &gt; 36 hr</td>
<td>15 studies, 753 patients</td>
<td>↓ Infections [↓ LOS]</td>
</tr>
<tr>
<td>Lewis, <em>BMJ</em> 2001 (surgery patients)</td>
<td>NPO vs &lt;24 hr</td>
<td>11 studies, 837 patients</td>
<td>↓ Infections [↓ LOS] ↑ Vomiting risk</td>
</tr>
<tr>
<td>Heyland <em>JPEN</em> 2003 (medical ICU patients)</td>
<td>&lt;24-48 hr</td>
<td>8 studies</td>
<td>Trend to ↓ infections and mortality</td>
</tr>
<tr>
<td>Lewis SJ, <em>J GI Surg</em> 2008 (surgery patients)</td>
<td>&lt;24 hr</td>
<td>13 studies, 1173 patients</td>
<td>Decrease mortality</td>
</tr>
<tr>
<td>Doig GS, <em>Int Care Med</em> 2009 (critically ill patients)</td>
<td>&lt;24 hr</td>
<td>5 studies</td>
<td>Decrease infection and mortality</td>
</tr>
<tr>
<td>Osland E, <em>JPEN</em> 2011 (GI surg with resection)</td>
<td>&lt;24 hr</td>
<td>15 studies, 1240 patients</td>
<td>45% decrease in morbidity, no increase anastomotic leak</td>
</tr>
<tr>
<td>Doig GS, <em>Injury</em> 2011 (trauma patients)</td>
<td>&lt;24 hr</td>
<td>3 studies</td>
<td>Decrease mortality</td>
</tr>
</tbody>
</table>

LOS, length of stay.
# Early Enteral Nutrition

**Table 2.** Early Feeding in the Surgical Populations: Why Is It Such a Problem Getting Enteral Nutrition Started?

- Lack of team understanding of the potential benefits of early feeding
- Poor understanding of postop ileus
- Waiting for flatus or signs of “bowel activity”
- Concern for complications
  - Aspiration
  - Ischemic bowel
  - Feeding will cause a “leak” of recent bowel anastomosis
- Lack of skills for tube placement
- Perception of inability to feed while on “pressors”
- Lack of communication between team members
Table 3. Early Feeding in Postop Setting: Can It Be Done Safely?

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>N</th>
<th>Population</th>
<th>Timing</th>
<th>Success (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>McDonald</td>
<td>1991</td>
<td>106</td>
<td>Burn</td>
<td>6 h</td>
<td>85</td>
</tr>
<tr>
<td>McCarter</td>
<td>1997</td>
<td>167</td>
<td>UGI</td>
<td>24 h</td>
<td>78</td>
</tr>
<tr>
<td>Heslin</td>
<td>1997</td>
<td>195</td>
<td>UGI Ca</td>
<td>24 h</td>
<td>80</td>
</tr>
<tr>
<td>Velez</td>
<td>1997</td>
<td>46</td>
<td>GI</td>
<td>6 h</td>
<td>81</td>
</tr>
<tr>
<td>Hedberg</td>
<td>1999</td>
<td>225</td>
<td>Postop</td>
<td>12 h</td>
<td>85</td>
</tr>
<tr>
<td>Braga</td>
<td>2002</td>
<td>650</td>
<td>Postop</td>
<td>12 h</td>
<td>91</td>
</tr>
<tr>
<td>DiFronzo</td>
<td>2003</td>
<td>86</td>
<td>Colon (postop)</td>
<td>48 h</td>
<td>97</td>
</tr>
<tr>
<td>James</td>
<td>2004</td>
<td>170</td>
<td>Whipple</td>
<td>24 h</td>
<td>85</td>
</tr>
<tr>
<td>Mosier</td>
<td>2011</td>
<td>153</td>
<td>Major burn</td>
<td>24 v 48</td>
<td>88</td>
</tr>
</tbody>
</table>

Ca, cancer; GI, gastrointestinal; UGI, upper gastrointestinal.
Perioperative Nutrition Support

Preoperative NS is indicated in severely malnourished patients undergoing major GIT surgery for 7-14 days if op can be safely postponed.

Enteral nutrition is the preferred route for periop NS.

Postoperative PN should not be routinely given in the immediate postoperative period.

Postoperative PN should be administered to patient who is anticipated to be unable to meet their nutritional needs (orally/enterally) for a period of 7-14 days.
Immunonutrition

Components: arginine, glutamine, nucleic acids, O-3FA, antioxidants

Mechanism: modulates immune response
           modulates inflammatory response
           improves gut function

Impact, ImmunAid
Clinical Benefits of Immune Enhancing Diet for Early Postinjury Enteral Feeding.

Moore et al 1994

- Immuno-aid
- Control

Time on ventilator (d)  ICU (d)  Hospital (d)  Intra-abd abscess (%)  MOF (%)

p<.05  p<.05
Early enteral immunonutrition in patients with severe sepsis
Bertolini et al Int Care Med 2003, 29:834

Italian Group for the evaluation of interventions in Intensive Care Medicine (GiViTI)

Multicentre RCT of critically ill to EEN(I) vs PN
Objective: n=1500, power=80%, mortality difference 7%
Trial stopped at interim analysis

<table>
<thead>
<tr>
<th></th>
<th>n=18</th>
<th>n=21</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU mortality</td>
<td>45</td>
<td>30</td>
</tr>
<tr>
<td>28 d mortality</td>
<td>20</td>
<td>15</td>
</tr>
</tbody>
</table>
Immunonutrition: A systemic review

Heyland 2001

22 RCT, n=2419

Pooled results
- No difference in mortality (RR 1.10)
- Reduced infectious Cx (RR 0.66, heterogeneity p<.001)
- Reduced LOS (-3.3 D, heterogeneity p<.001)

Elective Surgical Patients
- No difference in mortality
- Reduced infectious Cx (RR 0.54) p=.002
- Reduced LOS (-3.39D) CI –4.55 to –2.23

Critically Ill Patients
- No difference in mortality
- No difference in infectious Cx
- Reduced LOS (-3.34D) CI –8.27 to –1.45
Immunonutrition appear to
- reduce infectious complications
- LOS in elective surgical patients
- Mortality not affected

There are concern about its safety and efficacy
In certain subgroup of critically ill (septic) patients
Immunonutrition

Indications
- Elective GI surgery
- Blunt and Penetrating torso trauma

Relative Indications
- Major vascular surgery req
  post-op ventilation
- Major Head & Neck surgery
- Severe HI
- Burns
- Ventilator but not septic

Contraindications
- Pre-existing severe sepsis
Thank you