Nutritional Support in Critically Ill Patients

A. Shahrokhí, MSc.
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Eating a balanced diet is vital for being alive and good health.

Proper diet provides our bodies with the energy, protein, essential fats, vitamins and minerals to live, grow and function properly.

Australian National Health & Medical Research Council, 2014
Patients at Risk of Malnutrition:

- Under/Overweight Patients
- Patients who have recent weight loss
- NPO more than 10 days
- Hypermetabolic Patients (Burn, Fever, Infection, Sepsis, Trauma, ...)
- Great Surgeries (GI Disturbances)
- Critically Ill patients
Serious Illness Common Signs

Common signs include:

- Weight loss
- Poor appetite
- Increased thirst
- Increased breathing rate
- Sensitive to touch
- Wound not healing
- Tired, lack of energy
Malnourished Hospitalized Patients:

Increased Morbidity

- Compromised Surgical outcomes, Post Surgical Complications, Poor Wound Healing, Alteration in Immune Function, ...

Increased LOS

- Decreased Respiratory Muscles Function, Slower Ventilator Weaning, Increased Infection Rate, Pressure Ulcers, ...

Increase Mortality Rate

Burns, AACN 2014
Factors that affect nutritional status in critically ill patients:

- Inability to take oral diet
- Nausea/Vomiting/Diarrhea
- Glucose intolerance
- Renal dysfunction
- Liver dysfunction
- Pain
- Restricted fluid intake
- Delayed gastric emptying
- Reduced gut motility due to drugs,
Nutritional Needs Changes in Critically Ill Patients:

**Increased Nutrition Losses**
- Blood Loss
- Severe Diarrhea
- Fistulae
- Draining Abscesses
- Wounds/Pressure Ulcers
- ...

**Increased Nutrition Requirement**
- Fever
- Surgery
- Trauma
- Burns
- Infections
- Cancer
Simple Starvation due to inadequate intake

Hypermetabolism due to injuries that increase the metabolic rate

Critical ill patients have starvation+hypermetabolism

Catabolism

Protein-Calorie Malnutrition
<table>
<thead>
<tr>
<th>Category</th>
<th>Starvation</th>
<th>Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catabolism</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Glycogenolysis</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Glucogenesis</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Lipolysis</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>Ketosis</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>Energy expenditure</td>
<td>Decreased</td>
<td>Increased</td>
</tr>
<tr>
<td>Serum albumin</td>
<td>No change</td>
<td>Decreased</td>
</tr>
<tr>
<td>Urine urea nitrogen</td>
<td>&lt;5 g/day</td>
<td>&gt; 5 g/day</td>
</tr>
<tr>
<td>Nitrogen balance</td>
<td>Negative</td>
<td>Strongly negative</td>
</tr>
<tr>
<td>EC water</td>
<td>Mild increase</td>
<td>Marked increase</td>
</tr>
<tr>
<td>Disease states</td>
<td>Anorexia nervosa, malabsorption</td>
<td>Severe inflammation, sepsis, burns, head injury</td>
</tr>
</tbody>
</table>
Critically ill Patients Loose 10% - 20 % of body Proteins within a week
Malnutrition is common in acute-care settings, occurring in 30% to 50% of hospitalized patients.

Powers & Samaan, 2014
The Critical Care Unit nurses is in the best position to advocate for appropriate nutritional therapies and Facilitate the safe delivery of nutrition

Powers & Samaan, 2014
Nutrition Management

Monitor

Screen

Intervention

Assess
Nutritional Screening

Simple and Rapid Evaluation

Identifies

Malnourished  At Risk
NUTRITION ASSESSMENT
Nutritional Assessment:

- Health History
- Physical Examination
- Anthropometric Measurement
- Biochemical (Laboratory) Measurement
Health History:

- Maldigestion history
- Abdominal pain
- Diarrhea/Constipation
- Anorexia
- Weight Loss
- GI Surgery history
- Alcohol use
- Drugs
- ...
Physical Examination:

- **Inspection**: Abdomen appearance, Subcutaneous tissue, ...
- **Auscultation**: Bowel Sounds
- **Palpation**: Superficial/Deep
- **Percussion**: Mass/Fluid/Gas, ...
Anthropometric Measurement:

- **Height & Weight (IBW?)**
- **BMI**
- **TSF**
- **MAC**
**Ideal body Weight (IBW)**

**Female:**

\[ \text{IBW} = 45.5 + 2.3 \times \left( \frac{\text{height} - 150}{2.5} \right) \]

**Male:**

\[ \text{IBW} = 50 + 2.3 \times \left( \frac{\text{height} - 150}{2.5} \right) \]

**PBW?**
**Body Mass Index (BMI)**

\[
\text{BMI} = \frac{\text{Weight (Kg)}}{\text{Height (m)}^2}
\]

<table>
<thead>
<tr>
<th>وزن نماه توده بدني</th>
<th>وضعیت وزن</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 19</td>
<td>لاغر</td>
</tr>
<tr>
<td>19 – 24.9</td>
<td>طبيعي</td>
</tr>
<tr>
<td>25 – 29.9</td>
<td>دارای اضافه وزن</td>
</tr>
<tr>
<td>≤ 30</td>
<td>چاق</td>
</tr>
</tbody>
</table>
Adult Body Fat % = \((1.2 \times \text{BMI}) + (0.23 \times \text{age}) - (10.8 \times \text{gender}) - 5.4\)

\{ \text{Gender} \; \text{for men} : 0 \; \text{for women} : 1 \} 

<table>
<thead>
<tr>
<th>Description</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential fat</td>
<td>10–13%</td>
<td>2–5%</td>
</tr>
<tr>
<td>Athletes</td>
<td>14–20%</td>
<td>6–13%</td>
</tr>
<tr>
<td>Fitness</td>
<td>21–24%</td>
<td>14–17%</td>
</tr>
<tr>
<td>Average</td>
<td>25–31%</td>
<td>18–24%</td>
</tr>
<tr>
<td>Obese</td>
<td>32%+</td>
<td>25%</td>
</tr>
</tbody>
</table>
Biochemical Data

- **Serum proteins** (Total proteins, Albomin/Prealbumin, Ferritin, ...)
- **Electrolytes** (Na, K, Mg, Ca, Ph, ...)
- **Hematologic Values** (Hb, MCV, MCH, WBCs, ...)
MNA
Mini Nutritional Assessment

D:\95 96 1 PPt\CCN 94\Nutrition assessment\Tools\MNA Scoring Nestle.png

D:\95 96 1 PPt\CCN 94\Nutrition assessment\Malnutrition Assessment Tools 2014.pdf
Nutritional Support for Critically Ill Patients

Route?

Enteral Nutrition (EN)
* Oral (First Choice)
* OG/NG Tube (Second Choice)
* Postpyloric Feeding Tube (Third Choice)

When?
Within 24 hours

Quantity?
Day 1: 10-15 Kcal/kg/day
Day 2-4: 15-20 Kcal/kg/day
Day ≥ 5: 20-25 Kcal/kg/day

Composition?
- High quality Protein
- Low glycemic index
- Soluble fiber
- Omega 3 fatty acids

Up to Date 2016, Marik PE 2010
The two Commandments of Nutritional Support:

* If the bowel works, use it
  (and if it doesn’t, make it work)

* There is no disease process that benefits from starvation
Enteral Nutrition
Is the preferred method of Feeding The critically ill patients

Up to Date 2016

Nutrition support in critically ill patients Overview 24 12 2016.docx
In the critically ill patients, neither the presence nor the absence of bowel sounds, nor evidence of the passage of flatus or stool is required for the initiation of enteral feeding.

Marik, 2010
EN (Enteral Nutrition) TEN (Total Enteral Nutrition)

- **Oro/Nasogastric**
- **Gastrostomy**
- **Nasodeodenal**
- **Nasojejunal**
- **Jejunostomy**
- **Percutaneous Endoscopic Gastrostomy (PEG)**
- **Percutaneous Endoscopic Jejunostomy (PEJ)**

**Feeding Routes Through The Nose**
(or alternatively may be oral)

1. Nasogastric
2. Naso-duodenal
3. Naso-jejunal

**Gastrostomy Options**
- Percutaneous Endoscopic Gastrostomy (PEG)
- Percutaneous Radiologic Gastrostomy (PRG)
- Percutaneous Endoscopic Jejunostomy (PEJ)
- Percutaneous Radiologic Jejunostomy (PRJ)
- Percutaneous Endoscopic Gastrojejunoscopy (PEG/J)
- Button
- Surgically placed Gastrostomy

**Jejunostomy**

*Gastrostomy and jejunostomy tubes may be placed endoscopically, radiologically, or surgically.*
Tube Placement Confirmation

- **PH Measurement**
- **Air Bubble Auscultation**
- **Radiography**
- **Tube length measurement**

Figure 1 - A - Post-placement abdominal x-ray; B - Screenshot example of an electromagnetically guided tube.
Benefits of EN

1. Stimulates immune barrier function
2. Physiologic presentation of nutrient
3. Maintain gut mucosa
4. Simplifies fluid/electrolyte management
5. More complete nutrition than PN
6. Less infectious complications (and costs of associated complications)
7. Stimulates return of bowel function
8. Less expensive
Common Barriers to Optimizing EN Delivery:

- Diagnostic/Therapeutic procedures
- Tube obstruction
- Feeding held due to drug-nutrient interaction (Propofol(1.1 cal/ml, ...))
- Hypotensive episodes (need to be in recumbent position)
- Perceived or real "GI intolerance or dysfunction":
  - N/V/D
  - Abdominal distention & Complaints of fullness
  - Lack of BS
  - Aspiration risk/ no gag
  - GRV > 400ml
ENTRAL NUTRITION COMPLICATIONS:

- Pulmonary Aspiration & Aspiration Pneumonia (5-36%)
- Diarrhea
- Constipation
- Tube Occlusion
- Gastric Retention
- Dumping Syndrome
Reducing Aspiration Risk

- Strict use of Semi-recumbent (>30° BRE)
- Accurate Placement
- Proper Route (Continuous, Intermittent)
- Prokinetic Medication (Metoclopramide, ...)

No enough evidence to demonstrate association between gastric pH, colonization and pneumonia incidence between patients fed with cyclic vs. continuous feeding.

Up to date 2016, Burns, AACN 2014
GRV Measurement?

*D: \95  96  1 PPI\CCN 94\Nutrition assessment\GRV 2015.pdf

*Endogenous Secretion & Exogenous Additions
* The Cascade Effect
* Checking Gastric Residual Volume (Burns AACN, 2014: P 374)
Dumping Syndrome Prevention

Due to fast passage of the fluids from the bowel

- Abdomen examination (BS, Distention, ...)
- Assess stool characteristics
- I&O measurement
- Food proper temperature (room temperature)
- Pay attention to carbohydrate (sugar) content of the diet
- Slower nutrition
PARENTERAL NUTRITION

TPN

PPN
Peripheral Venous Access Vs Central Venous Access

- Fluids and medicines can be administered through catheter

VS

- Internal jugular vein
- Subclavian vein
- Femoral vein
- Median basilic vein
- Median cephalic vein
- Superior vena cava
- Deep vein (14F vein)

Jugular V.
Subclavian V.
Femoral V.
PICC
Even short-term PN used to supplement EN in ICU patients, has not enhanced benefits and it’s associated with increased infectious complication and length of stay (LOS).

Burns AACN 2014
There are no data that **Parenteral Nutrition** is of any benefit to critically ill patients.

The available evidence suggests that **Parenteral Nutrition** increases complications and mortality rates.

Marik 2010
PN is usually indicated in:

- Inability to absorb nutrients via GI tract due to:
  - Massive small bowel resection/short-bowel syndrome (at least initially)
  - Radiation enteritis
  - Severe diarrhea
  - Steatorrhea
- Complete bowel obstruction
- Persistent ileus
- Severe catabolism with or without malnutrition when GI tract is not usable within 5-7 days
- Inability to obtain enteral access / Inability to provide sufficient nutrients or fluids enterally
- Persistent GI hemorrhage / Acute abdomen
- Lengthy GI work-up requiring NPO status
- High output enterocutaneous (>500 ml) if enteral feeding ports cannot be distally placed
- Trauma requiring repeat surgical procedure
PN may be indicated in:

- Inflammatory bowel disease not responding to medical therapy
- Intensive chemotherapy / severe mucositis
- Major surgery/stress when enteral nutrition not expected to resume within 7-10 days
- Chylous ascites or chylothorax
- Enterocutaneous fistula (<500 ml)
- Partial small bowel obstruction
- Hyperemesis gravidarum when N&V persist longer than 5-7 days and EN is not possible
Contraindication for PN

- Functioning GI tract
- Treatment anticipated for < 5 days in patients without severe malnutrition
- Inability to obtain venous access
- A prognosis that does not warrant aggressive nutrition support
TPN Content

Carbohydrates

Aminoacids

Lipid

Vitamines

Minerals

Trace Elements
Mechanical Complications

- Septicemia
- GI tract atrophy
- Cath site infection
- Thromboembolism
Catheter-related Complications

**Infectious**
- Insertion site contamination
- Catheter contamination
- Septicemia

**Technical**
- Pneumothorax
- Hemothorax
Metabolic Complications

- Hypoglycemia
- Hyperglycemia
- Electrolyte imbalance (Loss/exceed)
- Refeeding Syndrome
- Hypervolemia
- Hypovolemia
- Anaphylactic shock
- Hypersmolar Coma
- Liver dysfunction
- Hypovolemia
- Hypervolemia
- Hyperosmolar Coma
Refeeding Syndrome

Potentially fatal condition resulting from rapid changes in fluids and electrolytes when malnourished patients are given oral, enteral, or parenteral feedings.

Patients with ongoing electrolyte losses (eg, from diarrhea, vomiting, fistulas) are at increased risk of refeeding syndrome.

Manifestations:
- Severe hypophosphatemia (including respiratory failure, cardiovascular collapse, rhabdomyolysis, seizures, and delirium)
- Hypokalemia
- Hypomagnesemia
A meta-analysis of 15 randomized trials (1647 patients) found that critically ill patients who received vitamins and trace elements, either alone or in combination, had a lower mortality rate than patients who did not receive them. Similar meta-analyses showed improvement in the duration of mechanical ventilation, but no differences in infectious complications, and Hospital or ICU length of stay.

Up to date 2016