How to feed the complex ICU patient - Case presentation
T. W. Felbinger (DE)
Modul 18.4 Clinical Case

ESPEN LLL
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Ethical dilemmas
Bioethical principles
Application of bioethical principles to “Nutrition at the end-of-life”
The decision-making process
receiving honoraria for educational lectures, consultations within the last 3 years from:

- Baxter Deutschland GmbH
- B.Braun Medical AG
- Fresenius Kabi AG
- Nutricia Danone AG
Present complaint: 55 year old morbidly adipose patient is admitted to the OR for emergency laparotomy (incarcerated inguinal hernia) under general anesthesia.

PMH: arterial hypertension, DM Type II, HLP, CAD.

The patient gained about 20kg in the last 3 years, mostly sedentary lifestyle, regular alcohol consumption (one to two bottles wine per day).

Physical status: Body weight 131kg, height 178cm, BMI 41.3 kg/m², shortness of breath in supine position, no other allergies or previous surgery has been reported.
- Emergency surgery was performed under general anesthesia.
- The open abdomen revealed intraoperatively an incarcerated jejunal segment with perforation and diffuse peritonitis.
- Resection of the gangrenous small bowel (70 cm) has been performed and ileal stoma was placed.
- Postoperatively the patient was submitted to the ICU.
On admission the patient remained sedated
vented (BIPAP, FiO2-0.6), sinus rhythm (90/min) blood pressure of 120/70 and urine output 40ml/h. Intermittent need for vasopressors
Blood chemistry: Hb 15.5 mg/dL, pO2 94mm Hg, pCO2 44 mmHg, pH 7.30, Lactic acid 2.1 mmol/L, Base access -4.6, Glucose 203 mg/dL, Potassium 3.2 mmol/L, Magnesium 0.6 mmol/L, Phosphate 0.4 mmol/L.
Question 1

a. Nutrition should be postponed in this patient for about 10 days since the patient is in a very good nutritional status.

b. Full nutritional support via gastric route is very likely to be successful in this patient within 3 days according to the ESPEN guidelines.

c. Minimal enteral nutrition support should be started in this patient within 24 hours and adjusted according metabolic tolerance.

d. Gastroenterologists should be called and nasojejunal tube must be placed within 24 hours.

e. Total nutritional support should be started from Day 1 to prevent energy deficit.
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b. Full nutritional support via gastric route is very likely to be successful in this patient within 3 days according to the ESPEN guidelines.

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e. Total nutritional support should be started from Day 1 to prevent energy deficit
Indications
All patients who are not expected to be on a full oral diet within 3 days should receive enteral nutrition (EN).

Application
There are no data showing improvement in relevant outcome parameters using early EN in critically ill patients.

Nevertheless, the expert committee recommends that haemodynamically stable critically ill patients who have a functioning gastrointestinal tract should be fed early (<24 h) using an appropriate amount of feed.

Kreymann KG et al., Clin Nutr 2006
POD 2-3

- Signs of a bilateral pneumonia on CXR
- Increasing pressure support and higher FiO2 on the ventilator
- pO2 71 mmHg, PCO2 53 mmHg, FiO2 0.7, PEEP 13 mmHg, BE –8, lactic acid 3.5mmol/L, CRP 232 mg/L,
- High dose norepinephrine was supported by Dobutamine (up to 20mg/h).
- Renal output decreased to 20-30ml/h despite aggressive fluid resuscitation.
- Enteral nutrition support was started on POD 1 (trophic feed), (standard solution, 1kcal/mL, 44g AA/L), but could not be advanced over 20ml/h on POD 2-3, due to abdominal distension, and repetitive regurgitation.
- Insulin drip remained constant at 2IU/h.
Question 2

a. Supplemental parenteral nutrition in this patient should be started advancing slowly to avoid hyperalimentation

b. SPN should be delayed for more than 7 days according to the results of the EPANIC trial

c. SPN should be withheld completely in order to limit the danger of line sepsis since the patient has enough endogenous substrates to be mobilized

d. Enteral and parenteral nutrition should both be withheld for at least 7 days and then reevaluated

e. TPN should be started in this patient with 3000 kcal/d despite hypermetabolism in order to minimize energy deficit
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**ESPEN Guidelines on Parenteral Nutrition: Intensive care**

<table>
<thead>
<tr>
<th>Indications</th>
<th>Recommendation</th>
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<tr>
<td>Patients should be fed because starvation or underfeeding in ICU patients is associated with increased morbidity and mortality. All patients who are not expected to be on normal nutrition within 3 days should receive PN within 24 to 48 h if EN is contraindicated or if they cannot tolerate EN.</td>
<td>C</td>
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Singer P et al., Clin Nutr 2009
EPaNIC Trial

Casaer M et al., NEJM 2011
protein, lipids seem to be responsible for the delayed recovery (by inhibition of autophagy?)

Casaer M et al., Am J Respir Crit Care Med 2013
No Panic after EPaNIC? Anti-EPaNIC Trials

- Heidegger C et al., Lancet 2013, SPN trial, n=300, SPN from d4 when EN<60% infections ↓↓

- Doig G et al., JAMA 2013
  australian trial, n=1372, SPN from d1 (max 1600kcal/d)
  LOS (↓), days on vent ↓

- Singer P et al., Intens Care Med 2011
  TICACOS, n=130, SPN from d1, SPN after indir. calorimetry
  mortality (↓)
Take into account:
- Nutritional status
- Degree of GI-failure
- Metabolic tolerance
- Hemodynamic stability
- Estimated ICU-stay

Weimann A, Singer P, Lancet 2013
a. Micronutrients need to be substituted since minimal enteral nutrition is insufficient for the provision of trace elements and vitamins

b. High dose supplementation of micronutrients in particular antioxidants must be started immediately in particular high dose selenium to reverse septic shock

c. Enteral plus parenteral supplementation of micronutrients are superior to parenteral supplementation in this patient

d. Pharmaconutrition with high dose glutamine need to be started as soon as possible

e. Micronutrients are neglectable during the first 2 weeks on SPN or TPN
Question 3

a. Micronutrients need to be substituted since minimal enteral nutrition is insufficient for the provision of trace elements and vitamins

b. High dose supplementation of micronutrients in particular antioxidants must be started immediately in particular high dose selenium to reverse septic shock

c. Enteral plus parenteral supplementation of micronutrients are superior to parenteral supplementation in this patient

d. Pharmaconutrition with high dose glutamine need to be started as soon as possible

e. Micronutrients are neglectable during the first 2 weeks on SPN or TPN
When PN is indicated in ICU patients the amino acid solution should contain 0.2–0.4 g/kg/day of L-glutamine (e.g. 0.3–0.6 g/kg/day alanyl-glutamine dipeptide).

Singer P et al., Clin Nutr 2009
A Randomized Trial of Glutamine and Antioxidants in Critically Ill Patients

Daren Heyland, M.D., John Muscedere, M.D., Paul E. Wischmeyer, M.D., Deborah Cook, M.D., Gwynne Jones, M.D., Martin Albert, M.D., Gunnar Elke, M.D., Mette M. Berger, M.D., Ph.D., and Andrew G. Day, M.Sc., for the Canadian Critical Care Trials Group

Glutamine should not be given in high dose parenterally in early shock, MODS

patient selection? (indication PN)?
dose (-0.78g/kg/d)?

Heyland D et al., NEJM 2013
### Metaplus – 6-Monats-Mortalität

<table>
<thead>
<tr>
<th>Total Group</th>
<th>Medical patients</th>
<th>Surgical patients</th>
<th>Trauma patients</th>
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<tbody>
<tr>
<td></td>
<td>IMHP (n=152)</td>
<td>HP (n=149)</td>
<td></td>
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<tr>
<td></td>
<td>P Value</td>
<td>P Value</td>
<td>P Value</td>
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<tr>
<td>New infections, No (%)</td>
<td>80 (53)</td>
<td>78 (52)</td>
<td>.96&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>Mortality, No (%)&lt;sup&gt;e&lt;/sup&gt;</td>
<td>30 (20)</td>
<td>29 (20)</td>
<td>.95&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>ICU</td>
<td>11 (14)</td>
<td>16 (22)</td>
<td>.20&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>Hospital</td>
<td>13 (17)</td>
<td>16 (22)</td>
<td>.39&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>28 days</td>
<td>11 (14)</td>
<td>12 (16)</td>
<td>.67&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>6 months</td>
<td>22 (28)</td>
<td>21 (29)</td>
<td>.90&lt;sup&gt;b&lt;/sup&gt;</td>
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<table>
<thead>
<tr>
<th>Total numbers</th>
<th>Numbr of events (deaths)</th>
<th>DF</th>
<th>Coefficient</th>
<th>SE</th>
<th>P Value</th>
<th>Hazard Ratio</th>
<th>95% CI</th>
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<tbody>
<tr>
<td>Treatment</td>
<td></td>
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</tr>
<tr>
<td>IMHP</td>
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<td>53</td>
<td>1</td>
<td>0.45</td>
<td>0.21</td>
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<td>HP</td>
<td>149</td>
<td>42</td>
<td>0</td>
<td>0.00</td>
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Van Zanten ARH et al., JAMA 2014
• Stabilization of the hemodynamics, improving pulmonary gas exchange.

• Second and third look lavage with placement of an abdominal Vacuseal-System in the operating theatre due to peritonitis

• OR: slow improvement of peritonitis without signs of an anastomotic leak.

• Enteral nutrition could be slowly advanced by 10 cc/h daily up to 50 cc per hour (1200 kcal/d, 53g/d AA). SPN was reduced in the same time to the same amount from 40 to 20 mL/h (550 kcal/d, 25g/d AA).

• Insulin was administered at 4 IU/h.

• However despite maximal conservative treatment with fluids and hemodynamic management, the patient developed acute renal failure requiring CVVH.
a. During CVVH micronutrients and water soluble with vitamins do not to be adjusted

b. Protein demand in this patient may be underestimated and needs to be adjusted since the patient has higher protein requirements due to his BMI over 40 and acute renal failure with CVVH

c. Energy supply should be increased to 40 kcal/kg/day

d. Dialysis should be withheld in order to limit additional protein loses

e. Protein should be withheld during CVVH in order to decrease protein losses via hemofiltration
Question 4

a. During CVVH micronutrients and water soluble vitamins do not need to be adjusted.

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Requirements

Macronutrient requirements are more influenced by the severity of underlying disease, type and intensity of extracorporeal RRT, nutritional status and associated complications, rather than by the ARF itself. Micronutrient requirements have been poorly investigated in ARF patients. In ICU patients with ARF, the enhanced requirements for water-soluble vitamins induced by extracorporeal therapy should be met by supplementing multivitamin products. In line with

<table>
<thead>
<tr>
<th>Nutritional requirements in patients with ARF (from Refs. 1,12).</th>
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<tbody>
<tr>
<td><strong>Energy (non-protein calories)</strong></td>
</tr>
<tr>
<td>Carbohydrates</td>
</tr>
<tr>
<td>Fat</td>
</tr>
<tr>
<td><strong>Protein (essential and non-essential amino acids)</strong></td>
</tr>
<tr>
<td>Conservative therapy, mild catabolism</td>
</tr>
<tr>
<td>Extracorporeal therapy, moderate catabolism</td>
</tr>
<tr>
<td><strong>CCRT, severe hypercatabolism</strong></td>
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Cano NJM et al., Clin Nutr 2009
Protein Supply and Outcome In Critically Ill

n=113, ICU, ITN (burn, sepsis)  
EN+PN, GRV<300mL  
targets:  
25-30 kcal/kg per day  
1.2-1.5 g/kg protein

Allingstrup MJ et al., Clin Nutr 2012
• During the next week pulmonary gas exchange improved as well as hemodynamics and weaning could be started.
• Abdomen was surgically closed.
• Patient was still in acute anuric renal failure requiring CVVH.
• Insulin drip was stable at 2IU/h
• EN: 60 mL/h (1526 kcal/d, 63g AA/d)
• SPN (3-chamber bag): 20 mL/h (550 kcal/d, 25g/d AA)
• Additional amino acids were applied with AA (10%): 20mL/h (50g AA/d).
Question 5

a. Protein supply in EN and PN standard products are sufficient for morbidly obese patients and patients with renal failure requiring CVVH

b. Morbidly obese hospitalized patients should receive a hypercaloric and hypoproteinemic diet

c. The lipid content of SPN should consist only of o-6-fatty acids in order to supply enough essential fatty acids

d. Nutrition plays no role in morbidly obese ICU patients due to high fat stores

e. Energy supply for morbidly obese hospitalized patients should be <14 kcal/kg actual BW, protein supply for morbidly obese hospitalized patients should be 1,2g/kg actual BW or 2-2,5 g/kg ideal BW
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**Question 3: Are Clinical Outcomes Improved With Hypocaloric, High Protein Diets in Hospitalized Patients With Obesity?** (Tables 5-6)

**Recommendation**

3a. Clinical outcomes are at least equivalent in patients supported with high protein hypocaloric feeding to those supported with high protein eucaloric feeding. A trial of hypocaloric high protein feeding is suggested in patients who do not have severe renal or hepatic dysfunction (weak). Hypocaloric feeding may be started with 50%-70% of estimated energy requirements or < 14 kcal/kg actual weight. High protein feeding may be started with 1.2 g/kg actual weight or 2-2.5 g/kg ideal body weight, with adjustment of goal protein intake by the results of nitrogen balance studies.

**Evidence Grade: Low.**

3b. Hypocaloric low protein feedings are associated with unfavorable outcomes. Clinical vigilance for adequate protein provision is suggested in patients who do not have severe renal or hepatic dysfunction (weak).

**Evidence Grade: Low.**

BMI > 40 kg/m²; USA 2011; m: 4.4%, f: 8.4%

Bariatric surgery: > 200,000/y

Flegal AM et al., JAMA 2012

The Mètre equations are as follows:

- **Men (kcal/day)** = 5 + 10 × **Weight (kg)** + 6.25 × **Ht(cm)** - 5 × **Age(y)**
- **Women (kcal/day)** = -161 + 10 × **Weight (kg)** + 6.25 × **Ht(cm)** - 5 × **Age(y)**

Choban P et al., JPEN 2013
„The basics for complex ICU cases“

• EN has priority over PN (except CI), high evidence!

• Early EN < 24h (trophic feed: 10-20 mL/h) low evidence
  (Wernerman J, COCC 2014, Koretz RL et al., Clin Nutr 2014)

• Suppl. PN, when EN is unsuccessfull (e.g > 3-5-7d, adaptation!)
  EPaNIC (NEJM 2011) vs SPN (Lancet 2013), australian study (JAMA 2013)

• SPN: CH / lipids (~ 60% / ~ 40% from non-protein-energy, ideally AiO-solution)

• adaptation according to metabolic and GI tolerance:
  - PG<150-180 mg/dL; Urea<180-200 mg/dL; TG<400 mg/dL

• CVVH and very high BMI require higher protein input

• Avoid:  Hyperalimentation during acute phase
  Hypoalimentation during chronic phase of disease