Module 18.4

Clinical Priorities for Solving Complex ICU Patient Problems

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Learning objectives

- Knowledge about organ failures influencing substrate metabolism;
- Knowledge of enteral nutrition during vasopressor therapy;
- Knowledge of timing to start SPN in an ICU patient on insufficient enteral nutrition;
- Knowledge of morbid adipositas and clinical nutrition.

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Key messages

- The use of vasoactive substances should not entirely preclude enteral nutrition;
- In the absence of increasing doses of vasoactive substances for hemodynamic support or increasing levels of lactic acid or change in clinical symptoms EN, slowly adjusted may be applied safely under close monitoring;
- Full enteral nutrition support is not necessary in hemodynamic compromised patient;
- Supplemental parenteral nutrition (SPN) is often needed in long-term intensive care patients in particular with in the presence of GI problems;
- Supplementation of antioxidants or high dose glutamine cannot be recommended to unselected ICU patients complicated by shock or multi organ dysfunction syndrome;
- During CVVH a higher protein supply of 1,5-1,7 g kg/d is recommended;
- In morbidly obese ICU patients a higher protein supply of 1,2 g/kg/d actual BW or 2-2,5 g/kg/d ideal body weight with a lower relative energy supply is recommended.
1. Introduction

Complex patients in the intensive care unit (ICU) usually include patients with prolonged hemodynamic instability, respiratory failure, renal failure, gastrointestinal (GI) failure, liver failure or combined multiorgan dysfunction syndrome. Furthermore, due to changes in lifestyle we also experience more patients with severe adipositas and their unique problems in our ICU’s.

Patients with multiorgan dysfunction syndrome are only a minority of all the patients we treat in the ICU. Despite the fact that these patients require most of our personnel and financial resources in the hospital they are rarely investigated thoroughly in interventional randomized controlled trials. Most studies presented in the literature include general critically ill patients, often patients with trauma, sepsis, medical or other reasons for admission. Patient subgroups with different medical conditions are usually pooled together in one study despite large differences in their specific pathologies.

Here we want to focus on some unique problems regarding nutritional therapy which complex ICU patients may present. This is important since all experts would agree that regarding nutrition therapy for the critical ill patients, we absolutely “need to do better” (1)! We have learned that ICU patients with complex problems receiving too much of energy intake during acute phases may develop infectious complications, fatty liver degeneration, electrolyte disturbances and respiratory fatigue due to excessive carbon dioxide production. However a caloric intake that is much too low over a prolonged period of time also may worsen outcome by increasing the rate of infections, fatigue, weakened muscle strengths, pressure sores, weaning failure and other complications (2).

2. Enteral Nutrition for the Patient with Hemodynamic Instability

The ESPEN guideline states that critically ill patients who are hemodynamically stable and have a functional GI tract should be fed early (<24h) with enteral nutrition using an appropriate amount (3). A definition about hemodynamic stability and instability is not given in these guidelines. However we experience an increasing number of patients that over a longer time (days, weeks) are dependent of vasopressors. With moderately increased levels of lactic acid it is difficult to make a general statement, when such a patient is considered to be hemodynamically stable or unstable. Only few data exist in patients or laboratory settings to evaluate the effect of enteral nutrition during endotoxemia or clinical sepsis. In some patients it might be very difficult to distinct whether feeding the hypotensive patients may worsen or protect against bowel ischemia (4). Kazmias reported in an experimental setting that enteral nutrition during endotoxemia may increase hepatic and splanchnic blood flow and may improve markers of splanchnic microcirculation (5). Zaloga et al. demonstrated in an animal model that increasing doses of vasopressors usually increase the mesenteric blood flow about 50-60% over baseline (6). However at a certain cutoff that may be individually completely different, blood flow drops dramatically. So for the individual patient we do not know when danger looms by high dose vasopressor support. Regular clinical examinations, observation of a rapid increase in vasopressor support, a close look at lactic acid levels and repetitive measurements of high gastric residual volumes (GRV)
altogether will be the best parameters to determine tolerance or intolerance of enteral nutritional support. Furthermore not only high dose vasopressors may result in a mesenteric flow reduction but also low output cardiac failure (7).

Khalid et al. reported in 1174 patients, that ICU and hospital mortality drops when enteral nutrition is started early in patients with hemodynamic instability (9). Unfortunately this was not a prospective randomized trial and only little information is given about the dose of vasopressors and cutoff for stopping enteral nutrition. Revelly et al. also reported in a few patients that enteral nutrition was applied successfully in patients on vasopressors or catecholamines (10). According to the ESPEN guidelines it is recommended to reach the goal of nutritional intake within 3 days (3). In patients with hemodynamic instability enteral nutrition with a low flow rate and only a slow increase during careful monitoring is advised (8).

Aside from enteral nutrition during vasopressor support, open abdomen treatment is an extreme form of a gastrointestinal problem in an ICU patient. Those patients include open abdomen treatments with abdominal vacu seal treatments and repetitive surgical explorations (e.g. every 24 to 48 hours). There are no rigorous trials to investigate the feasibility of enteral nutrition in such patients. Only at the level of case series or expert opinions there is some guidance in the literature (11, 12). Such statements include the recommendation to try enteral nutrition in ICU patients even during open abdomen. In addition it is recommended to start enteral nutrition at 20 to 30 mL/h in intubated patients with open abdomen as long as bowel function can be assumed and discontinuity of the bowel or the extent of bowel edema do not provide a clear contraindication against enteral nutrition.

So eventually, as Allen stated “the use of vasoactive substances should not entirely preclude from using the enteral route to supply nutrition. In the absence of increasing doses of vasoactive substances for hemodynamic support or increasing levels of lactic acid or change in clinical symptoms EN may be considered save and may be tried in such patients but more studies are needed” (13).

Most importantly the use of enteral nutrition during the hemodynamic instability does not make it mandatory to provide full enteral nutrition support. Supplemental parenteral nutrition (SPN) is often needed in long-term intensive care patients with such GI problems.

3. Supplemental Parenteral Nutrition for the ICU Patient

The specific patient selection (no malnutrition, mostly routine cardiac surgery, short term ICU stay) may explain the results of the EPaNIC study (14) where SPN started day 3 compared to SPN started at day 8 led to an increase in new infection and a delayed discharge from the ICU. The EPaNIC study made an excellent point, that unnecessary SPN in patients who are not malnourished or stay only for short time in the ICU should not be administred. However as the Swiss SPN study concluded (15) a different patient selection with the inclusion of only patients intolerant to >60% of target enteral nutrition at day four after admission may be responsible for their positive results with a reduction of infectious complications. Doig et al, (16) provided evidence that SPN even beginning at day one in patients with a relative contraindication against EN may be save and also
advantageous for patients outcome, when given in moderate doses, being slowly advanced and the maximal calories do not lead to hyperalimentation.

Koretz et al. recently reported that the effect of early enteral nutrition support on mortality in ICU patients was mostly shown in trials with less robust assessment (17). The authors presented evidence that there may be an effect of bias in trials of early enteral nutrition in ill patients. Examples that may lead to bias include inappropriate generation of the randomization sequence, failure to conceal allocation, inadequate or absent blinding of subjects, failure to do intention-to-treat-analysis, selective reporting of outcomes, imbalanced baseline characteristics, early stopping and vested interest.

It is discussed controversial at the moment whether or how much nutrition support should be given during the acute phase of critical illness. As Casaer (18) pointed out, large high quality randomized controlled trails supporting an outcome benefit during the acute phase of critical illness have not be performed. Most studies included only intensive care patients with a short length of stay in the unit. All experts would agree that for long term ICU patients in particular for those complicated by multiorgan dysfunction syndrome there is no doubt that nutrition therapy is an integral and essential part of the whole therapeutic concept. In patients with acute lung injury, without malnutrition and being less severe ill, Rice et al. demonstrated in the EDEN study (19) that tropic feed versus hyporcaloric enteral feed did not result in different mortality. For long term ICU patients with risk of malnutrition however, such delay of enteral nutrition support should be avoided according to our guidelines.

Maybe in earlier trials too often we delayed enteral nutrition due to high gastric residuals and started PN too early some of our ICU patients. Recently we learned in two multi center controlled trails that GRV measurements often unnecessarily may have led to a stop or a decrease of enteral nutrition support (20, 21). So GRV measurements maybe are dispensible in patients without GI problems (MICU, trauma). However whereas some think that monitoring GRV should be deleted from our guidelines, we believe that in particular for surgical ICU patients with severe GI problems GRV measurements will still have its place to early detect intraabdominal complications (22).

4. Glutamine and Antioxidants

The REDOXS-study (23) provided evidence that high dose glutamine together with antioxidants, particularly selenium did not improve outcome in patients with early shock and at least a two organ failure on admission into the study. It was disappointing to see that antioxidants in high dose supplementation did not make a difference in outcome. These results confirm the disappointing results of the SIGNET-Study (24) and are in contrast to earlier small studies demonstrating positive effects of antioxidants. One could criticize that glutamine in the REDOXS-study has been given in an excessive high dose (medium: 0.78 g/kg/d) to patients who frequently experience renal or liver dysfunction.

However recently the results of the METAPLUS study (25) confirmed as well that glutamine even given in recommended doses according to ESPEN guidelines given to predefined subgroups of surgical, medical or trauma ICU patients does not improve outcome. In medical ICU patients, a pre specified subgroup with the highest APACHE score, increased 6 month mortality was found even after adjustment for confounders. Therefore at this point supplementation of antioxidants or high dose glutamine cannot be
recommended to unselected ICU patients complicated by shock or multi organ dysfunction syndrome. However when PN is indicated in any form parenteral glutamine given at low doses (0.3-0.4 g/kg/d) in stable long term patients glutamine will likely be continued to be recommended since this conditionally essential amino acid is not contained in parenteral solutions.

5. Nutritional Adjustments during CVVH

In patients with renal failure on extracorporeal renal replacement therapy (CVVH) water soluble vitamins should be given in doubled dose. For continuous renal replacement therapy, additional protein loss of 10-20 g/d must be taken into account. Therefore the recommended dose for protein administration is 1.5-1.7 g kg/d in those patients (26). Newer studies generally conclude that for critically ill patients a higher protein supply may improve outcome when compared to low protein content in parenteral or enteral nutrition (27, 28).

6. Morbidly Obese Critically Ill Patients

In many countries the number of patients with severe adipositas (BMI >40kg/m²) increase significantly. Such patients being admitted to a hospital for bariatric surgery usually do not require artificial nutrition support except the application of the essential vitamins and trace elements. However whenever those patients are developing complications such as incarcerated inguinal hernia or ileus and being admitted postoperatively to the ICU, such patients have a high likelihood for the development of complications with increasing length of stay and worsened clinical outcome. Morbid obese patients during sepsis or septic shock lose significant amount of lean body mass. Unfortunately the loss of muscle mass in those patients is hardly seen due to their fat masses. Choban et al. recommend in these patients that low calorie but high protein diet may be superior to normal protein and normal caloric feeding. Protein in such patients may be given with 1,2 g/kg/d actual BW or 2-2,5 g/kg/d ideal body weight with adjustment of goal protein intake Intake by the results of nitrogen balance studies (29). Since normal standard products in enteral or parenteral nutrition do not contain enough protein to compensate for this additional demand, during intensive therapy any parenteral nutrition with additional doses of amino acid solution may be superior to just applying standard products.

7. Summary

Individualized medicine including tailored nutritional therapy is necessary for complex ICU patients since no major RCT’s include these patients exclusively. During acute phases endogenous substrate release may inhibit high exogenous energy intake making full nutrition unnecessary. Slow adjustments according to metabolic monitoring is mandatory. However for the long term ICU patient even with organ dysfunction, nutritional therapy becomes essential to avoid the negative effects of energy and essential substrate deficits. During different organ failures nutritional macro- and micro-substrates have to be adjusted to meet patients needs.
8. References


