Turkish Journal of Medical Sciences

http://journals.tubitak.gov.tr/medical/

Research Article

Turk J Med Sci
(2014) 44: 1055-1059

doi:10.3906/sag-1308-68

A general consideration of the importance of nutrition for critically ill patients

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Received: 19.08.2013 • **Accepted:** 12.02.2014 • **Published Online:** 24.10.2014 • **Printed:** 21.11.2014

Background/aim: Malnutrition is a common medical condition among intensive care unit patients. It should be monitored carefully, since early management of malnutrition can dramatically improve the medical condition of the patients. A general consideration of enteral feeding shows that it is much more useful than parenteral administration, because it is more physiological and poses a lower risk of hyperalimentation.

Materials and methods: In this retrospective study, we scanned all files and personal information of patients hospitalized in intensive care units between 2009 and 2012 due to various medical conditions. We evaluated the nutritional status of patients with biochemical parameters that were retrieved from the files.

Results: In total, 198 patients were identified from hospital records. Almost every patient was given nutritional support either through enteral or parenteral feeding. The albumin levels of 56 patients did not increase, even when they were fed with calculated nutritional support (36.6%). The prealbumin levels of the patients had a tendency to increase after the provision of nutritional additives.

Conclusion: In appropriately selected critically ill patients, the role of nutritional support in the management of nutritional deficiencies is important. In order to calculate proper feeding goals, a full nutritional assessment is necessary.

Key words: Nutrition, malnutrition, critical ill patient

1. Introduction

Nutrition plays an important role for every patient who is admitted to a hospital. For critically ill patients receiving treatment in intensive care units (ICUs), it becomes more important, since they are usually dependent on a physician for nutritional intake. Proper calculation of calories for these patients should be done to prevent further negative impact of malnutrition on the primary disease. The general condition of the patients might be the most accurate evaluation method for nutritional status, since bad nutrition can cause progression of the primary disease. Furthermore, many medical conditions require different additional nutritional support. This should be considered when calculating the total nutritional intake of patients.

In this study, we focus on the importance of early intake of nutritional dietary supplements and on ways to follow up on nutritional status.

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2. Materials and methods

In this retrospective study, we scanned 198 files and the personal information of patients hospitalized in ICUs for at least 5 days between 2009 and 2012 due to various medical conditions. We evaluated the follow-up notes that were retrieved from the files. Biochemical parameters were determined as albumin, prealbumin, and C-reactive protein (CRP) levels. In addition, fundamental electrolyte levels were considered when evaluating nutritional status. Main and additional medical conditions and their additive effects on malnutrition were noted carefully. Daily follow-up notes were read to understand the general condition of the patient during hospitalization. Malnutrition was defined as low albumin level (below 2 mg/dL) and weight loss of more than 10% during follow-up. Periodically measured prealbumin levels were also taken into consideration. We aimed to report the nutritional status of long-term ICU patients and the prevalence of malnutrition. Two unequal groups were determined with early and late nutritional additive administration. Early nutritional support was defined as nutritional support received by patients on the fifth day of admission or earlier.

All data retrieved from files were collected and entered into SPSS 17. Continuous variables were expressed as mean and standard deviation. Correlation between groups was analyzed with a t-test or the Mann–Whitney U test. Statistical significance was assumed as a $P < 0.05$.

3. Results

In total, 198 patients were identified from hospital records. These patients had been hospitalized in the ICU for 5 days or longer. Forty-five were excluded from the study due to lack of information, such as lost daily notes or insufficient biochemical parameters. Finally, 153 patients were accepted for further evaluation. Seventy-eight were men and 75 were women. The mean age of the patients was 58 years. The reasons for ICU admission varied extensively, but many patients had been diagnosed with chronic heart or lung disease.

Almost every patient had been administered nutritional support, either through enteral or parenteral nutrition. Only 5 patients had not received any nutritional support because of the quick progression of their medical condition (3.2%). Forty-seven patients had only received parenteral nutrition because their primary disease was gastrointestinal tract, which prevents enteral feeding (30.7%). Enteral feeding started on the fifth day of admission or earlier for 68 patients (44.4%). The remaining patients were given enteral nutrition frequently during the first week. Only 5 patients started enteral nutrition after 15 days (3.2%). Routinely, all patients were observed for basic biochemical parameters such as CRP, albumin, and prealbumin. Albumin levels were considered normal at a level above 2 g/dL. Electrolyte levels were measured and liver and kidney function tests were conducted daily. Twenty-three patients developed fulminant disease, and their nutritional status did not improve even when they received proper nutritional support (15%). Patients who were given early nutritional support were noted to improve faster. Due to lack of follow-up notes, we could only consider biochemical parameters as an improvement marker for the evaluation of the medical condition. In our study, the albumin levels of 56 patients did not increase even when they were given calculated nutritional support (36.6%). For this patient group, 40 did not show significant weight loss (greater than 10%). Sufficient increase in prealbumin levels was noted in 72 patients (47%).

Anthropometric measurements are very important for nutritional evaluation. However, accurate measurements usually become impossible during the follow-up period. Unfortunately, our notes about these measurements were not adequate to assess nutritional status correctly. Patients were weighed twice a week, and we discovered that 42 patients experienced significant weight loss (greater than 10%). This weight loss occurred in patients who were hospitalized for 15 days or more. Sixteen of these patients did not gain weight despite receiving calculated nutritional support.

Forty-five of 68 patients who were given early nutrition progressed quickly and recovered almost completely during ICU hospitalization, and they were discharged after a short ward follow-up (29.4%).

4. Discussion

In appropriately selected critically ill patients, the role of nutritional support in the management of nutritional deficiencies is important. A full nutritional assessment provides the necessary means to calculate proper feeding goals. The feeding route, which is either enteral or parenteral, depends on the intestinal function of the patient and his or her hemodynamic status. In order to avoid overfeeding and other complications, one must take into consideration the special roles of proteins, fats, and carbohydrates. Clinical trials have indicated effectiveness of certain disease-specific enteral formulas, yet it is still necessary to carry out careful cost-benefit analyses (1,2).

Malnutrition is defined as a change of body composition where deficiencies of macronutrients and micronutrients lead to organ dysfunction, reduced cell mass, and abnormal serum chemistry values. In properly selected critically ill and high-risk patients in the ICU, the role of nutritional support is essential for preventing and treating nutritional deficiencies (1). In critically ill patients, especially those with fluid overload or renal dysfunction, anthropometric data (skinfold thickness and arm muscle circumference) and creatinine height index (urinary creatinine level according to height) provide remarkably less accurate measures for malnutrition, although they are practical in ambulatory patients (2).

Despite the fact that fluid overload commonly does not allow for an accurate determination of dry weight in the ICU, the first step in assessing malnutrition in critically ill patients is to obtain a history of late involuntary weight loss (more than 5% within 1 month or 10% over 6 months). The focus of the physical examination should be on the symptoms of certain micronutrient deficiencies (such as glossitis, rash, or anemia), on symptoms of protein-calorie deficiency (such as temporal wasting), edema, and hydration state. In order to calculate body mass index (BMI), ideal body weight, percentage of ideal body weight, dry weight, and height are utilized (2).

For a person with a small frame, it is possible to reduce estimated body weight by 10%. On the contrary, it is possible to add 10% to a person with a large frame. Weight in kilograms divided by the square of the height in meters yields the definition of BMI. Normal BMI varies between 19 and 25. Significantly decreased survival is noted with a BMI below 14 (2,3).

Albumin is most commonly used in measuring splanchnic protein status in laboratories. In cases of isolated calorie malnutrition, hypoalbuminemia is seldom encountered, contrary to common belief. Rather, hypoalbuminemia is a marker of systemic inflammatory response, which gives prognostic importance to it. Hypoalbuminemia has been linked to increased morbidity and mortality among hospitalized patients. Albumin's daily hepatic synthesis rate is 120–170 mg/kg of body weight. Albumin is dispensed between the intravascular and extravascular spaces. In the case of injury, the liver increases production of acute-phase proteins and decreases albumin synthesis. Hypoalbuminemia occurs as a result of reduction in albumin accompanied by extravasation and enhanced catabolism (both mediated by cytokines). Hence, serum albumin concentration does not provide a sound index for nutritional status, but it functions as a metabolic stress and a marker of injury in response to injury (2). If we consider the 68 patients who received early nutritional support, albumin levels could not be increased despite insignificant weight loss (above 10%). This could be an indication that albumin alone is not a strong marker for malnutrition since there are many other factors that could affect albumin levels.

The prealbumin levels of the patients had a tendency to increase with nutritional additives, but in high-inflammatory conditions this tendency was very low or absent. If we consider that these patients were in very critical medical conditions and had high inflammatory status, the elevation in prealbumin levels was not as expected.

CRP levels are also commonly related to inflammation, and they did not decrease immediately after nutritional intake as expected. Improvement in CRP seemed to be mostly related to the regression of the primary disease.

Nutritional support has the following goals for ICU patients:

1. To provide nutritional support that is compatible with the present route of nutrient administration and the patient's medical condition.
2. To prevent and treat macronutrient and micronutrient deficiencies.
3. To provide nutrient doses compatible with the current metabolism.
4. To avoid complications that are linked to the technique of dietary delivery.
5. To enhance patient outcomes, including those affecting resource utilization, medical morbidities and mortalities, and subsequent patient performance.

4.1. Total parenteral nutrition in ICU

The enteral route is generally preferred to parenteral route due to the fact that it is more physiological and less expensive. Several studies have demonstrated that total parenteral nutrition (TPN) is linked to higher infection rates than enteral feeding, although this has not been corroborated in situations where equivalent calories were administered by each route and where overfeeding with TPN was eschewed. Among contraindications to enteral feeding are intractable vomiting, diffuse peritonitis, paralytic ileus, intestinal obstruction, and severe diarrhea. Reduced intestinal blood flow is linked to hypotension with hemodynamic instability and is attributed to low tolerance to enteral feeding (4,5).

TPN plays a significant role for patients whose gut is not functioning. It is sufficient to administer 25 kcal/kg of usual body weight to most patients with a normal BMI. This goal is similar to that calculated using the Harris–Benedict equation. Where BMI is <19, overfeeding may lead to refeeding syndrome, distinguished by electrolyte abnormalities (hypokalemia, hypophosphatemia, and hypomagnesaemia), congestive heart failure, and volume overload (3,5,6).

To prevent general overfeeding, it is possible to change the composition of TPN and especially carbohydrate overfeeding. A calorimeter may serve as an important tool for some patients. The daily protein (amino acid) goal in TPN varies between 1.2 and 1.5 g/kg and should be adjusted with periodic monitoring to help nitrogen retention and to provide protein synthesis. However, due to the fact that the cytokine and catabolic hormone cascade prevents anabolism, a positive nitrogen balance cannot usually be achieved in critically ill persons. Administering higher amounts of protein will possibly not promote lean mass accrual. It is possible to aggravate azotemia by a high protein load so that BUN values of >100 mg/dL may be taken as an indication to reduce nitrogen intake. However, this is not properly corroborated in an acute illness setting. A daily protein intake of 0.8 g/kg will be sufficient for individuals with chronic renal insufficiency. In persons for whom hepatic encephalopathy poses a major clinical problem, there is another possible indication for restricting protein consumption in TPN. Studies have indicated that using a high quantity of branched-chain amino acids (BCAAs) or reducing amino acid load improves mental status (6,7).

Omega-6-polyunsaturated fatty acids, which can be administered separately from the dextrose/protein or as part of a 3-in-1 solution, constitute the lipid component of TPN. Among the possible implications of lipid overfeeding is injury to the reticuloendothelial system, which might result in immunosuppression and can invalidate the beneficial effects of nutritional support. Nevertheless, particularly when the fat is infused slowly, as with a 3-in-1 solution, it is unlikely that limiting fat calories to 30% of total intake will cause this complication. A relative contraindication to adding lipids is triglyceride levels of >400 mg/dL (7).

It is necessary that carbohydrates form the remainder of the total daily calorie intake at between 3 and 5 g/kg, but the specific amount needs to be adjusted appropriately so that blood glucose level of <220 mg/dL can be sustained. Studies have demonstrated that postoperative hyperglycemia (blood glucose level of >220 mg/dL) increases the risk of nosocomial infection to a degree where the benefits of nutritional repletion are negated. Severe stress (e.g., postoperative patients) cooccurs with the rising plasma levels of the counterregulatory hormones glucagon, epinephrine, and cortisol. Hence, postoperative patients mostly face the risk of TPN-induced hyperglycemia (5,7).

Fluid restriction often plays a vital role for pulmonary, cardiac, postoperative, and renal patients in the ICU. It is possible to restrict TPN to 1 L for these types of patients. When nutrients are concentrated maximally, it is possible to have provision of 1000 kcal and 70 g of protein per liter. This amount often constitutes an essential percentage of the weight-based feeding goal. Generally, trace elements and vitamins are administered as components of the TPN. Moreover, it is possible to mix several medications, including histamine-2 receptor antagonists and metoclopramide, with the TPN solution.

4.2. Enteral nutrition in the ICU

Adequate gastric motility and emptying is necessary for intragastric feeding. Due to the high risk of aspiration, a residual of >150 mL is a relative contraindication to gastric feeding. In this case, nutritional support with TPN or small-bowel feeding is suitable. Even in the case of colonic ileus and/or gastric atony, postpyloric enteral feeding is generally efficient. It may be required to apply simultaneous nasogastric decompression for efficient small-bowel feeding. In order to start postpyloric enteral feeding, bowel sounds and the passage of gas or feces are not necessary. Secretory diarrhea is possible, but it is not an absolute indication to stop enteral feeding provided that the output does not exceed 1,000 mL/day. Evaluation is necessary for an output within this range (8).

Until tolerance is specified, eternal feeding is commonly initiated with an elemental formula containing a reduced fat content at low rates. It is possible to achieve the rate goal every 8 h as tolerated, provided that gastric residual is low and no abdominal distension and pain occur. It is necessary to order multiple vitamins separately. Caloric requirements are calculated with regard to TPN. The wide availability of disease-specific enteral formulas constitutes the main differences (3,9).

4.3. Disease-specific considerations

In order to reduce CO_2 production, pulmonary formulas are designed to be low in carbohydrates and high in fat (50%), which reduces ventilator demand. Preclinical studies have shown that a custom-made pulmonary formula increased cardiopulmonary hemodynamics and gas exchange and decreased pulmonary neutrophil accumulation and inflammatory cytokines. Among the ingredients of this disease-specific pulmonary formulation are γ-linolenic acid (which modifies production of proinflammatory cytokines), eicosapentaenoic acid, and antioxidants (vitamin C, vitamin E, and beta-carotene). It is also dense in calories and especially suitable for fluid-restricted patients with acute respiratory distress syndrome (3,4,8).

Relatively high amounts of the BCAAs valine, leucine, and isoleucine with low amounts of aromatic amino acids are contained in hepatic enteral formulas. Patients with hepatic encephalopathy are the target group of these products. The idea is that BCAA infusion compensates for the imbalance between aromatic amino acids and BCAAs in the plasma and central nervous system, which might add to commonly encountered mental disturbances. Short-term use of BCAA-enriched formulas may prove useful since they mitigate encephalopathy and improve nitrogen balance; however, extended use is costly and can limit protein synthesis, causing an insufficient nitrogen balance (8,10).

Particular renal formulas commonly contain low levels of protein or different proportions of BCAAs. The solutions usually contain dense calorie amounts of up to 2 kcal/mL. In order to obtain this density, some formulas may contain high amounts of fat. The ingestion of these fats may cause bloating and delayed gastric emptying. They contain significantly less potassium, phosphorus, and magnesium than typical enteral feeds. Furthermore, renal patients face the risk of certain micronutrient toxicities. However, feeding patients sufficiently is important to prevent malnutrition and body cell mass catabolism. Rather than underfeeding protein, it is optimal to feed critically ill patients with sufficient protein and to use dialysis to clear fluid and nitrogen (5,8).

According to our study, malnutrition appears to be a common problem in prolonged ICU hospitalization. Therefore, an early intervention in nutrition would be a useful approach for minimizing complications related to malnutrition. Early calculation of personal calorie needs is essential. Early intake of essential nutrition decreases the progression of the disease. The comparison of the 2 groups in terms of developing malnutrition showed that early therapy significantly improves the medical condition ($P < 0.05$).

In conclusion, a single marker is not appropriate for evaluating malnutrition. Patients must be evaluated in accordance with all clinical signs and biochemical values. Early dietary intake or parenteral additives significantly affect the medical condition of patients, improve recuperation, and decrease complication rates.

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