Original Article

Enteral and Parenteral Nutrition in Patients Admitted to Referral Teaching Hospital and Comparison of Their Effects with Existing Standards

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Abstract

Background: Proper nutrition is a basic requirement for all hospitalized patients, particularly critically ill patients who, for various reasons, are not able to maintain their nutritional status. Nutritional support is an essential component of care in the Intensive Care Unit (ICU) patients and it is commonly performed in two ways of enteral and parenteral nutrition. The present investigation aimed to investigate the nutritional status of this group of patients in comparison with existing standards.

Methods: In this study, 50 critically ill patients receiving nutritional support (42 patients were on enteral nutrition and 8 on parenteral) in a referral teaching hospital of Iran were investigated. Each patient was assessed individually and nutritional requirements including calorie and protein were calculated based on age, sex, height, weight, and the stress and activity factors. The total daily energy and protein were compared to standard calculated values. T-test was used to evaluate the differences between separate groups and $p<0.05$ was considered significant.

Results: Data showed that 70% of patients in the enteral group did not receive enough calories while only 7% obtained the required protein. In the parenteral group, none of the patients received enough calories or protein.

Conclusion: According to the results of this study, it seems that hospitalized ICU patients receive very poor nutritional support and greater attention should be paid to preventing possible malnutrition-related complications.

Keywords: Enteral nutrition, Intensive care unit, Nutritional support, Parenteral nutrition

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Introduction

Malnutrition is defined as deficiencies, excesses, or imbalances in a person's energy and/or nutrients intake (1). It is a serious condition and common problem in hospitalized patients, especially in surgical and intensive care units which leads to higher rates of related complications and greater risk of death compared to well-nourished patients (2,3). The nutritional support with parenteral nutrition is an important intervention and recommended in different medical and surgical conditions (4).

Proper nutritional care in hospitalized patients in critical care units shows an important role in influencing recovery and preventing disease progression (5,6). Nutrition needs are essential for stabilizing the normal conditions of patients and negligence of this factor can cause malnutrition (7). Previous studies have demonstrated that the rate of malnutrition and weight loss, as well as nutrient deficiencies and consequently lack of energy in patients in Intensive Care Unit (ICU) is higher than other patients (6).

Malnutrition in hospitalized patients results in many complications such as various infections, increased severity of the disease, inadequate response to medications, increased medical costs, and ultimately increased mortality (6-8). Therefore, it is important to evaluate the amount of energy and protein intake with the actual need in these patients. Several studies have shown the positive effect of increased protein and energy levels in patients with a severe disease such as infectious complications, which leads to faster physical and motor recovery and lower hospitalization rates (9,10). Therefore, investigating these methods regarding the amount of protein and calories absorbed and comparing them with the actual rate in individuals is of great importance in ICU patients.

Enteral nutrition has been defined as a normal oral diet with the use of liquid supplements, or delivery of part or all of the daily requirements by use of a tube (Tube feeding) (8). Generally, when oral nutrition is not possible or recommended, Total Parenteral Nutrition (TPN) should be considered (11). Total parenteral nutrition has been considered a way that fluids are given into a vein to provide most of the nutrients the body needs. This method has been used for the past 4 decades as a therapeutic and supportive approach for a wide range of diseases (12,13). The nutritional formulas should contain the main nutrients including carbohydrate, protein, lipid, water, electrolyte, vitamins, and minerals (14). The incidence of malnutrition in hospitalized patients has been reported to be over 40%, and even in the best treatment centers, there are nutritional problems (15). It has been revealed that adequate oral or intravenous nutritional support of hospitalized patients in the intensive care unit has led to a decrease in hospital stay (16).

However, some studies have reported that patients receive small amounts of their nutritional needs at the hospital (17,18). According to the remarkable role of adequate nutrition in the recovery process of hospitalized patients and the lack of accurate data of patients' nutritional status in previous investigations, the current study addressed this issue. In the present study, nutritional requirements of each critically ill patient (Energy, protein, lipid, and carbohydrate) and the rate of administration were estimated based on the recommended values and then compared with actual values received by patients in the hospitalization period for Enteral Nutrition (EN) or TPN.

Materials and Methods

Study procedures

This cross-sectional investigation (Observational) was conducted for 6 months in the ICU of Baqiyatallah Hospital-Tehran, Iran in 2018. Fifty hospitalized patients who received parenteral nutrition or EN with a mean age of approximately 63.5 years were reviewed retrospectively by clinical pharmacists.

All nurses provided EN solutions by dissolving a scoop of Entera Meal® formulas (54.6% carbohydrate, 14% protein, and 31.6% fat and maltodextrin provided by Karen Pharma & Food Supplement Co, Tehran, Iran) powder in 150 *ml* of water and gavage the patients within 10 to 30 *min*.

The route of EN administration in most patients was Nasogastric (NG) tube and the alternative and bolus administration was frequently used.

Participants and data collection

Information of patients admitted to intensive care units receiving parenteral nutrition or EN due to

internal problems, surgery or trauma was collected through contact with nutritionists, nurses, ward officials, and also patient records. The nutritional conditions of fifty hospitalized patients (56% males and 44% females) were evaluated in hospital ICUs with a mean age of approximately 63.5 years. The average duration of hospitalization was two weeks and most patients (88%) had no physical activity. Among the studied patients, 42 patients (84%) were in the EN group, and 8 (16%) in the TPN group.

In the EN group, the major reason for the initiation of tube feeding in all patients was reduced conscious level of patients and the inability to swallow food. Also, in the intravenous feeding, the cause of parenteral nutrition, the amount of enteral synchronous nutrition, the route of administration (peripheral or central vein), the onset and duration, the total daily calories, protein, and lipid intake, and occurred side effects were recorded.

The method of administration of EN in most patients was NG tube and intermittent and bolus administration was often used as presented in table 1.

In the TPN group, most patients received total parenteral nutrition due to oral intolerance or Nil Per Os (NPO) condition and most received Large Volume Parenteral (LVP) solutions via a central catheter (CV Line). The rate of glucose intake was 8 to 24 *hr*, and the mean glucose intake was 190 *g* daily. All patients received the LVP solutions of amino acids 10% frequently and they had an average daily intake of 50 *g* of protein, which were infused over 8 *h* (Table 2).

Nutritional assessment of patients

Two separate forms of parenteral nutrition or EN were designed to collect patient information. Afterward, energy (Calories), carbohydrate, protein, lipid and other nutritional intakes of patients were evaluated and then according to recommendations of American Society for Parenteral and Enteral Nutrition (ASPEN), the amount of energy and protein requirement of patients was calculated and compared with the intake by a nutritionist (described below) (19).

Demographic information, cause, length and duration of hospitalization, patient movement, the method of administration (NG, orogastric or percutaneous endoscopic gastrostomy), type of administration (Intermittent, infusion or cyclic), amount of intake (volume and interval), duration of intake at each turn and time of feeding onset in EN were recorded.

In the TPN group, carbohydrate requirements of patients were provided by LVP solutions in the form of dextrose/saline with dextrose 50%. Also, the protein and lipid requirements were provided by 10% amino acid intravenous infusion (Aminoven®) and 10% intravenous fat emulsion (Intralipid®), respectively. In EN group, the gavage formula was Entera Meal® Standard (1000 calories, 36 *g* of protein, 135 *g* of total carbohydrate, and 36 *g* of total fat in 1000 *ml* of prepared solution).

Table 1. Methods and types of administration of enteral nutrition presented as number (%)

	Methods of administration			Types of administration	
	Nasogastric	Orogastric	Percutaneous endoscopic gastrostomy	Intermittent and bolus	Persistent (continuous)
Number of patients (%)	33 (78%)	3 (7%)	6 (14%)	40 (95%)	2 (5%)

Table 2. Amounts and infusion duration of glucose, lipid and protein intake in patients who received TPN

	Received by patients			
	gr/day	*Cal/Day*	% of total daily Cal	Infusion duration (*hr*)
Sugars	190.6±76.7	648±260	72.2±15 Recommended: 60-70	11.7±5 Recommended: 24
Lipids	28.1±16	312.5±177	34.8±11.5 Recommended: 30-40	6.7±2 Recommended: 12
Proteins (Amino acids)	47±8.5	-	-	8±1.8 Recommended: 6-12

During the study, the patients did not receive any other oral dietary intake (in the form of solutions, liquid, *etc*.) in addition to the Entera Meal® or TPN formulas.
The Harris-Benedict equation was used to calculate a person's daily energy requirement, which is expressed as the daily energy expenditure (Calories) based on the Predicted Energy Expenditure (PEE), which represents the heat generated by the vital metabolism in a resting and fasting person (20). Therefore, this amount of energy must also include stress and activity factors to calculate the total amount of energy required during the day (21).

Basal Energy Expenditure (BEE) (Men) = 66 + 13.7W + 5H – 6A

BEE (Women) = 655 + 9.5W + 1.7H – 4.7A

BEE: Basal Energy Expenditure (*Kcal/day*); W: Weight (*kg*); H: Height (*cm*); A: Age (*yr*) (22).

The amount of total energy consumed by each patient during the day was also calculated using the following formulas and the input of the stress and activity factor:
Total Energy Expenditure (TEE) (*Kcal/day*) = BEE×Stress Factor×Activity Factor
Stress and activity factor values are expressed in tables 3 and 4, respectively.

Table 3. Stress factor values

Type of stress or injury	The factor of stress and injury
Minor surgery	1.1 - 1.3
Major surgery	1.2 - 1.4
Infection	1.2
Fracture	1.2 - 1.4
(Accident) Injury	1.4 - 1.6
Sepsis	1.6
Burn	1.6 - 2

Table 4. Activity factor values

Quality of patient activity	Patient activity factor
In bed	1.2
Out of bed	1.3
Normal activity	1.5

Statistical analysis

All patient data were summarized using SPSS software version 20.0 for descriptive statistical methods and they were expressed as mean±standard deviation (SD). Paired t-test and one sample t-test were used to evaluate the differences between separate groups and standards and $p<0.05$ was considered significant.

Ethical consideration

This study was conducted with the support of the Faculty of Pharmacy at Baqiyatallah University of Medical Sciences (BMSU) and was ethically approved by the Ethics Committee and supported by the Research Deputy of BMSU.

Results

Patients receiving EN were mostly gavaged with 100, 150, or 200 *ml* of Entera Meal® formulas every 3 *h*. The mean daily intake of patients was 1162 *ml* and the mean EN time was 5.3 days. The most common complication was diarrhea (20%) and vomiting (5%) and because of unconsciousness, heartburn and cramps could not be evaluated in studied patients.
In the TPN group, all patients received lipid LVP solutions except one (because of sepsis). Approximately 70% of patients received LVP solutions every other day equivalent to 28 *g* of lipid daily and the infusion rate was reported to be 8 *hr* on average.
Approximately half of the patients receiving TPN reported some types of side effects, often hyperglycemia, following this nutrition. The liver complication was also reported in one patient. The mean blood glucose was 146 *mg/dl*.
Water-soluble vitamins in 37% of the patients, lipid-soluble vitamins in none of the patients, and compounds containing the mineral trace element in only 12% of patients were administered.
The ratio of energy intake to energy requirement in both EN and TPN groups was calculated; on average, patients received only about 60% of their daily requirement calories (Figure 1A) in EN group and less than 40% in the TPN group. Protein requirement of patients was divided into three groups according to the severity of disease [Mild (1-1.2 *g/kg*), moderate (1.2-1.5 *g/kg*) and severe (1.5-2 *g/kg*)] and data revealed that on average, hospital nutrition (EN and

TPN) has not even provided half of the patients' daily protein requirement (Figure 1B) (19).

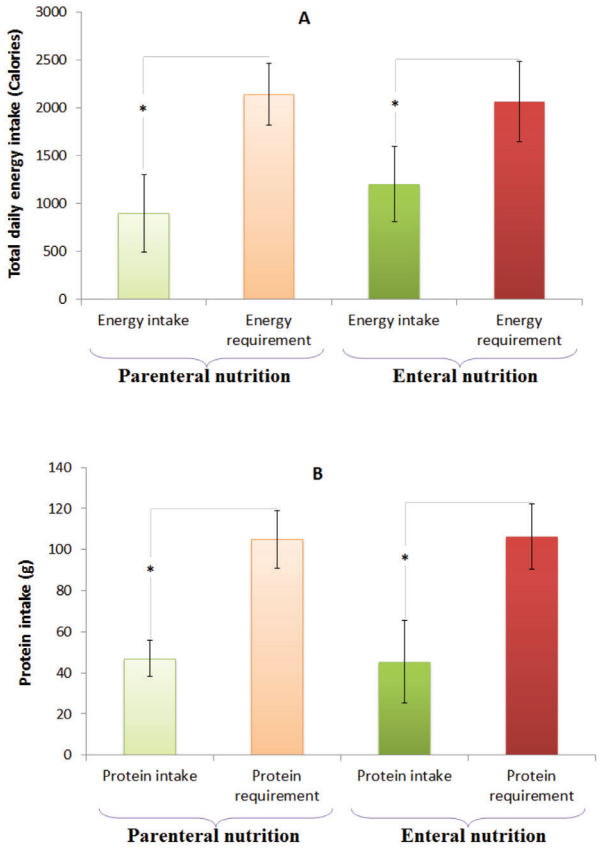

Figure 1A. The total daily energy intake in patients receiving total parenteral nutrition (TPN) (N=8) and enteral nutrition (EN) (N=42) in comparison to the calculated total daily energy requirement. B: The total daily protein intake in patients receiving TPN and EN in comparison to calculated total daily protein requirement. Data were expressed as mean±standard deviation.

* Significant difference at $p<0.05$ in comparison to another group according to one-sample t-test

Discussion

Malnutrition results from an imbalance between nutrient need and nutrient intake (7). Adequate nutritional support (orally or intravenously) in all patients, especially among hospitalized patients is crucial and effective in the process of healing diseases (9). Although it has been stated that the nutritional status of patients hospitalized in ICU wards in Iran was somewhat better than other countries, unfortunately, there have been several reports of inadequate nutrient intake in patients admitted to some hospitals (20-25). The results of the present study showed that on average, hospitalized patients in both EN and TPN groups received less energy than the recommended values which confirm previous estimates of hospital malnutrition in Iran (18,19). Similar to our study findings, other related investigations in South America have reported insufficient energy in the diet of hospitalized patients and in this study, it has been demonstrated that 100% of patients in the TPN group and 71% in the EN received inadequate calories (6,26). In a study in Argentina, approximately 47% of hospital patients suffered from malnutrition and in one-fourth of these cases, severe malnutrition was observed in terms of clinical symptoms (6). On the other hand, Hejazi *et al* reported that energy and protein intake in ICU hospitalized patients was significantly lower than the prescribed diet (26.2 and 26.4%, respectively) (18). Within the first seven days of hospitalization, it is desirable to reach the goal of providing the entire energy requirements by the EN or TPN routes (27).

The prevalence of malnutrition among hospitalized patients, including those in the ICUs, has increased steadily over the years (27). In the current study, 93% of the patients in the EN group, and all patients in the TPN group did not receive their required protein level. Enough protein in the diet as the most important macronutrient in ICU patient's nutritional intake had a significant ameliorating effect on wound healing, immune system response, and maintenance (28,29). Similar to our findings, the study of Mardani *et al* in hospitalized patients of the orthopedic ward at Shohadaye Ashayer hospital revealed that more than 79.9% of patients had malnutrition (22). Conversely, the assessment of nutritional intake in ICU patients of Ghaem hospital showed that the prepared solution was insufficient to meet the energy demand of patients but it provided more protein than the recommended daily amount (30).

Fortunately, the ratios of total daily lipid and carbohydrate intake were consistent with the ASPEN guidelines, but the infusion duration of lipid and sugar LVP solutions was lower than standards (19,31). It is usually recommended that 60-70% of the total estimated amounts of calories should be supplied by carbohydrates and the rest by lipids and protein in patients' diets (32).

In the previous studies, there was not any relation with mortality and the type of nutritional methods. Of

course, it has been revealed that early EN considerably reduced the rates of related complications (32). In this regard, several investigations have reported that firstly, there is a statistically significant relationship between the incidence and severity of malnutrition and the duration of hospitalization, and secondly, the history of various diseases such as cancer and infection causes malnutrition and increases the duration of hospitalization (33-35).

Some investigations cited that PN is commonly not prepared in compliance with established guidelines. To ameliorate the quality of nutritional therapy, a trained team in nutrition should be created (36,37). Though most hospitalized patients can be given EN support, even at its best, it cannot completely prevent or reverse the adverse catabolic effects of critical illness (27).

On the other hand, some previous studies reported the lack of an association between appropriate protocolized nutrition support and length of hospital stay or relevant clinical outcomes (38,39). It seems that the included patients in the study design were inadequate or certain criteria in the protocol may have affected some outcomes that were not detected when multiple items were evaluated altogether (40). However, this is clearly stated that implementing nutritional protocols had a positive impact on the beneficial volume intake, the time to start receiving nutrition therapy, and generally on the number of patients and days of nutrition therapy (20,40).

Conclusion

Considering inadequate calorie and protein intake in hospitalized patients, it is recommended that all patients at the beginning of ICU admission should be evaluated for nutritional status. Also, according to the patient clinical condition, the nutritional calculations (calorie and protein levels) should be performed for all patients to determine the target amount of main macronutrients. When these nutrition errors are resolved, the risk of nutrition related complications is decreased (41). Furthermore, greater attention should be paid to preventing or at least recognizing such errors during an early period of hospitalization with the use of an efficient approach. Nutrition should be tailored for each patient based on the formula used at a medical center. Finally, hospitals need to develop standardized protocols for the evaluation of nutritional status (42).

Limitations

Some studies indicate that the Harris-Benedict equation has been found to overestimate REE by 7 to 27% (43). However, if this high estimate of real values is correct, the results obtained in this study will still be statistically significant. Similar studies with more samples will be helpful in this regard.

Conflict of Interest

The authors confirm that there are no known conflicts of interest associated with the current publication.

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