ORIGINAL ARTICLE

The effects of implementing a nutritional support algorithm in critically ill medical patients

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Abstract

Objectives: To determine the effect of the enteral nutrition algorithm on nutritional support in critically ill medical patients.

Methods: The quasi-experimental study was conducted at a medical Intensive Care Unit of a university hospital in central Anatolia region in Turkey from June to December 2008. The patients were divided into two equal groups: the historical group was fed in routine clinical applications, while the study group was fed according to the enteral nutritional algorithm. Prior to collecting data, nurses were trained interactively about enteral nutrition and the nutritional support algorithm. The nutrition of the study group was directed by the nurses. Data were recorded during 3 days of care. SPSS 22 was used for statistical analysis.

Results: The 40 patients in the study were divided into two equal groups of 20(50%) each. The energy intake of study group was 62% of the prescribed energy requirement on the 1st, 68.5% on the 2nd and 63% on the 3rd day, whereas in the historical group 38%, 56.5% and 60% of the prescribed energy requirement were met. The consumed energy of the historical group on the 1st 2nd and 3rd day was significantly different (p=0.020). In the study group, serum total protein and albumin levels decreased significantly (p<0.05), but pre-albumin and fasting blood glucose levels were not changed on the 1st and 4th day. In the historical group, any of the serum parameters did not change. Enteral nutrition-induced complications, duration of stay in intensive care unit were not significantly different between the groups (p>0.05).

Conclusion: The use of standard algorithms for enteral nutrition may be an effective way to meet the nutritional requirements of patients.

Keywords: Enteral feeding algorithm, Intensive care unit. (JPMA 65: 810; 2015)

Introduction

Malnutrition is one of the main factors leading to increased mortality and morbidity. In patients admitted to intensive care unit (ICU), adequate and balanced nutrition has a favourable effect on outcomes.[1] Due to balanced nutrition, ICU patients stay for a shorter time on ventilators, have less complication and spend less time for rehabilitation.[2] Malnutrition may be induced by not starting nutritional support early enough or by not giving appropriate nutritional support according to the patient's body weight, nutritional history and actual energy requirements of patients. Moreover, in practice it is difficult to administer the targeted nutrients. Cessation of feeding during medical procedures and indecision about acceptable amounts of gastric residual are the causes of this. One study[3] showed residual volume to be the most important cause of reducing or stopping enteral nutrition. However, it is hard to determine the convenient residual volume to protect the patient from the risk of aspiration. Inadequacy of the methods involved in solving these kinds of problems lead to a reduction in the nutritional support received by patients.[4] In ICU patients, early enteral nutrition starting within the first 24-48 hours is recommended. If there is a serious trauma, burn or a condition increasing the catabolism, early enteral nutrition is recommended to protect the maintenance and unity of intestinal function.[2-4]

Using certain nutritional guidelines has resulted in a better nutrition for patients when compared with the nutritional support carried out without guidelines. Planned nutritional support provides a systematic and easily applied, measurable and evaluative way of administering the targeted nutrition amount.[5,6]

The current study was conducted to determine the effect of the enteral nutrition algorithm on nutritional support in internal ICU patients.

Patients and Methods

The quasi-experimental study was conducted from June to December 2008 in a medical ICU of a university hospital in central Anatolia region in Turkey, and comprised

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patients at least 18 years old having ventilatory support and diagnosed with multiple organ failure, having no ability to orally consume food, for more than three days thus requiring enteral support. The patients were divided into historical and study groups. The sample size was determined on the basis of power 80%, α 0.05, and considering the comparison of the difference between energy intake in the groups to be 35%. Randomisation was not done in the study. Patients who had enteral nutrition indication were placed in the historical group before the algorithm was applied, and after the application of algorithm they were taken to the study group. Also, nurses' education on the application of the algorithm was conducted and the difference before and after training was examined.

Data of the historical group was collected initially. Prior to collecting data from the study group, all ICU nurses were trained interactively about enteral nutrition and the nutritional support algorithm[6] outlining the steps of starting, arranging the dose and maintaining enteral nutrition.

Nurses from a surgical ICU were briefed on the algorithm for one month to make sure that they understood the process. In the light of this exercise, necessary changes were made to improve validity of the algorithm.

Coloured and clear printed versions of the algorithms were covered with PVC and hung on the head of each patient's bed. The historical group was administered the routine prescribed nutritional support, while the study group was administered the maximum nutritional support dose by gradual increase, according to the algorithm.

Energy requirements of the patients were calculated using guidelines outlined by European Society for Clinical Nutrition and Metabolism (ESPEN) on enteral nutrition for critically ill patients in acute phase.[7] As such, 20kcal/kg/day energy was given to the patients.

Body weight was measured only at the beginning of the study, according to the recommended methods specific to those patients because they were bed-bound and unconscious.[8]

A 12F nasoduo edenal tube was used in the study group patients. Nutrition of the study group was managed by the ICU nurses. Standard or disease-specific enteral products were started in 20ml amounts for the 1st day. Then the dose was gradually doubled every 4 hours based on the algorithm until the maximum dose was obtained unless there was an increase in gastric residual. After reaching the maximum dose, gastric residual was checked every 12 hours and enteral nutrition continued.[6] Comparison of the calculated energy amount with the patient's intake, starting time and increasing speed of nutritional support, comparing enteral and parenteral nutrition usage were recorded over a 3-day period.

The study was approved by the Ethics Committee of the Faculty of Medicine of Erciyes University and the institution where the study was conducted. Informed consent was obtained from patients who were intubated or from first degree relatives of those who were unconscious.

All statistical analyses were performed using SPSS 22. Data was expressed either as frequencies and mean ± standard deviation (SD). Shapiro-Wilk's test was used and a histogram and q-q plot were examined to assess data normality. A two-sided two-way analysis of variance (ANOVA) was applied to compare the differences between groups for continuous variables in repeated measures. The least significant difference tests were applied for multiple comparisons.

Results

The 40 patients in the study were divided into two equal groups of 20(50%) each. Overall, there were 19(47.5%) males and 21(52.5%) females. The mean age in the historical group was 57.1±21.4 years versus 63.4±18.6 years in the study group (p=0.326). Mean weight in the former group was 77.5±15.2kg against 85.6±12.5kg in the latter group (p=0.066) (Table-1).

The study and historical group patients required mean 1715±55.7kcal/day and 1551±67.3kcal/day respectively. The energy intake of the study group patients was 62% of the prescribed energy requirement on the 1st, 68.5% on

Table-1: Demographic characteristics.

Gender	Study Group n (%)	Historical Group n (%)	p value
-Male	12 (60.0)	7 (35.0)	0.133
-Female	8 (40.0)	13 (65.0)	
	Study Group Mean±SD	**Historical Group Mean±SD**	
Age (year)	**63.4±18.6**	**57.1±21.4**	**0.326**
Weight (kg)	**85.6±12.5**	**77.5±15.2**	**0.066**
	Study Group Median (p25% - p75%)	**Historical Group Median (p25%- p75%)**	
Duration of stay in Intensive Care Unit (day)	11.50± 6.48 (3.0-28.0)	17.15 ± 15.30 (3.0-58.0)	0.578
Hospitalisation (day)	16.15 ± 9.93 (5.0-41.0)	19.40 ± 15.94 (6.0-58.0)	0.925

SD: Standard deviation.

Table-2: Daily energy and protein consumption.

Energy consumption	Study Group Mean±SD	Historical Group Mean±SD	p value
1st day	1065.20±480.64	590.20±495.14*	0.004
2nd day	1175.50±550.17	879.33±490.09*	0.080
3rd day	1088.64±589.65	926.66±493.44*	0.352
p value	0.528	0.020	
Protein consumption			
1st day	40.75 ±17.22	29.86± 21.22*	0.083
2nd day	49.35 ±21.92	42.45± 20.48*	0.310
3rd day	47.28 ± 23.10	44.32± 22.82*	0.687
p value	0.218	0.028	

SD: Standard deviation
Prescribed energy requirements
Study group 1715±55.7 kcal/day
Historical group 1551±67.3 kcal/day
* The differences between the first and the second days and between the first and the third days was significant.

the 2nd and 63% on the 3rd day, whereas in the historical group 38%, 56.5% and 60% of the prescribed energy requirement were met respectively (p=0.020) (Table-2). Although protein intake of the study group was higher than the historical group, but the difference was not statistically significant (p=0.028).

In the study group serum total protein and albumin levels were decreased significantly, but pre-albumin and fasting blood glucose levels were not changed on the 1st and 4th day. In the historical group, any of the serum parameters has not changed (p>0.05) (Table-3). Hospitalisation and duration of stay in ICU were compared and it was determined that study group stayed for a shorter time in hospital and ICU than the historical despite no significant difference (p>0.05).

Enteral nutrition-induced complications on the 1st, 2nd and 3rd days between the study and historical groups were not significantly different (p>0.05). The mortality rate was 14(70%) and 15(75%) in the study and historical groups respectively.

Discussion

Enteral nutrition is preferred and recommended because it is a physiological method, protecting the functions and unity of the intestine, causing less complications and being cost-effective.[9] In ICU patients in particular, enteral nutrition is recommended and commonly used as a nutritional support.[10] In addition, approximately more than 40% patients suffer from malnutrition. Malnutrition leads to an increase in the infection rate, delay in wound-healing, staying longer on a ventilator and in hospital and a rise in healthcare prices.[1,11,12] Malnutrition in ICUs is induced by starting nutritional support late, by difficulties in adhering to the nutritional prescriptions according to the patient's body weight and by not determining actual energy requirements.[7,11]

In recent studies, it has been demonstrated that patients who received enteral nutrition were not given the appropriate feeding dose according to their requirements.[13-16] ICU patients were shown to take only 51-58% of the prescribed feeding dose and were fed less than they needed.[17] Similarly, we found that the energy amount prescribed and consumed by the study group was close to their requirements, while it was lower in the historical group. One study[18] succeeded in administering the prescribed dose to patients who were on enteral nutrition protocol, but the administered dose was found

Table-3: Levels of blood glucose and serum proteins.

Biochemical Parameters	Study Group 1st day Mean±SD	Study Group 4th day Mean±SD	Historical Group 1st day Mean±SD	Historical Group 4th day Mean±SD	p value
Total protein (mg/dL)	5.50 ±1.30	4.91± 0.77	5.08 ± 0.65	5.10 ± 0.59	0.206 0.388
p value	0.013		0.93		
Albumin (mg/dL)	2.21 ± 0.79	1.91 ± 0.56	2.06 ± 0.68	1.88 ± 0.58	0.612 0.935
p value	0.006		0.105		
Pre-albumin (g/dL)	9.32 ± 5.18	8.60 ± 4.05	8.21 ± 2.66	9.67 ± 2.07	0.4 0.297
p value	0.339		0.564		
Fasting Blood Glucose (mg/dL)	121.5 ± 58.13	115.6 ± 38.05	120.9 ± 57.74	112.9 ± 43.01	0.974 0.838
p value	0.663		0.558		

SD: Standard deviation.

to be less than the energy requirement.

In ICU patients, starting early enteral nutrition within 24-48 hours is recommended. While most of the study groups started to receive enteral nutrition on the 1st day. The historical group was either fed parenterally or could not be fed. In another study,[6] 76.2% of the study group and 66.7% of the historical group started to receive enteral nutrition on the 1st day after implementing the algorithm, and after 2 days the whole study group and 66.7% of the historical group were enterally fed.

There are inadequacies in meeting the prescribed feeding dose in enterally nourished ICU patients. The most important factors for this condition are low energy intake, problems with feeding tubes and pausing nutritional support during certain care and treatment activities.[19] In addition, gastrointestinal problems are an important factor preventing enteral nutrition. The common complications seen in enterally-fed ICU patients are an increase in gastric residual volume, nausea, vomiting and diarrhoea. Nutrition is stopped because of these complications.[16] In our study, diarrhoea and an increase in gastric residual volume were detected. Enteral nutrition-induced complications did not statistically differ on the 1st, 2nd and 3rd days ($p>0.05$).

In ICU patients, energy and protein stores decrease because of hypercatabolism. This leads to a tendency for infections and delay in wound-healing.[12] One study[15] compared ideal energy and protein requirements with the actual needs of enterally-fed ICU patients and demonstrated that patients were administered inadequate protein and that 54% of them could consume the ideal protein requirement. A study[16] determined that ICU patients on ventilators could consume 75.6% of the prescribed protein and 61.2% of the required energy which is similar to the findings of the present study.

Serum albumin and pre-albumin levels decrease in conditions such as injury or trauma, and increase when these conditions improve.[20] Albumin has a half-life of 20 days, while pre-albumin has a half-life of 2 days in adults. Pre-albumin is the first parameter to change because of its half-life in nutritional deficiency. In the study group, serum total protein and albumin levels was decreased significantly, but pre-albumin and fasting blood glucose levels were not changed on the 1st and 4th day. In the historical group, any of the serum parameters did not change. This may have been induced by multiple organ failure seen in most of our patients and, therefore, by acceleration in the catabolic processes which cause an increase in protein requirement and by not meeting the need quickly enough. Similarly, one study[21] determined low albumin and pre-albumin levels after nutritional support. In another study[22] also there was no difference between the 1st and 7th day pre-albumin levels. However, contrary to the findings of our study, one study[23] determined an increase in the pre-albumin levels of the patients who received early enteral nutrition together with parenteral nutrition, though the results were not clinically better.

Using enteral nutrition protocols in ICUs means the patient starting early enteral nutrition and consuming optimum energy, thus resulting in a decrease in hospitalisation, mortality and morbidity.[17] Our study group stayed shorter durations in hospital and ICU than the historical group ($p>0.05$). However, the mortality rates of the two groups were similar. It has shown that hospitalisation, frequency of complications and mortality rate decrease in patients consuming adequate energy who had been fed early.[24] However, another study[9] found that early enteral nutrition raised duration of hospitalisation and the risk of infections.

Conclusions

The use of standard algorithms for enteral nutrition may be an effective way to meet the nutritional requirements of patients.

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