Original Article

Standard enteral feeding improves nutritional status compared with hospital-prepared blended formula among Intensive Care Unit (ICU) patients

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Summary. *Introduction:* There have been great advances in enteral nutrition among critically ill patients in recent decades. However, manufactured standard enteral formula is a new material in Iran and most hospitals are still opting to use traditional hospital-prepared blended formulas. *Objective:* To evaluate effects of standard enteral feeding for improving nutritional status compared with hospital-prepared blended formula among Intensive Care Unit (ICU) patients. *Methods:* Forty patients participated in enteral feeding by the standard system and forty patients participated in enteral feeding by hospital-prepared blended formulas. *Results:* Albumin was much increased in the standard enteral feeding group compared to hospital-prepared blended formulas ($P<0.005$). There were significant differences in results of albumin, hemoglobin (Hg) and calcium before and after feeding. *Conclusion:* The macronutrients intake was elevated after standard enteral nutrition and helped patients to recover. The standard enteral formula has more benefits than hospital-prepared blended formulas for ICU patients and medical care givers should be advised and taught to use it rather than hospital-prepared blended formula.

Key words: enteral feedings, albumin, nutritional intake.

Introduction

Critical illness is typically linked with a catabolic stress state in which patients commonly demonstrate a systemic inflammatory response (1). Critically ill patients are at particular risk of malnutrition, which occurs in up to 40% of cases (2). So, it is important to correct caloric and nutrient deficiencies whenever possible. The term enteral means within or by the way of gastrointestinal tract (3). Enteral tube feeding was used by the ancient Greeks and Egyptians some 3,500 years ago (4). However, over the past three decades, understanding of the molecular and biological effects of nutrients in maintaining homeostasis in the critically ill population has made exponential advances (1, 5, 6).

The enteral feeds can be given in the form of solutions and powders which require reconstitution. Quality control tests like osmolality, pH, etc are also taken into consideration (3). Countries like the USA, UK, and Australia, based on studies evaluating safety and cost, adopted the closed system (liquid) formulations as routine (7, 8). However, the standard enteral formula (whether in solution or powder) is a new idea in the hospitals of Iran, and most hospitals still use traditional hospital-prepared blended formulas. The osmolality, microbial contamination, calorie and nutrients

values of these kitchen-made formulas are based on estimation and these properties can vary greatly (depending on preparation procedures). On other hand, several biomarkers have been used to evaluate critically ill patients, like albumin (9). Serum albumin concentration is a prognostic factor, lower albumin levels are indicators of worse severity in critical illness (10, 11) and it has antioxidant properties in physiological conditions (12).

The objective of this study was to evaluate the effects of standard enteral feeding and hospital-prepared blended formulas on albumin, calcium, hemoglobin, RBC, WBC and hematocrit among Intensive Care Unit (ICU) patients.

Methods

The Ethical committee of Tabriz University of Medical Sciences approved this study (Ethical code: 92205). An informed consent was obtained from patients participating in the study, or from their relatives. The study was conducted in the ICU of the Imam Reza Hospital of Tabriz University of Medical Science, Tabriz, Iran. A total of 80 patients were included in the study (40 patients in standard enteral feeding and 40 patients in hospital-prepared blended formulas).

Patients were classified into their groups at the time of the first blood analysis for their biomarkers at ICU admission. Those patients staying in ICU for more than 24 hours were enrolled in the study. Patients who had received anti-inflammatory drugs or corticosteroids before admission, patients with bleeding in GI or enteral feeding intolerance, patients who were hemodynamically unstable, patients with immunosuppressive illness, patients with chronic organ failure, and patients with previous organ transplantation were excluded from the study.

Inclusion criteria were: patients aged over 18 years, amenability to enteral feeding, no obstruction in the gastrointestinal (GI) tract, no GI bleeding, normal kidney function and enteral nutrition tolerance.

Blood samples were collected in glass tubes. Blood was processed within two hours. It was centrifuged at 1,600 g for 15 minutes.

Feeding protocol

During the 24 hours after admission patients were weighed and, based on Harris-benedict equation, their calorie requirements estimated and randomly allocated to one of the treatments (standard enteral feeding or hospital-prepared blended formulas). The estimated calorie for hospital-prepared blended formulas was 50–60% from carbohydrates, 25–35% from fat and 15–20% from protein. The estimated calorie for the standard system enteral feeding was 55% from carbohydrate, 30% from fat and 15% from protein. Calorie density in hospital-prepared blended formulas are estimated to be about 0.7 kcal/ml while calorie density for the formulas used for standard enteral feeding was 1 kcal/ml based on manufacturers' instruction. The first day of feeding, about 30% of needed calorie was provided, rising to the maximum calorie requirement over three days after beginning enteral nutrition.

The total volume of hospital-prepared blended formula was divided into 6 doses and infused every 3 hours by syringe, manually by a nurse. This type of feeding was paused from 1 AM to 7 AM. But continuous standard enteral feeding was not halted. On the first and seventh days of admission all biochemical parameters were measured.

Statistical analysis

Before intervention, the important and influential variables were adjusted between Standard enteral feeding group and hospital-prepared blended formula group. For quantitative data, normality was evaluated by the Q-Q plot, then Mauchly's W test was checked for an identity covariance matrix, finally repeated measure with control covariates test was used by Minitab Software version 17. The results include six P-values. The first was $P\text{-value}_{feeding}$ for comparing two groups, the second was $P\text{-value}_{time}$ for comparing variations before and after PTMC in two groups, the third was $P\text{-value}_{Age}$ for controlling age as confounding variables. The level of significance was set at 0.05 and all results were expressed as Mean±SEM (standard error of mean).

Results

The mean age was 50.1±18.7 and 49.9±18.1 years in the hospital-prepared blended formulas group and the standard enteral feeding system group, respectively.

The results revealed that there was a significant difference in albumin, hemoglobin (Hg) and calcium between standard enteral feeding (case) as well as hospital-prepared blended formulas (control) (P=0.000). There was also a significant difference in the before-and-after results of feeding albumin (P=0.000), hemoglobin (P=0.000) and calcium (P=0.000). Although albumin was increased in all groups, statistically (P=0.000), it had increased much more in the standard enteral feeding group (P=0.000). Calcium was increased in those who received standard enteral feeding (case group) but decreased in control (P=0.000).This study did not find any significant differences between the case and control groups for MCV (p=0.477), HTC (p=0.834) and RBC (0.655). However, these three factors had significant differences before and after feeding. MCV had increased while HTC had decreased in both groups, significantly. There was a significant difference in WBC between the two groups (p=0.002). Although WBC had decreased in the control group, it had increased in the case group, but these differences were non-significant (0.728).

Discussion

This study found that standard enteral feeding had more benefits than feeding hospital-prepared blended formulas. Standard feeding increased albumin levels more than hospital-prepared blended formulas feeding. It seems that the manufacturers' precise determination of ingredients in standard system formulas have a pivotal role in the reported association (13, 14). Human albumin has been shown to scavenge free radicals, which have pivotal role in inflammatory disease; so patients with hypo-albumineamia have a reduced ability to scavenge free radicals (15). Large case-control and cohort studies have shown an inverse association between serum albumin and mortality (16, 17). In hospitalized patients low serum albumin is associated with higher mortality, higher rates of complication and longer lengths of stay in hospital (18, 19).

Furthermore, microbial total counts also have a role in these significant differences so in light of the reported association of albumin and mortality in ICU patients, ICU feeding by standard formula can reduce bad prognoses in patients (20, 21).

This study showed decrements in RBC and hemoglobin levels before and after feeding, and these decrements were lower in standard enteral feeding. It seems these decrements occur in response to trauma and only enteral nutrition can decline these critical conditions. The findings of this study suggest that the standard system is more effective (12). Neither standard enteral feeding nor hospital-prepared blended formulas had increased hemoglobin and RBC. WBC status after intervention showed significant increase in the case group. So, in accordance with other studies, it seems that the standard enteral feeding system has more benefits than hospital-prepared blended formulas (22).

Conclusion

Standard enteral nutrition has a key role in the reduction of mortality and could reduce catabolic effects

Table 1. Descriptive variables of study population

	Control		Case				
	Before	**After**	**Before**	**After**	**P time**	**P Group**	**P Age**
Albumin	2.93±0.09	3.94±0.11	2.96±0.10	4.61±0.04	0.000	0.000	0.445
Calcium	4.16±0.6	4.17±0.05	3.82±0.04	4.28±0.50	0.000	0.000	0.688
MCV	86.62±0.53	87.75±0.75	86.42±0.57	88.80±0.66	0.005	0.477	0.992
HTC	38.97±0.75	35.32±0.52	38.36±0.73	35.40±0.62	0.000	0.834	0.004
Hg	13.06±0.19	11.98±0.22	12.93±0.19	12.58±0.17	0.000	0.035	0.035
RBC	4.38±0.06	4.00±0.07	4.29±0.08	4.00±0.07	0.000	0.655	0.006
WBC	10.17±0.50	9.02±0.73	10.37±0.48	11.90±0.54	0.728	0.002	0.977

of trauma in ICU patients by providing calories and micronutrients. The macronutrient intake is elevated after standard enteral nutrition and helps patients to recover. Our results revealed that standard enteral formula has more benefits than hospital-prepared blended formulas for ICU patients; medical care givers should be advised and taught to use the standard enteral formula rather than a hospital-prepared blended formula.

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