

Retrospective Evaluation of Unstable Patients Fed Parenterally in Intensive Care Unit: Single Center Experience

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ABSTRACT

The aim of this study was to determine the demographic and clinical characteristics of patients fed with total parenteral nutrition who were hemodynamically unstable in the ICU.

This study was performed retrospectively in the medical intensive care unit of a university hospital. Information was obtained from the patients' files, the hospital electronic registry system and nutrition unit registration forms.

This study included 51 patients. The mean age of the patients was 57 ± 19 years, of the patients 47% were male and 53% were female. When the reasons for total parenteral nutrition were evaluated, it was found that the most common causes of total parenteral nutrition were because of septic shock (47%) and gastrointestinal bleeding (23%). The daily caloric intake of the patients was $1,389 \pm 286$ kcal, and the target caloric value was $1,824 \pm 256$. The number of days with mechanical ventilation was 5 (median 0–42), the number of days stayed in the intensive care unit was 9 (median 1–125) and the number of days stayed in the hospital was 13 (median 1–155). The mortality rate of the patients was 71%. Serum albumin levels were found to be lower in patients who died than in those who lived, and these low albumin levels were statistically significant ($p=0.015$).

In this study, it was seen that total parenteral nutrition was most commonly applied to the patients in a state of septic shock who had vasopressor support and to the patients who had gastrointestinal bleeding. In addition, it was determined that the target energy value could not be reached.

Key Words: Total parenteral nutrition, intensive care, mortality, risk factor

Introduction

Malnutrition is a frequent clinical condition in intensive care units (1), which increases morbidity and mortality (2,3). Appropriate caloric intake in intensive care patients is an important part of treatment (4). Critical care patients are generally fed enterally. Total parenteral nutrition (TPN) is necessary in some cases where enteral feeding is contraindicated and target energy cannot be achieved by enteral feeding. It should be switched to parenteral nutrition in cases of severe haemodynamic instability, intestinal obstruction, major upper gastrointestinal bleeding, severe vomiting or diarrhoea (5).

There is not much data about the indications of parenteral nutrition and whether it meets the needs of patients appropriately. When parenteral nutrition is used as the main source of nutrition, it is not known whether patients are able to intake an adequate amount of calories. In addition, it is not clear what the usage rates are of total parenteral nutrition in

nutrition units, and to what ratio it is administered to patients in the intensive care units. The aim of our study was to determine the demographic and clinical characteristics of hemodynamically unstable patients fed with TPN in the intensive care unit.

Materials and Methods

Ethical approval was obtained from the same university's ethical committee (Date 09.01.2015 decision no: 2015/13). The study was conducted at an 18-bed intensive care unit of a university hospital in December 2014. Patients older than 18 years and staying longer than 24 hours in the intensive care unit who were given total parenteral nutrition were included in the study. Patients receiving enteral nutrition and TPN were also included in the study. Patients fed with a ready-made parenteral product (not prepared in the nutrition unit) were not included in the study.

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Received: 12.05.2019, Accepted: 18.11.2019

Information was obtained from patients' files, the hospital's electronic registry system and nutrition unit records. The following data were recorded: patient's age, weight, sex, and his or her underlying disease; the type of operation performed (if applicable); albumin and prealbumin values; amount of calories, protein and fat per day; C reactive protein (CRP) and procalcitonin values; number of days hospitalised in the ICU; and number of days with mechanical ventilation. In addition, mortality rate was recorded for the patients who were followed up with mechanical ventilatory therapy. Calories given to the patients were calculated according to the Harris-Benedict equation (6).

Statistical Analysis: Descriptive statistics for the continuous variables were presented as Mean, Standard deviation, minimum and maximum values while count and percentages for categorical variables. Normality assumption of the variables was tested with Kolmogorov-Smirnov test. Mann-Whitney U test was used for non-normal distributed variables, while Student t test was performed for the normally distributed variables. Chi-square test was performed to determine the relationship between categorical variables. Statistical significance level was considered as 5% and SPSS (ver: 15) statistical program was used for all statistical computations.

Results

The study included 51 patients. The mean age of the patients was 57 ± 19 years. Of the patients, 53% were female and 47% were male. The most common causes of parenteral nutrition were for the patients with septic shock (47%) and gastrointestinal system (GIS) bleeding (23%). The total daily caloric intake of the patients was $1,389 \pm 286$ kcal; the protein amount was 68 ± 15 g; the carbohydrate amount was 161 ± 50 g; and the fat amount was 33 ± 13 g. The target calories required to be given to patients were $1,824 \pm 256$ kcal/day. In the laboratory measurements of patients, the protein level was 5 ± 0.89 g/dl, the albumin level was 2 ± 0.65 mg/dl and the prealbumin level was 7 (median 1–7) mg/dl. The number of days with mechanical ventilation was 5 (median 0–42), the number of days in the intensive care unit was 9 (median 1–125) and the number of days stayed in the hospital was 13 (median 1–155). The mortality rate was 71%. Detailed demographic information of the patients are given in Table 1.

When both the surviving and deceased patients were evaluated according to the target calorie amount, it was $1,792 \pm 210$ kcal/day for the surviving patients and $1,826 \pm 274$ kcal/day for the deceased patients ($p=0.666$). However, when the actual calories given to

these patients were evaluated, it was $1,445 \pm 321$ kcal/day for surviving patients and $1,365 \pm 271$ kcal/day for patients who had died ($p=0.369$) (Table 2).

It was found that the serum albumin levels of deceased patients were lower than those of surviving patients and were statistically significant ($p=0.015$) (Table 2).

Discussion

In this study evaluating TPN-fed patients in the intensive care unit, it was determined that the target energy value could not be reached. Achieving nutrition targets is a major problem for intensive care professionals and dieticians worldwide (7-9).

The optimal caloric requirement for intensive care patients is not known (10, 11). This may be due to a late start to nutritional intake or frequent discontinuation of nutritional intake, even if the feeding was started in time (12). For the patients fed with TPN in our study, 47% of them were diagnosed with septic shock and needed a vasopressor. All GIS-stable patients in the intensive care unit were fed enterally.

The use of nutritional guidelines and protocols provide both adequate caloric intake recommendations and standardization; these guidelines are very helpful to clinicians in making decisions about patient nutrition. However, there are differences between the guidelines, especially for hemodynamically unstable patients, and the situation can become complicated. Haemodynamic instability may impair bowel function and can cause dysmotility or nonocclusive bowel ischemia (13-15). The European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines suggest feeding within the first 24 hours for haemodynamically stable patients with normal intestinal function, but they do not make any recommendations for unstable patients (16). The American Society for Parenteral and Enteral Nutrition (ASPEN) guidelines do not recommend early feeding until haemodynamic stability is achieved (11). The Canadian guidelines do not recommend waiting for fluid therapy in patients who are not hemodynamically stable (17). The severe sepsis and septic shock guidelines published in 2012 focus on fluid loading in hemodynamically unstable patients rather than feeding. These guidelines suggest glucose and enteral feeding rather than TPN in the first week of sepsis and septic shock patients; if TPN is to be given to these patients, then the guidelines advise it only as an addition to enteral feeding (18).

In our study, feeding with TPN began within the first

Table 1. General characteristics of patients

Variable	
Age, year (Mean \pm SD)	57 \pm 19
Sex, n (%)	
Male	24 (47)
Female	27 (53)
Weight, kg (Mean \pm SD)	65 \pm 16
Diagnoses of patients with parenteral feeding, patients (%)	
Septic shock	24 (47)
GIS bleeding	12 (23)
Other	7 (14)
Postoperative status	4 (8)
Support to enteral feeding	3 (6)
Fistula with high output	1 (2)
Calories delivered to patients, kcal / day (Mean \pm SD)	1389 \pm 286
Parenteral nutrition beginning day number, Medyan (Min-Max)	2(1-16)
Macronutrients given to patients, gr / day (Mean \pm SD)	
Protein	68 \pm 15
Carbohydrate	161 \pm 50
Oil	33 \pm 13
Protein, gram /dl (Mean \pm SD)	5 \pm 0,89
Albumin, mg /dl (Mean \pm SD)	2 \pm 0,65
Prealbumin, mg /dl Medyan (Min-Max)	7 \pm (1-7)
CRP, mg /L Medyan (Min-Max)	104(3-463)
Procalcitonin, ng / ml Medyan (Min-Max)	2(0-188)
MV days, Medyan (Min-Max)	5(0-42)
Length of stay in intensive care (day), Medyan (Min-Max)	9(1-125)
Length of stay in hospital (day), Medyan (Min-Max)	13(1-155)
Mortality, n (%)	36 (71)

GIS: Gastrointestinal system, MV: mechanical ventilation ng: nanogram CRP: C reactive protein kg: kilogram, SD: Standard Deviation

two days after admission to the intensive care unit. It was observed that target caloric intake could not be reached, although feeding was not started late. We think this is because the majority of the patients were diagnosed with septic shock (47%). After haemodynamic stability was reached in patients with septic shock diagnosis, we started low dose enteral feeding (10 kcal/kg/day) and we gave 739 kcal/day TPN on average. Because of this, full caloric nutrition could not be provided to our hemodynamically unstable patients.

The feeding of hemodynamically unstable patients is quite a difficult issue (19). Vasoconstriction was seen in the superior mesenteric artery in haemodynamic instability cases (20). The autoregulation of the superior mesenteric artery may be impaired depending on the vasopressor agents used, even if the macrohemodynamic condition is normal (21).

Studies with angiography showed vasoconstriction in the branches of the superior mesenteric artery when cardiac flow was reduced (22,23). However, there are some results supporting the opposite of these studies associated with vasopressors. In the experimental study of endotoxemia conducted by Zaloga et al., it was shown that splanchnic blood flow in the vasopressor group increased 50–60% compared to the baseline state (24). In critical care patients especially in sepsis splanchnic blood flow is important (25). In hemodynamically unstable patients, enteral nutrition can be performed by following GIS intolerance findings (11). In an observational study conducted by Khalid et al., they showed that early feeding of the patients receiving vasopressor therapy reduced mortality (26). In our study, 27% of patients had upper-GIS endoscopy due to upper-GIS bleeding. Since enteral feeding of the patients was stopped for 48 hours after the endoscopic procedure, they received TPN during this period. McClave et al.

Table 2. Factors affecting mortality

Variable	Living n=15	Dead n=36	p
Age, year (Mean \pm SD)	51 \pm 19	59 \pm 19	0,188
Sex, n (%)			
Male	12	41	0,232
Female	18	29	
Weight, kg (Mean \pm SD)	67 \pm 14	64 \pm 17	0,634
TPN indications, n (%)			
Septic shock	3(6)	21(41)	
GIS bleeding	4(7,8)	8(15,7)	0,100
Postoperative state	2(3,9)	2(3,9)	
Support to enteral feeding	1(2)	2(3,9)	
Fistula with high output	1(2)	0(0)	
Other	4(7,8)	3(5,9)	
Calories delivered to patients, kcal/day (Mean \pm SD)	1445 \pm 321	1365 \pm 271	0,369
Target calorie, kcal/day (Mean \pm SD)	1792 \pm 210	1826 \pm 274	0,666
TPN starting day, Median (Min-Max)	3(1-12)	2(1-16)	0,824
Macronutrients given, g/day (Mean \pm SD)			
Protein	72 \pm 18	66 \pm 14	0,164
Carbohydrate	173 \pm 58	157 \pm 46	0,297
Fat	38 \pm 16	31 \pm 12	0,094
Protein, gram/dl (Mean \pm SD)	5 \pm 1,07	5 \pm 0,83	0,207
Albumin, mg/dl (Mean \pm SD)	3,02 \pm 1,14	2,4 \pm 0,50	0,015
Albumin before PN mg/dl (Mean \pm SD)	2,5 \pm 0,72	2,2 \pm 0,61	0,097
Prealbumin, mg/dl Median (Min-Max)	8(0,64-19)	6,6(1,67-20)	0,582
CRP, mg/L Median (Min-Max)	56(3-463)	113(11-372)	0,235
Procalcitonin, ng/ml Median (Min-Max)	1,1(0,04-188)	1,8(0,12-100)	0,469

TPN: total parenteral nutrition, CRP: C reactive protein, SD: Standard Deviation

suggested that patients with a high risk of upper-GIS bleeding should wait for the first 48 hours after endoscopy for enteral feeding (27). In a study by de Lédinghen et al. performed on patients with oesophageal variceal bleeding, they suggested that there was no difference in haemorrhaging between the patients being fed via nasogastric tube and the patients without enteral feeding (28).

In another study conducted with 200 patients in a medical intensive care unit, it was determined that the number of days of mechanical ventilation decreased if adequate nutritional support was provided (29). In our study, no such difference was found. In another study, Woodcock et al. compared the effects of enteral feeding and TPN, and they found that the rate of failure to achieve energy intake was 78% in the enteral nutrition group and 25% in the TPN group (30).

In our study, most of the patients were switched to TPN after enteral feeding, and the target nutrition

could not be achieved. The prealbumin value was determined as 7mg/dl on average. Albumin and prealbumin levels in critically ill patients are reduced due to inflammation, infection and excessive fluid load, therefore they are not very good indicators of nutrition (11). Considering that 47% of the patients were in septic shock, it can be supposed that the prealbumin value was low because it is an acute phase reactant; the high levels of mean CRP and procalcitonin values support this interpretation. In our study, albumin levels were lower in patients who died. This is because albumin is an acute phase reactant, in addition to the loss of kidney function and malnutrition in the patients caused by many other reasons. We cannot link the low level of albumin in these patients to just one reason; it may be related to infection because most of the patients were in septic shock.

In this study, in which patients fed with TPN in an intensive care unit were evaluated, it was frequently observed that the patients in septic shock receiving

vasopressor support and the patients with GIS bleeding were fed with TPN. In addition, it was determined that the target energy value could not be reached. Failure to reach the target values was thought to be related to hypocaloric nutrition. There is a need for prospective studies about this topic.

Conflict of Interest: No conflict of interest was declared by the authors.

Ethics Committee Approval: Ethics committee approval was received for this study from Erciyes university.

Referee evaluation: External independent.

Informed Consent: Patient consent was not obtained from the patients who participated in this study because this study is performed retrospectively.

References

1. Korfali G, Gundogdu H, Aydintug S, Bahar M, Besler T, Moral AR, et al. Nutritional risk of hospitalized patients in Turkey. *Clinical nutrition (Edinburgh, Scotland)* 2009; 28: 533-537.
2. Shpata V, Prendushi X, Kreka M, Kola I, Kurti F, Ohri I. Malnutrition at the time of surgery affects negatively the clinical outcome of critically ill patients with gastrointestinal cancer. *Medical archives (Sarajevo, Bosnia and Herzegovina)* 2014; 68: 263-267.
3. Fatemeh Osooli, Saeed Abbas, Shadi Farsaei, Payman Adibi. Identifying Critically Ill Patients at Risk of Malnutrition and Underfeeding: A Prospective Study at an Academic Hospital. *Adv Pharm Bull* 2019; 9: 314-320.
4. Paolo Cotogni. Management of parenteral nutrition in critically ill patients. *World Journal of Critical Care Medicine* 2017; 6: 13-20.
5. Annika Reintam Blaser, Joel Starkopf, Waleed Alhazzani, Mette M. Berger, Michael P. Casaer. Early enteral nutrition in critically ill patients: ESICM clinical practice guidelines. *Intensive Care Med.* 2017; 43: 380-398.
6. Didace Ndahimana, Eun-Kyung Kim. Energy Requirements in Critically Ill Patients. *Clin Nutr Res* 2018; 7: 81-90.
7. De Jonghe B, Appere-De-Vechi C, Fournier M, et al. A prospective survey of nutritional support practices in intensive care unit patients: what is prescribed? What is delivered? *Critical care medicine* 2001; 29: 8-12.
8. O'Meara D, Mireles-Cabodevila E, Frame F, et al. Evaluation of delivery of enteral nutrition in critically ill patients receiving mechanical ventilation. *American Journal of Critical Care* 2008; 17: 53-61.
9. Rice TW, Swope T, Bozeman S, Wheeler AP. Variation in enteral nutrition delivery in mechanically ventilated patients. *Nutrition (Burbank, Los Angeles County, Calif)* 2005; 21: 786-792.
10. Doig GS, Simpson F, Delaney A. A review of the true methodological quality of nutritional support trials conducted in the critically ill: time for improvement. *Anesthesia and analgesia* 2005; 100: 527-533.
11. McClave SA, Martindale RG, Vanek VW, et al. Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (ASPEN). *Journal of Parenteral and Enteral Nutrition* 2009; 33: 277-316.
12. Stephen A. McClave, Mohamed A. Saad, Mark Esterle, Mary Anderson, Alice E. Jotautas. Volume-Based Feeding in the Critically Ill Patient. *Journal of Parenteral and Enteral Nutrition* 2015; 39: 707-712.
13. Brouwers M, Stacey D, O'Connor A. Knowledge creation: synthesis, tools and products. *Canadian Medical Association Journal* 2010; 182: 68-72.
14. Cahill NE, Dhaliwal R, Day AG, Jiang X, Heyland DK. Nutrition therapy in the critical care setting: What is "best achievable" practice? An international multicenter observational study*. *Critical care medicine* 2010; 38: 395-401.
15. McClave SA, Chang W-K. Feeding the hypotensive patient: does enteral feeding precipitate or protect against ischemic bowel? *Nutrition in clinical practice* 2003; 18: 279-284.
16. Andus T. ESPEN guidelines on enteral nutrition: liver disease - tube feeding (TF) in patients with esophageal varices is not proven to be safe. *Clinical nutrition (Edinburgh, Scotland)* 2007; 26: 272; author reply 3-4.
17. Dhaliwal R, Cahill N, Lemieux M, Heyland DK. The Canadian critical care nutrition guidelines in 2013: an update on current recommendations and implementation strategies. *Nutrition in clinical practice : official publication of the American Society for Parenteral and Enteral Nutrition* 2014; 29: 29-43.
18. Dellinger RP, Levy MM, Rhodes A, et al. Surviving sepsis campaign: international guidelines for management of severe sepsis and septic shock: 2012. *Critical care medicine* 2013; 41: 580-637.
19. Stefan Ludewig, Rami Jarboub, Michael Ardel, Henning Mothes, Falk Rauchfuß. Bowel Ischemia in ICU Patients: Diagnostic Value of I-FABP Depends on the Interval to the Triggering Event. *Hindawi Gastroenterology Research and Practice.* 2017. DOI:10.1155-2017-2795176
20. Daisuke Kurita, Takeo Fujita, Yasumasa Horikiri, Takuji Sato, Hisashi Fujiwara. Non-occlusive mesenteric ischemia associated with enteral feeding after esophagectomy for esophageal

- cancer: report of two cases and review of the literature. Kurita et al. *Surgical Case Reports* (2019) 5:36 DOI:10.1186-s40792-019-0580-2.
21. Bradbury AW, Brittenden J, McBride K, Ruckley CV. Mesenteric ischaemia: a multidisciplinary approach. *The British journal of surgery* 1995; 82: 1446-1459.
 22. Lawlor DK, Incullet RI, Malhaner RA. Small-bowel necrosis associated with jejunal tube feeding. *Canadian journal of surgery Journal canadien de chirurgie* 1998; 41: 459-462.
 23. Park WM, Gloviczki P, Cherry KJ, Jet al. Contemporary management of acute mesenteric ischemia: Factors associated with survival. *Journal of vascular surgery* 2002; 35: 445-452.
 24. Zaloga GP, Roberts PR, Marik P. Feeding the hemodynamically unstable patient: a critical evaluation of the evidence. *Nutrition in clinical practice : official publication of the American Society for Parenteral and Enteral Nutrition* 2003; 18: 285-293.
 25. Paul Wischmeyer. Nutrition therapy in sepsis. *Crit Care Clin* 2018; 34: 107-125.
 26. Khalid I, Doshi P, DiGiovine B. Early enteral nutrition and outcomes of critically ill patients treated with vasopressors and mechanical ventilation. *American journal of critical care : an official publication, American Association of Critical-Care Nurses* 2010; 19: 261-268.
 27. McClave SA, Chang WK. When to feed the patient with gastrointestinal bleeding. *Nutrition in clinical practice : official publication of the American Society for Parenteral and Enteral Nutrition* 2005; 20: 544-550.
 28. de Ledinghen V, Beau P, Mannant PR, et al. Early feeding or enteral nutrition in patients with cirrhosis after bleeding from esophageal varices? A randomized controlled study. *Digestive diseases and sciences* 1997; 42: 536-541.
 29. Barr J, Hecht M, Flavin KE, Khorana A, Gould MK. Outcomes in critically ill patients before and after the implementation of an evidence-based nutritional management protocol. *Chest* 2004; 125: 1446-1457.
 30. Woodcock NP, Zeigler D, Palmer MD, Buckley P, Mitchell CJ, MacFie J. Enteral versus parenteral nutrition: a pragmatic study. *Nutrition (Burbank, Los Angeles County, Calif)* 2001; 17: 1-12.