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Originals

Evolution of nutritional therapy prescription in critically ill patients

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Abstract

Aim: **The aim of this study was to investigate factors that may affect the evolution of the caloric prescription in critically ill patients. Local: Intensive care unit patients. Patients: 60 patients (33 M and 27 F); median age = 49 (15-93) y were followed prospectively. They were divided in three groups according to the diagnostic: a) trauma (n = 20); b) surgical (n = 22), and 3) medical treatment (n = 18). Forty-and-one (68.3%) patients received enteral nutrition (EN), 17 (28.3%) parenteral nutrition (TPN), and 2 (3.4%) TNP and EN. Nutritional status was graded B or C by global subjective evaluation. Methods: Endpoints of the study were the time to begin the nutritional support, success or failure of the caloric prescription, and the evolution of the planned caloric prescription. The caloric evolution was considered as success if the prescription for the patient attained: a) 25% of the caloric requirements on the 1st day; b) 50% until the 3rd day; c) 75% until the 6th day; and e) 100% until the 10th day of the beginning of the support. Results: In 54 (90%) patients, the nutritional support has begun until 48h after admission and in 73.3% (44 patients), until the first 24 hours. EN was most prescribed for both trauma and medical patients while NPT was most used for surgical patients ($p < 0.01$). Success in caloric prescription was obtained in 73.3% (44) of the patients. There was no statistical difference for the success on the evolution of the prescription related to sex, age, diagnostic group, albumin level, type of support, mortality, use of fiber or glutamine. Success was attained earlier in patients without (median = 3.8 [95%CI, 5.7-16.7] days) than with (11.2 [95%CI, 5.7-16.7] days; $p < 0.01$) mechanical ventilation. Conclusions: Early nutritional support and success on the evolution of the caloric prescription can be accomplished in most critically ill patients. Evolution of the caloric prescription was slower in mechanical ventilated patients.**

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Key words: *Critically ill. Nutrition. Enteral nutrition. Parenteral nutrition. Nutritional team. Hospital malnutrition.*

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EVOLUCIÓN DE LA PRESCRIPCIÓN DE LA TERAPIA NUTRICIONAL EN PACIENTES CRÍTICAMENTE ENFERMOS

Resumen

Objetivo: **El objetivo de este estudio fue investigar los factores que pueden afectar la evolución de la prescripción calórica en pacientes críticamente enfermos. Ambito: Pacientes de la unidad de cuidados intensivos. Pacientes: 60 pacientes (33 M y 27 F); con edad mediana = 49 (15-93) años fueram seguidos prospectivamente. Fueron divididos en tres grupos según el diagnóstico: a) trauma (n = 20); b) quirúrgico (n = 22), y 3) tratamiento clínico (n = 18). Cuarenta-y-uno (68,3%) pacientes recibieron la nutrición enteral (EN), 17 (28,3%), la nutrición parenteral (TPN) y 2 (3,4%) TNP y EN. El estado nutritional era B o C calificado por la evaluación subjetiva global. Métodos: Las variables de resultado del estudio fueran el tiempo de comenzar el suorte nutricional, éxito o non de la prescripción calórica, y la evolución de la prescripción calórica prevista. La evolución calórica fue considerada como éxito si la prescripción para el paciente logró: a) el 25% de los requisitos calóricos en el 1º día; b) el 50% hasta el 3ro día; c) el 75% hasta el 6to día; y e) 100% hasta el 10mo día del inicio de lo suporte. Resultados: En 54 pacientes (90%), la terapia nutricional ha comenzado hasta 48h después de la admisión y en 73,3% (44 pacientes), hasta las primeras 24 horas. La EN fue prescrita más para el trauma y los pacientes clinicos mientras que NPT fue utilizada más para los pacientes quirúrgicos ($p < 0.01$). El éxito en la prescripción calórica fue obtenido en 73,3% (44) de los pacientes. No hubo diferencia estadística para el éxito para la evolución de la prescripción relacionada con el sexo, la edad, el grupo de diagnóstico, el nivel de la albúmina, el tipo de suporte, la mortalidad, el uso de la fibra o la glutamine. El éxito fue logrado mas rapidamente en pacientes sin (mediana = 3,8 [95%CI, 5,7-16,7] días) que con (11,2 [95%CI, 5,7-16,7] días; $p < 0,001$) ventilación mecánica. Conclusiones: El suporte precoz y el éxito en la evolución de la prescripción calórica se pueden lograr en pacientes críticamente enfermos. La evolución de la prescripción calórica fue más lenta en pacientes con ventilacion mecánica.**

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Palabras clave: *Pacientes críticos. Nutrición. Nutrición enteral. Nutrición parenteral. Terapia nutricional. Desnutrición hospitalaria.*

Introduction

Critically ill patients are related to higher malnutrition rates and greater incidence of nosocomial infections and mortality[1-3]. The cause and incidence of malnutrition in intensive care units (ICU) are multifactorial and the nutritional management is an important issue[4-9]. In this tertiary setting, the multidisciplinary nutritional team (MNT) is important and has been related to better outcome for the critically ill. To achieve good results, the MNT should assure the early and proper caloric/nitrogen ratio to the patient, and supervise the whole nutritional therapy from the prescription to the administration by both enteral and parenteral routes. This is also particularly important to estimate whether the planned caloric requirement was reached[10]. Some reports have emphasized the mismatch between the amount prescribed and received by the patients[10-17]. However, few papers have directly aimed at investigating which factors may affect the evolution of the prescription of the caloric requirements in critically ill patients[13, 15, 17, 18]. This information would help to evaluate the efficacy of the MNT as well as the understanding of the difficulties found in the evolution of the caloric prescription. Thus, the objective of this study was to investigate factors that may affect the evolution of the caloric prescription made by an universitary MNT in critically ill patients.

Material and Methods

Sixty critically ill patients (33 M [55%] and 27 F [45%]) admitted in the intensive unit care of the Julio Muller Universitary Hospital with a median age of 49 (15-93) years old were followed prospectively. Patients in terminal status or not candidate to nutritional therapy were excluded. They were divided in three groups according to the diagnostic: a) trauma (brain and thermal injury; n = 20); b) post-operative care of gastrointestinal operations (n = 22), and 3) medical treatment (n = 18).

Table I
Demographic data of the patients

Variable	*N (%)*
Sex	
Male	33 (55)
Female	27 (45)
Age (median and range)	49 (15-93)
Group	
Surgical	22 (36.7)
Trauma	20 (33.3)
Medical	18 (30)
Nutricional support	
Enteral nutrition	41 (68.3)
Parenteral nutrition	17 (28.3)
Enteral + Parenteral nutrition	2 (3.4%)

Table II
Days from admission to the first prescription of the nutritional therapy and type of support according to the group of diagnosis

Group	*Time (mean; CI 95%)*	*P*	*EN/TPN (N)**	*P**
Medical (n = 18)	2.1 (1.5-2.8)	0.92	18/0	< 0.01
Trauma (n = 20)	2.0 (1.4-2.6)		16/3	
Surgical (n = 22)	2.1 (1.4-2.7)		7/14	

* One patient from each trauma and surgical group received EN and TPN.
EN: enteral nutrition. TPN: total parenteral nutrition.

The demographic data of the patients can be seen in table I. Forty-and-one (68.3%) patients received enteral nutrition (EN), 17 (28.3%) parenteral nutrition (TPN), and 2 (3.4%) TNP and EN. All patients were evaluated as grade B or C by global subjective evaluation.

Only the coordinator of the study knew that the study was been carried out to avoid biases. Endpoints of the study were the time since admission to begin the nutritional support, success or failure of the caloric prescription, and the evolution of the planned caloric prescription. Factors that may affect the normal evolution of the caloric prescription investigated were sex, age, route (EN or NPT), serum albumin (above or less than 3.0 g/dL), mechanical ventilation (yes or no), clinical diagnosis, use of glutamine and fiber, and mortality. The caloric requirements were calculated to reach the maximum of 2000 cal/day (25-35 cal/kg/day) adjusted as appropriate for each individual. The protein intake was calculated to reach 1.5 to 2g/kg/day.

The caloric evolution was considered as success if the prescription for the patient attained: a) 25% of the caloric requirements on the 1st day; b) 50% until the 3rd day; c) 75% until the 6th day; and e) 100% until the 10th day of the beginning of the support. Thus, in case of the patients remained in ICU for only three day and for instances attained 50% of the caloric requirement it was considered as a case of success.

Statistical analysis

Chi-square or Fisher's exact tests were used for contingent tables. Kaplan-Meyer survival curves were used to analyze the success or failure of the caloric prescription during hospitalization. The log-rank test was used to compare factors in survival curves. It was established a 5% level ($p < 0.05$) for statistical significance. All analysis were done by the statistical package SPSS for *Windows* 12.0.

Results

The mortality observed was 28.3% (17 patients) without difference among the groups. The median length

Table III
Mean time (CI 95%) to accomplish success in the evolution of caloric prescription of the patients according to different variables

Variable	*Days (mean)*	*CI 95%*	*P*
Mechanical ventilation			
Yes (n = 36)	11.2	5.7-16.7	
No (n = 24)	3.8	3.0-4.7	< 0.01
Group			
Trauma (n = 20)	7.5	4.5-10.5	
Surgical (n = 22)	5.4	4.1-6.7	
Medical (n = 18)	7.2	1.4-13.0	0.35
Route			
NPT (n = 17)	4.3	3.2-5.4	
EM (n = 41)	10.3	5.3-10.4	0.10
Outcome			
Discharge (n = 43)	10.0	4.8-15.3	
Death (n = 17)	5.7	4.3-7.1	0.86
Fiber (n = 41)			
Yes (n = 23)	11.7	4.4-19.0	
No (n = 18)	5.8	4.2-7.4	0.82
Glutamine (n = 41)			
Yes (n = 15)	5.7	4.2-7.2	
No (n = 26)	12.9	5.4-20.4	0.55
Sex			
Female (n = 27)	5.7	4.0-7.3	
Male (n = 33)	10.1	4.2-16.0	0.84
Age (years)			
> 60 (n = 19)	5.7	4.0-7.4	
< 60 (n = 41)	9.3	4.2-14.4	0.93

EN: enteral nutrition. TPN: total parenteral nutrition.

of ICU stay was 12 (2-88) days and the median length of nutritional therapy was 13 (1-88) days. Low serum albumin (less than 3.0 g/dL) was present in 83.8% of the patients without significant difference with the clinical diagnosis. Forty-and five (75%) patients required mechanical ventilation during ICU stay.

In 54 (90%) patients, the nutritional support has begun until 48h after admission and in 73.3% (44 patients), until the first 24 hours. There was no difference between the time to begin the support and diagnosis. EN was mostly prescribed for both trauma and medical patients while NPT was generally employed for surgical patients ($p < 0.01$) (table II). Medical (13/18) and trauma (10/20) patients received more fiber than surgical (2/22) patients ($p < 0.01$). There was no difference in the prescription of intravenous glutamine though there was a tendency ($p = 0.09$) for trauma (10/20; 50%) patients to received it more than the other two (surgical = 8/22; 36.3%; medical = 3/18; 16.7%). None of the patients received either oral or enteral glutamine.

Success in caloric prescription was obtained in 73.3% (44) of the patients. In median, the success was attained by the 4th and 5th day (fig. 1). There was no

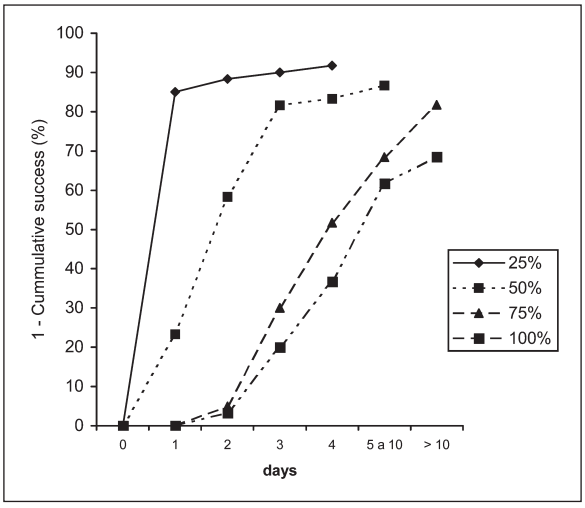

Fig. 1.–Cumulative success curve of the caloric prescription according to the percent attained.

statistical difference for the success during the evolution of the prescription related to sex, age, diagnostic group, albumin level, type of support, mortality, use of fiber or glutamine (table III). Success was attained almost three times earlier in patients without (median = 3.8 [95%CI, 5.7-16.7] days) than with (11.2 [95%CI, 5.7-16.7] days; $p < 0.01$) mechanical ventilation (fig. 2).

The cumulative percentage of patients reaching the planned caloric requirements can be seen in table IV. Between 88 and 94% of them attained 25% of the calories on the first day and between 85 and 87% reached 50% on the third day depending on the route of the support (table IV and fig. 1). Both EN and NPT were similar in all phases (25, 50, 75 and 100% of total caloric requirements).

Discussion

The results of the study showed that a suitable evolution of the caloric prescription was possible in nearly 75% of the critically ill patients. It can be reasonably assumed that most of them have received the amount prescribed, that the diet was well tolerated and the MNT efficient. Although the endpoint of the study was not to investigate how much of the amount prescribed have really been delivered, our findings suggest that it is possible to achieve a satisfactory evolution of nutritional prescription in ICU patients.

The only variable associated with a delay during the normal caloric prescription was the mechanical ventilator dependence. Indeed, patients with mechanical-assisted ventilation were three times slower to reach success. In accordance, some earlier reports have stated that respiratory procedures are an impediment for the normal delivery of calories in the critically ill under mechanical ventilation[15, 16, 19, 20]. Reason for that might be related to most serious conditions of the patients or even association with concomitant hemodina-

Table IV
Cumulative numbers (%) of patients with successfull caloric prescription according to the type of nutritional support (EN = enteral nutrition; TPN = total parenteral nutrition)

Day of the nutritional support	Amount of Caloric Requeriments Prescribed							
	25%		50%		75%		100%	
	EN	TPN	EN	TPN	EN	TPN	EN	TPN
Until the 1st	36 (87.8)	15 (88.2)	8 (19.5)	6 (35.3)	2 (4.9)	1 (5.9)	–	–
Until the 3rd	39 (95.1)	–	35 (85.4)	14 (82.3)	22 (53.6)	9 (52.9)	8 (19.5)	4 (23.5)
Until the 6th	40 (97.6)	–	38 (92.7)	–	31(75.6)	14 (82.3)	21 (51.2)	9 (52.9)
Until the 10th	–	–	–	–	36 (87.8)	–	27 (65.8)	10 (58.8)
After the 10th	–	–	–	–	–	–	31 (75.6)	–

• 2 patients did not attained 25% (1 NE and NPT each).
• 5 patients did not attained 50% (3 EN and 2 TNP)
• 7 patients did not attained 75% (5 EN and 2 TNP)
• 16 patients did not attained 100% (10 EN and 6 TNP)

mic instability[19, 20]. The administration of more aggressive early enteral nutrition in these patients may associate with infectious complications and prolonged length of stay[21].

Early nutrition is vital for critically ill patients for many reasons[22-26]. In this concern, almost 75% of the patients have begun the nutritional therapy during the first 24 hours after admission. Clinical studies have demonstrated that early enteral nutrition administered within the first 48 hours of admission decreases the incidence of nosocomial infections in these patients, but not the mortality, with the exception of special groups of patients, particularly surgical ones[26]. Early nutrition may diminish the catabolic response, maintain the integrity of the mucosal barrier, and decrease the length of hospital stay[22, 26]. A faster evolution of the caloric prescription and most optimal deliver of nutrients is also additional advantages of early nutritional support[23-24].

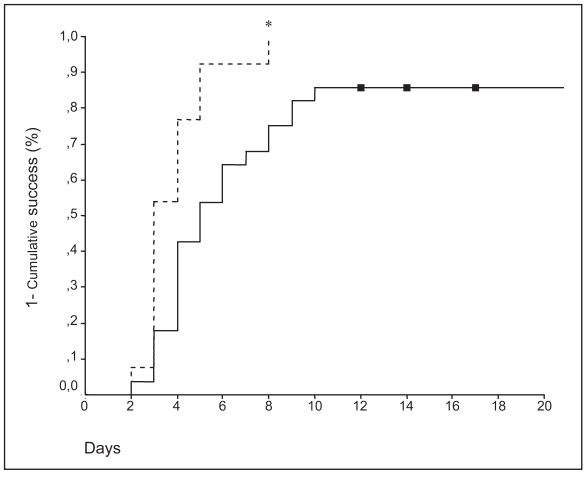

Fig. 2.–Cumulative success survival curve of the caloric prescription according to the patient be with (continuous line) or without (dotted line) mechanical ventilation, P < 0.01 versus with mechanical ventilation.*

The findings have shown that between the third and the sixth day half of the patients have attained the caloric requirements. These figures vary considerably in the literature. However, most of the papers report that about 50% of the patients in ICU reach 100% of the programmed calories and this is attained by the 6th day of the support[16, 17]. In this context, the use of established protocols associated with appropriate team work are crucial to improve results[18]. We believe that the results shown here are due to the nutritional team effort of our institution, in which is the dietitian the professional in charge of the nutritional prescription that is confirmed and signed by the physician.

Consistently with other reports[7, 8], NPT was the route of choice for postoperative patients. However, there was no difference in the caloric evolution when compared to EN. Contrarily of our findings, the amount of calories delivered may be greater with parenteral route in these patients[8, 9].

Immune-nutrients are becoming a common prescription for the critically ill[27]. In our study glutamine was most used in surgical patients because NPT was the main route for them. However, as the enteral route seems to be appropriate as well to receive glutamine, it was a surprise to notice that it was not prescribed in EN patients. Therefore, an immediate meeting with the nutritional team to discuss and change concepts in this issue was done. On the other hand, fibers were commonly prescribed for patients under EN. Fibers may prevent bacterial translocation, produce short-chain fatty acids and diminish the incidence of diarrhea[28-30]. Nevertheless, either fibers or glutamine prescriptions have not affected the evolution of the caloric prescription.

Malnutrition is a common diagnosis in ICU patients, and serum albumin is low accordingly[31, 32]. Critically ill patients frequently receive inadequate nutritional sup-

port during their ICU stay because physicians underestimate the nutritional needs of patients, and the initiation of nutritional therapy is often delayed[12, 32]. Enteral tube feeding delivered in the ICU may result in grossly inadequate nutritional support. In a large number of patient caloric requirements are not met because of underordering by physicians and reduced delivery through frequent and often inappropriate cessation of feedings[12]. Thus the nutritional team in the ICU may improve the results by offering a better approach to the critically ill. The nutritional status or the low level of albumin of the patients of this study has not influenced the evolution of the caloric prescription in the present study as it has in other report[12].

The overall results showed that early nutritional support and success on the evolution of the caloric prescription can be accomplished in most critically ill patients independently of the type of nutritional support. Evolution of the caloric prescription was slower in mechanical ventilated patients.

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