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Enteral nutrition in critical patients; should the administration be continuous or intermittent?

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Abstract

Enteral nutrition therapy (ENT) is an essential part in the management of critically ill patients, having a significant impact on these patients' clinical results. It can be administered on a continuous or intermittent basis using an infusion pump. There is a discussion on which of these techniques has the best performance, involving a number of factors such as nausea, diarrhea, and particularly the relationship between diet volume and the ratio of programed calories to calories effectively supplied to the critical patients.

Objectives: **To compare the forms of continuous or intermittent infusion of enteral nutrition, using as primary outcome the level of estimated caloric needs daily supplied.**

Methods: **Observational prospective randomized clinical study carried out in an intensive care unit on 41 patients divided into two groups, of intermittent (ENT during 18 hours with a 6-hour nocturnal pause), or continuous (ENT during 24 hours continuously) administration. The secondary outcome variables measured in this study were bowel evacuation, distension, emesis, with the primary outcome variable being the relationship between infusion volume and the estimated-to-supplied ratio of caloric needs. The rejection index of the null hypothesis was established at 5% for all the tests.**

Results: **Most of the patients received more than 60% infusion of enteral diet over the 5 days of study (p = 1.0), with no difference regarding the provision of caloric needs. No statistically significant difference between groups was found in the variables vomiting, abdominal distension or diarrhea.**

Conclusion: **The administration modalities of continuous or intermittent enteral nutrition are similar in which regards the comparison of the variables included in this study.**

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Keywords: *Enteral nutrition. Intermittent and continuous administration.*

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NUTRICIÓN ENTERAL EN PACIENTES CRÍTICOS; ¿SU ADMINISTRACIÓN DEBERÍA SER CONTINUA O INTERMITENTE?

Resumen

La terapia con nutrición enteral (TNE), una parte esencial del manejo de los pacientes críticos, tiene un impacto significativo en los resultados clínicos de estos pacientes. La TNE puede administrarse de forma continua o intermitente utilizando una bomba de infusión. Existe una discusión sobre cuál de estas dos técnicas tiene un mejor rendimiento, lo que implica una serie de factores como náuseas, diarrea y especialmente la relación entre el volumen de la dieta y la proporción entre calorías que se programan y las que realmente se proporcionan efectivamente a los pacientes críticos.

Objetivos: **Comparar las formas continua e intermitente de infusión de nutrición enteral, utilizando un nivel de necesidades calóricas estimadas suministradas diariamente como resultado principal.**

Métodos: **Estudio clínico prospectivo y observacional, de distribución aleatoria, de 41 pacientes en una unidad de cuidados intensivos (UCI), divididos en dos grupos, intermitente (TNE durante 18 horas con una pausa nocturna de 6 horas) o continua (TNE durante 24 horas de forma continua). Evaluamos como variables secundarias de resultados la evacuación, distención, emesis y como variable principal de resultado la relación entre el volumen de infusión y el cociente entre necesidades calóricas estimadas a suministradas. Se estableció el índice de rechazo de la hipótesis nula en el 5% para todos los tests.**

Resultados: **La mayoría de los pacientes recibieron > 60% de la infusión de la dieta enteral a lo largo de los 5 días del estudio (p = 1,0), sin observarse diferencias en la provisión de las necesidades calóricas. No se observaron diferencias estadísticamente significativas entre los grupos con respecto a las variables vómitos, distensión abdominal o diarrea.**

Conclusión: **Las modalidades intermitente o continua de administración de la nutrición enteral son similares en lo que respecta a la comparación de las variables de este estudio.**

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Palabras clave: *Nutrición enteral. Administración continua e intermitente.*

Introduction

Nutrition therapy is essential among the health care practices for critically ill patients. It is an adjuvant therapy which main objective is to attenuate the development of malnourishment.[1] Its efficiency depends on a number of factors, such as metabolic status of the patient and his/her response and behavior during the treatment.

Enteral nutrition therapy (ENT) has presented good results for a critically ill patient, therefore this is generally preferred to a total parenteral nutrition whenever the patient's gastrointestinal tract allows for it.[2] The use of enteral nutritional support is linked to reduced infective complications, maintenance of intestinal mucosal barrier integrity, and reduced bacterial translocation.[1]

However, the clinical behavior of this group of patients may interfere with ENT, thus affecting its administration and, as a consequence, its efficiency. This clinical characteristic may be directly linked to severity of the disease or to its treatment, with the requirement for sedatives, mechanical ventilation and therapy with antibiotics or vasoactive drugs.

The clinical manifestations of these alterations generally occur through the presence of intercurrent disorders such as abdominal distension, vomiting, and diarrhea.[3,4] Pulmonary infection caused by bronchial aspiration due to the increased volume of gastric residue between feeding steps, which has high morbidity and mortality, is one of the most feared complications.[5,6] Such complications may interfere with one of the basic concepts of the objective of this therapy, which is to supply calories to the patient; additionally, they may determine a decrease in the total caloric infusion goal prescribed to the patient.

Therefore, the modality of ENT infusion, either continuous or intermittent, may influence such complications.

However, few studies can be found in the literature with conclusive results on this subject, mainly in critical patients. The purpose of this study is to compare two methods of ENT infusion (continuous or intermittent), and the way in which they can contribute toward complications which impair the efficacy of the therapy.

Methods

Observational, prospective, randomized clinical study, carried out on patients under clinical treatment, over 18 years of age, of both genders, candidates to receive enteral nutrition therapy exclusively. The nasoenteral feeding tube was placed in gastric location and data were collected during the first five days in hospital. Patients with diabetes, hypothyroidism or any surgery in the upper gastrointestinal tract were excluded. The project was approved by the Research Ethical Committee of Julio Muller University Hospital (CEP 637/09).

On admission to the ICU, patients were randomly assorted to Group I-intermittent (ENT for 18 hours, with one 6-hour nocturnal pause), or Group II-continuous (ENT for 24 hours uninterruptedly). In both groups enteral nutrition therapy was delivered through an infusion pump.

In addition, on admission to the ICU patients had their nutritional status assessed using the Global Subjective Evaluation-GSE; severity of their condition and metabolic stress was assessed using APACHE II (acute physiology and chronic health evaluation) score (< 10 indicates mild disease). Caloric and protein needs were estimated by the following rules: a) 25-30 calories/kg of body weight, and b) 1.5 g of protein/kg of body weight. The estimated caloric needs were gradually delivered during the first three days of hospital stay (30%, 60% and 100%, respectively). A commercially available processed enteral formula (Peptamen®), nutritionally complete, was used for both groups, containing 100% whey protein, with 1.5 cal/ml caloric density.

Patients underwent bedside gastric residue volume assessment by manual aspiration performed before installation of any new step of enteral diet. The cutpoint level of 250 ml was established to continue or suspend ENT administration, which is in agreement with the protocol followed in our medical service.

The level of caloric needs was determined by observing the quantity of ENT infusion collected by the nursery report and annotations made on the fluid balance form, continuously monitored during 24 hours. Inherent complications due to the use of ENT were also monitored, with the following study variables being chosen: incidence of diarrhea, bowel constipation, distension and vomit.

Sample calculation was based on the variable gastric residue; considering an 80% beta error (type II) the sufficient number of patients was calculated to be 16. The Chi-square and Fisher's Exact tests were used to compare categorical data and to test the association between independent variables. Student's *t* or Mann Whitney's tests were used to compared two continuous variables. Comparison between variables was made using Relative Risk (RR) with a 95% Confidence Interval. The rejection index of the null hypothesis was established at 0.05 or 5% ($\alpha = 5\%$).

Results

After randomization 41 patients were included in the study, 18 (44%) in Group I (intermittent) and 23 (56%) in Group II (continuous).

Demographics and clinical data are displayed in table I, where no difference between the groups could be identified.

The percentage of nutritional intake received along the study days was described. During the five study days it could be noticed that 17 patients (74%) in

Table I
Demographics and clinical data of the study sample

Variable	G1 (18 h)		G2 (24 h)		p
	Mean	SD	Mean	SD	
Estimated weight (kg)	70.2	± 15.2	60.5	± 14.7	0.08*
Height (cm)	1.7	± 0.2	1.6	± 0.1	0.66*
Age (years)	68.9	± 19.4	61.3	± 20.8	0.23*
BMI (kg/m²)	24.6	± 5.0	22.3	± 4.3	0.13*
Gender (M/F)					0.76**
Male	10		14		
Female	08		09		
ASG (n%)					0.59***
A	01 (06)		03 (13)		
B	11 (61)		11 (48)		
C	06 (33)		09 (39)		
Apache	20.7	4.95	22.4	6.05	0.33****

*Student t – Data as mean + SD.
**Fisher's Exact Test.
***Chi-square Test.
****Mann Witney's Test.
ASG Avaliação Subjetiva Global.

Table II
Achievement of caloric needs along the study days

Day when CN* was achieved	G1 (18 h)			G2 (24 h)			p**
	Freq	%	% Acum	Freq	%	% Acum	
Did not achieve	08	44	–	06	26	–	–
Day in-hospital		0	0	01	04	04	1.00
First day	01	06	06	01	04	09	1.00
Second day	04	22	28	07	30	39	0,52
Third day	03	17	44	06	26	65	0.22
Fourth day		0	44	01	04	70	0.12
Fifth day	02	11	56	01	04	74	0.32
Overall total	18	100	–	23	100	–	–

*CN: Caloric needs.
**Fisher's Exact Test.

Group II, but only 10 patients (56%) in Group I received adequate caloric intake. Although the needs in Group II were achieved more quickly and in a higher percentage, no statistically significant difference could be found in this study (p = 0.32), as shown in table II.

Complementing table II, figure 1 demonstrates the gradual increase of ENT acceptance as length of hospital stay advanced.

The study patients were evaluated according to the complications they showed along the days of data collection. Table III displays the results obtained after exploring the variables bowel evacuation, distension, and emesis. Both groups were similar in this regard, with no statistically significant difference (p < 0.05 for the three items above described).

At the end of data collection only 3 (7%) patients died, and 38 (93%) patients who remained in the study until the fifth day were considered as being discharged from the project. There was no significant difference between the two groups (p = 0.57).

Discussion

A mandatory discussion when using ENT relates to what administration method is chosen, whether intermittent or continuous.

A global analysis of our data demonstrated that both study groups had similar results, with no significant differences relating to the method of ENT administration to the critical patients.

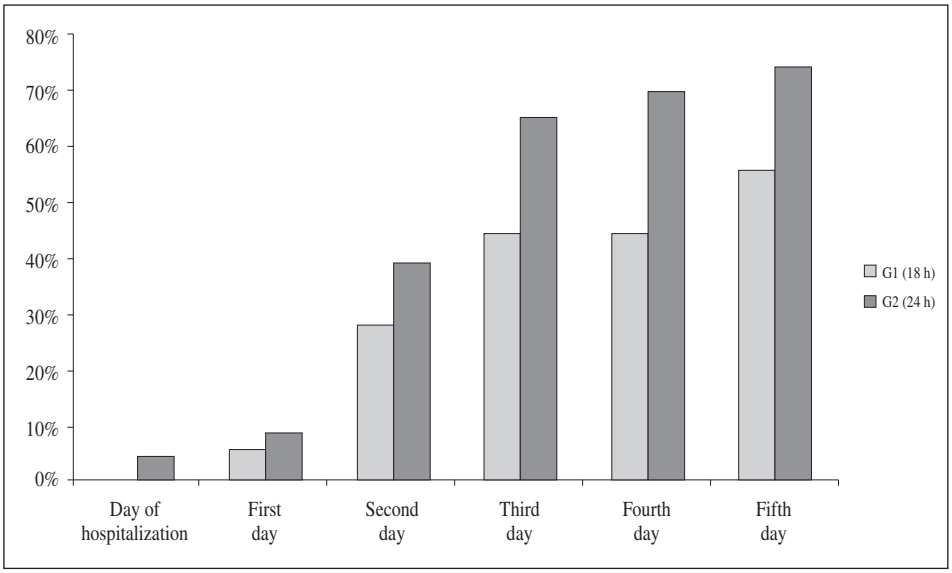

Fig. 1.—Days of hospitalization to achieve the caloric needs.

Table III
Results of bowel evacuation, distension and emesis assessments

Evacuation	*G1 (18 h)*	*G2 (24 h)*	*p*
Normal	10 (56%)	10 (44%)	
Diarrhea	05 (28%)	06 (26%)	0.57*
Constipated	03 (17%)	07 (30%)	
Distension			
No	06 (33%)	09 (39%)	0.70*
Yes	12 (67%)	14 (61%)	
Emesis			
No	14 (78%)	16 (70%)	0.72**
Yes	04 (22%)	07 (30%)	

*Chi-square Test.
**Fisher's Exact Test.

Intermittent infusion resembles more the usual, regular feeding process, which follows the physiological cycles. Interruption of the administration is programmed, thus allowing for a temporary rest from the nutrition therapy of the patient.

Continuous infusion has the typical feature of providing a constant and slow flow, as required by patients who do not tolerate any type of more rapid or voluminous infusion.[5]

In this study we consider that the regularity of infusion was maintained in both forms of administration by programming the pump drip, the only difference laying in the planned drip interruption in the intermittent form.

After determining the amount of caloric needs, we observed during the five days of the study that neither group achieved the supply of total estimated caloric needs, according to table II.

Patients in Group II achieved the prescribed caloric needs more rapidly, especially during the first 48 to 72 hours. This difference was maintained until the fifth day, yet no statistically significant difference was seen in the comparison with Group I. A study showing results similar to ours found that a high percentage of critical patients received less than 50% of the initially prescribed caloric needs during the first days of ENT.[6]

A study conducted at the Julio Muller University Hospital of UFMT involving critical patients in the intensive care unit showed that 75.6% of patients using ENT took up to six days to fulfill their nutritional needs.[7] Their data are similar to the ones in this study. It is worth noticing that an early achievement of the programmed target of nutritional needs in fact interferes positively with the critical patient's treatment.

Both methods presented advantages and disadvantages, since the differences they showed may interfere with several physiological processes, consequently with clinical processes as well.

As an example of such advantages, Vanessa Fujino et al.[8] suggest, in a revision of the literature, that a nocturnal interruption of six hours should be programmed aiming to reduce the intragastric bacterial population. During the nocturnal pause the gastric pH that was not blocked by the diet falls down to a bactericidal level in the stomach, thus decreasing the gastrointestinal tract bacterial population. This in turn will favor the decrease in levels of nosocomial pneumonia due to bacterial increase.

The variables we chose to represent complications of using ENT in the study patients are often commented in studies about this subject.[3,4,9] One of the most discussed complications in this setting is the presence of diarrhea, which often may become a factor to determine suspension of ENT in critical patients.

In a prospective study comparing the continuous and intermittent methods of infusion, a higher incidence of diarrhea, tube displacement and aspiration pneumonia was evidenced by the intermittent method

of administration without the use of infusion pump. In the group receiving continuous ENT there was greater occurrence of pump obstruction, however they had as advantage a higher percentage of infusion of the daily prescribed diet.[9]

Ciocon et al.[10] showed results where diarrhea was significantly more frequent in the intermittent than in the continuous group.

In our study the variables diarrhea and constipation were equally frequent in both groups. After analyzing the variables, no statistically significant difference was found, thus asserting the groups parity.

Decrease in the incidence of this complication in the ICU is considered a positive aspect, in addition to the fact that in both surveys it was not a cause for interruption of ENT administration.[3,9-11] It may be associated to medications or infections rather than ENT. Additionally, diarrhea may adversely affect absorption of nutrients and the nutritional status itself. These factors lead to additional stress for the patient and to increased healthcare costs.[3,12]

Whenever the patient presents with diarrhea, ENT administration modality in critical patients is also a very important point, which should be analyzed along with the type of formula employed. Evidence exists that the continuous use through infusion pump is a strong ally in the treatment of diarrhea, since a decrease to small doses of the volume infused may enhance the patient's tolerance to the enteral formula.[5,9]

In relation to the variable constipation, although the comparison of the groups yielded no significant difference in our results, there is still controversy in the literature on constipation in critical patients, so that no specific definitions are available on this matter. Some studies suggest that there is an association between the critical status of a patient, who usually takes many drugs, and the incidence of bowel constipation.[12-14]

The variables abdominal distension and emesis were evaluated as well, however results were equipoise between the two groups, showing no statistically significant difference.

Even if we consider the difficulties of collecting data in critical patients, some remarks must be made to our study. The reduced number of study days made it impossible to evaluate the patients over longer periods, which might likely yield different results.

Based on the present results, besides a mere adoption of ENT administration protocols for critical patients, we believe we can give a contribution to the clinical practices followed nowadays in the ICU. The scientific demonstration that no difference exists in results of using continuous or intermittent administration enables us to choose more freely which ENT form of delivery will best fit the clinical status of the patient and the procedures adopted at any given moment regarding its *propaedeutics* and therapeutic options.

Therefore, if needed, we can decide to submit the patient to a programmed pause in his diet (intermittent infusion). During this period a number of activities can be scheduled which interfere with the infusion, especially for the ICU routine procedures, with no damage to the enteral nutrition therapy.

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