CONTINUOUS VERSUS BOLUS INFUSION OF ENTERAL NUTRITION IN INTENSIVE CARE UNIT

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ABSTRACT

The aim of the present study *is to identify the benefits and complications of continuous versus intermittent administration of enteral feeding in critically ill patients.* ***Subjects and methods:*** *The present study included 40 critically ill patients, who were eligible to participation in the study. They were selected from AL-Azhar university hospital (New Damietta) during period from January 2011 to January 2012.They were divided into two equal groups according to enteral feeding method.* ***Group A:*** *included 20 cases received their nutrition by continuous enteral nutrition.* ***Group B:*** *included 20 cases received their nutrition by bolus enteral nutrition. Results were assessed daily for at 72 hours. It included anthropometric and biochemical nutritional assessments, hematological counts, thorax X-ray, and measurement of abdominal circumference. Consumption of vasoactive drugs, sedatives, antibiotics, and mechanical ventilation was documented, and duration of hospitalization in the ICU. Infused volumes were accurately recorded. The complication rate was calculated per patient and a single episode of vomiting, diarrhea, or distention was enough to define the case as complicated.* ***Results****: There was no significant difference between intermittent and continuous groups as regard to patient characteristics, laboratory data, ICU parameters or GIT complications. In the first day, there was significant decrease of actually administered amount in*

intermitted group when compared to continuous group (657.00±43.02 vs 745.75±16.72 respectively). On the other hand, no significant difference was found between both groups at days 2 and 3 (table 4). No case reported aspiration and mortality rate was zero. ***Conclusion:*** *complication rate was comparatively low with either bolus or continuous administration. Continuous administration provided a higher dietary intake on the first day in Group II, but by the third day, no difference remained between the two groups.*

Keywords: *enteral nutrition, continuous or bolus infusion.*

INTRODUCTION

Hypercatabolism due to physiological and psychosocial stressors associated with critical illness is a main characteristic in critically ill patient. Consequently, if nutritional support is not adequately provided to meet increased bodily demands, malnutrition may result **(Btaiche et al., 2010).**

Enteral nutrition (EN) is considered as the route of choice for critically ill patients with a functional gastrointestinal (GI) tract who cannot receive adequate oral nutrition **(Whelan, 2007).** EN can be administered by the continuous method given over 16–24 h or the bolus method given over 10–15 min, 4–6 times/day **(August and Teitelbaum, 2002).** EN is a physiologic means as it provides trophic effects to maintain intestinal physiology, prevents gut villi atrophy, decreases intestinal permeability stimulates intestinal perfusion, preserves gut immunity, and is associated with reduced hospital length of stay and cost **(Roberts and Zaloga, 2000).** However, the ability to provide adequate EN in critically ill patients is often hampered by pulmonary, GI, metabolic, and mechanical complications **(Schmidt and Martindale, 2001).**

Concerning pulmonary complications, aspiration is the most life-threatening complication of EN; it usually refers to the entry of oropharyngeal

or gastric content into the lungs. The incidence of aspiration ranges from less than 4% to more than 70% **(Collard et al., 2003).** Many causes can lead to aspiration including advanced patient's age, decreased level of consciousness, diminished gag or cough reflex, sedation, presence of a tracheal tube, supine position, malpositioning of EN tube, vomiting, or HGRV. Consequently, aspiration can cause a wide range of serious complications including, but not limiting to, pneumonia and acute respiratory distress syndrome (ARDS). Once ARDS develops, the mortality rate can increase to 40–50% **(Metheny, 2002).**

Among GI complications, the most common are nausea and vomiting (20%), HGRV (20–70%), diarrhea (63%), and constipation (5–83%) **(Whelan et al., 2009; Nassar et al., 2009).** These complications usually interfere with the achievement of adequate EN. The main concern with high gastric residual volume and vomiting is the risk for aspiration of gastric content according to some research studies **(Metheny et al., 2006).** However, this risk was not reported elsewhere **(Metheny et al., 2008).**

AIM OF WORK

The aim of the present work is to identify the benefits and complications of continuous versus intermittent administration of enteral feeding in critically ill patients.

methodology

Patient: The present study included 40 critically ill patients, who were eligible to participation in the study. They were selected from AL-Azhar university hospital (New Damietta) during period from January 2011 to January 2012. They were divided into two equal groups according to enteral feeding method.

Group A: included 20 cases received their nutrition by continuous enteral nutrition.

Group B: included 20 cases received their nutrition by bolus enteral nutrition.

Inclusion criteria

- Seriously ill patient,
- Both sexes
- Aged 20 to 80 years
- Patients unable to ingest an oral diet, with conserved gastrointestinal function
- Consent for participation in the study.

Exclusion criteria

- Irreversible coma
- Cancer
- Death or discharge before 72 hours of observation;
- Intestinal fistula, obstruction, necrosis, peritonitis,
- Contraindication to enteral diet;
- Intolerance to the prescribed nutrients or infusion regimen;

Group A: continuous infusion

All included patients received a complete, polymeric, commercial preparation composed of (1.0 kcal/mL, 56g protein/ mL), by nasogastric tube (10 French) and electronic infusion pump. The position of tube was confirmed daily by thorax X-ray images taken as a routine in these critical patients. When

the tube was shown to be displaced, the action was registered, and the tube was reinserted or repositioned again in its appropriate position. A standard prescription of 25 kcal/mL was adopted.

The daily calculated amount was received to the patient continuously for 24 hours;

Group B: Bolus infusion

The total daily feeding period was also 24 hours; however, feeding was given by 8 boluses. Each was administered over a 1-hour period each at intervals of 3 hours (1-hour infusion period followed by a 2-hour standby period).

General management: all patients were managed by administration of additional fluids or electrolytes, antibiotics, vasoactive drugs, mechanical ventilation, and other procedures according to medical conditions.

Definition of measurements:

Abdominal distension was defined as whenever abdominal circumference increased 3 cm or more. Diets were marked with anilin-blue dye so pulmonary aspiration could more easily be recognized, and pneumonia was affirmed whenever a new lung infiltrate at thorax X-ray. **(August and Teitelbaum, 2002).**

Methods of assessment:

Results were assessed daily for at 72 hours. It included anthropometric and biochemical nutritional assessments, hematological counts, thorax X-ray, and measurement of abdominal circumference. Consumption of vasoactive drugs, sedatives, antibiotics, and mechanical ventilation was documented, and duration of hospitalization in the ICU was documented. Infused volumes were accurately

recorded. The complication rate was calculated per patient and a single episode of vomiting, diarrhea, or distention was enough to define the case as complicated.

Data collection:

Collected data included patient's health characteristics such as the patient's age, sex, height, weight, as well as past medical and surgical history and current medication. Acute Physiology and Chronic Health Evaluation (APACHE II score) was performed daily to assess the patients' severity of illness. Moreover, neurologic parameters including Glasgow coma score (GCS) and cough reflex were evaluated to identify patient's level of consciousness and cough. The complication rate was also documented.

Statistical analysis

The collected data were organized, tabulated and statistically analyzed using statistical package for social science (SPSS) version 16; running on IBM compatible computer. For quantitative data, mean and standard deviation (SD) were calculated, while relative frequency and percent distribution were calculated for categorical data. Student's (t) test or Chi square (X^2) were used to compared groups in quantities and qualitative data respectively. P value ≤ 0.05 was considered significant.

RESULTS

General characteristics and laboratory data were represented in table (1). There was no significant difference between intermittent and continuous groups as regard to age (64.0±3.83 vs 62.30±5.00 respectively); sex (males represented 55% and 70% of intermittent and continuous groups respectively). In addition, there was no significant difference between both groups as regard to BMI and any one of laboratory data.

In addition, there was no significant difference between intermittent and continuous groups as regard to ICU parameters (table 2) or gastrointestinal complications (table 3).

As regard to amount of feeding, the prescribed amount for both groups was 800, 1200 and 1200 in days 1, 2 and 3 successively. In the first day, there was significant decrease of actually administered amount in intermitted group when compared to continuous group (657.00±43.02 vs 745.75±16.72 respectively). On the other hand, no significant difference was found between both groups at days 2 and 3 (table 4). No case reported aspiration and mortality rate was zero.

Table (1): Comparison between intermittent and continuous as regard to general characteristics and laboratory findings

	Intermittent	Continuous	test	p
Age	64.0±3.83; 56-72	62.30±5.00;53-71	1.20	0.23(NS)
Sex (male)	11(55.0%)	14(70.0%)	0.96	0.32(NS)
Weight	66.65±2.56	65.60±3.31	1.12	0.26(NS)
Height	1.688±0.023	1.689±0.022	0.07	0.94(NS)
BMI	23.37±0.51	22.98±0.84	1.73	0.09(NS)
Serum albumin	3.51±0.22	3.57±0.21	0.87	0.38(NS)
Hemoglobin	11.33±0.48	11.18±0.40	1.09	0.28(NS)
Lymphocyte count	1360.50±64.02	1397±75.50	1.68	0.10(NS)
WBCs count	13532.50±549.70	13461.50±1233.40	0.23	0.81(NS)
Blood urea	54.35±12.11	54.25±12.35	0.03	0.98(NS)
Serum creatinine	1.12±0.24	1.15±0.19	0.50	0.62(NS)

Table (2): Comparison between intermittent and continuous as regard to ICU findings

	Intermittent	Continuous	p
Indication for ICU admission Respiratory insufficiency Heart disease Neurologic problems	 7(35.0%) 7(35.0%) 6(30.0%)	 5(25.0%) 12(60.0%) 3(15.0%)	 0.26(NS)
Time in ICU (days)	15.55±351; 9-22	15.80±1.82; 11-18	0.77(NS)
Need mechanical ventilation	8(40.0%)	7(35.0%)	0.74(NS)
Need sedation	8(40.0%)	6(30.0%)	0.51(NS)
Vasoactive drugs	8(40.0%)	9 (45.0%)	0.74(NS)
Antibiotics	13(65.0%)	13(65.0%)	1.0(NS)
APACHI score	19.10±1.51	19.80±1.93	0.21(NS)
GCS	7.25±1.25	7.30±1.21	0.89(NS)

Table (3): Comparison between intermittent and continuous as regard to gastrointestinal complications

Variable	Day	Intermittent	Continuous	p
Vomiting	Day 1	2(10.0%)	1(5.0%)	0.54(NS)
	Day 2	1(5.0%)	0(0.0%)	0.31(NS)
	Day 3	1(5.0%)	0(0.0%)	0.31(NS)
Diarrhea	Day 1	1(5.0%)	2(10.0%)	0.54(NS)
	Day 2	0(0.0%)	1(5.0%)	0.31(NS)
	Day 3	2(10.0%)	1(5.0%)	0.54(NS)
Tube obstruction	Day 1	0(0.0%)	0(0.0%)	
	Day 2	1(5.0%)	1(5.0%)	1.0(NS)
	Day 3	1(5.0%)	1(5.0%)	1.0(NS)
Tube displacement	Day 1	1(5.0%)	1(5.0%)	1.0(NS)
	Day 2	1(5.0%)	0(0.0%)	0.31(NS)
	Day 3	1(5.0%)	1(5.0%)	1.0(NS)

Table (4): Comparison between intermittent and continuous as regard to enteral nutritional

Variable		Intermittent	Continuous	p
Day 1	Prescribed	800	800	
	Administered	657.00±43.02	745.75±16.72	<0.001*
Day 2	Prescribed	1200	1200	
	Administered	923.50±23.90	938.50±34.79	0.12(NS)
Day 3	Prescribed	1200	1200	
	Administered	928.50±16.31	924.00±18.07	0.43(NS)

DISCUSSION

For many years, it has been recommended that enteral nutrition should be introduced slowly and adjusted according to tolerance. High-risk cases are substantially more prone to motility derangements **(Serpa, et al., 2003).**

Some authors advocate continuous administration of the diet as a means of overcoming possible gastric stasis and reflux, yet there is not wide consensus about the efficacy of such an approach **(ROCCO, 1998; Twyman, 1997).** Thus, the present study was designed to identify the benefits and complications of continuous versus intermittent administration of enteral feeding in critically ill patients.

In the present work, there was no statistical significant difference was found between the two groups in relation to the incidence vomiting. This may indicate that vomiting was not affected by the EN method itself **(Quigley et al., 2001)** more over**.**

No incidence of aspiration related to the EN. Similar results were reported in other studies **(Stevens et al., 2002).** This finding could be related to the application of known protocols during the EN administration and reflected by the low incidence of vomiting in both groups. Moreover, Few cases of HGRV were identified which is in accordance with **Elpern et al. (2004) Metheny et al.**

(2008) and O'Meara et al. (2008) On the other hand, a number of investigators did find a high incidence of HGRV **(Leary-Kelley et al., 2005; Reintam et al., 2009).** This could be related to the inclusion of patients who were subject to a higher risk for delayed gastric emptying such as those suffering from sepsis and hemodynamic instability, and receiving sedatives **(Charney et al., 2001).**

Furthermore, no statistical significant difference was found between the two groups concerning the incidence of HGRV. Similar results have been reported in other studies **(MacLeod et al., 2007; Chen et al., 2006).**

In the present study, intermittent enteral feeding fail to provide as much volume as the continuous modality on the first day, but at the third day, the advantage had disappeared. In addition, when complications are considered, the differences between the two routines were even more subtle and could not be statistically confirmed. Thus, both therapies were actually very successful, since total diet-related morbidity was quite low for such a critical population, and nearly 80% of the nutritional intake goal was reached by 72 hours. It had been accepted by **Berry and Braunschweig (1998)** that, whenever 80% of the energy needs of the patient are supplied by 72 hours, the replenishment program should be considered adequate.

In short, results of the present study found that, complication rate was comparatively low with either bolus or continuous administration. In addition, continuous administration provided a higher dietary intake on the first day in Group II, but by the third day, no difference remained between the two groups. Finally, both methods displayed a deficit of actually supplied volume when compared with diet prescription, but this shortcoming was small, similar in both groups, and justified in circumstances of critical disease and intensive care.

The present study had one limiting step in the form of short duration of observation (72 hours). It is postulated that, an observation period longer than 72 hours would perhaps amplify the differences between both techniques; however, this was not feasible due to busy ICU. In addition, more aggressive bolus feedings with syringe injections that are typically performed at high pressures and short times would potentially underscore the limitations of one versus the other method.

Further studies should include longer alimentation periods and populations with different risk scores to advance the knowledge about these widely adopted therapeutic techniques.

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مقارنة التغذية المعوية المستمرة بالتغذية علي دفعات لدي مرضي الرعاية المركزة

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قسم التخدير والرعاية المركزة (كلية طب الأزهر – دمياط).

صممت الدراسة الحالية بهدف التعرف علي فوائد ومضاعفات التغذية المعوية المستمرة مقارنة بالتغذية المعوية علي دفعات في مرضي الرعاية المركزة.

وقد اشتملت الدراسة الحالية علي ٤٠ مريض من مرضي الرعاية المركزة، تم تقسيمهم إلي مجموعتين طبقا لاستراتيجية التغذية المعوية . الأولي اشتملت علي ٢٠ مريض ممن تم تغذيتهم بصورة مستمرة، والثانية اشتملت علي ٢٠ مريض ممن تم تغذيتهم علي دفعات (وجبات). وقد تم تقييم المرضي لمدة ٧٢ ساعة من بداية الدراسة إلي نهاية فترة المتابعة . وقد تم تقييم العوامل الآتية لكل المشاركين في الدراسة: القياسات المترية، التحاليل المخبرية، منها نسبة الهيموجلوبين، وعدد كرات الدم البيضاء، عمل أشعة عادية علي الصدر، وقياس محيط البطن . كما تم تسجيل استخدام الأدوية داخل الرعاية المركزة خلال فترة الدراسة، وقياس الاحتياج إلي التهوية الرئوية الصناعية وفترة البقاء بالرعاية المركزة . كما تم قياس كمية الطعام المتناولة كل يوم، ومقارنتها بما هو مستهدف . وأخيرا فقد تم قياس نسبة الم ضاعفات أثناء فترة التغذية المعوية.

وقد أسفرت نتائج الدراسة عن عدم وجود فروق ذات دلالة إحصائية بين نوعي التغذية بالنسبة لمعاملات الخصائص الشخصية، القياسات المعلمية، القياسات أثناء وجود المريض بالرعاية المركزة، أو نسبة المضاعفات. وعلي الجانب الآخر فقد وجد نقص يعتد به إحصائيا في كمية الغذاء المتناولة فعليا لدي المجموعة التي تناولت تلك الكمية علي وجبات متفرقة مقارنة بالتغذية المستمرة في اليوم الأول، وبحلول اليوم الثالث، اختفي ذلك الفرق.