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Incidence of aspiration and gastrointestinal complications in critically ill patients using continuous versus bolus infusion of enteral nutrition: A pseudo-randomised controlled trial

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ABSTRACT

Enteral nutrition (EN) for the critically ill and mechanically ventilated patients can be administered either via the continuous or bolus methods. However, there is insufficient evidence supporting which of these methods may have a lower risk of aspiration and gastrointestinal (GI) complications. This study was conducted in order to identify the incidence of aspiration and GI complications using continuous enteral nutrition (CEN) and bolus enteral nutrition (BEN) in critically ill patients at the Rafik Hariri University Hospital (RHUH), Beirut, Lebanon.

Methods: A pseudo-randomised controlled trial was conducted on 30 critically ill mechanically ventilated patients receiving EN for more than 72 h. Patients were randomly assigned into the following groups: an experimental group that received CEN and a control group that received BEN. Furthermore, patients' health characteristics data as well as the incidence of aspiration and GI complications (high gastric residual volume "HGRV", vomiting, diarrhoea, and constipation) were subsequently collected.

Results: There were no statistically significant differences between the effects of CEN versus BEN groups on the occurrence of aspiration, HGRV, diarrhoea, or vomiting ($P > 0.05$). However, constipation was significantly greater in patients receiving CEN (10 patients (66.7%)) as compared with those receiving BEN (3 patients (20%)) ($P = 0.025$).

Conclusion: CEN versus BEN methods did not affect the incidence of aspiration, HGRV, vomiting or diarrhoea. However, the incidence of constipation was significantly greater in patients receiving CEN.

Introduction

Critically ill patients are characterised by the presence of hyper-catabolism due to physiological and psychosocial stressors associated with critical illness. Consequently, if nutritional support is not adequately provided to meet increased bodily demands, malnutrition may result.[1] 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.[2] 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.[3] 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.[4] However, the ability to provide adequate EN in critically ill patients is often hampered by pulmonary, GI, metabolic, and mechanical complications.[5]

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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%.[6] 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%.[7]

Among GI complications, the most common are nausea and vomiting (20%), HGRV (20–70%), diarrhoea (63%), and constipation (5–83%).[8–11] These complications usually interfere with the achievement of adequate EN. The main concern with HGRV and vomiting is the risk for aspiration of gastric content according to some research studies.[12,13] However, this risk was not reported elsewhere.[14,15]

Based on the aforementioned, this study was performed to determine the incidence of aspiration and GI complications using continuous versus bolus infusion of EN in critically ill patients.

Methods

Study design

Pseudo-randomised controlled trial.

Setting and participants

The study was conducted during the period of June 2011–December 2011 at the Intensive Care Unit on 30 critically ill patients of both genders. The study was approved by the Institutional Review Board of the hospital, where the Ethics Committee also granted ethical approval. Before enrolment, a written informed consent was obtained from the legal proxy of each patient.

Inclusion criteria were as follows: Patients aged between 20 and 80 years were attached to mechanical ventilation and received EN through nasogastric (NG) or orogastric (OG) tubes for more than 72 h. On the other hand, exclusion criteria included: (1) Patients with haemodynamic instability requiring inotropic drugs and having sepsis[16]; (2) Patients with severe diarrhoea (more than 1 L/day), gastrointestinal bleeding, intestinal fistula or obstruction, ileus, hyperglycemia, or carcinomatosis[17]; (3) Patients receiving sedatives, anticholinergics, prokinetics and/or muscle relaxant[18]; and (4) patients whose feeding was stopped before the completion of the 3-day study.

Intervention

Patients were assigned every other one into two equal groups; experimental group included those who were receiving CEN given over 24 h, and control group included those who were receiving BEN given over 15 min every 4 h. The study was conducted for three consecutive days.

Both groups: All patients received sterile commercial normocaloric high molecular standard diet.[19] Anthropometric measurements were taken by dieticians, and the volume of feed to be administered was prescribed collaboratively with the physician based on the estimated caloric requirements, protein, fluid, and micro-nutrients' requirements. The volume of formula was advanced gradually every day according to the hospital ICU policy as follows: day 1: 33% of the target volume, day 2: 66% of the target volume, and day 3: 100% of the target volume. Placement of the feeding tube was done, and tube was checked daily by CXR or by auscultation of the abdomen while insufflating 20 cm^3 of air into the tube. Bowel sounds were assessed by auscultation of the intestinal peristaltic movements before feeding administration to exclude patients with intestinal obstruction or ileus. Blue food dye was added to the given feeding every 4 h after physician's permission, with a dose of 12 mg/kg/day.[20]

Bolus group (control group): Feeding was administered by gravity using Tommy syringe over 10–15 min every 4–6 h. Patient's position was maintained at 45–60 degrees during process and at least 1 h after EN administration. Placement of feeding tube was checked before feeding administration, and tube was flushed with 30 ml of water before and after EN. The rest of the feeding formula was kept in the refrigerator for further use within 24 h, and it was discarded after 24 h of opening EN formula container.[21]

Continuous group (experimental group): Feeding was continuously administered over 24 h through a feeding pump. Patients were kept at a position of 45–60° over 24 h of the continuous EN administration. Tube placement was checked every 4 h after turning off the EN pump, then the tube was flushed with 60 ml of water before being reconnected to the EN pump. EN formula and tubing were changed every 24 h.[21]

Data collection

Data were collected using the study tool which 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. Additionally, Acute Physiology and Chronic Health Evaluation (APACHE II score) were performed daily to assess the patients' severity of illness. Moreover, neurologic parameters including Glasgow coma score (GCS) and cough reflex were evaluated every 4 h over the 3-day period of the study to identify the patient's level of consciousness and cough reflex. Complications related to the EN were assessed and recorded using the tool over 3 days including the incidence of pulmonary aspiration and the occurrence of gastrointestinal complications (HGRV, vomiting, constipation, or diarrhoea).

Primary outcomes

Pulmonary aspiration was detected by assessing its clinical manifestations (desaturation, tachycardia, and cyanosis) continuously and by inspecting tracheal secretions for any blue colouration during tracheal suctioning. Oxygen saturation was monitored using a pulse oximeter, and it was considered low (desaturation) if it was <90%.[22] Heart rate was assessed by continuous cardiac monitoring and was described as tachycardia if it was >100 beats/min.[23] The patient's facial colour was assessed to detect central cyanosis indicating tissue hypoxia.

Concerning GI complications, GRV was assessed every 4 h using Tommy syringe, with EN being given at 6:00 a.m. The residue was aspirated and collected repeatedly until no more fluid could be withdrawn. Incidence of HGRV was reported when the aspirated GRV was more than 200 ml.[3] Vomiting was assessed continuously for its incidence, amount, colour, and content. Diarrhoea was reported when the patient passed 3 or more times of loose stool per day; a sample was obtained for analysis and culture to eliminate infectious diarrhoea.[24] Constipation was reported when the patient had absent bowel movement for three consecutive days or more.[10]

Secondary outcomes

GCS and presence of cough reflex were assessed in the 3-day study, as well as the results of stool analysis, culture and clostridium difficile.