Occurrence of gastrointestinal side effects associated with early use of commercial diets in ITU patients

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Abstract

Background. The purpose of this retrospective study was to analyse the occurrence of gastrointestinal side effects in enterally fed ITU patients.

Methods. We analysed the records of 195 ITU patients fed enterally, over at least five days, with commercial mixtures administered as 20-hour infusions. Gastric retention, the number of defecations, and incidents requiring discontinuation of enteral feeding, were noted during the first 3 days of nutrition.

Results. Enteral nutrition was usually started during the first week of treatment (median 4, range: 1–33). In 118 patients receiving parenteral nutrition, the median day of implementing enteral feeding was day 5; some received enteral mixtures much earlier (day 2). The mean infusion rates of enteral mixtures were: 33 mL h⁻¹ on day 1, 58 mL h⁻¹ on day 2, and 68 mL h⁻¹ on day 3. Gastric retention was observed in 49 (25.1%) patients during the first day, in 37 (19.0%) on day 2, and in 25 (12.8%) on day 3. Discontinuation of enteral nutrition was necessary in 6 patients due to: surgery (1), high gastric retention (4), gastrointestinal bleeding (1). A statistically significant correlation was found between the occurrence of gastric retention, infusion rates and CRP, and between the number of defecations and infusion rates.

Conclusions. Enteral feeding with commercial diets is well tolerated when implemented gradually. Intolerance and the need for the discontinuation of enteral feeding were usually associated with a worsening of the patient’s general condition and progression of the underlying disease.

Key words: complications, nutrition, enteral

According to the definition of the ESPEN (European Society for Clinical Nutrition and Metabolism), enteral nutrition (EN) involves the supply of special medical diets through a tube, fistula or orally. According to the ASPEN (American Society for Parenteral and Enteral Nutrition), EN is the supply of commercial diets to the gastrointestinal tract through a tube or fistula yet not via the mouth. Both societies recommend the nutrition through the gastrointestinal tract, whenever possible [1, 2].

ESPEN recommends to initiate enteral feeding in all patients treated in ITUs when full oral feeding is not planned within the first three days of hospitalisation. In patients with severe general conditions but haemodynamically stable and with the efficient gastrointestinal tract, EN should be started within < than 24 h, which is called early nutrition [3]. In contrast, according to the ASPEN guidelines, EN should be initiated in patients with increased catabolism and metabolic disorders hospi-
nalised for > than 2 days, even when peristalsis has not been restored [4].

According to ESPEN, in the acute and initial stage of disease, the supply of calories should not exceed 20–25 kcal kg
⁻¹ day
⁻¹. During convalescence (anabolic phase), the supply ought to be increased to 25–30 kcal kg
⁻¹ day
⁻¹ [3]. The ASPEN guidelines do not define the caloricity of diets but the number of portions or rate of infusion depending on a supply method (a bolus or continuous infusion). Gastric feeding using bolus injection starts with 3–8 portions of undiluted preparations daily, increasing the volume by 60–120 mL every 8–12 h, until the target volume has been achieved. In continuous infusions, the initial rate should be 10–40 mL h
⁻¹ and can be gradually increased by 10–20 mL h
⁻¹ every 8–12 h, considering the patient’s tolerance. The target volume and planned energy supply should be preferably reached on day 2–3 of enteral nutrition [4]. The available study findings demonstrate that ITU patients tolerate only the diet supply lower than 70% of the target dose [5].

The enteral formula should be tailored to the stage and severity of disease as well as patient’s tolerance [2, 3]. The supply of preparations has to be adjusted to the patient age, underlying disease, state of nutrition, efficiency of the gastrointestinal tract, and energy demands. Moreover, the manner and site of diet administration are important [2].

To minimise the risk of aspiration of gastric contents to the bronchial tree, the ITU patients should be fed through a tube or fistula and not orally. The advantages of jejunum supply over gastric supply have not been demonstrated [2].

It is worth mentioning that in severely ill patients treated in ITUs, the nutritional protocol is often extremely difficult to be followed, which is primarily caused by possible complications.

The aim of the study was to assess the incidence of gastrointestinal side effects in patients treated with commercial enteral diets in the Intensive Therapy Unit.

**METHODS**

The study design was approved by the Bioethics Committee.

The medical records of 195 patients treated in the ITU in the years 2009–2010, who received enteral commercial diets for at least 5 days (polymeric, peptide, diabetic) were analysed. The diets were supplied through a nasogastric or orogastric tube in continuous infusions over 20 h day
⁻¹.

The data regarding the ITU day of enteral nutrition institution as well as earlier parenteral nutrition and the rate of commercial diet infusion were analysed. On day 1 (T1), 3 (T2) and 5 (T3) of enteral nutrition, its gastrointestinal tolerance was assessed by analyzing the degree of gastric retention (> 100 mL day
⁻¹ was considered significant), the number of defecations and necessary cessation of EN. This form of nutrition was abandoned due to intensive gastric retention (> 300 mL day
⁻¹) or persistent diarrhoea defined as numerous, abundant faeces accompanied by water-electrolyte imbalance.

The results were statistically analysed. The data were compared using the Student’s t-test and the relationships were assessed using a simple linear correlation. P < 0.05 was considered significant.

**RESULTS**

The medical records regarded 101 (51.8%) male and 94 (48.2%) female patients. Their age ranged from 19 to 101 years. The mean APACHE II score on admission was 25 (range 4–54). Before ITU admission, 67 patients were treated surgically. In total, 37 patients died during hospitalisation.

The causes of treatment included: respiratory failure (n = 107), circulatory failure (n = 4), septic shock (n = 43), multiple organ failure (n = 23), conditions following abdominal aorta surgery (n = 11), acute gastrointestinal diseases (n = 10), acute pancreatitis (n = 8), haemorrhagic shock (n = 3), renal dysfunction (n = 1), and septic shock resulting from the impaired bone marrow function (n = 2).

The analysis of records showed that enteral nutrition was instituted on day 4 of ITU stay, on average (range 1–33).

One hundred and eighteen patients (80%) were fed parenterally prior to institution of enteral nutrition; in such cases, EN was generally initiated on ITU day 5 (range 1–33). In patients without earlier parenteral feeding, EN was averagely started on day 2 (range 1–7). The differences were significant (p < 0.05).

The mean rate of infusion was 33 mL h
⁻¹ on day 1, 58 mL h
⁻¹ on day 2 and 68 mL h
⁻¹ on day 3; the differences were significant (p
₁₁–₂ < 0.05; p
₂₂–₃ < 0.05).

On day 1, the water-diluted mixtures were administered to 28 (14.4%) patients, on day 3 to 11 (5.6%), and on day 5 to 6 (3.1%) patients.

According to the nurses’ documentations regarding gastrointestinal tolerance of EN, gastric retention was observed in 49 (25.1%), 37 (19.0 %) and 25 (12.8%) patients at T1, T2 and T3, respectively. The values were significantly different (p
₁₁–₂ < 0.05, p
₂₂–₃ < 0.05). The rate of commercial diet supply and incidence of gastric retention are illustrated in Figure 1.

Premature discontinuation of enteral nutrition was necessary in 10 patients (Fig. 2). In six of them, EN was discontinued during the first three days (in 1 due to necessary surgery, in 4 because of intensive retention and in 1 due to alimentary haemorrhage). Five of these patients were re-fed enterally at T3. In 4 patients, EN was withdrawn on day 5 (in 1 due to oncoming surgery, in 3 because of high retention). A significant positive correlation was found between gastric reten-
tion and the rate of infusion at T1, T2, and T3 (p_T1 < 0.05; p_T2 < 0.05; p_T3 < 0.05).

The number of defecations was 1–6 at T1, 1–11 at T2 and 1–7 at T3. The differences were significant (p_T1-T2 < 0.05; p_T2-T3 < 0.05). A significant positive correlation was observed between the number of bowel movements and the rate of infusion (p_T1 < 0.05; p_T2 < 0.05; p_T3 < 0.05). In none of the cases, enteral nutrition had to be discontinued due to frequent and abundant stools.

The concentration of CRP ranged from 38.5 to 326.2 mg L⁻¹ (0 117.1 mg L⁻¹) at T1, from 26 to 129 mg L⁻¹ (0 91.4 mg L⁻¹) at T2, and from 19.4 to 219 mg L⁻¹ (0 113.2 mg L⁻¹) at T3. The CRP concentration was found to be significantly higher in patients whose enteral feeding was discontinued (p_T2 < 0.05; p_T3 < 0.05). Furthermore, a significant correlation was demonstrated between gastric retention and increased CRP concentration (p_T1 < 0.05; p_T2 < 0.05; p_T3 < 0.05).

**DISCUSSION**

The lack of nutrients supplied to enterocytes and colonocytes adversely affects the morphology of cells and their function as a barrier stimulating the immune response [6]. Unlike parenteral nutrition, enteral feeding has beneficial effects on the gastrointestinal tract, stimulates natural peristaltic movements as well as digestion and absorption of nutrients. Hence, the process of intestinal villous atrophy is inhibited [7]. The nutrition of intestinal epithelial cells enhances the gut-associated lymphoid tissue (GALT), preventing bacterial translocation from the alimentary environment to the blood, mesenteric lymph nodes and abdominal organs [7, 8].

The factors contributing to this translocation include alterations in intestinal bacterial microflora, physical injuries to the intestinal endothelium and visceral hypoxia [8]. The bacteria multiply due to reduced resistance of the intestinal mucosa resulting from the ongoing disease. The presence of toxins or radiation leads to physical damage to the intestinal endothelium and impairs its function. The process is enhanced by the lack of enterocyte nutrition [6].

The study carried out in Gdańsk demonstrated that the commonest microorganism inducing sepsis is *Escherichia coli*; amongst 6916 patients, 263 developed documented bacteraemia caused by this pathogen; 16 of them were hospitalized in ITU and 4 died [9].

Only some bacterial species are capable of translocation to the lymph nodes, including the family of *Enterobacteriaceae*, e.g. *Escherichia coli* and *Klebsiella pneumoniae*, as well as some other families (*Pseudomonas aeruginosa*, *Enterococcus* and some streptococci). The comparison of biological material samples (faeces, blood) demonstrated that their phenotypic features were strongly correlated, which proves bacterial translocation from the gastrointestinal tract to the vascular bed and stresses the benefits resulting from enteral nutrition [9].
The nutritional protocol can be difficult to follow in the ITU setting due to metabolic disorders, limited possibilities of using individual nutrients by the body as well as impaired gastrointestinal function in ITU patients. In our material, enteral nutrition was provided using the continuous method with a 20-hour infusion and 4-hour night break. The mean rate of infusions was gradually increased during the successive days of treatment, which is in accordance with the guidelines suggesting the initiation of nutritional therapy at the volume of 10–40 mL h⁻¹ and its gradual increase up to the target volume on day 2–3 [3].

In the study population, 60% of patients received parenteral feeding prior to enteral nutrition, which was averagely introduced on ITU day 5; those without earlier parenteral feeding received enteral nutrition earlier, on day 2, on average.

Analysis of management in 703 ITU patients disclosed beneficial effects of nutritional therapy (reduced mortality, shorter hospitalization) in patients with enteral nutrition started after 48 h of ITU stay (patients receiving enteral and parenteral nutrition as well as those receiving only enteral nutrition). Moreover, increased mortality rates were found in patients with parenteral nutrition instituted within 48 h after ITU admission [10].

In our study, nutrition had to be discontinued due to intensive retention only in 7 patients; in none of the patients enteral nutrition was stopped due to frequent and abundant faeces, although 12 developed diarrhoea. According to the French study, the incidence of adverse side effects was markedly higher in the group of 100 ITU patients. The authors distinguished two subgroups: in subgroup 1 — enteral feeding was instituted on hospitalization day 1 and in subgroup 2 — after 24-hour stay. The initial rate of commercial diet supply was 25 mL h⁻¹ and was gradually increased by another 25 mL h⁻¹ each day to achieve the supply of 25 kcal kg⁻¹ day⁻¹. Enteral feeding was discontinued in 40 patients (29 of subgroup 1 and 11 of subgroup 2) due to substantial retention (> 300 mL day⁻¹). The other side effects observed were diarrhoea (n = 35), vomiting (n = 12), regurgitation (n = 8) and colon dilation (n = 7) [11].

Another method of enteral nutrition is to supply the nutritional mixture in bolus doses of 200–300 mL at 3-4-hour intervals. However, the assessment of both methods (a bolus vs. continuous infusion) demonstrated that half the patients experienced gastric retention, irrespective of the method applied [12].

In our material, a significant positive correlation was observed between gastric retention and increased CRP concentrations, which is likely to indicate the adverse effects of severe general conditions of patients on their gastrointestinal function.

CONCLUSIONS
1. Enteral nutrition with commercial diets instituted gradually is well tolerated by ITU patients.
2. Intolerance and discontinuation of nutritional enteral feeding are most commonly associated with deterioration of patients’ general conditions and progression of underlying diseases.

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References