Analysis the Effect of Enteral Nutrition on Critically Ill Patients with Hyperglycemia

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ABSTRACT: OBJECTIVE To observe the effect of enteral nutrition on critically ill patients with hyperglycemia such as glucose, lipids, electrolytes, nitrogen balance, protein and so on. **METHODS** Retrospective analysis 207 cases of hyperglycemia patients applied with three different enteral nutrition of the same calorie. **RESULTS** Glucerna group patients had small change in fasting blood glucose and didn't need additional insulin. The fasting blood glucose of Nutrison fibre group and Ensure group increased significantly (P<0.05) and need additional insulin therapy. The electrolyte blood lymphocyte count, albumin and transferrin levels of three groups were in normal range. And there was no significant difference in three groups (P>0.05). All patients had negative nitrogen balance in early stage. There was no significant change in serum triglyceride, cholesterol before and after enteral nutrition (P>0.05). **CONCLUSION** The critically ill patients with hyperglycemia should use enteral nutrition as soon as possible. High dietary fiber and monounsaturated fatty acids nutritional supplements are more beneficial than the high sugar nutritional supplements for them. The usage of insulin is reduced without affecting the lipid.
KEY WORDS: enteral nutrition; hyperglycemia; critically illness; serum triglyceride; cholesterol

肠内营养对高血糖症危重患者的应用分析

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摘要：目的 观察肠内营养对高血糖危重患者血糖、血脂、电解质、氮平衡、蛋白质等的影响。**方法** 回顾分析 207 例高血糖症危重患者应用 3 种相同热量的肠内营养支持。**结果** 益力佳组患者空腹血糖变化不大，无需加用胰岛素；而能全力组和安素组患者的空腹血糖升高明显(P<0.05)，需加用胰岛素治疗；3 组患者的电解质、血淋巴细胞计数、前清蛋白及转铁蛋白浓度均维持在正常范围。3 组间比较无显著性差异(P>0.05)；所有患者早期均存在负氮平衡；3 组患者肠内营养前后的血清三酰甘油、胆固醇等无明显变化(P>0.05)。**结论** 对高血糖症危重患者应尽早进行肠内营养支持，高膳食纤

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维与单不饱和脂肪酸营养配方比高糖营养配方更有利于高血糖危重患者血糖的下降，胰岛素使用量也减少，同时不影响血脂。

关键词：肠内营养；高血糖症；危重病；血清三酰甘油；胆固醇
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Nutritional support in critically ill patients has an important role in reducing the incidence of complications and mortality. Early appropriate enteral nutrition treatment not only provides patients with metabolic energy source, but also reduces stress ulcer complications. In this study, critically ill patients with hyperglycemia were applied with Ensure, Nutrison fibre or Glucerna, and observe the effect of enteral nutrition on critically ill patients with hyperglycemia.

1　Material and Methods

1.1　Case selection

ICU patients in our hospital from 2007 to 2009 were selected. Inclusion criteria: ①Age≥18 years old; ②APACHE-II score≥16; ③admission fasting blood glucose (FBG)≥7.8 mmol·L^{-1}; ④no past history of diabetes. 131 male and 76 female patients aged 18 to 75 (mean 58.6) were selected. Multiple injuries (55 cases), brain trauma (87 cases), cerebral hemorrhage (26 cases) and cerebral infarction (37 cases) were included. GCS score was 5 to 10. Patients were randomly divided into three groups (n=69). The patients stayed in ICU for 2 days and then were applied with Ensure (Abbott Laboratories, USA), Nutrison fibre (Nutricia Pharmaceutical Co., Ltd.), Glucerna (Abbott Laboratories, USA). The comparison of three kinds of nutritional ingredients was listed in Tab 1.

Tab 1　The comparison of three kinds of enteral nutrition
表 1　三种营养剂配方成分比较

Energydistribution	Sugars/%	Protein/%	Monounsaturated fatty acids/%	Polyunsaturated fatty acids/%	Saturated fatty acids/%	calories/ kJ·mL^{-1}
Nutrison fibre	49.0	16.0	21.3	11.1	2.6	4.184
Glucerna	33.3	16.7	35.7	9.8	4.3	4.184
Ensure	53.2	16.7	0.4	25.7	3.6	4.184

1.2　Research methods and monitoring index

The patient was admitted to hospital for two days after starting tube feeding. The first day were given Ensure, Nutrison fibre or Glucerna 1 995. 6 kJ (≥5 h), the second day 3 987.6 kJ (≥10 h), the third to ten day 5 961.7 kJ (≥16 h). And they were continuously observed for 10 days. During the study period, patients were given intravenous administration with the same dose of glucose (10% glucose solution 500 mL, or glucose 50 g) and intravenous infusion with isotonic saline. Every morning FBG was measured. If FBG ≥ 11.1 mmol·L^{-1}, appropriate insulin(10–18 U insulin was added in 500 mL 10% glucose solution) was added. Everyday the 24 h blood urea nitrogen and creatinine concentration were measured, and then the nitrogen balance was calculated. The fasting blood lipids, serum potassium, sodium, chlorine, liver and kidney function, albumin and transferrin protein were measured on the first 5 days and 10 days before nutritional support. Record whether the patients have vomiting, diarrhea and other gastrointestinal symptoms after giving the nutrient solution.

1.3　Statistical methods

All data was expressed with $\bar{x} \pm s$. Comparison and application of multiple analyses of variance F test. All statistical data was treated with SPSS software.

2　Results

2.1　The effect on electrolyte, lymphocyte, albumin and nitrogen balance

The electrolyte, blood lymphocyte count, albumin and transferrin concentrations of all patients were maintained at normal range. There was no significant difference between three groups (P＞0.05), see Tab 2. All patients had a negative nitrogen balance at early stage. On the fifth days after nasal feeding the patients were converted to positive nitrogen balance, see Tab 3. Three patients in Ensure group and three patients in Nutrison fibre group had diarrhea on day 3 and 4 respectively after nasal feeding. And they gave up the treatment.

Tab 2 The effect of three kinds of enteral nutrition on electrolyte, lymphocyte and albumin
表 2 3 种营养剂对患者电解质、淋巴细胞、蛋白质的影响

Items	Glucerna			Nutrison fibre			Ensure		
	0 d	5 d	10 d	0 d	5 d	10 d	0 d	5 d	10 d
K^+/mmol·L^{-1}	3.61±0.35	3.78±0.39	3.89±0.47	3.71±0.37	3.78±0.31	3.87±0.41	3.51±0.39	3.72±0.39	4.07±0.41
Na^+/mmol·L^{-1}	139.26±5.64	139.45±6.51	140.74±5.47	137.51±6.98	138.61±7.21	139.42±6.74	135.63±5.26	136.91±5.07	137.27±6.02
Cl^-/mmol·L^{-1}	99.56±2.86	100.77±3.18	100.68±2. 17	102.42±3.21	99.82±2.56	101.91±2.72	98.81±2.10	99.27±3.51	99.72±3.43
lymphocyte/×10^9·L^{-1}	4.03±1.24	4.74±1.55	4.82±1.39	4.31±2.08	4.71±1.40	4.81±1.30	4.40±1.27	4.86±1.63	4.20±1.71
prealbumin/g·L^{-1}	0.30±0.06	0.33±0.07	0.32±0.04	0.31±0.07	0.32±0.05	0.32±0.08	0.32±0.07	0.31±0.06	0.32±0.04
transferrin/g·L^{-1}	2.17±0.53	2.78±0.69	4.47±0. 61	2.08±0.42	2.78±0.51	4.28±0.52	2.08±0.51	2.70±0.94	4.15±0.42

Tab 3 The effect of three kinds of enteral nutrition on nitrogen balance
表 3 3 种营养剂对患者氮平衡的影响

Group	nitrogen balance/g·d^{-1}		
	0 d	5 d	10 d
Nutrison fibre	–3.58±0.34	1.31±0.45	2.91±0.41
Glucerna	–3.58±0.41	1.52±0.40	3.15±0.36
Ensure	–3.61±0.42	1.18±0.33	3.00±0.36

2.2 The effect on fasting blood glucose

The FBG of sixteen patients in Ensure group and seven patients in Nutrison fibre group were significantly elevated (＞11.1 mmol·L^{-1}). These patients need insulin therapy. The Glucerna group patients' FBG fluctuation is small and needn't insulin therapy. There was significant difference between three groups (P＜0.05), see Tab 4.

Tab 4 The effect of three kinds of enteral nutrition on fasting blood glucose
表 4 3 种营养剂对患者空腹血糖的影响

Group	blood glucose/mmol·L^{-1}			
	0 d	3 d	7 d	10 d
Nutrison fibre	8.8±0.90	9.7±0.83[1)]	10.4 ±0.88[1)]	11.6 ±0.87[1)]
Glucerna	8.6±0.75	8.5±0.70[2)]	8.1±0.76[2)]	8.3±0.724[2)]
Ensure	8.7±0.87	9.4±0.86[1)]	10.2 ±0.91[1)]	11.7 ±0.97[1)]

Note: Compared with 0d, [1)]P<0.05, compared with other two groups, [2)] P<0.05
注：与肠内营养前相比，[1)]P<0.05，与其他 2 组相比，[2)]P<0.05

2.3 The effect on blood lipid

The serum triglyceride and cholesterol changed little after nutrition therapy. And there was no significant difference before and after treatment, see Tab 5.

Tab 5 The effect of three kinds of enteral nutrition on blood lipid
表 5 3 种营养剂对血脂的影响

Group	triglyceride/mmol·L^{-1}			cholesterol/mmol·L^{-1}		
	0 d	5 d	10 d	0 d	5 d	10 d
Nutrison fibre	1.97±0.22	2.07±0.26	2.10±0.23	5.04±0.11	5.07±0.11	5.09±0.12
Glucerna	2.04±0.23	2.06±0.24	2.08±0.24	5.00±0.12	5.04±0.12	5.06±0.13
Ensure	1.96±0.21	2.06±0.23	2.08±0.24	5.00±0.14	5.05±0.10	5.07±0.11

3 Discussion

Diasip can control blood glucose and improve nutritional status and respiratory failure in critically ill patients with hyperglycemia[1]. Enteral nutrition has a good preventing function on stress hyperglycaemia after operation in aged patients[2]. Severe traumatic brain injury patients with elevated blood glucose given enteral nutrition support as early as possible can reduce complications and improve prognosis[3]. Enteral nutrition and parenteral nutrition support less likely to cause high blood sugar reactions[4]. Therefore, enteral nutrition support is critically important for the rehabilitation of patients[5].

The general formula (the standard formula), the carbohydrate (CHO) heat production accounts for about 55% of total calories, fat accounts for about 33%. They have a large number of simple sugars that can be rapidly absorbed, so they have a greater impact on blood sugar. Fiber-containing formula is based on the standard formula by adding a certain amount of fiber, so it can increase dietary viscosity, slower gastric emptying and reduce intestinal mucosa of the inter-layer diffusion hydrostatic. And transit time of the fibers in the small intestine is extended, thereby delays the absorption of CHO[4]. Some people believe that even though dietary fiber-containing formula has the above-mentioned advantage, the total amount of CHO has more important impact on blood glucose than the type of CHO[5].

Glucerna is a good new enteral nutrition and its

dietary fiber and monounsaturated fatty acids (monounsaturated fatty acids, MUFA) ratio increased substantially. It's specifically good for high blood sugar patient. Peters thought that Glucerna can help control blood sugar levels by increasing dietary fiber which can delay gastric emptying time and slow down the gastrointestinal tract in nutrient absorption. McCargar's study was consistent with the findings [6].

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