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Efficacy of early enteral nutrition support for patients with coma after neurosurgery

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ABSTRACT

Objective This study aimed to explore the efficacy of early enteral nutrition support for patients with coma after neurosurgery.

Methods A total of 50 hospitalized patients with severe craniocerebral injuries who was in a coma after neurosurgery from September 2018 to January 2020 were enrolled in the study. The patients were randomly divided into two groups (25 cases/group) using the random number table method. The control group received delayed enteral nutrition support, while the experimental group received early enteral nutrition support. Their nutritional status indicators, serum inflammatory factors, immunity indicators, complication incidence, Glasgow Coma Scale (GCS) score, recovery time, mechanical ventilation duration, and inpatient days were compared between the two groups.

Results Although the levels of nutritional status indicators (including prealbumin, transferrin, albumin, and hemoglobin) increased in both groups after treatment, their levels were significantly higher in the early enteral nutrition support group than in the control group ($P<0.05$), concomitant with lower levels of serum interleukin-6 (IL-6), C-reactive protein (CRP), and procalcitonin (PCT), and higher levels of $CD3^+$% and CD4/CD8 ratio in the peripheral circulation ($P<0.05$). Regarding the complication incidence, no complication was observed in the early enteral nutrition support group, while 4 (16%) cases in the control group had ventilator-associated pneumonia (n=1), diarrhea (n=2), or refeeding syndrome (n=1), $P<0.05$. The GCS scores of the two groups were higher after treatment than before treatment ($P<0.05$). However, the GCS score after treatment was higher in the early enteral nutrition support group than the control group ($P<0.05$). The recovery time, mechanical ventilation duration, and inpatient days were shorter in the early enteral nutrition support group than in the control group ($P<0.05$).

Conclusions Early enteral nutrition for post-operative coma patients with severe craniocerebral injury could effectively improve nutritional status of patients, reduce inflammation, enhance immunity, reduce complication incidence, and promote patients' recovery.

Key words Neurosurgery; Severe craniocerebral injury; Coma; Early enteral nutrition support

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INTRODUCTION

Severe craniocerebral injury is a common critical illness in neurosurgery. Patients with severe craniocerebral injury are often dangerously ill, progress quickly, and have a high risk of disability and mortality [1-3]. Currently, surgery is the main approach for the treatment of severe craniocerebral injury. Surgical treatments can effectively reduce intracranial pressure and clear intracranial hematoma. However, after the operation, a considerable number of patients are still in a coma and unable to eat on their own. Because of the rapid energy consumption in these patients, malnutrition is prone to occur, which will affect their prognosis [4]. In order to ensure the good nutritional status of the patients in a coma post-neurosurgery, it is necessary to implement nutritional support for the recovery of these patients. At present, enteral nutritional support is the most commonly used nutritional support method. However, there is no uniform standard for the timing of its implementation.

Therefore, this randomized controlled study involving 50 cases of severe craniocerebral injury patients in our hospital from September 2018 to January 2020 was carried out, aiming to explore the effect of early enteral nutrition support in patients with coma after neurosurgery.

MATERIALS AND METHODS

General information

A total of 50 patients with severe craniocerebral injuries who was in a coma after neurosurgery in our hospital from September 2018 to January 2020 were enrolled in this study. The random number table method was adopted for grouping, and the patients were divided into 25 cases in each group. The control group including 14 males and 11 females received delayed enteral nutrition support. Their age ranged from 25 to 74 years old, with an average age of 52.13±12.34. The duration between disease onset to hospital admission of these patients was 0.7-4.0 hours, and the average length was 2.30±0.52 hours. The experimental group received early enteral nutrition support group, including 15 males and 10 females. Their age ranged from 24 to 73 years old, with an average age of 51.68±12.29 years old. The duration between disease onset to hospital admission was 0.6~4.0 hours, and the average length was 2.28±0.53 hours. The age, gender, and the length between disease onset to hospital admission were comparable between the two groups (P>0.05). This study was approved by the Institutional Medical Ethics Committee, and informed consent was provided by the patient’s family.

The inclusion criteria were listed below. (1) After a comprehensive clinical examination, the patient was diagnosed with severe craniocerebral injury; (2) The patient had indications for surgery and surgical treatment was performed; (3) Glasgow coma scale (GCS) score ≤8 (in a coma); (4) The time to hospital after injury ≤ 4 hours; (5) Age ≥ 18 years old.

The exclusion criteria were: (1) combined with other neurological diseases; (2) mental disorders; (3) gastrointestinal bleeding; (4) combined with severe infection; (5) combined with chronic underlying diseases such as hypertension and diabetes.

Intervention

The experimental group received early enteral nutrition support. The enteral nutrition support was implemented for these patients on the second day after admission. A jejunal catheter was inserted through the patient's nasal cavity, and the Short-Peptide Enteral Nutrition (Peptison) was infused through the catheter (20-30 ml per hour); the infusion rate was adjusted according to the patient's specific conditions. The maximum rate was controlled at 120 ml per hour.

Delayed enteral nutrition support was implemented in the control group, and the patients received

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nutrition support on day 7 after admission. The steps of enteral nutrition support were the same as those in the early enteral nutrition support group.

Observation parameters

Nutritional indicators (including prealbumin, transferrin, albumin, hemoglobin), inflammation indicators (including interleukin-6, C-reactive protein, procalcitonin, abbreviated as IL-6, CRP, PCT), immunity indicators (including $CD3^+$%, CD4/CD8 ratio), complication incidence, GCS score, recovery time, mechanical ventilation time, and inpatient days were compared between the two groups.

The GCS score scale was used to assess patients in a coma. The score ranged from 0 to 15 points, which was inversely proportional to the degree of consciousness disorder. The patients with a score $\leqslant$ 8 were considered in a coma.

Statistical analysis

The SPSS 22.0 software was used in this study. The count data is expressed as n, and the $\chi 2$ test was performed. The measurement data was expressed as (mean ± standard deviation), and the t-test was performed. $P<0.05$ indicated that the difference was statistically significant.

RESULT

Comparison of nutritional status indicators

The levels of prealbumin, transferrin, albumin, and hemoglobin in the two groups were higher after treatment than before treatment. However, the levels of prealbumin, transferrin, albumin, and hemoglobin after treatment were higher in the early enteral nutrition support group than in the control group, $P<0.05$ (Table 1).

Table 1. Comparison of nutritional status indicators

Parameters	Timepoint	Control group (n=25)	Early enteral nutrition support group (n=25)
Prealbumin (g/L)	Pre-treatment	0.20±0.08	0.21±0.10
	Post-treatment	0.30±0.09#	0.42±0.12#*
Transferrin (g/L)	Pre-treatment	31.04±1.35	31.17±1.41
	Post-treatment	32.49±1.46#	33.98±1.37#*
Albumin (g/L)	Pre-treatment	35.66±1.80	35.83±1.85
	Post-treatment	38.09±2.31#	40.95±2.74#*
Hemoglobin (g/L)	Pre-treatment	104.15±1.72	104.31±1.76
	Post-treatment	106.52±2.39#	109.94±2.87#*

Note：#P<0.05, compared to pre-treatment; *P<0.05, compared to the control group

Comparison of serum inflammatory factors

The levels of serum IL-6, CRP, and PCT in the two groups were lower after treatment than before treatment ($P<0.05$). However, the levels of IL-6, CRP, and PCT after treatment were lower in the early enteral nutrition support group than in the control group ($P<0.05$), as shown in Table 2.

Table 2. Comparison of serum inflammatory factors

Parameters	Timepoint	Control group (n=25)	Early enteral nutrition support group (n=25)
IL-6 (ng/L)	Pre-treatment	26.61±3.49	26.48±3.52
	Post-treatment	22.50±2.87#	19.64±2.39#*
CRP (mg/L)	Pre-treatment	9.83±1.61	9.72±1.64
	Post-treatment	8.20±1.47#	6.69±1.29#*

PCT (ng/ml)	Pre-treatment	6.35±1.80	6.14±1.87
	Post-treatment	4.46±1.31#	3.09±1.02#*

Note： #P<0.05, compared to pre-treatment; *P<0.05, compared to the control group

Comparison of immunological status

As shown in Table 3, $CD3^+$% and CD4/CD8 ratio of the two groups were higher after treatment than before treatment (P<0.05). However, the $CD3^+$% and CD4/CD8 ratio after treatment were higher than those of the control group in the early enteral nutrition support group (P<0.05), indicating the enhanced T cell immunity in patients receiving early enteral nutrition support.

Table 3. Comparison of immunological status as indicated by T cell immunity

Parameters	Timepoint	Control group (n=25)	Early enteral nutrition support group (n=25)
$CD3^+$ (%)	Pre-treatment	35.43±2.91	35.61±2.86
	Post-treatment	39.12±3.57#	43.84±4.65#*
CD4/CD8	Pre-treatment	1.30±0.15	1.34±0.16
	Post-treatment	1.49±0.19#	1.70±0.22#*

Note： #P<0.05, compared to pre-treatment; *P<0.05, compared to the control group

Comparison of complications

The incidence of complications was compared between the early enteral nutrition support group and the control group, and the early enteral nutrition support group had a lower frequency of complications than the control group (P<0.05), as shown in Table 4.

Table 4. Comparison of complication incidence [n (%)]

Complications	Control group (n=25)	Early enteral nutrition support group (n=25)
Ventilator-associated pneumonia	1 (4%)	0 (0%)
Diarrhea	2 (8%)	0 (0%)
Refeeding syndrome	1 (4%)	0 (0%)
Total incidence	4 (16%)	0 (0%)*

Note： *P<0.05, compared to the control group

Comparison of the Glasgow Coma Scale score

Before treatment, the GCS score of the early enteral nutrition support group was 6.27±1.04 and that of the control group was 6.15±1.09; after treatment, the GCS score of the early enteral nutrition support group was 9.82±1.31, and that of the control group was 8.53±1.20. The GCS scores of both groups were higher after treatment than before treatment (P<0.05), and the GCS scores after treatment were higher in the early enteral nutrition support group than the control group (P<0.05).

Comparison of recovery time, mechanical ventilation duration, and inpatient days

The recovery time, mechanical ventilation duration, and inpatient days in hospital were shorter in the early enteral nutrition support group than in the control group (P<0.05), as shown in Table 5.

Table 5. Comparison of recovery time, mechanical ventilation duration, and inpatient days

Complications	Control group (n=25)	Early enteral nutrition support group (n=25)
Recovery time	3.49±0.87	2.61±0.72*
Mechanical ventilation duration	8.23±2.08	6.14±1.85*

Inpatient days	13.91±2.57	10.38±2.20*

Note： *P<0.05, compared to the control group

DISCUSSION

Severe craniocerebral injury mainly refers to severe trauma to the human brain caused by high-energy external effects. After the injury, the patient's intracranial pressure increases sharply, and there could be many hematomas in the skull, which may cause compression on the cranial nerves and result in functional damage to the nerves, therefore threatening the patient's life [5-6]. The condition of patients with severe craniocerebral injury is often highly dangerous and the disease could progress rapidly. In order to save the lives of patients and improve the survival rate of patients, surgical treatments such as decompressive craniectomy and intracranial hematoma removal are recommended for severe craniocerebral injury. It can effectively remove the intracranial hematoma, reduce intracranial pressure, and control the progress of the disease.

Due to severe brain trauma, patients with severe craniocerebral injuries often fall into a coma, unable to breathe spontaneously, and lose the ability to eat spontaneously through the mouth. Because the absorption of nutrient elements by these patients is reduced, and the body metabolism is disordered, their energy consumption is faster than healthy individuals and their energy demand is also increased. This will lead to the breakdown of the balance between the nutrition intake and nutrition consumption, increase the risk of malnutrition, and aggravate the patients' condition. In order to ensure that the nutritional energy taken by patients with severe craniocerebral injury and coma can meet their body needs, it is recommended to implement nutritional support for these patients. Enteral nutrition support is one of the most commonly used nutritional support methods in the clinical. It is mainly through the infusion of nutrient solution into the patient's gastrointestinal tract using a nasal feeding tube, which can promote the patient's gastrointestinal tract to fully absorb the nutrient solution and supplement it for the patient [7-8]. Clinically, there is no consensus on the timing of enteral nutrition in patients with severe head injury and coma. This study focuses on this problem and implements early enteral nutrition and delayed enteral nutrition for patients with severe craniocerebral injury and coma.

The results of this study generated at least two findings. First, after treatments, the levels of prealbumin, transferrin, albumin, and hemoglobin were higher in the early enteral nutrition support group than in the control group, indicating that early enteral nutrition support can help improve the nutritional status of patients with severe craniocerebral injury and coma. The reason could be that early enteral nutrition can protect the structural integrity of the gastrointestinal mucosa of the patient promptly, improve its gastrointestinal function, enhance the absorption capacity of the patient's gastrointestinal tract for nutrients, and rebuild the balance between nutrient intake and consumption. Second, after treatment, serum levels of IL-6, CRP, and PCT in the early enteral nutrition support group were lower than those in the control group, and $CD3^+$ cell percentage and CD4/CD8 ratio were higher in the early enteral nutrition support group than that in the control group. Moreover, the incidence of complication and GCS score was lower in the early enteral nutrition support group than the control group. The recovery time, mechanical ventilation duration, and inpatient days in the early enteral nutrition support group were shorter than those in the control group. These results indicate that early enteral nutrition can also reduce severe inflammatory responses of coma patients with severe craniocerebral injury and improve their immunity, thereby reducing complications and speeding up disease recovery. This could be attributed to the fact that compared with delayed enteral nutrition, early enteral nutrition can supplement the patient's promptly and efficiently catch up with the high metabolic state of the body, decrease the release of inflammatory factors, regulate the immune function, and avoid complications that interfere with the progress of their consciousness recovery.

In summary, for patients with severe craniocerebral injuries who is in a coma post-operation, early

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enteral nutrition may effectively improve the patient's nutritional status, reduce inflammation, enhance immunity, and help reduce complications and promote recovery.

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STATEMENT

There is no conflict of interest in this article.

REFERENCES

[1] Fulkerson, Daniel H., White, Ian K., Rees, Jacqueline M. et al. Analysis of long-term (median 10.5 years) outcomes in children presenting with traumatic brain injury and an initial Glasgow Coma Scale score of 3 or 4[J]. Journal of neurosurgery., 2015, 16(4):410-419.

[2] Rundhaug, Nils Petter., Moen, Kent Goran., Skandsen, Toni. et al. Moderate and severe traumatic brain injury: effect of blood alcohol concentration on Glasgow Coma Scale score and relation to computed tomography findings[J]. Journal of neurosurgery., 2015,122(1):211-218.

[3] Lu, Hsueh-Yi, Li, Tzu-Chi, Tu, Yong-Kwang. et al. Predicting Long-Term Outcome After Traumatic Brain Injury Using Repeated Measurements of Glasgow Coma Scale and Data Mining Methods[J]. Journal of medical systems, 2015, 39(2):47-52.

[4] Sherer, Mark., Sander, Angelle M., Maestas, Kacey Little. et al. Accuracy of Self-reported Length of Coma and Posttraumatic Amnesia in Persons With Medically Verified Traumatic Brain Injury[J]. Archives of Physical Medicine and Rehabilitation, 2015, 96(4):652-658.

[5] Aadal, Lena., Mortensen, Jesper., Nielsen, Jorgen Feldbaek. et al. Weight Reduction After Severe Brain Injury: A Challenge During the Rehabilitation Course[J]. The Journal of neuroscience nursing, 2015, 47(2):85-90.

[6] Suehiro, Eiichi., Koizumi, Hiroyasu., Fujisawa, Hirosuke. et al. Diverse Effects of Hypothermia Therapy in Patients with Severe Traumatic Brain Injury Based on the Computed Tomography Classification of the Traumatic Coma Data Bank[J]. Journal of neurotrauma, 2015, 32(5):353-358.

[7] Horn, Susan D., Kinikini, Merin, Moore, Linda W. et al. Enteral Nutrition for Patients With Traumatic Brain Injury in the Rehabilitation Setting: Associations With Patient Preinjury and Injury Characteristics and Outcomes[J]. Archives of Physical Medicine and Rehabilitation, 2015, 96(8 Suppl.3):S245-S255.

[8] Zhang, Xuan., Jiang, Xiaoying. Effects of Enteral Nutrition on the Barrier Function of the Intestinal Mucosa and Dopamine Receptor Expression in Rats With Traumatic Brain Injury[J]. JPEN: Journal of parenteral and enteral nutrition, 2015, 39(1):114-123.

