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Effect of Enteral Nutrition Support through Percutaneous Endoscopic Gastrojejunostomy Tube on Immune Function, Endocrine Function and Prognosis in Patients with Severe Craniocerebral Injury

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Keywords

Fibrinogen, Homocysteine, Uric acid, Type 2 diabetes mellitus, Cerebral infarction

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Abstract

Objective To explore the effects of enteral nutrition support through percutaneous endoscopic gastrojejunostomy (PEG-J) tube on immune function, endocrine function and prognosis of patients with severe craniocerebral injury, so as to improve nutritional status of patients more effectively. **Methods** 65 patients with severe craniocerebral injury treated in our hospital from Jun. 2018 to Oct. 2020 were selected, and divided into control group (n=26) and observation group (n=39). Control group was treated with intranasal or oral indwentional gastric tube. Observation group received percutaneous endoscopic gastrojejunostomy. The dosages of propofol and fentanyl before 7 d, the levels of immune (CD_4^+,CD_8^+, CD_4^+/CD_8^+ ratio) and endocrine function indicators (thyroid stimulating hormone (TSH), free T3 (F-T3), free T4 (F-T4)) on the 1st d and 7th d of treatment and prognosis (28 d mortality, duration of mechanical ventilation, duration of ICU, and incidence of ventilator-associated pneumonia (VAP)) were compared between the two groups. **Results** No significant difference existed in the dosages of propofol and fentanyl between the two groups before 7 d of treatment. On the 1st d of treatment, CD_4^+, CD_8^+ and CD_4^+/CD_8^+ levels barely differed between the two groups, but obviously reduced after 7 d of treatment, with CD_4^+ and CD_4^+/CD_8^+ levels evidently higher in observation group than in control group, and similar CD_8^+ level in the two groups. The similar trends were observed on the serum levels on the 1st d of treatment and the 7^{th} d of treatment. **Conclusion** PEG-J enteral nutrition support therapy has a good effect on patients with severe craniocerebral injury through relieving pain and restless symptoms, and improving immune and endocrine functions, with better prognosis.

Introduction

Severe craniocerebral injury is one of the common conditions in the intensive care unit (ICU). It is an injury to the cranial tissue caused by direct or indirect violence to the head, which is critical and places patients at greater risk of disability and death [1]. The enhanced gluconeogenesis, accelerated protein catabolism and reduced protein synthesis in patients with severe craniocerebral injury result in insufficient nutrient supply in the body, further increasing the length of hospital stay, incidence of infection and morbidity and mortality, therefore timely nutritional support for patients with severe craniocerebral injury is particularly important in clinical treatment [2-4]. At present, it is commonly believed that enteral nutrition is more effective in correcting malnutrition in patients, and some studies have shown that early enteral nutrition can reduce the inflammatory response of patients with severe craniocerebral injury, improve the internal environment of the body and promote recovery [5]. Early enteral nutrition is a form of nutrition support via the gastrointestinal tract. The main routes include oral and transcatheter input, of which transcatheter input mainly includes intranasal or oral indwelling gastric tube and percutaneous gastrojejunostomy tube (PEG-J) [6]. Although it has the advantages of being non-invasive, economical and can be used at an early stage, it is prone to reflux and misaspiration, resulting in apnea or asphyxia. Some scholars found[7] that PEG-J could improve the quality of life and nutritional status of patients with cancer-caused intestinal obstruction and reduce the incidence of complications, but few studies have reported the role of PEG-J in the nutritional supply of severe cranio-cerebral injury. Therefore, in this study, PEG-J was applied to enteral nutrition support in severe craniocerebral injury in order to improve the nutritional status of patients more effectively.

Data and methods

General information

Study subjects

Sixty-five patients with severe craniocerebral injury who attended our hospital from June 2018 to October 2020 were selected as study subjects and divided into control group (n=26) and observation group (n=39) according to different enteral nutrition support therapies. The difference between the two groups was statistically significant (P<0.05) due to the different preoperative preparation time for enteral nutrition support therapy, but the difference in gender, age, body mass index (BMI) and acute physiological and chronic health score (APACHE II) between the two groups was not statistically significant (P>0.05) and was comparable, see Table 1.

Table 1 Comparison of clinical baseline information between the two groups

Groups	Cases	Gender (male/female)	Age (years old)	BMI (kg/m^2)	APACHE II score(point)	Time of tube placement (d)
Observation group	39	23/16	60.24±6.35	22.45±2.37	16.24±2.41	3.71±0.74
Control group	26	16/10	62.48±6.19	21.48±2.16	15.89±2.26	1.24±0.32
t/χ^2		0.043	-1.407	1.674	0.588	16.018
P		0.836	0.164	0.099	0.559	0.000

Inclusion and exclusion criteria

Inclusion criteria: all patients were clinically diagnosed with severe craniocerebral injury [8], with onset <24 h and were mechanically ventilated; exclusion criteria: those who died within 24 h of admission; those who did not breathe on their own for 24 h for non-pharmacological reasons; those with chronic diseases of the heart, liver, kidney, lungs and other vital organs; those who had previous gastrointestinal surgery; those with severe damage to the gastrointestinal tract The study was conducted in patients with severe coagulation disorders, severe

abdominal hypertension and general oedema; intolerance or allergy to the drugs used in the study; and poor compliance with the study.

Methods

Operation method

Patients in the control group were immediately admitted to the hospital with an intranasal or oral gastric tube and enteral nutrition support. In the observation group, enteral nutrition support was administered via a gastric tube and PEG-J was performed within 5 d of admission: the patient fasted for at least 8 h before the procedure and was placed in a supine position with the head elevated at 30°. The gastroscope was inserted through the oral cavity, and the puncture site was set 3-5 cm outside the left upper abdominal rib cage in the lower midline by means of finger pressure on the abdominal wall and fluoroscopy, and the patient was given conventional local anaesthesia. The gastrostomy tube is pulled into the gastric cavity until it is firmly attached to the gastric wall; the left lateral position is changed, the caudal end of the gastrostomy tube is separated, the connector is attached externally, the small enterostomy tube is placed into the gastric cavity through the gastrostomy tube, the small enterostomy tube is slowly delivered to the descending duodenum with the help of the gastroscope using foreign body forceps, then the gastroscope and foreign body forceps are retreated to the gastric cavity, the small enterostomy tube is again clamped in the gastric cavity with foreign body forceps and continued to the small intestine, and after confirming that the fistula is fixed, enteral After confirming that the fistula is fixed, enteral nutritional support is administered.

Enteral nutrition

Allergy was used as the enteral nutrition preparation and the final target energy was 30 kcal/(kg-d) in both groups. In the control group, the speed of enteral nutrition was adjusted according to the amount of gastric contents remaining in the patient, and the rate of enteral nutrition was adjusted upwards by 10 ml/h every 6 h. If the amount of gastric contents remaining was <250 ml, the rate of enteral nutrition was adjusted upwards by 10 ml/h; if the amount of gastric contents remaining was ≥250 ml, the enteral nutrition rate was maintained and the gastric contents were infused back. 10 ml/h and the gastric contents were returned. In the observation group, the rate of enteral nutrition was adjusted according to whether the patient had reflux and vomiting, and the adjustment method was the same as that of the control group. If after 7 days of enteral nutrition the patient is still unable to achieve the target energy, the patient will be supplemented with parenteral nutrition preparations.

Treatment

Patients in both groups were treated with conventional heavy craniocerebral injury treatment, monitored blood glucose and serum albumin levels, and given sedative and analgesic drugs by micropump injection. The sedative drug of choice was propofol injection, with a target RASS sedation score of -1 to 0. The analgesic drug of choice was fentanyl citrate injection, with a target CPOT pain score of <2. If the patient is mechanically ventilated for more than 14 d, a tracheotomy is performed.

Observation indicators

① Comparison of propofol and fentanyl dosage in the first 7 d between the two groups. Immune function: 5 ml of fasting peripheral venous blood was collected in the morning on the 1st and 7th day of treatment, respectively, and the serum was separated by centrifugation (3500 r/min for 10 min) and stored at -80℃ for measurement. Endocrine function: 5 ml of fasting peripheral venous blood was collected in the morning on the 1st and 7th day of treatment, respectively, and serum thyroid stimulating hormone (TSH) levels were measured by immunofluorescence analysis, and serum free T3 (F-T3) and free T4 (F-T4) levels were measured by radioimmunoassay. ④ Prognostic indicators: 28-d morbidity and mortality rate, duration of mechanical ventilation, ICU time and incidence of ventilator-associated pneumonia (VAP), the starting point of observation was the time when the patient was transferred to ICU, the end point was

the time when the patient was transferred out of ICU or died, the follow-up period was 28 d. 28-d morbidity and mortality rate = number of morbidity and mortality cases/total cases × 100%, incidence of ventilator-associated pneumonia (VAP) = occurrence of The incidence of VAP = number of VAP cases/total cases × 100%.

Statistical methods

Statistical analysis was performed using SPSS 19.0. Count data were compared using the χ2 test, and measurement data were expressed as mean ± standard deviation ($\bar{x}\pm s$).

Results

Comparison of propofol and fentanyl dosage in the first 7 d between the two groups

There was no significant difference between the dosage of propofol and fentanyl in the first 7 d between the two groups (P>0.05), see Table 2.

Table 2 Comparison of propofol and fentanyl dosage in the first 7 d in the two groups

Groups	Cases	Propofol (mg)	Fentanyl (mg)
Observation group	39	913.65±105.47	0.71±0.16
Control group	26	964.39±135.69	0.79±0.19
t/χ^2		-1.693	-1.831
P		0.095	0.072

Comparison of immune function index levels between the two groups of patients at d 1 and d 7 of treatment

On the first day of treatment, there was no significant difference in the levels of CD4+, CD8+ and CD4+/CD8+ ratio between the two groups (P>0.05); on the seventh day of treatment, the levels of CD4+, CD8+ and CD4+/CD8+ ratio of patients in both groups were significantly lower than those on the first day of treatment (P<0.05), but the levels of CD4+ and CD4+/CD8+ ratio of patients in the observation group were significantly higher than those in the control group (P<0.05). However, the CD4+ level and CD4+/CD8+ ratio of patients in the observation group were significantly higher than those in the control group (P<0.05), and there was no significant difference between the CD8+ levels of patients in the two groups (P>0.05), see Table 3.

Comparison of endocrine function index levels between the two groups of patients at d 1 and d 7 of treatment

On the 1st d of treatment, there was no significant difference between the serum TSH, FT3 and FT4 levels of patients in both groups (P>0.05); on the 7th d of treatment, the serum TSH, FT3 and FT4 levels of patients in both groups were significantly lower than those on the 1st d of treatment (P<0.05), but the serum TSH, FT3 and FT4 levels of patients in the observation group were significantly higher than those in the control group (P<0.05), see Table 4.

Table 3 Comparison of immune function index levels between the two groups of patients at d 1 and d 7 of treatment

Groups	Cases	CD_4^+ (%)		CD_8^+(%)		CD_4^+/CD_8^+	
		1d	7d	1d	7d	1d	7d
Observation group	39	34.42±5.78	25.78±4.36[a]	24.42±3.78	22.24±3.45[a]	1.41±0.36	1.16±0.24[a]
Control group	26	35.69±6.12	21.29±4.18[a]	25.13±3.66	21.35±3.12[a]	1.42±0.29	1.00±0.19[a]
t		-0.848	4.134	-0.751	1.058	-0.118	2.853

P	0.400	0.000	0.455	0.294	0.906	0.006

Note: Comparison with d 1, [a]P<0.05.

Table 4 Comparison of endocrine function index levels between the two groups at d 1 and d 7 of treatment

Groups	Cases	TSH (Uiu/mL)		FT3 (pg/mL)		FT4 (pg/mL)	
		1d	7d	1d	7d	1d	7d
Observation group	39	0.87±0.36	0.75±0.27[a]	3.51±0.49	2.86±0.33[a]	11.23±1.65	9.65±1.23[a]
Control group	26	0.91±0.29	0.61±0.26[a]	3.49±0.48	2.64±0.29[a]	10.79±1.82	8.87±1.09[a]
t		-0.473	2.078	0.163	2.761	1.011	2.619
P		0.638	0.042	0.871	0.008	0.316	0.011

Note: Comparison with d 1, [a]P<0.05.

Comparison of the prognosis of patients in the two groups

The duration of mechanical ventilation, ICU time and the incidence of VAP were significantly less in the observation group than in the control group (P<0.05), and there was no significant difference in the 28-d morbidity and mortality rate between the two groups (P>0.05), see Table 5 and Figure 1.

Table 5 Comparison of the prognosis of patients in the two groups

Groups	Cases	28 d death rate[n(%)]	Duration of mechanical ventilation(d)	ICU time(d)	VAPrate[n(%)]
Observation group	39	2(5.13)	7.68±2.15	13.42±3.15	8(20.51)
Control group	26	2(7.69)	12.46±2.39	16.57±4.24	14(53.85)
t		0.178	-8.397	-3.435	7.741
P		0.673	0.000	0.001	0.005

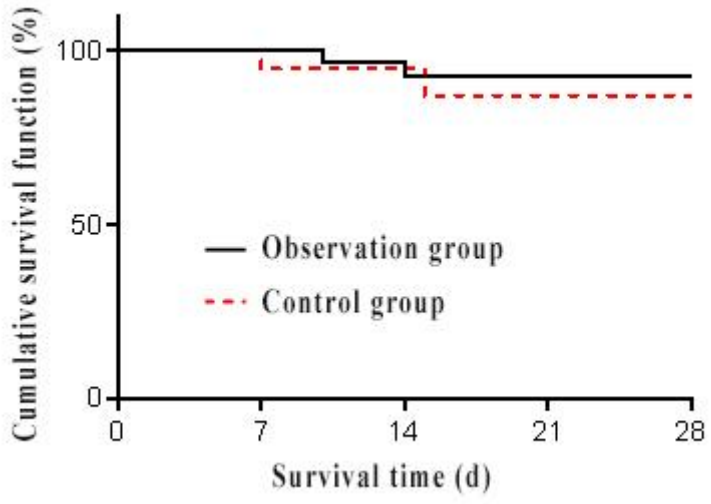

Figure 1 28 d survival curves for both groups

Discussion

With the increasing number of construction and traffic accidents and violent crimes, the incidence of severe craniocerebral injuries is gradually on the rise [9]. Severe craniocerebral injury can induce a stress response in patients, causing abnormalities in central nervous function, resulting in increased secretion of substances such as catecholamines, glucocorticoids and glucagon, and decreased insulin secretion, leading to a state of high oxygen consumption, metabolism and energy consumption, and abnormal endocrine, immune and gastrointestinal functions, which affect the prognosis of patients [10-12]. Some studies reported [13] that in the early treatment of severe craniocerebral injury, enteral nutrition can regulate the body's stress and immune response, correct the malnutrition state and has a high safety level. Enteral nutrition support can meet the normal physiological needs of patients, promote the recovery of gastrointestinal dynamics, prevent enteric-derived infections, stimulate the secretion of digestive juices and gastrointestinal hormones, and facilitate the increase of visceral blood flow, resulting in a lower incidence of adverse effects [14]. Roch AM et al. found[15] that the application of PEG-J enteral nutrition support therapy in patients with necrotizing pancreatitis was more effective than the nasojejunal tube approach. PEG-J can provide enteral nutrition more effectively and reduce the occurrence of complications. Santos C A et al[16] also reported that PEG-J has a better nutritional support effect in cancer patients. In this study, PEG-J was applied to enteral nutrition support in patients with severe craniocerebral injury, and good results were achieved.

The neurological damage to the brain in patients with severe craniocerebral injury leads to an increase in intracranial pressure and psychological stress, and there is often discomfort during the placement of enteral nutrition catheters, leading to severe pain and agitation [17]. Propofol is a short-acting alkyl acid anesthetic with a rapid and stable onset of action, while fentanyl acts centrally and has a strong analgesic effect, so the two are used together to improve the analgesic and sedative effects [18]. In this study, we found that the dosage of propofol and fentanyl in the first 7 d in PEG-J patients was less than that in patients with transnasal or oral gastric tubes, which indicates that PEG-J patients have a lesser degree of pain and agitation. This is due to the long-term compression and friction of the upper airway and gastrointestinal tract by the gastric tube, which tends to cause discomfort, whereas the PEG-J tube is less invasive, has a faster postoperative recovery, is more comfortable than the gastric tube, and is easier to tolerate, thus reducing the dosage of propofol and fentanyl. In addition, the reduced dosage of drugs reduces the disruption of bowel function, further relieving patients' pain and agitation symptoms [19].

Patients with severe craniocerebral injury are in a state of excessive stress and energy depletion, and the body's energy reserves and stress tolerance are insufficient, resulting in immune and endocrine dysfunction [20]. Some studies have reported [21] that CD4+ levels and CD4+/CD8+ ratios are decreased in patients with severe craniocerebral injury, and CD4+ can improve the body's immune response ability, while CD8+ can cause a decrease in immune response ability. are common clinical endocrine indicators. Liu YY and other scholars [22] found that patients with heavy craniocerebral injury may have thyroid dysfunction, resulting in reduced thyroid hormone secretion. In this study, we found that the CD4+ level, CD4+/CD8+ ratio, serum TSH, FT3 and FT4 levels of patients in the observation group were significantly higher than those in the control group on the 7th day of treatment, suggesting that PEG-J tubes can alleviate the body's immune and endocrine dysfunction. The intestine is rich in lymphatic system, which not only has the function of nutrient absorption, but also has a better immunomodulatory effect. PEG-J has better stability and is not easy to detube, which increases the success rate of enteral nutrition, which is conducive to the body's nutrient absorption, provides sufficient energy for neural cell metabolism, thus improving cell metabolism disorders, reducing brain tissue damage and relieving the body's immune and endocrine dysfunction.

In addition, this study also found that the duration of mechanical ventilation, ICU time and the incidence of VAP were significantly better in the observation group than in the control group, and there was no significant difference in the 28 d morbidity and mortality rate between the two groups, which indicated that PEG-J could improve the prognosis of patients. PEG-J was well tolerated by the patients. The tip of the PEG-J catheter was located behind the pylorus, which was less prone to reflux and less irritating to the nasopharyngeal mucosa, resulting in less nasopharyngeal secretions, which facilitated coughing and sputum, thus reducing the incidence of VAP. In addition, PEG-J can improve the nutritional status of patients, enhance the immune function of the body and promote disease recovery, thus shortening the time of mechanical ventilation and ICU for patients.

In conclusion, PEG-J enteral nutrition support therapy has a better effect on patients with severe craniocerebral injury, it can relieve patients' pain and agitation symptoms, improve the body's immune and endocrine function, and the patients have a better prognosis.

Acknowledgement

Not applicable.

Conflict of Interest

The authors declare no conflicts of interest.

Author Contributions

Conceptualization, Data curation, Y.D; Writing - Original draft, D.D.F; Writing - review and editing, J.Y; All authors have read and agreed to the published version of the manuscript.

Ethics Approval and Consent to Participate

The study was approved by the Medical Ethics Committee, and the patients were informed and consented.

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Availability of Data and Materials

The data presented in this study are available on request from the corresponding author.

Supplementary Material

Not applicable.

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