



Effect of Consistency of Diet on Swallowing and Blood Biochemical Components of Patients with Dysphagia After Brain Injury Surgery

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ABSTRACT

The objective of this study was to explore the effect of food consistency diet on different indicators and scales in patients with dysphagia after brain injury surgery. Patients (104) with traumatic brain injury who underwent surgical treatment were selected in the First Hospital of Jilin University between August 2020 to August 2022. Food consistency diet plan was implemented since February 2021, and 52 patients were divided into groups by random number table. The control group (GC) carried out routine postoperative diet, and the research group (GR) carried out quantitative food consistency diet plan on the basis of GC. After the intervention, the score of the standardized swallowing assessment (SSA) scale in GR was lower and the score of the functional oral intake scale (FOIS) scale in GR was higher. The total incidence of cyanosis, dyspnea, dysphonia, irritating cough and asphyxia in the study group was lower. GR has higher hemoglobin (Hb), albumin (Alb), prealbumin (PA) and total protein (TP). The implementation of food consistency diet plan in patients with dysphagia after brain injury surgery is helpful to the recovery of their swallowing function. It can reduce the incidence of aspiration related symptoms, ensure the intake of sufficient nutrients, and improve the levels of Hb, ALb, PA and TP.

Article Information

Received 15 March 2023
Revised 20 April 2023
Accepted 01 June 2023
Available online 24 July 2023
(early access)

Authors' Contribution

SJ and LS conducted the experiments in this study. HW and YL contributed to the design and interpretation of the current study and wrote the article. All authors read, revised, and approved the final manuscript.

Key words

Food consistency diet, Postoperative brain injury, Dysphagia, Nutrition level

INTRODUCTION

Brain injury is an open injury of brain under external force, and the incidence rate of disease can reach 15% in the incidence rate of total body injury. Its disability rate and mortality rate can reach 36.3% and 64.3%, ranking the first place in trauma diseases, and is an important cause of death of patients (McCarty and Lerner, 2021). Operation is an important treatment for craniocerebral injury, which can improve the symptoms and promote the prognosis of the disease. Although the effect of surgical treatment is significant, the brain nerve is prone to functional abnormalities under the influence of trauma and surgery, leading to postoperative dysphagia. It is reported (Frajkova *et al.*, 2020) that dysphagia will not only severely limit the

intake of nutrients in patients, but also lead to malnutrition. And swallowing disorders will reduce the body's immunity to the outside world and delay wound healing. Thus, the rehabilitation treatment plan is affected and the surgical treatment effect is reduced. Dysphagia is mainly manifested as eating irritating cough, eating difficulty, aspiration, etc. This will significantly increase the risk of aspiration pneumonia and asphyxia, threatening the life safety of patients. Although the implementation of routine nursing has certain nursing effects, it lacks pertinence and comprehensiveness in improving swallowing disorders and nutritional status. To this end, scientific and effective nursing measures are also needed, which is an urgent problem to be solved in clinical nursing. Studies on the elastic consistency and change rules of food related to food rheology have found that the laws of food tensile deformation and shear deformation often exist during individual swallowing. Food has a very important impact on swallowing function. Quantitative food consistency diet plan nursing is a nursing plan established on the basis of food rheology research, which helps to gradually recover swallowing function by improving food properties and quality (Roddy *et al.*, 2020). Therefore, this study was undertaken to improve the quality of life of patients with dysphagia after brain injury surgery. The implementation

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0030-9923/2023/0001-0001 \$ 9.00/0



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effect of food consistency diet plan has been analyzed and quantified.

MATERIALS AND METHODS

Patients

Patients (104) with brain injury who underwent surgical treatment in our hospital from August 2020 to August 2022 were selected as the study subjects. Quantitative food consistency diet plan nursing was implemented since February 2021, and 52 patients were divided into groups by random number table. There was no significant difference between the two groups in gender, age, Wada drinking water score and injury factors.

Inclusion criteria: (1) Through CT or magnetic resonance examination, it was diagnosed as craniocerebral injury, and all of them were operated for the first time in our hospital; (2) Postoperative vital signs and condition were stable; (3) The swallowing function of Wadian drinking water test was rated as grade III~V (Vermaire *et al.*, 2021); (4) Conscious and able to communicate normally. (5) The information is complete and meets the research requirements.

Exclusion criteria: (1) complicated with gastrointestinal functional organic disease; (2) Dysphagia caused by pharyngeal or esophageal diseases; (3) Postoperative complications, such as lung infection, brain hernia and persistent epilepsy; (4) Previous history of swallowing dysfunction; (5) Combined with other body injuries, such as abdominal, chest, spine, pelvis and other important position injuries or fractures.

Experimental plan

The patients were divided into groups, control (GC) and experimental (GR). GC was given routine postoperative diet care. Through the evaluation of Wada drinking water test, it was clear that the patient's swallowing function was in the grading standard. On the basis of the implementation of the routine diet nursing process, the patients were provided with diet guidance, including the type, nature, quantity and contraindication of diet intake. The patients and their families were informed of the types of diet they can eat daily, such as vegetables, lean meat, cereals, etc., and avoid eating liquid, semi-liquid, or dry, hard food.

The diet plan for GR was implemented on the basis of GC. (1) The preparation of paste food 6.4 g/bag of food thickener Shun Ning Bao (Nestle Health Science Co., Ltd.) was of warm boiled water added into it and stirred evenly to make it syrup consistency. Now, 1.5 bags of Shun Ning Bao were added, and the same stirring was used to form the consistency of egg custard. This was followed by addition

of 2 bags of Shun Ning Bao, and the pudding consistency was formed after stirring. (2) For swallow paste test before the test, the patients were allowed to swallow 5mL of syrup, 10mL of egg custard and 20mL of pudding with a 5mL teaspoon to evaluate whether the patient swallowed the thick food at one bite. During the experiment, it was judged whether there was abnormal sound, choking, and reduction of blood oxygen saturation level > 3% during swallowing. If one of the adverse symptoms occurred during swallowing, it means that the swallowing test is over. And the consistency of safe swallowing food is the previous level of food consistency, which is the standard to guide the patient to eat. (3) Implementation of diet plan nursing.

Incidence rate of aspiration related symptoms including cyanosis, dyspnea, dysphonia, irritating cough, asphyxia was recorded from the beginning of intervention to the discharge of the patient. Total incidence = number of cases/total number of cases × 100%.

For determination of nutritional indicators, 5mL of fasting venous blood was taken from the patient in the morning before and after the intervention for 4 weeks, and 2mL of serum was taken after centrifugation. The hemoglobin (Hb) level was measured by hematology instrument colorimetry. The levels of albumin (ALb), prealbumin (PA) and serum total protein (TP) were measured by automatic biochemical analyzer and rate transmission turbidimetry.

The questionnaires were completed by the patient or family members. 52 valid questionnaires were recovered, with a recovery and effective rate of 94.55%.

Statistical analysis

Using SPSS26.0 software, the measurement data conforms to the normal distribution and is described by the mean±standard deviation ($\bar{x}\pm s$). The independent sample *t*-test is used to count the data and the number of cases (*n*) and rate (%) within the group. Chi-square test was used between groups.

RESULTS

There were 52 females with a mean age of 45.68±12.37 years and 52 males with a mean age of 45.83±11.67 years. Table I shows demographic and traumatic brain injury related variables of the patients who participated in the study. As the table shows, there are no significant differences between the groups so it can be concluded that they are homogenous groups.

Table II shows SSA, Hb, Alb, TP and PA for before and after the intervention. No significant baseline differences

Table I. Basic information comparison (x±s, %).

Group	n	Gender		Age	Wada drinking water score	Injury factors			
		Male	Female			Traffic injury	Violent injury	Falling injury	Others
GC	52	24	28	45.68±12.37	3.16±0.28	21	14	13	4
GR	52	27	25	45.83±11.67	3.32±0.39	19	16	15	2
χ^2/t	-	0.346		0.064	0.601	1.043			
P	-	0.556		0.949	0.549	0.791			

Table II. Effect of consistency of diet on swallowing and blood biochemical components.

Index	Time	Group		t	P
		GC (n=52)	GR (n=52)		
SSA	Before intervention	25.49±2.61	25.93±2.35	0.492	0.624
	After intervention	20.07±2.20	15.48±1.96	11.551	0.000
Hb (g/L)	Before intervention	68.48±13.29	68.61±13.07	-0.862	0.391
	After intervention	107.42±14.59	114.28±15.34	2.337	0.021
ALb (g/L)	Before intervention	20.79±3.27	20.45±3.60	-0.694	0.489
	After intervention	35.67±4.92	37.49±5.87	2.872	0.005
TP (g/L)	Before intervention	62.03±8.71	62.59±9.12	-0.862	0.391
	After intervention	77.39±11.98	71.32±10.54	2.337	0.021
PA (mg/L)	Before intervention	110.49±35.29	110.52±34.37	0.600	0.550
	After intervention	175.49±41.69	196.27±43.25	2.135	0.035

Normal value of each index: Hb: male 120~165g/L, female 100~150g/L; ALb: 40~55g/L; TP: 60~83; PA: 240~350mg/L (Tetsuka *et al.*, 2021).

Table III. Comparison of FOIS functional grading.

Group	n	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7
Before								
GC	52	5	10	15	11	5	4	2
GR	52	6	11	15	10	5	3	2
t	-	0.287						
P	-	0.791						
After								
GC	52	2	4	6	9	12	11	8
GR	52	0	1	2	5	15	17	12
t	-	2.369						
P	-	0.003						

were found between the GR and the GC. While the SSA scores of the GR at after the intervention were significantly lower than those of the GC, the Hb, Alb, TP and PA scores were higher. The GR had lower scores at after the intervention compared to the GC.

Table III shows the comparison of FOIS functional grading for before and after the intervention. Before the intervention, FOIS evaluation grade has no difference (P >

0.05). After the intervention experiment, FOIS evaluation grade has difference (P < 0.05). The swallowing function grading of GR patients is better (P < 0.05). Furthermore, Table IV shows the comparison of the incidence of aspiration related symptoms for the study groups. The total incidence of cyanosis, dyspnea, dysphonia, irritating cough and asphyxia in GR was lower (P < 0.05).

Table IV. Comparison of the incidence of aspiration related symptoms.

Group	n	Cyanochoiria	Expiratory dyspnea	Dysphonia	Irritant cough	Stifle	Total incidence
GC	52	0(0.00)	1(1.92)	5(9.62)	8(15.38)	0(0.00)	14(26.92)
GR	52	0(0.00)	0(0.00)	1(1.92)	2(3.85)	0(0.00)	3(5.77)
t	-	-	1.010	2.830	3.983	-	8.509
P	-	-	0.315	0.093	0.046	-	0.004

DISCUSSION

Brain injury is a sudden and accidental brain injury disease in neurosurgery. It is the injury of brain tissue, blood vessels and nerves under the action of external forces, which often leads to different degrees of permanent dysfunction (Wang *et al.*, 2021; Capizzi *et al.*, 2020). The occurrence of dysphagia is the muscle dysfunction that innervates the swallowing nerve or soft palate, tongue and other positions under the influence of injury, resulting in the inability of patients to deliver daily water and food from the mouth to the stomach. However, the recovery period is in a high consumption state, and the body cannot obtain sufficient water and nutrients. This will not only aggravate the degree of dysphagia in patients with brain injury after operation, but also lead to the occurrence of complications related to aspiration (Cates *et al.*, 2022). Eltringham *et al.* (2020) found that increasing the consistency of food intake can effectively promote the eating status of patients with dysphagia and improve the swallowing function to a certain extent. The implementation of quantitative food consistency diet plan nursing is a diet plan nursing measure implemented on the basis of food consistency test. During the implementation of nursing, the consistency of the patient's safe swallowing of food is defined, so as to guide the patient's personalized diet and improve the accuracy, pertinence and scientificity of the implementation of diet nursing (Kodama *et al.*, 2021).

After intervention, GR's SSA score was lower ($P<0.05$), and its FOIS rating was better ($P<0.05$). GR's total incidence of cyanosis, dyspnea, dysphonia, irritative cough and asphyxia in decreased significantly ($P<0.05$). Quantitative food consistency diet plan nursing can improve the swallowing function of patients after brain injury surgery and reduce the incidence of aspiration related symptoms. Song *et al.* (2022) implemented fine personalized diet management under the food consistency level assessment mode in patients with dysphagia after acute cerebral infarction, improving swallowing function and reducing the occurrence of adverse symptoms related to aspiration. Analysis of main causes: The biggest hidden danger of dysphagia after brain injury surgery is that the viscosity of food is low, the speed of food flowing through

the bottom of the throat after eating is too fast, the time is short. And the neuromuscular does not respond in a short time, leading to swallowing dysfunction and causing symptoms related to aspiration. This time, the quantitative food consistency diet plan nursing was implemented. The thickener was used to make food of different consistency. The shape of the food taken by the patient was determined through the paste swallowing experiment, which provided an important reference basis for the patient's daily intake of food properties. So, patients could choose a diet with the consistency appropriate to his own height in the diet, avoid eating choking caused by too loose food properties, and provide high safety for the intake of food. This method can slow down the speed of food flowing through the throat, puncture the nerve and muscle function of the throat, and improve the swallowing function (Zhang *et al.*, 2022). On the basis of clarifying the characteristics of the patient's safe swallowing of food, it is necessary to help them formulate a diet, improve the comfort of the diet environment, and optimize the eating posture. Therefore, it can reduce the impact of external adverse factors on eating, maximize the safety of food intake, and reduce the total incidence of aspiration related symptoms (Illei and Shyu, 2020).

Quantitative food consistency diet plan nursing can improve the nutritional index level of patients after brain injury surgery. After intervention, the levels of GRHb, ALb, PA and TP increased compared with GC ($P<0.05$). Quantitative food consistency diet plan nursing has a high feasibility in the implementation of swallowing disorders in patients with brain injury after surgery. It can significantly improve the implementation of safe eating behavior of patients in the rehabilitation period after surgery, reduce the adverse events caused by swallowing disorders, and gradually restore the diet to the normal state. In addition, the implementation of diet guidance for patients strengthened their psychological relaxation and support, so that they could eat daily safe food with a happy mood and relaxed mind. This will help the body to absorb food nutrients and promote the improvement of the level of various nutritional indicators of the body (Li *et al.*, 2021).

There are limitations in the present study. The study only selected single-center subjects, and the long-term

rehabilitation indicators of patients were not evaluated, resulting in the limitations of the study results. Therefore, to improve the research effect, it needs select research objects in multiple centers, increase the evaluation of long-term indicators after surgery, and improve the research effect.

CONCLUSION

To sum up, the implementation of quantitative food consistency diet plan nursing in patients with brain injury after surgery has achieved ideal nursing effect. It can objectively and accurately guide patients' diet, reduce swallowing disorders caused by low food consistency, and reduce the occurrence of aspiration related symptoms. It ensures the daily diet intake of patients after operation, and promotes the recovery of body nutrition level.

Funding

Not applicable.

IRB approval

This study was agreed and approved by the Hospital Ethics Committee of the First Hospital of Jilin University, and was in line with the Helsinki Declaration.

Ethical approval

The study was carried out in compliance with guidelines issued by ethical review board and committee of the First Hospital of Jilin University, China. The official letter would be available on fair request to corresponding author.

Statement of conflict of interest

The authors have declared no conflict of interest.

REFERENCES

- Capizzi, A., Woo, J. and Verduzco-Gutierrez, M., 2020. Traumatic brain injury: An overview of epidemiology, pathophysiology, and medical management. *Med. Clin.*, **104**: 213-238. <https://doi.org/10.1016/j.mcna.2019.11.001>
- Cates, D.J., Evangelista, L.M. and Belafsky, P.C., 2022. Effect of pretreatment dysphagia on postchemoradiation swallowing function in head and neck cancer. *Otolaryngol. Head Neck Surg.*, **166**: 506-510. <https://doi.org/10.1177/01945998211009853>
- Eltringham, S.A., Kilner, K., Gee, M., Sage, K., Bray, B.D., Smith, C.J. and Pownall, S., 2020. Factors associated with risk of stroke-associated pneumonia in patients with dysphagia: A systematic review. *Dysphagia*, **35**: 735-744. <https://doi.org/10.1007/s00455-019-10061-6>
- Frajkova, Z., Tedla, M., Tedlova, E., Suchankova, M. and Geneid, A., 2020. Postintubation dysphagia during COVID-19 outbreak-contemporary review. *Dysphagia*, **35**: 549-557. <https://doi.org/10.1007/s00455-020-10139-6>
- Illei, P.B. and Shyu, S., 2020. Fine needle aspiration of thymic epithelial neoplasms and non-neoplastic lesions. *Semin. Diagn. Pathol.*, **37**: 166-173. <https://doi.org/10.1053/j.semmp.2020.04.006>
- Kodama, S., Fujiwara, S., Okawa, J., Shitara, S., Hori, K. and Ono, T., 2021. Modulation of tongue motion and tongue pressure during liquid swallowing with different bolus volumes. *J. Oral Rehabil.*, **48**: 1243-1251. <https://doi.org/10.1111/joor.13248>
- Li, H., Cen, K., Sun, W. and Feng, B., 2021. Prognostic value of geriatric nutritional risk index in elderly patients with heart failure: A meta-analysis. *Aging Clin. Exp. Res.*, **33**: 1477-1486. <https://doi.org/10.1007/s40520-020-01656-3>
- McCarty, M.F. and Lerner, A., 2021. The second phase of brain trauma can be controlled by nutraceuticals that suppress DAMP-mediated microglial activation. *Exp. Rev. Neurother.*, **21**: 559-570. <https://doi.org/10.1080/14737175.2021.1907182>
- Ninfa, A., Pizzorni, N., Eplite, A., Moltisanti, C. and Schindler, A., 2021. Validation of the Italian version of the functional oral intake scale (FOIS-It) against fiberoptic endoscopic evaluation of swallowing and nutritional status. *Dysphagia*, **37**: 137-147. <https://doi.org/10.1007/s00455-021-10257-9>
- Roddy, G.W., Rosa, R.H., Viker, K.B., Holman, B.H., Hann, C.R., Krishnan, A., Gores, G.J., Bakri, S.J. and Fautsch, M.P., 2020. Diet mimicking fast food causes structural changes to the retina relevant to age-related macular degeneration. *Curr. Eye Res.*, **45**: 726-732. <https://doi.org/10.1080/02713683.2019.1694156>
- Song, M., Liu, L., Feng, B., Chen, J. and Yang, Y., 2022. A preliminary study on the effect evaluation of electroacupuncture combined with balloon dilation in the treatment of dysphagia after cerebral infarction. *J. Behav. Brain Sci.*, **12**: 236-251. <https://doi.org/10.4236/jbbs.2022.125013>
- Tetsuka, S., Suzuki, T., Ogawa, T., Hashimoto, R. and Kato, H., 2021. Anti-Ro/SSA antibodies may be responsible for cerebellar degeneration in Sjogren's syndrome. *J. clin. med. Res.*, **13**: 113-120. <https://doi.org/10.14740/jocmr4429>
- van der Meulen, M., Dirven, L., Bakunina, K., van den

- Bent, M.J., Issa, S., Doorduijn, J.K. and Bromberg, J.E., 2021. MMSE is an independent prognostic factor for survival in primary central nervous system lymphoma. *J. Neuro-Oncol.*, **152**: 357-362. <https://doi.org/10.1007/s11060-021-03708-8>
- Vermaire, J.A., Terhaard, C.H., Verdonck-de Leeuw, I.M., Raaijmakers, C.P. and Speksnijder, C.M., 2021. Reliability of the 100 mL water swallow test in patients with head and neck cancer and healthy subjects. *Head Neck*, **43**: 2468-2476. <https://doi.org/10.1002/hed.26723>
- Wang, D., Hu, X., Xiao, L., Long, G., Yao, L., Wang, Z. and Zhou, L., 2021. Prognostic nutritional index and systemic immune-inflammation index predict the prognosis of patients with HCC. *J. Gastrointest. Surg.*, **25**: 421-427. <https://doi.org/10.1007/s11605-019-04492-7>
- Zhang, W., Pan, H., Zong, Y., Wang, J. and Xie, Q., 2022. Respiratory muscle training reduces respiratory complications and improves swallowing function after stroke: A systematic review and meta-analysis. *Arch. Phys. Med. Rehabil.*, **103**: 1179-1191. <https://doi.org/10.1016/j.apmr.2021.10.020>

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