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Impact of Individualized Nutritional Interventions on the Effect of Nutritional Improvement in Neurosevere Patients

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Abstract. Neurocritical care patients have highly heterogeneous nutritional needs due to metabolic disorders, organ dysfunction, and other pathophysiologic characteristics. Current nutritional support studies mostly focus on the effects of single nutritional formulas or isolated nutrients. Also, there is a lack of systematic comparisons between individualized nutritional interventions and fixed-formula regimens regarding clinical outcomes. This study aimes to investigate the differences in the effects of individualized nutritional interventions and fixed formulas (Jevity, Glucerna) on the improvement of nutritional metabolic indexes in neurocritical care patients. The study included 120 neurologically ill patients, divided into three groups: Jevity, Glucerna, and individualized nutrition. It compared the cystatin/creatinine ratio (SI), albumin, and hemoglobin before and after the 2-week intervention in the three groups. The results show that individualized nutritional support can improve the nutritional status of neurocritical care patients more effectively, but its modulating effect on albumin and long-term prognosis still need to be verified by large-sample studies.

Keywords: Individualized nutritional interventions, neurocritical patients, creatinine, cystatin

1. Introduction

Neurocritical patients usually experience severe consciousness disorders, comorbidities and complications, leading to complex conditions characterized by high morbidity, recurrence, disability and mortality [1]. These patients are often in a high metabolic state, and are highly susceptible to malnutrition due to eating disorders [2]. Malnutrition not only affects disease recovery, but also may increase complication rates, which in turn affects patient prognosis [3-4]. Therefore, effective nutritional support for neurocritical care patients has become an important topic in clinical research. Although studies on enteral nutrition exist, most focus on single nutritional modalities and lack systematic comparisons between individualized nutritional regimens and fixed-formula nutritional preparations, resulting in a weak evidence-based basis for clinical practice.

This study focuses on the nutritional support of neurocritical care patients, and uses clinical data analysis to compare the effects of individualized nutritional regimens and fixed-formula nutritional preparations (Jevity and Glucerna) on improving the nutritional status of patients. It explores the clinical application value of different nutritional programs by comparing their effects on patients'

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physiological indicators. This study provides data support for future optimization of individualized nutritional formulations, enabling clinicians to precisely adjust the nutritional structure of patients' diets to meet nutritional requirements, enhance the body's metabolic function, repaire nerve damage, reduce adverse event risks, and optimize the prognosis [5].

2. Research methods

2.1. Research design

This study is an intervention study that sets up a control

2.1.1. Study subjects

The main subjects of this study are 120 neurocritical patients in Shanghai Wo Bin Rehabilitation Hospital, including those with unstable vital signs due to neurological diseases or injuries who need to be admitted to the intensive care unit. In this study, three groups of patients (40 individuals per group, totaling 120) implementing different intervention modalities respectively were categorized according to gender and age ratio: 60-69 years old, 70-79 years old, 80-89 years old, and over 90 years old. .

2.1.2. Interventions

Tube feeding of Glucerna (1 liter provides about 1000 Kcal) involves the gradual administration of a nutrient solution into the body via gravity or an enteral feeding pump. The typical prescribed amount per session is usually 250-500 ml, with an input duration of 20-40 minutes, performed 5-8 times a day. Similarly, tube feeding of Gavisom (1 liter also provides about 1000 Kcal) can meet daily nutritional needs with 2000 Kcal (4 bottles).. Individualized intervention involves comprehensive nutritional screening and assessment, along with laboratory tests, evaluation of organ function, clinical manifestations, gastrointestinal function, and the patient’s actual tolerance. This approach formulates personalized nutritional plans, emphasizing micronutrients such as vitamins, trace elements, functional nutrients like DHA, glutamine, etc. These nutritional formulas are rich in micronutrients and immune-enhancing factors, which not only replenish the energy and nutrients required by patients, but also improve cellular metabolism and regulate the immune function.It will be dynamically adjusted according to the changes in the patients’ condition, nutrition-related indexes, organ function, gastrointestinal function, and tolerance to the nasal feed solution.

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Table 1: Compositional list and comparison of the used Jevity and Glucerna

Ingredient	Jevity	Glucerna
Energy	107 kcal	101 kcal
Protein	4g (whey protein hydrolysate)	4.18g
Fat	3.47g (mainly vegetable oil)	5.44g (rich in monounsaturated fatty acids)
Carbohydrate	14.05g (Maltodextrin as the main component)	8.14g (low-liter sugar formula)
DF	1.76g	1.44g
Vitamin A	377IU	546IU
Vitamin D	0.75ug	28IU
Vitamin E	2.3mga-TE	3.2IU
Vitamin C	10mg	11mg
Vitamin B1	0.17mg	0.16mg
Vitamin B2	0.20mg	0.18mg
Vitamin B6	0.23mg	0.21mg
Vitamin B12	0.39ug	0.30ug
Sodium	93mg	93mg
Calcium	92mg	70mg
Iron	1.4mg	1.3mg
Potassium	157mg	130mg
Zinc	1.1mg	1.2mg
Magnesium	22mg	20mg
Phosphorus	72mg	65mg

Table 1 shows that patients receiving Jevity tube-feeding therapy typically exhibit impaired or partially impaired gastrointestinal function, making them unable or unwilling to consume sufficient amounts of conventional food to meet their nutritional needs for enteral nutrition therapy. In contrast, patients treated with Glucerna tube-feeding therapy are characterized by diabetes mellitus. Those undergoing treated with personalized therapy often present with a combination of impaired gastrointestinal function, maldigestion, malnutrition, diabetes, and other related disorders.

2.1.3. Intervention time

This study involved participants receiving Jevity, Glucerna, and individualized treatment, for a duration of 14 days (i.e., 2 weeks). The choice of this time period was mainly to observe the effects of short-term nutritional interventions on physiological indices of neurocritical patients and to assess the initial effects of different nutritional regimens in improving patients' nutritional status and clinical prognosis. The two-week period provides sufficient data to assess the effects of short-term nutritional interventions while minimizing the interference of other confounding factors that may be associated with prolonged interventions. It is important to note that there are challenges in statistical analysis due to the high variability in individualized nutritional intake, with specific nutritional intake and composition varying from person to person.

2.2. Effectiveness indicators

The effectiveness of the interventions was assessed using several key indicators.

First, the cystatin difference was calculated as the difference between the cystatin value after two weeks of intervention and the pre-intervention cystatin value. The reference value for cystatin is 0.51-1.09mg/L, and in the study subjects, no samples had cystatin values below 0.51 mg/L.

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Therefore, a value greater than 1.09 mg/L was used as the criterion to determine whether cystatin levels were normal.

Second, the cystatin/creatinine ratio (SI) was analyzed. Recent studies has indicated that SI can be used as a screening index for malnutrition, and others have found it to be an effective index for assessing the muscle content, nutritional status, and prediction of poor prognosis in critically ill patients [6]. In this study, the difference between SI values after two weeks of intervention and pre-intervention SI values were recorded.

Lastly, this study evaluated albumin and hemoglobin levels by calculating the differences between their values after two weeks of intervention and their pre-intervention levels. Patients were required to fast before the examination, and fasting blood samples were taken early in the morning. Cystatin and creatinine values were measured by enzyme-linked immunosorbent assay (ELISA) while albumin values were detected by colorimetric assay. Meanwhile, hemoglobin was detected by using the method of high ferricyanide hemoglobin (HiCN).

2.3. Data collection and processing

In this study, data collection began with a total of 70 neurocritical patients over 60 years old who had received personalized treatment for more than two weeks .Second, another group of 70 neurocritical patients in the fixed-formula nutritional treatment population, who had been treated with Glucerna and Jevity for more than two weeks, was screened. Next, physiological index data such as cystatin, creatinine, uric acid, urea nitrogen, hematocrit and albumin were obtained from both groups approximately two weeks of treatment. Samples with uric acid higher than normal values were excluded. On this basis, the gender ratio and age distribution of the personalized treatment group were further determined, including four age levels: 60-69 years old, 70-79 years old, 80-89 years old and 90 years old and above. Subsequently, matched samples were randomly selected according to the gender proportion of the personalized treatment group and the age distribution in both the Elijah group and the Javits group, so that the demoTableic characteristics of the two groups were consistent. Eventually, the target study sample was determined, including 40 people from the personalized treatment group and 40 from each of the fixed-formula nutritional groups (Elijah and Gavisom), for a total of 120 people.

For the collection and processing of experimental data, the levels of creatinine, cystatin, hematocrit, and albumin values of the target samples at 14-day intervals were recorded. The SI was calculated using the formula SI=creatinine/cystatin*100%. The subtraction of the values of the before and after time points was used to reflect the improvement of the patients after two weeks of treatment; higher values indicated better improvement status, while lower values suggested the opposite.

The statistical results were compared and summarized by using SPSS software to analyze the experimental results with multiple paired samples Friedman test and one-way ANOVA.

3. Results and analysis

3.1. Description of the basic characteristics of the research subjects

The three groups of study subjects are all neurocritical patients, and their common points are impaired consciousness. These patients exhibited varying degrees of impaired consciousness, which could manifest as coma, drowsiness, or confusion. This impairment is often a result of compromised brain function due to primary conditions such as craniocerebral injuries or cerebrovascular

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accidents. Additionally, many participants experienced dysphagia, a condition that arises from weakened or absent swallowing reflexes due to impaired brain function. This can lead to serious complications, including aspiration and pneumonia. Furthermore, these patients often presented with unstable vital signs, characterized by abnormal respiration, heartbeat, blood pressure, and other critical indicators, which may stem from their primary diseases or related complications.

3.2. The effects of Jevity and Elijah, individualization on cystatin C indexes

Table 2: Results of cystatin ANOVA for each group

	Jevity	Glucerna	Individuation	PIndividuation vs PJevity	PIndividuation vs PGlucerna
Pre-intervention cystatin	1.415	1.507	1.308		
After intervention, cystatin	1.457	1.581	1.359	0.900	0.526
D-value	0.041	0.074	0.S051		

As shown in Table 2, at the end of the study, the cystatin C index was higher than its initial level in all three groups of subjects. After conducting an analysis of variance, the statistical rsults showed that the P-value of Individuation group compared with Jevity group was 0.900, and the P-value of Individuation group compared with Glucerna group was 0.526. These results indicated that the differences in cystatin C level changes among the different intervention regimens were not significant, suggesting that there might be no significant difference among the three nutritional intervention modalities in improving cystatin C levels.

3.3. Comparison of the influence of Jiawei, Yili and individualized treatment on creatinine index

Table 3: Results of creatinine ANOVA for each group

	Jevity	Glucerna	individuation	PIndividuation vs PJevity	PIndividuation vs PGlucerna
Pre-intervention creatinine	59.317	60.5	45.371		
Creatinine after intervention	51.979	53.097	45.702	0.062	0.15
D-value	-7.337	-7.403	0.331		

As shown in Table 3, the P-values of the three groups were not significant, indicating that there was no significant difference in creatinine 1, creatinine 2, and creatinine difference between Javisil, Elijah, and Individualized. The mean creatinine difference for Jevity and Elijah was negative, indicating that there was an overall trend of decreasing creatinine in patients after treatment with Jevity and Elijah. Furthermore, since all P-values were greater than 0.05, there was no significant difference between the matched pairs of samples in each group. According to Cohen's d value, the magnitude of difference between Gavisom and Elijah was moderate as was the difference between Gavisom and Individualized treatment. In contrast, the magnitude of difference between Elijah and Individualized was very small.

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3.4. The influence of individualization on SI value

Table 4: Results of the SI ANOVA for each group

	Jevity	Glucerna	individuation	PIndividuation vs PJevity	PIndividuation vs PGlucerna
Pre-intervention SI	40.954	37.741	35.017		
Post-intervention SI	35.619	33.08	34.291	0.029	0.064
D-value	-5.793	-4.662	-0.889		

As shown in Table 4, the mean values of Gavisomics and Individualization in terms of difference are -5.793/-0.889 respectively. Due to the satisfaction of variance chi-square, the one-sample ANOVA test was used, yielding a P-value of 0.029** (≤ 0.05), indicating a statistically significant difference between the various intervention modalities.

In addition to this, Table 4 demonstrates the results of the ANOVA of means, which reveal that the SI difference of personalized nutritional therapy is greater than that for Jevity nutritional therapy. This indicates that personalized nutritional interventions are more effective in improving the nutritional status of patients with neurological critical illnesses.

Moreover, the mean values of Ilica and Individualized in terms of difference are -4.662/-0.889. The one-sample ANOVA test shows a p-value of 0.064*>0.05, which reflects the significance at the 10% probability.

From the ANOVA mean comparisons, it can be found that the SI difference of personalized nutritional treatment is greater than that for Glucerna Nutritional Treatment, which indicates that personalized nutritional intervention is more effective in improving the nutritional status of patients with neurocritical illness.

3.5. Effect of individualized, individualized on Albumin and Heme indexes

Table 5: Results of ANOvariance for each group

	Jevity	Glucerna	individuation	PIndividuation vs PJevity	PIndividuation vs PGlucerna
Pre-intervention albumin	33.521	34.348	34.911		
Posterior intervention albumin	34.074	34.953	35.368	0.256	0.833
D-value	-1.559	0.85	0.609		

Table 5 shows that the mean values of Gavisomics and Individualized in terms of albumin difference (calculated by subtracting the values from the two time points) are -1.559/0.609. Since variance chi-squaredness was not satisfied, Welch's ANOVA test was used, and the ANOVA resulted in p-value of 0.256>0.05. Therefore, the statistical result is not significant, which indicates that there is no significant difference in the albumin difference 1 among different intervention modalities.

Additionally, table 5 exhibits the mean values of Elijah and Individualized on Albumin Difference 2, 0.85/0.609 respectively. As variance chi-square was satisfied, one-sample ANOVA test was used, yielding a P-value of 0.833>0.05. Therefore, the statistical result was not significant between the different intervention modalities on the Albumin Difference 2.

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Table 6: Results of heme analysis of variance for each group

	Jevity	Glucerna	individuation	PIndividuation vs PJevity	PIndividuation vs PGlucerna
Pre-intervention heme	102.424	105.824	104.66		
Post-intervention heme	101.438	105.395	111.313	0.012	0.04
D-value	-4.188	0.827	7.021		

Table 6 presents the mean values of Gavisom and Individualized in terms of hemoglobin difference, which are -4.188/ and .021. Due to the satisfaction of variance chi-square, one-sample ANOVA test was used, resulting in a P-value of 0.012** ≤ 0.05. This indicates the statistical results are significant, demonstrating a significant difference between different modes of interventions 1 in terms of the hemoglobin difference.

Table 6 also demonstrates that the albumin and hemoglobin difference of personalized nutritional treatment is greater than that of Elijah's nutritional treatment. However, since the differences in albumin levels among the various interventions are not significant, this does not indicate that personalized nutritional treatment is more effective in nutritional improvement for patients with neurological critical illness. The difference of hemoglobin difference indicates that personalized nutritional intervention is better for improving nutritional status of neurocritical patients.

Table 6 shows the mean values of Iliga and personalized on hemoglobin difference 2 are 0.827 and 7.021 respectively. Due to the satisfaction of variance chi-square, one-sample ANOVA test was used, yielding a P-value of 0.040** ≤ 0.05, so the statistical result is significant, indicating a significant difference between the different intervention modalities on the hemoglobin difference 2.

It can be found from the comparison of mean values that the hemoglobin difference of personalized nutritional treatment is greater than that of Elijah's nutritional treatment, while the albumin difference is smaller than that of the Elijah's group. However, since the difference in albumin levels among the intervention modalities are not significant, it can't show that Elijah's nutritional treatment is more effective in nutritional improvement for the patients with neurological critical illness. The significant hemoglobin difference further supports the conclusion that personalized nutritional intervention is more effective in improving the nutritional status of neurocritical patients.

4. Conclusion

The results of this study showed that there was no significant improvement in cystatin C indexes in the three groups of Jevity, Glucerna and individualized treatment. The proportion of patients with elevated cystatin C increased in the Jevity group, suggesting a possible impact on renal function, which was similarly observed in the Glucerna group. Nearly half of the patients in both groups had elevated cystatin C levels, and four patients in the Jevity group showed abnormal indicators, suggesting that both fixed-formula nutrition may increase the risk of kidney disease. Cystatin C levels were elevated in more than 60% of the patients in the individualized treatment group; hwoever, this did not lead to an increase in the number of abnormal indicators. This finding suggests that individualized feeding may have some improvement in renal function, despite lack of conclusive evidence to rule out the potential risk.

In terms of creatinine levels, 70% of patients in the Jevity group showed a decrease in creatinine levels after treatment, while 57% of patients in the Glucerna group also showed a decreasing trend. In contrast, 54% of patients in the individualized treatment group showed an increase in creatinine levels, with three patients recovering from higher values to normal. There was no significant

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difference in creatinine levels among the three groups, and the effect of individualized nutrition on muscle mass improvement needs to be further verified. While there was no significant change in albumin level, the changes in SI and hematocrit were substantial with individualized intervention showing better improvement. This suggests that individualized nutrition may be more advantageous in optimizing nutritional status.

A limitation of this study is the relatively small sample size, which may affect the generalizability of the results. Future studies should explore the differences between different interventions in nutritional improvement of neurocritical care patients with an expanded sample size to provide more basis for clinical practice. In addition, other factors affecting the nutritional status of neurocritical care patients can be studied in depth to providing a more comprehensive and effective nutritional treatment program.

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