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Assessment of the Condition of Patients with Organic Damage to the Central Nervous System, Who Underwent Nutritional Treatment During Hospitalization

Ocena stanu pacjentów z organicznym uszkodzeniem ośrodkowego układu nerwowego, poddanych leczeniu żywieniowemu w trakcie hospitalizacji

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Abstract

Introduction. Malnutrition is a condition in which, due to a lack of absorption or supply of appropriate nutrients, changes occur in body composition and impairment of physical and mental functioning, which can adversely affect the treatment of diseases.
Aim. The study aimed to assess the condition of patients with organic damage to the central nervous system (CNS) who underwent nutritional therapy during hospitalization.
Material and Methods. The retrospective analysis included 42 patients hospitalized due to traumatic brain injuries or vascular CNS disorders who received enteral nutrition through a nasogastric tube. Clinical outcomes were evaluated using the Glasgow Coma Scale (GCS) at admission and the Glasgow Outcome Scale (GOS) at discharge. Biochemical parameters, including total protein, albumin, leukocytes and C-reactive protein (CRP), were analyzed before and after nutritional intervention.
Results. The results showed no significant relationship between the initial neurological status (GCS) and the final clinical outcome (GOS). A statistically significant association was found between older age and lower functional independence at discharge. Longer duration of nutritional therapy was strongly correlated with prolonged hospitalization. Nutritional treatment did not significantly affect total protein or albumin levels; however, it led to statistically significant reductions in inflammatory markers, including CRP and leukocyte counts.
Conclusions. Nutritional therapy proved beneficial primarily in reducing inflammation, which may support recovery in patients with organic CNS damage. The findings emphasize the importance of early nutritional assessment, individualized nutritional strategies and interdisciplinary collaboration in the care of neurological patients. **(JNNN 2025;14(4):151–157)**
Key Words: malnutrition, neurological patients, nutritional therapy

Streszczenie

Wstęp. Niedożywienie jest stanem, w którym, z powodu braku wchłaniania lub dostarczania odpowiednich składników odżywczych, dochodzi do zmian w składzie ciała oraz upośledzenia funkcjonowania fizycznego i psychicznego, co może niekorzystnie wpływać na leczenie chorób.
Cel. Celem pracy była ocena stanu pacjentów z organicznym uszkodzeniem ośrodkowego układu nerwowego (OUN), u których podczas hospitalizacji zastosowano leczenie żywieniowe.

Materiał i metody. Analizą retrospektywną objęto 42 pacjentów hospitalizowanych z powodu urazów czaszkowo-mózgowych lub chorób naczyniowych OUN, u których wdrożono żywienie dojelitowe przez sondę nosowo-żołądkową. Stan kliniczny oceniano za pomocą skali Glasgow (GCS) przy przyjęciu oraz skali Glasgow Outcome Scale (GOS) przy wypisie. Przeanalizowano również parametry biochemiczne, takie jak białko całkowite, albuminy, leukocyty oraz białko C-reaktywne (CRP), przed i po interwencji żywieniowej.
Wyniki. Wyniki wykazały brak istotnego związku pomiędzy stanem neurologicznym przy przyjęciu (GCS) a stanem klinicznym przy wypisie (GOS). Stwierdzono natomiast, że wiek istotnie wpływa na poziom samodzielności — osoby starsze osiągały gorsze wyniki funkcjonalne. Czas trwania leczenia żywieniowego był silnie skorelowany z długością hospitalizacji. Terapia żywieniowa nie miała istotnego wpływu na poziom białka całkowitego i albumin, jednak prowadziła do statystycznie istotnego obniżenia markerów zapalnych — CRP i leukocytów.
Wnioski. Leczenie żywieniowe okazało się szczególnie korzystne w redukcji stanu zapalnego, co może wspierać proces zdrowienia pacjentów z organicznym uszkodzeniem OUN. Uzyskane wyniki podkreślają znaczenie wczesnej oceny stanu odżywienia, indywidualizacji terapii żywieniowej oraz współpracy interdyscyplinarnej w opiece nad chorymi neurologicznymi. **(PNN 2025;14(4):151–157)**
Słowa kluczowe: niedożywienie, pacjenci neurologiczni, leczenie żywieniowe

Introduction

Malnutrition is a condition in which, due to a lack of absorption or supply of appropriate nutrients, changes occur in body composition and impairment of physical and mental functioning, which can adversely affect the treatment of diseases. Malnutrition is found in 20–40% of patients admitted to the hospital. Malnutrition can worsen in 70% of patients who were malnourished at the time of admission and can develop in 30% of well-nourished patients during hospitalization, known as hospital malnutrition. Attention should be paid to patients with neurological disorders, who are often at risk of malnutrition due to symptoms accompanying neurological diseases that adversely affect prognosis. These symptoms include neurogenic dysphagia, gastrointestinal dysfunction, cognitive and consciousness disorders, motor limitations, or depression [1,2].

Particular attention should be paid to dysphagia occurring in patients with neurological disorders, which can cause nutritional disorders. Dysphagia refers to swallowing disorders at any stage of the swallowing process: the preoral phase, when food is taken in, the oral phase when chewing and forming boluses occur, and the pharyngeal and esophageal phases when food moves to the stomach. In patients with neurological disorders, dysphagia can occur in 50% of them [1,3]. The priority in treating dysphagia is to resume oral intake of food by the patient [3]. During dysphagia, cooperation with a speech therapist is recommended, through which the patient can take even small amounts of fluids through exercises and proper head positioning [4]. Swallowing disorders can lead to malnutrition or aspiration pneumonia, and ultimately to the patient's death, so detecting dysphagia at an early stage is highly beneficial for the patient and their prognosis in treating neurological diseases [1].

Every patient admitted to the hospital ward should be assessed for the risk of malnutrition. This is equally important for patients with head injuries. The nutritional status of patients can be assessed using a nutritional interview, anthropometric measurements including current body weight, unintentional weight loss, body mass index (BMI), arm circumference, skinfold thickness over the triceps muscle, handgrip strength, and bioimpedance, biochemical tests — serum levels of total lymphocyte count, albumin, prealbumin, and transferrin, and additionally using nutritional assessment scales: Mini Nutritional Assessment (MNA), Malnutrition Universal Screening Tool (MUST), Nutritional Risk Screening 2002 (NRS 2002), and Subjective Global Assessment (SGA) [5,6].

Particularly important among these scales is the NRS 2002 scale. It was created in 2002 and its purpose is screening and analysis of malnutrition in hospitalized patients. With its help, patients whose disease qualifies them for nutritional treatment can be identified, and malnutrition indicates the need for nutritional treatment. The questions in the first part of the questionnaire can show the degree of malnutrition before hospitalization, while the second part of the questionnaire focuses on the severity of the disease and adjusting the energy value to it. It is possible to score from 0–6 points for both parts, and an additional point is added if the patient is over 70 years old. Scoring 3 points qualifies the patient for nutritional treatment [6,7].

The aim of the study was to assess the condition of patients with organic damage to the central nervous system, who underwent nutritional treatment during hospitalization. Specific objectives are: to assess the impact of the applied nutritional treatment on the final clinical outcome assessed on the GOS scale depending on age and gender; to assess the impact of the applied nutritional treatment on the final neurological condition of patients with selected organic CNS damage compared to the clinical condition at admission; to assess the impact of the duration of nutritional treatment on the

length of hospitalization; to assess the impact of the applied nutritional treatment on the results of selected biochemical parameters (total protein, albumin, leukocytes, CRP).

Material and Methods

The study group consisted of patients who, during hospitalization in the Department of Neurosurgery and Neurology of the Provincial Hospital in Bielsko-Biała, due to organic damage to the central nervous system (as a result of cranio-cerebral injuries or vascular diseases of the CNS), underwent nutritional treatment through a nasogastric tube.

Inclusion Criteria for Patients in the Study: Patients admitted to the Department of Neurosurgery and Neurology with symptoms of organic damage to the central nervous system as a result of cranio-cerebral injuries or vascular diseases of the central nervous system, who were included in nutritional treatment. Patients who had complete medical documentation covering the studied parameters.

Exclusion Criteria: Patients who had nutritional treatment included in the terminal stage of cancer. Patients with incomplete medical documentation.

The method used in the study was a retrospective assessment of patients' medical documentation, taking into account sociodemographic and clinical data of the patients. The analysis included laboratory test results and nursing observations. The neurological condition at admission was assessed using the GCS scale [8], and at discharge using the GOS scale [9]. The collected information was used to create a database in MS Excel 2016, which was used for statistical calculations.

The Shapiro–Wilk test was used to assess the normality of data distribution. The Student's t-test for dependent samples was used to compare mean values before and after nutritional intervention. In cases where the data distribution did not meet the normality assumptions, the Wilcoxon test for dependent samples was used, which is a non-parametric equivalent of the Student's t-test, allowing for the assessment of changes in medians. Additionally, the relationship between the duration of nutritional treatment and the length of hospitalization was assessed using Spearman's rank correlation, which allowed for the identification and assessment of the strength and direction of the relationship between these variables. Data analysis was performed using IBM SPSS version 28.0 PL software. A significance level of 0.05 (5%) was adopted for the study.

Results

Data from 42 patients with organic damage to the central nervous system were included in the analysis. Among them, 57.1% (N=24) were men and 42.9% (N=18) were women. To better characterize the study group, the age of the patients was analyzed. The average age of patients treated with nutritional therapy was 70.48±14.69 years (ranging from 36 to 94 years). The patients treated with nutritional therapy were divided into two age categories: <70 years and >70 years. In the group of patients who received nutritional therapy, there were 24 men (57.14%) and 18 women (42.86%). The average age of men was 66.92 years (ranging from 37 to 87). The average age of women was 75.22 years (ranging from 36 to 94). The average length of hospitalization was 35.10±22.02 days, with a range of 10 to 116 days. The average duration of nutritional treatment was 22.51±20.73 days, with a range of 2 to 95 days (Table 1).

The most commonly used preparation was Nutrison in 31.0% of cases, Nutrison Diason was received by 16.7% of patients, Nutrison Energy by 11.9% of the subjects. Cubison and Diben were administered in 7.1% of cases, Nutrison Protein Advance in 2.4% of patients. Additionally, 23.8% of patients were treated with more than one nutritional mixture, which emphasizes the individualization of nutritional therapy to more effectively address diverse nutritional needs.

The study analyzed a number of clinical parameters to gain a fuller understanding of the health status and response of patients to nutritional therapy. Among these parameters were indicators such as the Glasgow Coma Scale (GCS) at admission and the Glasgow Outcome Scale (GOS) at discharge, used to assess the neurological condition and clinical outcomes of patients after treatment (Table 2).

Table 1. Data of Analyzed Patients (N=42)

Variable	M	SD	Min	Max	W	p
Age of Patients (in years)	70.48	14.69	36	94	0.940	0.030
Length of Hospitalization (days)	35.10	22.02	10	116	0.770	<0.001
Duration of Nutritional Treatment (days)	22.51	20.73	2	95	0.799	<0.001

M — mean; SD — standard deviation; Min — minimum value; Max — maximum value; W — Shapiro–Wilk test value; p — significance of the Shapiro–Wilk test

Table 2. Clinical Parameters at Admission and Discharge (N=42)

Variable	M	SD	Min	Max	W	p
GCS at Admission	8.36	3.07	3	15	0.956	0.108
GOS at Discharge	2.98	0.90	2	5	0.805	<0.001

M — mean; SD — standard deviation; Min — minimum value; Max — maximum value; W — Shapiro–Wilk test value; p — significance of the Shapiro–Wilk test

Table 3. Analysis of laboratory parameters of patients at admission and discharge (N=42)

Variable	M	SD	Min	Max	W	p
Total protein						
Before nutritional therapy [g/dl]	6.05	0.72	4.6	7.5	0.981	0.720
After nutritional therapy [g/dl]	6.20	0.66	4.8	7.6	0.970	0.354
CRP						
At admission [mg/l]	70.18	63.87	0.62	249.30	0.902	0.002
At discharge [mg/l]	33.51	26.48	1.23	98.66	0.902	0.002
Albumin						
Before nutritional therapy [g/dl]	3.33	0.54	2.4	4.8	0.957	0.119
At discharge [g/dl]	3.33	0.59	2.1	4.25	0.961	0.168
Leukocytes						
At admission [10^3/mm^3]	11.19	4.17	4.1	23.5	0.948	0.061
At discharge [10^3/mm^3]	9.61	3.39	3.5	18.5	0.971	0.373

M — mean; SD — standard deviation; Min — minimum value; Max — maximum value; W — Shapiro–Wilk test value; p — significance of the Shapiro–Wilk test

To illustrate changes in laboratory parameters, some of them were analyzed. The levels of total protein before and after nutritional therapy, creatinine and CRP at discharge and admission, albumin before the initiation of nutritional therapy and at discharge, and the number of leukocytes at admission and discharge were analyzed (Table 3).

The average total protein value before nutritional therapy was 6.05±0.72 g/dl, suggesting relatively low variability among the subjects. In contrast, the total protein values after nutritional therapy show a slight improvement with an average of 6.20±0.66 g/dl.

CRP values at admission oscillate around an average of 70.18±63.87 mg/l, indicating significant differences in the inflammatory state among patients at the beginning of the study. CRP at discharge noticeably decreases, reaching an average of 33.51±26.48 mg/l. Albumin levels before the initiation of nutritional therapy and at discharge have very similar average values (3.33 g dl), with slight differences in standard deviations, indicating the stability of this clinical parameter during treatment. Analyzing leukocytes at admission and discharge, a decrease in the average value from 11.19 to 9.61 (103/mm^3) is observed. The Shapiro–Wilk test used to assess the normality of distributions indicates that most parameters do not differ significantly from the normal distribution, considering significance values higher than 0.05.

As part of the assessment of the condition of patients with organic damage to the central nervous system (CNS), whose nutritional therapy was an element of treatment during hospitalization, it was also important to examine how demographic and clinical variables affect clinical outcomes at discharge. Particularly interesting were aspects such as the gender and age of patients, as well as their clinical condition at hospital admission, measured using the Glasgow Coma Scale (GCS). The analysis of these variables allowed for a deeper understanding of how these factors affect the overall functional status of patients at discharge, assessed using the Glasgow Outcome Scale (GOS).

The average clinical score at discharge for women was 2.89±0.83, while for men, this average was slightly higher at 3.04±0.95. The Mann–Whitney U test value was –0.429, and the level of statistical significance reached 0.668. The low Z value indicates that the differences in clinical outcomes between genders are not statistically significant (Table 4).

Table 4. GOS rate at discharge

GOS at discharge	N	M	SD	Z	p
Gender					
Women	18	2.89	0.83	–0.429	0.668
Men	24	3.04	0.95		
Age					
<70 years	20	3.15	0.93	–1.683	0.024
>70 years	22	2.81	0.85		

N — number of observations; M — mean; SD — standard deviation; Z — value of the Mann–Whitney U test; p — significance of the Mann–Whitney U test

Individuals under 70 years of age (N=20) achieved an average GOS score of 3.15±0.93, suggesting that most patients in this age group achieved a moderate level of independence or better. In contrast, for the group of individuals over 70 years of age (N=22), the average GOS score was slightly lower, at 2.81±0.85. This result may indicate a slightly worse overall functional status in this age group at discharge. The obtained Z value was

–1.683, and the level of statistical significance reached 0.024. These results indicate that there are statistically significant differences in GOS scores between the younger and older age groups, suggesting that age affects the degree of independence or level of disability of patients at discharge from the hospital, with older individuals showing a lower level of independence (Table 4).

The Spearman's rho correlation coefficient value was 0.179, indicating a weak correlation between the initial clinical condition of patients and their condition at discharge. The level of significance for this correlation was 0.256, which means that there is no statistically significant relationship between GCS scores at admission and GOS scores at discharge in the studied group.

This analysis is a key element in assessing the effectiveness of healthcare. As part of the study, a Spearman's rank correlation analysis was conducted to examine the relationship between the duration of nutritional treatment and the length of hospitalization. The Spearman's rho correlation coefficient value was 0.659, indicating a strong positive correlation between the duration of nutritional treatment and the length of hospitalization. A p-value of less than 0.001 indicates a high level of statistical significance for this correlation. These results suggest that longer nutritional treatment is associated with an extended length of hospital stay.

The impact of the applied nutritional treatment on the levels of total protein, C-reactive protein (CRP), albumin, and leukocytes in a group of patients hospitalized due to organic CNS damage was analyzed. These parameters were chosen due to their importance in monitoring nutritional status, inflammatory status, and the overall response of the body to treatment (Table 5).

Table 5. Study of the impact of applied nutritional therapy on the levels of selected parameters

Parameter	M	SD	t	p
Total Protein				
Before nutritional therapy	6.05	0.72	–1.449	0.155
After nutritional therapy	6.20	0.66		
Albumin				
Before nutritional therapy	3.33	0.54	–0.021	0.984
At discharge	3.33	0.59		
Leukocytes				
At dimension	11.19	4.17	2.082	0.044
At discharge	9.61	3.39		
CRP				
At dimension	70.18	63.87	–2.570	0.010
At discharge	33.51	26.48		

M — mean; SD — standard deviation; t — Student value; p — significance of the Mann–Whitney U test

The average total protein level before the start of nutritional therapy was 6.05±0.72 g/dl. After the application of nutritional therapy, the average total protein level increased to 6.20±0.66 g/dl. The t-test value for dependent samples was –1.449, and the level of statistical significance reached 0.155. Although an increase in the average total protein level after nutritional therapy is observed, a p-value greater than 0.05 indicates that statistically significant differences between protein levels before and after treatment were not confirmed.

The study of the effectiveness of the applied nutritional therapy on the albumin level among patients with organic damage to the central nervous system shows no statistically significant changes in the level of this protein. The average leukocyte level at hospital admission was 11.19±4.17 (103/mm³). After the application of nutritional therapy, it decreased to 9.61±3.39 (103/mm³) with a standard deviation (103/mm³), suggesting a potential improvement in the inflammatory state. The t-test value for dependent samples was 2.082, and the level of statistical significance reached 0.044. This result indicates a statistically significant difference in leukocyte levels before and after nutritional therapy.

The average CRP level at hospital admission was 70.18±63.87 mg/l. After the application of nutritional therapy, the average CRP level significantly decreased to 33.51±26.48 mg/l. A low p-value below the statistical significance threshold of 0.05 indicates that the observed reduction in CRP levels is statistically significant.

Discussion

The study focused on the impact of nutritional therapy on the condition of patients with organic damage to the central nervous system. A group of patients with organic CNS damage due to injuries and vascular diseases was selected due to the highest frequency of nutritional therapy in these patient groups. The analysis of medical documentation showed that the majority of patients were men (57.14%). Organic damage to the central nervous system can result from injuries, which men experience more frequently, as shown in Szewczak's work [10]. Men are also a group more prone to strokes, which may contribute to a greater problem of damage in this gender [11].

Organic damage to the central nervous system can affect people regardless of age, but in our analysis, it was shown that it mainly affects older people, as the average age is 70.48 years. The literature confirms that, apart from children, people over 65 years of age, especially men, are most at risk of traumatic brain injuries, with falls being the most common cause [12].

The task of nutritional therapy is to improve and maintain the health status of patients. Our research shows that most patients had a moderate degree of consciousness impairment, as suggested by the GCS scale. Comparing the clinical condition of patients on the GCS and GOS scales, no significant improvement was observed, which may be related to the fact that the GOS scale measures long-term outcomes, while the GCS scale is particularly important at the very beginning of patient assessment and shortly after possible treatment to assess whether its results are positive. Based on studies from 18 hospitals in Taiwan, it was found that in patients with severe traumatic brain injury who received enteral nutrition, the GCS score improved after 7 days of treatment, especially in those patients who had 6–8 points on the GCS scale [13]. In one hospital in Tianjin, the impact of nutritional therapy on patients with severe cranio-cerebral injury was studied. All patients achieved significantly higher GCS scores after 14 days, but the most positive impact was observed when enteral nutrition was introduced 25–48 hours after injury [14]. Unfortunately, there is a lack of studies.

The functional status assessed using the GOS scale is very important for the overall assessment of patients' functioning after treatment. The study aimed to check whether there is a relationship between the age of patients and the outcome at discharge. Significant differences were observed between the independence status of younger and older patient groups. Older people have a worse clinical condition and greater difficulty in returning to full functionality compared to younger people. Similar results were obtained by Renner et al., where the impact of age on the GOS score was also demonstrated [15].

In our research, biochemical parameters were analyzed before and after the application of nutritional therapy. The focus was mainly on albumin, protein, CRP, and leukocyte levels. In this study, it was observed that the albumin level may not change after the application of nutritional therapy, suggesting no impact on this parameter. In the study by Liu Ruidong Zhou Yip, the assumption of no significant differences in albumin levels after nutritional therapy was also confirmed [14]. However, in one study by Fan Ming-chao et al. [16], where two routes of nutritional therapy — enteral and parenteral — were compared, it was shown that enteral nutrition significantly lowers serum albumin parameters, although parenteral nutrition is much more beneficial. In the studies by Walewska et al. [17], the serum albumin level increased after 6 months of nutritional therapy, but most patients struggled with malnutrition, resulting in low albumin levels, so its increase is definitely desirable.

Acute phase protein, or CRP, is a useful parameter recommended for testing in cases of central nervous system damage to visualize the extent of inflammation and to monitor whether the disease is subsiding during treatment. The studied patients had high CRP levels before the introduction of nutritional therapy. A beneficial effect of nutritional therapy on the reduction of CRP levels was observed. In the studies by Koniecka et al. [18], the application of nutritional therapy in a group of neurological patients caused a significant decrease in C-reactive protein levels after 6 and 12 months of treatment, suggesting a positive impact of nutrition on the reduction of the inflammatory marker. Similar results regarding the reduction of CRP levels after the introduction of nutritional therapy were observed by researchers in China. A significant decrease in acute phase protein concentration was observed after 14 days of treatment [19].

The average leukocyte level in our study was slightly above normal. However, after nutritional intervention, a decrease in white blood cell concentration was observed. In the study by Tuncay et al., the average leukocyte level in the blood was above normal, but after the application of enteral nutrition, a decrease in the parameter was observed. The leukocyte concentration was within normal limits, although the improvement was not very significant [20]. In the studies by Konecka et al., the comparison of biochemical parameters showed that nutritional therapy reduced the concentration of leukocytes in the blood, even though the values of white blood cells were within normal limits before and after treatment [18].

In summary, nutritional therapy is part of the therapeutic process and aims to improve and maintain the appropriate nutritional status of patients. For patients with organic damage to the central nervous system, enteral nutrition may be the only form in which the patient receives food and provides the necessary nutrients for regeneration.

Conclusions

1. The initial clinical condition of patients at admission, assessed using the GCS scale, who underwent nutritional therapy did not affect the final clinical condition on the GOS scale.
2. Longer use of nutritional therapy had a significant impact on the length of hospitalization, resulting in longer hospital stays for patients who were treated with nutritional therapy for a longer period compared to those whose nutritional therapy duration was shorter.
3. Nutritional therapy did not affect protein and albumin levels but did impact the reduction of biochemical inflammatory parameters — CRP and leukocytes. The reduction in both CRP and leukocyte levels is an indicator of the normalization of inflammatory parameters, which accelerates patient recovery.

Implications for Nursing Practice

Nurses should be trained in assessing the nutritional status of patients upon hospital admission using standardized tools such as the Mini Nutritional Assessment (MNA) or Nutritional Risk Screening 2002 (NRS 2002). Early detection of malnutrition can prevent its worsening and improve patient prognosis.

Nurses should also systematically assess biochemical parameters (e.g., albumin, total protein, CRP) and anthropometric measurements (e.g., body weight, BMI) to adjust nutritional therapy to the changing needs of the patient.

Nutritional therapy should be tailored to the individual needs of patients. Nurses should educate patients and their families about the importance of proper nutrition and ways to cope with potential problems such as dysphagia.

Effective nutritional therapy requires collaboration between various specialists, including doctors, dietitians, speech therapists, and nurses. Nurses play a key role in coordinating care and communication among members of the medical team.

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