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Original Article

Effect of standard nutritional support therapy based on nutritional risk screening on post-operative nutritional status and quality of life in patients with glioma

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Abstract: Objective: To explore the effect of standard nutritional support based on nutritional risk screening on nutrition conditions and living quality in glioma patients after surgery. Methods: The clinical information of 100 patients with glioma treated at the Sichuan Provincial People's Hospital from April 2021 to April 2022 was reviewed retrospectively. Among them, 39 patients received routine nutritional support during the perioperative period (routing group) and 61 patients received standard nutritional support (standard group). The relevant clinical data were collected, and the postoperative albumin (ALB) level, prealbumin (PA) level, hemoglobin (Hb) level, patient-generated subjective global assessment (PG-SGA) score, Kanofsky performance score (KPS), and short-term prognosis were compared between the two groups. Finally, factors affecting the efficacy of nutritional support in patients with glioma were analyzed. Results: 14 days after the surgery, the levels of ALB, PA, and Hb of the standard group were significantly higher than those in the routing group (all $P < 0.05$). The PG-SGA scores of the two groups decreased with time, and the PG-SGA scores of the standard group were significantly lower than those of the routing group at 30 d and 60 d after the operation (intergroup effect: $F = 9.077$, $P = 0.003$, time effect: $F = 75.28$, $P < 0.001$, and interaction effect: $F = 3.111$, $P = 0.047$). The KPS scores of the two groups increased with time, and the KPS scores of the standard group were significantly higher than those of the routing group at 30 d and 60 d after operation (intergroup effect: $F = 4.458$, $P = 0.044$, time effect: $F = 31.333$, $P < 0.001$, and interaction effect: $F = 3.507$, $P = 0.032$). Within 6 months after discharge, the tumor recurrence rate of the standard group was significantly lower than that in the routing group ($P < 0.05$). After 60 days of the surgery, nutritional support therapy worked well in 32 patients, and the results of the logistic regression analysis displayed that age was an independent factor affecting the efficacy of nutritional support in post-operative glioma patients. Conclusion: Standard nutritional support based on nutritional risk screening can improve the nutrition condition and living quality of post-operative glioma patients and is worthy of clinical application.

Keywords: Glioma, nutritional risk screening, standard nutritional support, quality of life

Introduction

Gliomas are tumors that originate in the glial cells of the nervous system with an incidence of 35.2%-61.0% of intracranial tumors, which have the features of high morbidity rate, high recurrent rate, high death rate, and low healing rate [1]. WHO divides gliomas into four classes: I-IV. The median overall lifetime of class I and II glioma patient is 11.6 years, and the median overall lifetime of class III glioma patient is about 3 years, while that of class IV patient is only about 15 months [2]. Related research has displayed that the prognosis of glioma is related to the patient's age, gender, tumor radionics characteristics, molecular biological characteristics, body function, and other factors [3]. In late years, nutritional indicators have shown significant value in cancer treatment, as methods of cancer diagnosis and treatment have been improved. A meta-analysis pointed out that nutritional condition is a vital factor influencing the prognosis of glioma patients [4].

Nowadays, the therapy of glioma is mainly surgical resection, assisted by radiation therapy, chemical therapy, targeted therapy, etc. Malnutrition is common in patients with malignant tumors during treatment [5, 6]. Nutrition deficiency reduces the body's tolerance to anti-tumor therapy, increases the risk of adverse reactions to anti-tumor therapy, and reduces their quality of life. Therefore, strengthening nutritional risk screening and effective nutritional support for glioma patients has important clinical meaning. However, at this stage, there is still a lack of exploration of the influence of nutritional support in post-operative glioma patients. Because of this, this research retrospectively analyzed clinical information of glioma patients and explored the impact of standard nutritional support therapy on post-operative nutrition conditions and quality of life.

Material and methods

Subjects

The clinical information of 100 glioma patients treated at Sichuan Provincial People's Hospital from April 2021 to April 2022 was analyzed retrospectively. Inclusion criteria: (1) Patients who were initially diagnosed with glioma. (2) Patients whose postoperative pathological results showed isocitrate dehydrogenase mutation (mainly by immunohistochemistry) and/or 1p/19q co-deletion (mainly by genome-wide hybridization array) in tumor cells [7]. (3) Patients who received surgical treatment and postoperative concurrent chemotherapy. (4) Patients who had NRS2002 score ≥ 3 at admission. (5) Patients who aged 18 or older. (6) Patients whose clinical data required for the study were complete. Excluded criteria: (1) Patients with recurrent or metastatic glioma. (2) Patients with craniocerebral diseases, malignant tumors, immune diseases, or hematological illnesses. (3) Patients with severe hepatic, kidney, heart, or lung dysfunction. (4) Patients with preoperative clinical evidence of acute infection. (5) Patients with perioperative death. This research was authorized by the Medical Ethics Committee of Sichuan Provincial People's Hospital.

Study sample size calculation

Sample size calculation formula: $N=\frac{2(Z_{1-\alpha/2}+Z_{1-\beta})^2 s^2[1+(n-1)\times\rho]}{n(\mu_1-\mu_2)^2}$, where N indicates the sample size for each group, n is the number of repeated measurements. $Z_{1-\alpha/2} = 1.96$, $Z_{1-\beta} = 1.28$. We set $n = 3$, $\rho = 0.6$, $\mu_1-\mu_2 = 0.5$, and $s = 0.7$, which resulted in $N = 30$. That is, the sample size for inclusion in each group should be at least 30 and the total sample size should be at least 60. After consideration, we expanded the sample size to 100 cases.

Perioperative nutritional support therapy

Standard nutritional intervention treatment: (1) Preoperative nutritional management: The patient-generated subjective global assessment (PG-SGA) was used to evaluate the nutritional status, and patients with malnutrition needed nutritional management. The target nutrition management was 20-30 kcal/kg/d for energy and 0.8-1.5 g/kg/d for protein. Nutritional interventions should be selected according to the patient's situation. For example, patients who consume less than 80% of their target calories intake can be supplemented with oral nutrition. Enteral nutrition can be selected if oral intake is less than 50-60% of the target calories. Patients with intramuscular nutrition contraindications or intolerance may opt for parenteral nutrition. The principles of nutritional intervention on the first day before operation: high calorie, high protein, and high carbohydrate. (2) Postoperative nutrition management: After the patient returned to the ward after anesthesia, the amount of water intake could be increased as appropriate. Eating can be started at post-operative 2 h, with a diet of carbohydrate-based nutrient solution given priority. A day after the operation, a liquid balanced diet with 1/2 of the target total calories was provided. Two days after the operation, the semi-fluid was mainly made up of high protein and high fat, with 2/3 of the target calories. Three days after the operation, the target total calories were given and a high protein, high fat, and low carbohydrate soft meal diet was given. From 4 days after the operation to discharge, nutritional guidance was given according to the patient's condition that gradually return to a normal diet.

Routine nutritional support: Patients were given standard amounts of enteral and parenteral nutritional support, with the duration of nutritional intervention not exceed 4 days. Or the amount of intervention did not reach the standardized nutritional intervention treatment, and the duration of nutritional intervention did not exceed 2 days. Or only a general dietary intervention was provided.

Collecting data

We collected clinical information from the hospital's electronic record system, including: age, gender, body mass index (BMI), basic disease history, tumor location, tumor stage, tumor diameter, pathological type, pathological grade, surgical method, serum albumin (ALB), hemoglobin (Hb), prealbumin (PA), PG-SGA score, and Kanofsky performance score (KPS).

Evaluation indicators

Primary evaluation indexes: ALB, PA, and Hb levels were compared before nutrition intervention and 14 days after surgery. 5 ml of fasting elbow venous blood were drawn from the patients on the morning of the second day after enrollment and 14 days after surgery, which were centrifuged at 3000 r/min for 10 min, and the upper serum was taken and stored in a refrigerator at -80°C. The ALB levels were assayed by the biuret spectrophotometry method (instrument: Beckman colter AU5800). The PA levels were assayed by immunoturbidimetry (instrument: Beckman colter AU5800). The Hb levels were assayed by the high iron cyanide method (instrument: Sysmex XT-4000i). The PG-SGA scores and KPS were compared before nutrition intervention, 30 days after surgery, and 60 days after surgery. PG-SGA score of 0-1 indicates well-nourished, a score of 2-3 indicates doubted dystrophy, a score of 4-8 indicates middling-cacographic, 9 or above indicates severe dystrophy, and PG-SGA score of 4 is the critical value for the diagnosis of malnutrition [8]. KPS has a total score of 100, the higher score indicates higher living quality, and 70 is taken as the critical value [9].

Secondary evaluation indexes: Readmission rate, tumor recurrence rate, and mortality rate were compared between the two groups 6 months after discharge. Factors affecting the efficacy of nutritional support in glioma patients after surgery were analyzed. The efficacy of standard nutritional support was determined by the PG-SGA score and KPS at 60 days after surgery. Good efficacy: PG-SGA score > 70, and the poor efficacy: PG-SGA score > 4 or KPS < 70.

Statistical analysis

SPSS 23.0 was used for data process. Quantitative data according to normal distribution were expressed by the mean ± standard deviation (x±sd), and an independent-samples test was adopted for comparison between groups. Qualitative data were described as the case number and percent [n (%)], and a chi-square test was adopted for comparison between groups. When 1 ≤ the theoretical frequency < 5, the Yates' continuity correction was applied. When a theoretical frequency < 1, the Fisher's exact test was used. A repeated measures analysis of variance was used to compare the data at different time points between groups, which was then corrected using the Bonferroni test. Logistic regression was used to screen factors impacting the efficacy of nutritional support in medical glioma patients after surgery. *P* < 0.05 suggested a significant difference.

Results

General data

Sixty-one glioma patients who received standard nutritional support after surgery were included in the standard group, and the other 39 patients who received routine nutritional support after surgery were included in the routine group. There were no noticeable differences between the two groups in age, sex, BMI, basic disease history, tumor location, tumor diameter, pathological type, pathological grade, and surgical method (all *P* > 0.05, **Table 1**).

Nutrition index levels

Before the nutritional intervention, there were no noticeable differences between the two groups in the levels of ALB, PA, and Hb (all *P* > 0.05); while 14 days after the surgery, the levels of ALB, PA, and Hb of the standard group were higher than those of the routine group, and the differences were statistically significant (*P* < 0.05, **Table 2**).

PG-SGA score and KPS

At 30 and 60 days after the surgery, the PG-SGA scores of the standard group were less

Table 1. General data

Data	Routine group (n = 39)	Standard group (n = 61)	$t/\chi^2/Z$	*P*
Age (x±sd)	40.05±7.12	42.07±8.55	1.224	0.224
Sex [n (%)]			0.248	0.618
Male	23 (58.97)	39 (63.93)		
Female	16 (41.03)	22 (36.07)		
BMI (kg/m^2, $\bar{x}$±sd)	19.79±1.69	20.08±1.59	0.862	0.391
Basic disease history [n (%)]				
Hypertension	10 (25.64)	23 (37.70)	1.566	0.211
Diabetes	8 (20.51)	16 (26.23)	0.426	0.514
Tumor location [n (%)]			0.506	0.918
Frontal lobe	17 (43.59)	30 (49.18)		
Parietal lobe	10 (25.64)	16 (26.23)		
Temporal lobe	7 (17.95)	9 (14.75)		
Else	5 (12.82)	6 (9.84)		
Tumor diameter [n (%)]			1.574	0.210
≤ 5 cm	20 (51.28)	39 (63.93)		
> 5 cm	19 (48.72)	22 (36.07)		
Pathological type [n (%)]			0.788	0.674
Astroglioma	8 (20.51)	9 (14.75)		
Oligodendroglioma	8 (20.51)	16 (26.23)		
Glioblastoma	23 (58.98)	36 (59.02)		
Pathological grade [n (%)]			0.503	0.478
Low grade	27 (69.23)	38 (62.30)		
High grade	12 (30.77)	23 (37.70)		
Surgical method [n (%)]			0.701	0.402
Total resection	23 (58.97)	41 (67.21)		
Partial splenectomy	16 (41.03)	20 (32.79)		

Note: BMI: body mass index.

Table 2. Comparison of nutritional indicators between the two groups

Group	Case	ALB (g/L)		PA (mg/L)		Hb (g/L)	
		Before nutritional support	14 days after surgery	Before nutritional support	14 days after surgery	Before nutritional support	14 days after surgery
Routine group	39	29.73±6.31	33.08±4.38	332.65±46.34	336.14±24.36	101.82±12.12	105.28±27.64
Standard group	61	27.72±5.34	36.01±6.53	327.60±52.82	349.77±27.54	100.98±17.54	124.82±18.69
t		1.712	2.683	0.488	2.522	0.282	3.882
P		0.090	0.009	0.626	0.013	0.779	< 0.001

than those of the routine group (intergroup effect: F = 9.077, P = 0.003). The PG-SGA scores of the two groups tended to decrease over time (time effect: F = 75.28, P < 0.001). There was an interaction between group and time (F = 3.111, P = 0.047), as shown in **Figure 1**.

At 30 and 60 days after the surgery, the KPS in the standard group was higher than that in the routine group (intergroup effect: F = 4.458, P = 0.044). The KPS scores of the two groups tended to increase over time (time effect: F = 31.333, P < 0.001). There was an interaction effect between group and time (F = 3.507, P = 0.032), as shown in **Figure 2**.

Short-term prognosis condition

Six months after discharge, there were no noticeable differences between the two groups in readmission rate and mortality (both P >

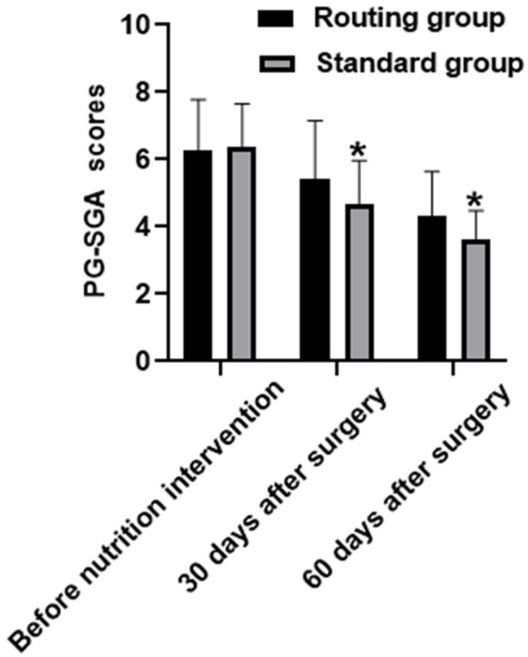

Figure 1. Comparison of PG-SGA between the routine and the standard groups in the same period. *, $P < 0.05$. PG-SGA scores: the patient-generated subjective global assessment scores.

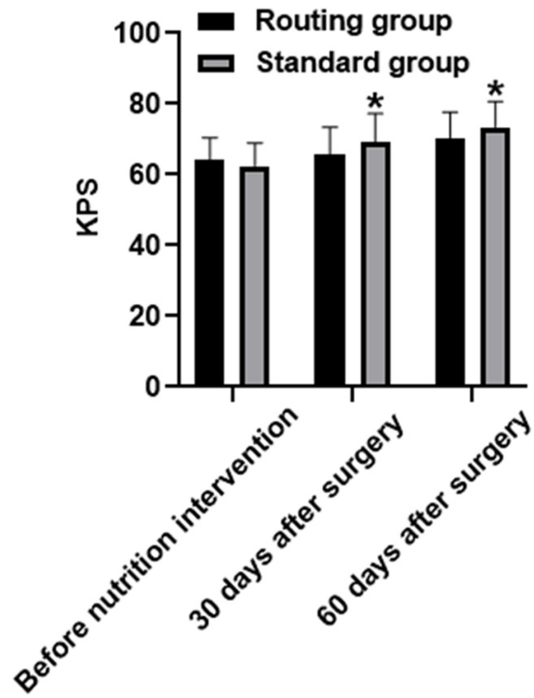

Figure 2. Comparison of the KPS between the routine group and the standard group in the same period. *, $P < 0.05$. KPS: Kanofsky performance score.

0.05), while the tumor recurrence rate of the standard group (3.28%) was noticeably lower than that of 17.95% in the routing group ($P < 0.05$), see **Table 3**.

Analysis of factors affecting the efficacy of nutritional support

On the 60th day after the surgery, 62 patients were considered to have good nutritional support and were included in the good efficacy group. Sixty-eight patients did not meet the criteria and were included in the poor efficacy group. There were noticeable differences between the good and poor efficacy groups in age, BMI, tumor diameter, pathological type, and pathological grade (all $P < 0.05$), as shown in **Table 4**.

The efficacy (0 = good, 1 = poor) was used as the dependent variable, while those indicators of statistical significance in the univariate analysis were included in the Logistic regression model as independent variables, and the assignments are shown in **Table 5**. Logistic analysis showed that age was an independent factor for the efficacy of nutritional support in post-operative glioma patients, as shown in **Table 6**.

Discussion

Currently, the standard treatment of glioma is surgery with post-operative radiation or adjuvant temozolomide-based chemotherapy. However, due to the invasive growth of glioma and no obvious boundary with brain tissue, it is almost impossible to completely remove the tumor [10]. While radiotherapy and chemotherapy can solidify the effect of surgery, they also have a variety of side effects. While killing tumor cells, they also damage normal tissues, especially the mucosa of the digestive tract, which affects the body's absorption and digestion of nutrients [11]. Despite advances in treatment methods and techniques, overall survival rate in glioma patients has not been improved significantly. In this research, glioma patients at nutritional risk were considered as the research targets to explore the effects of standard nutritional support therapy on post-operative glioma patients.

ALB is a commonly used indicator of malnutrition in clinical practice. It is the most important

Table 3. Comparison of short-term prognosis between the two groups

Group	Case	Readmission	Tumor recurrence	Mortality
Routine group	39	9 (23.08)	7 (17.95)	1 (2.56)
Standard group	61	16 (26.23)	2 (3.28)	0
χ^2		0.850	4.588	1.899
P		0.356	0.032	0.168

Table 4. Univariate analysis of the factors affecting the efficacy of nutritional support in patients with glioma

Data	Good efficacy group (n = 32)	Poor efficacy group (n = 68)	$t/\chi^2/Z$	*P*
Age (x±sd)	32.78±4.87	45.28±5.82	10.525	< 0.001
Sex [n (%)]			0.660	0.416
Male	18 (56.25)	44 (64.71)		
Female	14 (43.75)	24 (35.29)		
BMI (kg/m^2, $\bar{x}$±sd)	21.64±0.71	19.18±1.31	12.157	< 0.001
Basic disease history [n (%)]				
Hypertension	12 (37.50)	21 (30.88)	0.431	0.511
Diabetes	4 (12.50)	20 (29.41)	2.548	0.110
Tumor location [n (%)]			0.627	0.890
Frontal lobe	15 (46.88)	32 (47.06)		
Parietal lobe	7 (21.88)	19 (27.94)		
Temporal lobe	6 (18.75)	10 (14.71)		
Else	4 (12.50)	7 (10.29)		
Tumor diameter [n (%)]			4.980	0.026
≤ 5 cm	24 (75.00)	35 (51.47)		
> 5 cm	8 (25.00)	33 (48.53)		
Pathological type [n (%)]			6.311	0.043
Astroglioma	6 (18.75)	11 (16.18)		
Oligodendroglioma	3 (9.38)	21 (30.88)		
Glioblastoma	23 (71.88)	36 (52.94)		
Pathological grade [n (%)]			7.765	0.005
Low grade	27 (84.38)	38 (55.88)		
High grade	5 (15.62)	30 (44.12)		
Surgical method [n (%)]			0.461	0.497
Total resection	22 (68.75)	42 (61.76)		
Partial splenectomy	10 (31.25)	26 (38.24)		
Standard nutritional support [n (%)]			1.188	0.276
Yes	22 (68.75)	39 (57.35)		
No	10 (31.25)	29 (42.65)		

Note: BMI: body mass index.

protein in human plasma. ALB levels are abnormally low when the body is malnourished. Sakibul Hug found that ALB < 39 g/L was associated with significantly reduced survival in patients with glioblastoma [12]. PA is a glycoprotein synthesized by the liver and its level can reflect the function of the liver in synthesizing and secreting proteins. Hb is a special protein that transports oxygen in red blood cells and an important indicator for judging anemia in the body [13]. There was no significant difference in ALB, PA and Hb levels between the routine and the standard groups prior to nutritional intervention. On the 14th day after the opera-

Table 5. Assignment of the variables

Factors	Assignment
Age	Original value input
BMI	Original value input
Tumor diameter	1 = ≤ 5 cm, 2 = > 5 cm
Pathological type	1 = Astroglioma, 2 = Oligodendroglioma, 3 = Glioblastoma
Pathological	1 = Low grade, 2 = High grade

Note: BMI: body mass index.

Table 6. Multivariate analysis of the factors affecting the efficacy of nutritional support in patients with glioma

Factors	*B*	*SE*	*Wald*	*P*	*OR (95% CI)*
Age	0.491	0.182	7.292	0.007	1.635 (1.144-2.335)
BMI	-0.918	0.728	1.594	0.207	0.399 (0.096-1.661)
Tumor diameter	0.573	0.895	0.409	0.552	1.773 (0.307-10.239)
Pathological type	0.383	0.539	0.504	0.478	1.466 (0.510-4.215)
Pathological grade	0.506	0.998	0.258	0.612	1.659 (0.235-11.723)

Note: BMI: body mass index.

tion, the standard group had significantly higher levels of ALB, PA, and Hb than those of the routine group. The results suggest that standard nutritional support can improve patients' nutritional indicators. Standard nutritional support is based on a comprehensive understanding of the nutritional status of patients, and a nutritional treatment plan based on a scientific theoretical basis can meet the individualized nutritional needs of the patients to a certain extent.

PG-SGA is a nutritional assessment tool based on SGA and is widely recommended by the Academy of Nutrition and Dietetics (AND) for cancer patients [14]. KPS is a commonly used physical scoring system for cancer patients and an important basis for evaluating whether patients can tolerate anti-tumor treatment [15]. Relevant studies have shown that low KPS may be related to perioperative fatigue and may also increase the risk of postoperative infection [16, 17]. Several studies have also shown that the KPS score is an independent factor affecting the prognosis of glioma [18-20]. The results of this study showed that the standard group achieved better PG-SGA scores and KPS at 30 and 60 d after surgery than the routine group. It can be argued that patients can benefit from the individualized nutritional support and that their nutritional status and physical condition can be improved.

Recurrence of glioma has long been a difficulty in clinical research. Despite postoperative concurrent radiotherapy and chemotherapy, the recurrence rate of glioma is still very high [21]. At present, the treatment of recurrent glioma is daunting, and there is no standard treatment [22]. The results of this study showed that the rate of tumor recurrence was significantly lower in the standard group than that in the routine group at 6th month after discharge. This suggests that standard nutritional support such as palliative care can improve short-term efficacy after surgery. However, this result still lacks long-term observation.

Finally, we analyzed the factors influencing the efficacy of nutritional support in glioma patients after surgery and found that older age was a dangerous factor for poor efficacy. Many studies have shown that old age is a dangerous factor for poor prognosis of glioma [23-25]. For older patients, nutritional intervention strategies should be developed based on a comprehensive assessment and multidisciplinary approaches. However, we didn't further study the accurate cutoff value for the age in this study, which needs to be further improved. In addition, the research has several limitations. This is an retrospective single center research with relatively small sample size, so, the data may not be broadly representative. Thus, this research finding needs to be further validated.

In summary, standard nutritional intervention based on nutritional risk screening can benefit glioma patients by helping improve postoperative nutritional condition and quality of life and reduce the risk of postoperative tumor recurrence. Screening for nutritional risk in glioma patients and giving reasonable nutritional support is of crucial clinical significance.

Disclosure of conflict of interest

None.

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