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CLINICAL RESEAPCH

Effects of Hyperbaric Oxygen Combined with MGS on Electroencephalogram and Oxidative Stress Indicators in Patients with Traumatic Epilepsy

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Keywords

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Abstract

Objective To analyze the effect of hyperbaric oxygen combined with monosialotetrahexosyl ganglioside sodium (MGS) on electroencephalogram (EEG) and oxidative stress indicators in patients with traumatic epilepsy. **Methods** 124 patients with traumatic epilepsy in our hospital from January 2018 to August 2020 were selected and divided into the control group and observation group by random number table method, 62 cases in each group. The control group was treated with conventional anti-epileptic drugs combined with MGS, and the observation group was treated with hyperbaric oxygen on the basis of the control group. The improvement of clinical symptoms, EEG outcome and oxidative stress level in the two groups were compared. **Results** After treatment, the epileptic seizure frequency and duration in the two groups were evidently lower than those before treatment (P<0.05), and the epileptic seizure frequency and duration in the observation group were apparently lower than those in the control group (P<0.05); after treatment, the total effective rate in the observation group was obviously higher than that in the control group (P<0.05); after treatment, the levels of nitric oxide (NO) and total antioxidant capacity (T-AOC) in the two groups were significantly higher than those before treatment (P<0.05), and the level of malondialdehyde (MDA) was apparently lower than that before treatment (P<0.05), and the levels of NO and T-AOC in the observation group were obviously higher than those in the control group (P<0.05), the level of MDA in the observation group was apparently lower than that in the control group (P<0.05). **Conclusion** Combined application of hyperbaric oxygen and MGS in the treatment of traumatic epilepsy can effectively reduce the clinical symptoms of patients, reduce the level of oxidative stress, with a good curative effect.

Introduction

Traumatic epilepsy is a common complication after

craniocerebral injury, which is mainly caused by traumatic injury to brain tissue, leading to the decrease of the number of neurons, the decline of neurological function, the down-regulation of Na^+, K^+-ATPase activity on the glial cell membrane, and the damage of blood-brain barrier function. Traumatic epilepsy occurring on the basis of primary injury will further aggravate the brain and nerve tissue injury in patients, resulting in further deterioration of the patients' condition, threatening the life safety of patients [1]. Therefore, it is of great significance to find an effective treatment for traumatic epilepsy. Monosialotetrahexosyl ganglioside sodium (MGS) can exert neuroprotective effects by reducing nerve cell edema, inhibiting nerve degeneration, and is mainly used for vascular or traumatic central nervous system injury in clinic [2]. Hyperbaric oxygen therapy, a green and safe physiotherapy, is able to significantly regulate the ischemic and hypoxic conditions of brain tissue, and is beneficial for the prompt repair of brain cell function [3]. At present, the efficacy of hyperbaric oxygen combined with MGS in the treatment of traumatic epilepsy remains to be investigated. Therefore, in this study, hyperbaric oxygen combined with MGS was applied to patients with traumatic epilepsy, and its effects on electroencephalogram (EEG) outcome, oxidative stress level, and so on were observed, in order to provide a reference for the clinical treatment of traumatic epilepsy.

Materials and methods

Clinical data

General data

A total of 124 patients with traumatic epilepsy in our hospital from January 2018 to August 2020 were selected and divided into the control and observation groups using the random number table method, with 62 patients in each group. There were no significant differences (P>0.05) in the comparison of general data between the two comparable groups, as shown in Table1.This study was reviewed and approved by the hospital ethics committee, and all patients gave written informed consent.

Table 1 Comparison of general data between two groups

Group	Cases	Gender (cases)		Age (years)	Seizure types (cases)			disease duration (years)
		Male	Female		Simple partial seizures	Complex partial seizures	Generalized seizure	
Observation group	62	36	26	42.26±6.85	28	18	16	3.53±1.22
Control group	62	39	23	41.34±5.86	30	20	12	3.36±1.14
χ^2/t		0.304		0.804		0.746		0.802
P		0.582		0.423		0.689		0.424

Inclusion and exclusion criteria

Inclusion criteria: 1) a definite history of craniocerebral trauma before onset; 2) no previous history of epilepsy, including family history of epilepsy, history of febrile convulsion, etc.; 3) having at least two and more typical clinical seizures in the history of the disease, manifested as consciousness disturbance, limb convulsions, sialorrhea and other symptoms. Exclusion criteria: 1) patients with severe heart, kidney, liver and other important organ dysfunction; 2) patients with other mental diseases; 3) patients contraindicated to hyperbaric oxygen therapy; 4) patients allergic to anti-epileptic drugs used in this study.

Treatment

The control group was treated with MGS combined with conventional anti-epileptic drugs. Depending on

the type of seizures, patients were treated with conventional anti-epileptic drugs such as sodium valproate, phenobarbital, carbamazepine, and vitamin B6. In addition to these anti-epileptic drugs, MGS was used at the same time, 250 ml of 5% glucose solution was added in 200 mg MGS injection (Beijing Saisheng Pharmaceutical Co., Ltd., H20093980), and intravenous drip treatment was carried out. The treatment was once a day, 10 times for one course. After 2 courses, the patients were rested for 5-7 days with a total treatment of 4 courses.

The observation group was treated with hyperbaric oxygen on the basis of the control group, the treatment scheme was that the pressure in a single medical oxygen chamber was slowly and steadily increased to 0.23 MPa within 20 min, stable oxygen absorption was maintained for 30 min by wearing a face mask at 0.23 MPa, stable oxygen absorption was again maintained for 20 min after an interval of 10 min, then left the chamber after the pressure was reduced for 20 min to the normal pressure, once a day, 10 times for 1 course, after 2 courses of treatment, resting for 5 ~ 7 days, the total treatment was 4 courses.

Outcome measures

Improvement of clinical symptoms

Before and after treatment, the frequency and duration of epileptic seizures in both groups were observed and recorded.

EEG outcome

After treatment, the EEG was reviewed in both groups and the outcome of the patients was evaluated using the EEG efficacy evaluation criteria [4]: when reviewing the EEG, if the patient showed occasional or complete disappearance of the ictal waveform, it is evaluated as markedly effective; if the patient showed significant reduction of the ictal waveform and the paroxysmal waveform rhythm, it is evaluated as effective; and if the patient did not show significant improvement of the ictal waveform, it is evaluated as ineffective.

Oxidative stress level

Before and after treatment, 5ml of fasting venous blood was extracted from the two groups. The plasma nitric oxide (NO) level was measured by nitrate reductase method, and the plasma malondialdehyde (MDA) and total antioxidant capacity (T-AOC) levels were detected by spectrophotometry. The detection kit was purchased from Roche diagnostic company of the United States, and the operation was carried out in strict accordance with the instructions.

Statistical analysis

SPSS 20.0 was used for statistical analysis. The count data was expressed by the number of cases, and the comparison was performed by χ^2 test. The measurement data was expressed by mean ± standard deviation ($\bar{x}\pm s$), and the comparison was performed by *t* test. $P<0.05$ was considered as the difference with statistical significance.

Results

Comparison of the improvement of clinical symptoms between the two groups

Before treatment, there was no significant difference in the frequency and duration of epileptic seizures between the two groups ($P>0.05$); after treatment, the frequency and duration of epileptic seizures in the two groups were significantly lower than those before treatment ($P<0.05$), and the frequency and duration of epileptic seizures in the observation group were significantly lower than that in the control group ($P<0.05$), see Table 2.

Table 2 Comparison of the improvement of clinical symptoms between the two groups

Group	Cases	Seizure frequency (time/month)		Seizure duration (min)	
		Before treatment	After treatment	Before treatment	After treatment
Observation	62	5.74±1.62	1.54±0.42*	5.83±1.75	2.14±0.67*

group					
Control group	62	5.43±1.70	2.77±0.73*	6.04±1.92	3.56±0.96*
t		1.039	-11.500	-0.637	-9.551
P		0.301	0.000	0.526	0.000

Note: compared with before treatment: *P<0.05.

Comparison of EEG outcome between the two groups

The total effective rate in the observation group was significantly higher than that in the control group (P<0.05), as shown in Table 3.

Table 3 Comparison of EEG outcome between the two groups [cases (%)]

Group	Cases	Markedly effective	Effective	Ineffective	Total effective rate
Observation group	62	34 (54.84)	23 (37.10)	5 (8.06)	57 (91.94)
Control group	62	26 (41.94)	22 (35.48)	14 (22.58)	48 (77.42)
χ^2					5.035
P					0.025

Comparison of oxidative stress indicators between two groups

Before treatment, there was no significant difference in the levels of NO, T-AOC and MDA between the two groups (P>0.05); after treatment, the levels of NO and T-AOC in the two groups were significantly higher than those before treatment (P<0.05), and the level of MDA was significantly lower than that before treatment (P<0.05), and the levels of NO and T-AOC in the observation group were significantly higher than those in the control group (P<0.05), and the level of MDA in the observation group was significantly lower than that in the control group (P<0.05), as shown in Table 4.

Table 4 Comparison of oxidative stress indicators between two groups

Group	Cases	NO (μmol/L)		T-AOC (nmol/mL)		MDA (μmol/mL)	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Observation group	62	35.24±5.38	45.47±6.12*	12.17±3.32	17.34±3.57*	40.77±5.85	32.64±4.78*
Control group	62	34.14±6.53	41.74±5.85*	12.75±3.16	15.44±4.02*	41.53±6.59	35.86±5.92*
t		1.024	3.469	-0.996	2.783	-0.679	-3.332
P		0.308	0.001	0.321	0.006	0.499	0.001

Note: compared with before treatment: *P<0.05.

Discussion

Seizures in patients with traumatic epilepsy have the characteristics of brief, suddenness and recurrence, which are clinically difficult to control perfectly, and the probability of complete cure is low. At present, patients with traumatic epilepsy in clinic are mostly treated with conventional anti-epileptic drugs such as sodium valproate, phenobarbital, and carbamazepine, which can reduce the clinical symptoms and suppress the seizures of patients to some extent. However, due

to the long disease duration of patients with traumatic epilepsy, some patients will develop drug resistance during the course of conventional anti-epileptic drug treatment, resulting in poor efficacy and the condition further progresses to refractory epilepsy [5]. Therefore, it is important to find other effective therapies for traumatic epilepsy to improve the treatment efficacy and improve the prognosis of patients. Dan Huang et al. [6] found that hyperbaric oxygen therapy can effectively reduce the clinical symptoms and improve the neurological function of patients with post-stroke epilepsy. Hui Li [7] found that MGS treatment could effectively improve neurological function in children with brain injury syndrome.

In this study, the control group was treated with conventional anti-epileptic drugs combined with MGS, and the observation group was treated with hyperbaric oxygen based on the control group. The results showed that after treatment, the frequency and duration of epileptic seizures in the two groups were significantly lower than those before treatment, and that the frequency and duration of epileptic seizures in the observation group were significantly lower than those in the control group, and the total effective rate in the observation group was significantly higher than that in the control group, indicating that hyperbaric oxygen combined with MGS has good curative effect in the treatment of patients with traumatic epilepsy, and could effectively reduce the clinical symptoms of patients. MGS can pass through the blood-brain barrier and directly enter the injured nerve cell membrane, strengthening and stabilizing the cell membrane lipid bilayer structure in an embedded neuronal manner, thereby increasing the cell membrane stability, improving the activity of nerve cell membrane enzymes, and promoting the recovery of nerve cell function. At the same time, MGS also improves the hypoxic condition of brain tissue, improves the energy metabolism of brain tissue and cells, reduces the secretion of excitatory amino acids, and then accelerates the remodeling of nerve cells, which is beneficial for alleviating neurological functional damage [8]. Therefore, MGS treatment has a certain effect on patients with traumatic epilepsy, which can effectively improve patient neurological function and then reduce patients' clinical symptoms. Hyperbaric oxygen therapy is a measure that has been popularized in the treatment of cerebrovascular diseases in recent years, which can rapidly increase the partial pressure of blood oxygen and promote aerobic metabolism in brain tissue; while it can promote cerebral vasoconstriction, inhibit capillary blood exudation, reduce intracranial pressure, block the vicious cycle of brain edema caused by ischemia and hypoxia, and favors the formation of collateral circulation in brain tissue at the injured site as well as the repair of injured neurons. In addition, hyperbaric oxygen therapy can increase the permeability of the blood-brain barrier, which makes the anti-epileptic drugs and MGS more easily pass the blood-brain barrier into nerve cells and improve the clinical efficacy of the anti-epileptic drugs and MGS [9]. Therefore, the use of hyperbaric oxygen combined with MGS in the treatment of patients with traumatic epilepsy can further improve the therapeutic effect and reduce the clinical symptoms of patients.

Studies have shown [10] that oxidative damage runs through the pathogenesis of traumatic epilepsy, in which oxygen free radicals play an important role. During seizures in patients with traumatic epilepsy, the imbalance of body oxidation/antioxidant results in a large generation of oxygen free radicals, by attacking unsaturated fatty acids in biological membranes, free radicals can trigger lipid peroxidation, release lipid metabolites MDA and other substances harmful to the body; and can destroy the continuity and integrity of the cell membrane and cause excessive discharge of neurons, leading to the reduction of T-AOC level; can also inhibit the activity of body NO synthase, causing the fall of NO level. Our results showed that after treatment, the levels of NO, T-AOC in the two groups were significantly higher than those before treatment, the level of MDA was significantly lower than that before treatment, the levels of NO, T-AOC in the observation group were significantly higher than those in the control group, and the level of MDA in the observation group was significantly lower than that in the control group,

suggesting that hyperbaric oxygen combined with MGS can effectively reduce the level of oxidative stress in patients with traumatic epilepsy. MGS can repair damaged nerve cells through the blood-brain barrier, alleviate the massive death of nerve cells caused by ischemia and hypoxia, avoid the massive loss of fatty acids from nerve cell membrane, thus maintaining the resistance of neurons to the damage of oxygen free radicals and reducing the release of oxygen free radicals, so it can effectively alleviate the oxidative stress reaction caused by the excessive release of oxygen free radicals. And during hyperbaric oxygen treatment, oxygen, through hyperbaric action, can significantly increase the oxygen partial pressure difference of pulmonary vein and alveolus in patients with brain injury, increase the oxygen uptake and storage capacity of the body, so it can significantly improve the level of cerebral oxygen metabolism, improve cerebral circulation, reduce brain injury, and then reduce the oxidative stress reaction of the body. Therefore, the combination of hyperbaric oxygen and MGS applied in traumatic epilepsy treatment could effectively reduce the level of oxidative stress in patients.

In conclusion, the combination of hyperbaric oxygen and MGS in traumatic epilepsy treatment can effectively reduce the clinical symptoms of patients and reduce the level of oxidative stress in the body, and has good efficacy.

Declaration of conflict-of-interest

The authors declare no conflict-of –interest.

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