

Original Research Article

Effect of guipizide maleate with hyperbaric oxygen therapy on neurophysiology and coagulation indices in patients with severe craniocerebral injury

Hai-yun Liu¹, Yong-hua Shang^{2*}

¹Department of Neurosurgery, The 900th Hospital of China Joint Logistic Support Force, Fuzhou 350025, ²Department of Neurology, Fuzhou Second Hospital, The Third Clinical Medical College, Fujian Medical University, Fuzhou 350007, China

*For correspondence: **Email:** Yonghua_Shang@163.com

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Abstract

Purpose: To assess the effect of guipizide maleate combined with hyperbaric oxygen therapy on neurophysiological and coagulation indices in patients with heavy craniocerebral injury.

Methods: The study involved a total of 80 patients with craniocerebral injuries who were admitted to The 900th Hospital of China Joint Logistic Support Force, Fuzhou, China from January 2017 to June 2021. Patients were randomly divided into study group and a control group comprising 40 patients each. The study group received guipizidine maleate combined with hyperbaric oxygen therapy while control group received hyperbaric oxygen therapy. Differences in neurophysiological and coagulation indices were recorded for the two groups after treatment.

Results: Short latency somatosensory evoked potential (SLSEP) N20 wave amplitude of the study group was significantly greater than that of control group ($p < 0.05$). At 3 months follow-up, Glasgow outcome score (GOS), Karnofsky performance status (KPS) score, and Barthel index in the study group were significantly lower than in control group ($p < 0.05$). The combined incidence of complications in the study group was 5 % (2/40), which was lower than in control group, 17.50 % (7/40)

Conclusion: The combination of guipizide maleate with hyperbaric oxygen has good therapeutic effect on patients with severe craniocerebral injury. It significantly improves neuro-physiological and coagulation indices, reduces the incidence of complications during treatment, and improves neurological function. However, further clinical trials are required to validate these findings.

Keywords: Guipizide maleate, Hyperbaric oxygen, Severe craniocerebral injury, Neurophysiology, Coagulation index, Neurological function

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INTRODUCTION

Traumatic brain injury (TBI) is one of the most common high-risk traumatic disorders [1]. Data shows it is the deadliest of all injuries to other parts of the body, with high mortality and

disability rates [2]. Epidemiological study indicates that the vulnerable group of traumatic craniocerebral injury is predominantly young adult males and the major cause of injury-related death among adolescents in developed countries [3]. Increase in transportation, construction, and

natural disasters in China had led to an increased incidence of traumatic brain injury year after year [4]. Severe craniocerebral injury is a more critical injury in traumatic craniocerebral injury, accounting for about 13 – 21 % of the total number of cases with traumatic craniocerebral injury and its rapid progression, high incidence of sequelae and mortality pose great burden to patients and their families [5]. The mainstay of clinical treatment for severe craniocerebral injury is still non-surgical, including intra-cranial pressure monitoring, sub-critical hypothermia, dehydration therapy, hyperbaric oxygen therapy, and pharmacological treatment [6]. Hyperbaric oxygen therapy has been shown to improve prognosis of patients with severe craniocerebral injury. This treatment can alleviate the symptoms of hypoxia in brain tissue, reduce cerebral edema, and bottom intra-cranial pressure and promote awakening [7]. Guipizide maleate, a piperazine derivative, has been shown to inhibit platelet aggregation and reduce blood viscosity in pharmacological studies [8]. This study aimed to investigate the effect of guipizide maleate combined with hyperbaric oxygen therapy on neuro-physiological and coagulation indices in patients with heavy craniocerebral injury.

METHODS

General patient data

The study involved a total of 80 patients with craniocerebral injury who were admitted to The 900th Hospital of China Joint Logistic Support Force, Fuzhou, China from January 2017 to June 2021. Patients were randomly divided into study group and a control group comprising 40 patients each. The study group received guipizidine maleate combined with hyperbaric oxygen therapy and control group received hyperbaric oxygen therapy. The study was approved by the Ethics Committee of The 900th Hospital of China Joint Logistic Support Force, Fuzhou (approval no. 56377288) and conducted following the procedures outlined in the guidelines for the diagnosis and treatment of severe traumatic brain injury [9].

Inclusion criteria

Patients who met the relevant diagnostic criteria in the guidelines for diagnosing and treating heavy craniocerebral Injury [9] and complete clinical data.

Exclusion criteria

Patients who suffered concurrent psychiatric disorders, injury events exceeding 6 h,

concurrent malignant tumors, concurrent hypertension, myocardial infarction, congenital coagulation disorders, and concurrent severe organic diseases.

Intervention/treatments

Patients in the groups were given the same basic treatment, including hematoma removal, minimally invasive surgery, dehydration to reduce intracranial pressure, nutritional support, correction of water-electrolyte disturbances, and hemostasis.

Patients in the control group were treated with hyperbaric oxygen in addition to basic therapy, with a uniform increase to 2 atm for 15 min after admission, followed by oxygen inhalation for 60 min, and then a slow reduction to normal pressure for 20 min. Treatment frequency was once daily for 10 days, with each treatment interval of 3 days, for a total of 3 courses of treatment.

Patients in the study group were treated with guipizide maleate in addition to basic therapy. The drug (2 mL x 4) was dissolved in 500 mL of saline intravenous infusion and administered at a rate of 100 mL/h. The infusion was completed within 5 h, and the treatment frequency was once daily for 14 days.

Evaluation of parameters/indices

Neurophysiological monitoring was performed at 1, 2, 3, 4, and 5 days after treatment. Blood samples were collected from the study group and control group at the time of admission and 5 days after treatment, and coagulation indices (FIB and PT) were measured in triplicates. Glasgow outcome score (GOS) [10], Karnofsky performance status (KPS) score [11], and Barthel score [12] were recorded and compared during follow-up (3 months after discharge). The GOS score ranged from 1 to 5, with 5 for a good recovery and normal life and 1 for death. A point of 100 means that the subject is functioning well in activities of daily living and does not need the help of others, while a point of 0 means that he or she is functioning very poorly and is not independent. The incidence of complications was also evaluated between the two groups of patients.

Statistical analysis

The data collected were analyzed using SPSS 16.0. Count data were expressed as percentage (%) and analyzed using Chi-square test. Measurement data were expressed as mean ±

standard deviation (SD). Differences were analyzed using *t*-test, and $p < 0.05$ was considered statistically significant.

time of admission and 5 days after treatment (Table 3, Figure 1).

RESULTS

Clinical profile of patients

The general clinical data such as gender, age, Glasgow coma scale (GCS point), cause of injury, and site of injury were compared, and the results showed that there was no significant difference between the two groups ($p > 0.05$) (Table 1).

Neurophysiological indices of patients after treatment

Neurophysiological indices were significantly greater in study group than control group after treatment was performed at 1, 2, 3, 4, and 5 days after treatment (Table 2).

Coagulation indices of patients during treatment

Coagulation indices (FIB and PT) of study group were significantly lower than control group at the

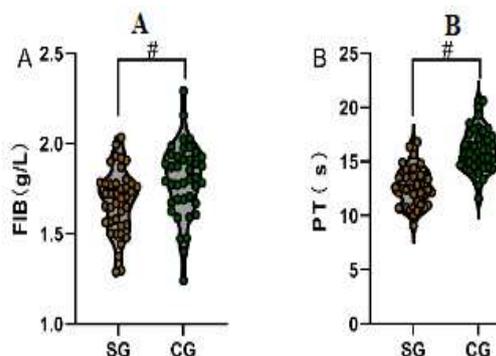


Figure 1: Coagulation indices between two groups of patients on treatment. The FIB (A) and PT (B) of patients in study group were significantly lower than those of the control group at day 5 of treatment ($\#p < 0.05$)

Performance indices at 3-month follow-up after discharge

The comparison results showed that the GOS score, KPS score, and Barthel Index score of the study group were significantly higher than control group ($p < 0.05$; Table 4)

Table 1: Clinical data of patients (mean \pm SD, n = 40)

Clinical data		Study group	Control group	<i>t</i> / χ^2	<i>P</i> -value
Gender	Male	30	26	0.952	0.329
	Female	10	14		
Mean age (years)		45.12 \pm 4.18	46.43 \pm 3.53	1.514	0.134
GCS point		5.92 \pm 0.99	5.88 \pm 1.02	0.178	0.859
Cause of injury	Car accident	26	25	0.054	0.816
	Fall	14	15		
	Frontotemporal	24	26		
Injured area	Top	1	1	0.526	0.365
	Occipital	1	1		
	Multiple	14	12		

Table 2: Neurophysiological indices (Short latency somatosensory evoked potential (SLSEP) N20 wave amplitude) after treatment (mean \pm SD, n = 40)

Group	Day 1	Day 2	Day 3	Day 4	Day 5
Study group (μ V)	1.20 \pm 0.23	1.51 \pm 0.21 [#]	1.55 \pm 0.10 [#]	1.84 \pm 0.20 [#]	2.01 \pm 0.21 [#]
Control group (μ V)	1.20 \pm 0.21	1.30 \pm 0.21	1.31 \pm 0.21	1.57 \pm 0.19	1.62 \pm 0.22
<i>T</i> -value	0.000	4.472	6.526	6.190	8.110
<i>P</i> -value	1.000	<0.001	<0.001	<0.001	<0.001

[#] $p < 0.05$ vs control

Table 3: Coagulation indicators of the groups (n = 40)

Group	FIB (g/L)		PT (s)	
	On admission	5 days after treatment	On admission	5 days after treatment
Study group	2.07 \pm 0.33	1.68 \pm 0.18	21.21 \pm 4.05	12.69 \pm 1.76
Control group	2.17 \pm 0.29	1.79 \pm 0.20	21.03 \pm 4.26	15.99 \pm 1.93
<i>T</i> -value	1.440	2.586	0.194	7.990
<i>P</i> -value	0.154	0.012	0.847	<0.001

Table 4: Performance indices at 3-months follow-up after discharge (n = 40)

Group	GOS Rating	KPS Rating	Barthel Index
Study group	4.42±0.20 [#]	86.73±5.65 [#]	87.31±9.47 [#]
Control group	2.61±0.28	75.34±6.04	80.21±7.03
T-value	33.268	8.710	3.807
P-value	<0.001	<0.001	<0.001

[#]P < 0.05 versus control

Incidence of complications

Incidences of complications such as pneumonia delayed intra-cranial hematoma, hyperfibrinolysis, and hypotension in the two groups were counted and compared between the groups. The results showed that the total incidence in the study group was 5.00 % (2/40), which was lower than that of the control group, 17.50 % (7/40) (Figure 2).

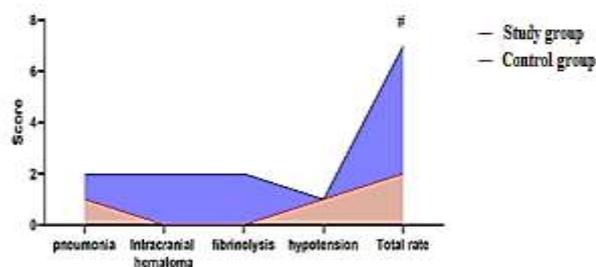


Figure 2: Comparison in complication rates between the two groups. The combined incidence rate of the study group was 5.00 % (2/40), which was significantly lower than that of the control group at 17.50 % (7/40) ([#]p < 0.05)

DISCUSSION

Car accidents falls, blows and impact injuries are all common causes of craniocerebral injury, and reports worldwide showed that traffic accidents are the leading cause of all types of craniocerebral injury [13]. Due to the brain's high fast metabolism, it consumes more than 1/5 of the total amount of oxygen in the body, but weighs less than 1/20 of the body weight and derives energy from the absorption of glucose under normal circumstances [14]. Severe craniocerebral injury is a disorder caused by vascular damage to the brain cells leading to ischemia and hypoxia of brain tissue [15].

The results showed that study group (treated with guipizide maleate and hyperbaric oxygen) has significantly better neurophysiological parameters than control group (treated with hyperbaric oxygen alone). In a study of 50 patients with severe craniocerebral injury, it was found that a higher rate of cerebral oxygen metabolism and more active neurophysiological

activity indicated better prognosis [16]. It has also been shown that hyperbaric oxygen therapy significantly improved neurophysiological parameters of patients with craniocerebral injury and that such changes are closely correlated with neurological function [17]. In this study, hyperbaric oxygen therapy can alleviate the symptoms of cerebral hypoxia by increasing oxygen tension and content of brain cells [18]. The combined effect of guipizide and hyperbaric oxygen was effective in stabilizing brain cell membranes and protecting neurons, resulting in significantly more active neurophysiological activity in the study group.

This study also compared coagulation-related indices between the two groups after treatment. High intracranial pressure increases the risk of hypercoagulability and hyperfibrinolysis, thereby increasing mortality and disability [19]. This study revealed that coagulation-related indices of study group showed more significant improvement than control group after treatment. The overall complication rate of study group was significantly lower than control group. This result was also replicated in another study [20]. In a similar study, the incidence of cranial edema and hyperfibrinolysis the analyzed to be closely related to the addition of guipizide maleate [21]. This study also compared the neurological function indices of the two groups of patients 3 months after discharge, and the results showed that the KPS, GOS, and Barthel points of the patients in the study group were higher than those of the control group. This suggested that the recovery of neurological function and daily living ability of the study group was better than control group. The reason for this was that early application of guipizide maleate had a good protective effect on neuronal cells, thus improving clinical outcomes. Thus, a combination of guipizide maleate and hyperbaric oxygen has good therapeutic effects on patients with heavy craniocerebral injury.

DECLARATIONS

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None provided.

Ethical approval

The study was approved by the Ethics Committee of The 900th Hospital of China Joint Logistic Support Force, Fuzhou (approval no. 56377288).

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of Interest

No conflict of interest associated with this work.

Contribution of Authors

The authors declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by them.

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