Study on the Effect of Mild Hypothermia Combined with Postural Intervention in Craniocerebral Trauma and Its Impact on Prognosis

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We attempt to study the effect of mild hypothermia combined with postural intervention on meropenem intervention in patients with craniocerebral trauma and its impact on prognosis. We selected eighty patients with craniocerebral trauma who received meropenem intervention in hospital from February 2020 to February 2023 for the trial. Then divided them into an experimental group (n=40 cases) and a reference group (n=40 cases) according to the computer-numbered random number table method. Reference group received conventional nursing intervention, after receiving the same intervention as reference group, added mild hypothermia combined with postural intervention to the experimental group. Compared both groups on the results of the intervention, serum calcitonin gene-related peptide, myelin basic protein and brain-derived neurotrophic factor levels, complications and prognosis. After 2 w of intervention, experimental group had lower the national institutes of health stroke scale scores, but higher the Glasgow coma scale scores than reference group (all p<0.05). After 2 w of intervention, experimental group had higher serum calcitonin gene-related peptide and brain-derived neurotrophic factor levels but lower myelin basic protein levels than reference group (all p<0.05). The overall complication rate in the experimental group was lower than that in the reference group (10.00 % *vs.* 30.00 %) (p<0.05). After 2 w of intervention, Glasgow prognostic scale scores were higher in both groups than before the intervention and experimental group had higher scores than reference group (all p<0.05). The effect of mild hypothermia combined with postural intervention on meropenem intervention in patients with craniocerebral trauma is better and can promote the improvement of patient's neurological function and prognosis, which is worthy of promotion and application.

Key words: Craniocerebral trauma, meropenem, mild hypothermia, postural intervention, prognosis

Craniocerebral trauma is one of the more common forms of neurosurgery and is often caused by car accidents, violence and falls from height[1]. With increasing modernization and the continued development of the transport industry, the incidence of craniocerebral trauma is increasing year by year, especially in patients with severe craniocerebral injuries, who are often in critical condition and have a poor prognosis. Surgery is an important tool in craniocerebral trauma treatment, however, patients are at risk of intracranial infection after surgery, which may be detrimental to their recovery. Meropenem is one of the effective antibacterial drugs for the prevention of intracranial infections. It exerts its antimicrobial effect by inhibiting bacterial cell wall synthesis and its use in the prevention of infections in craniocerebral trauma has been reported in studies[2]. Mild hypothermia is a widely used physical intervention in neurosurgery to improve the clinical therapy effects of patients with craniocerebral trauma and to promote neurological recovery[3]. Postural interventions are designed to improve cerebral blood flow and cerebral perfusion pressure levels in patients with craniocerebral trauma by adjusting the posture of the patient, thereby promoting recovery[4]. However, little research has been reported on the use of mild hypothermia combined with postural interventions in patients with craniocerebral trauma. In this paper, we investigated the effect of mild hypothermia combined with postural intervention on meropenem

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intervention in patients with craniocerebral trauma and its impact on prognosis. We selected eighty patients with craniocerebral trauma who received meropenem intervention in hospital from February 2020 to February 2023 for the trial. Then divided them into an experimental group (n=40 cases) and a reference group (n=40 cases) according to the computer-numbered random number table method. Experimental group consisted of 25 males and 15 females; age were from 38-69 y old, mean (57.32±6.21) y old; body mass index 18-32 kg/m^2, mean (23.51±1.67) kg/m^2; injury types were 19 cases cerebral contusions, 6 cases intracranial haematomas, 11 cases diffuse axonal injuries, 4 cases others; causes of injury were 18 cases traffic accidents, 14 cases falls from height, 8 cases violent blows; years of education from 5-16 y, mean (9.12±1.07) y. Reference group consisted of 27 males and 13 females; age were from 35-69 y old, mean (57.19±6.20) y old; body mass index 18-32 kg/m^2, mean (23.60±1.69) kg/m^2; injury types were 20 cases cerebral contusion, 5 cases intracranial haematoma, 10 cases diffuse axonal injury, 5 cases other; causes of injury were 20 cases traffic accident, 13 cases fall from height, 7 cases violent percussion; years of education from 5-16 y, mean (9.19±1.10) y. The differences of the above information of both groups were small ($p>0.05$) and could be compared at follow-up. Inclusion criteria all were diagnosed with severe craniocerebral trauma by imaging; all were adults; post-injury coma duration >6 h; confirmed sensitive to meropenem by drug sensitivity test and using meropenem to prevent infection. Exclusion criteria combined with major infections or immune diseases; associated with severely impaired vital organ function or organic lesions; allergy to meropenem. Patients have signed consent forms and the study was approved by the hospital medical ethics committee. The reference group used conventional nursing interventions, including gastrointestinal nutrition, health education and psychological guidance. After receiving the same conventional nursing interventions as reference group, added mild hypothermia combined with postural intervention to the experimental group; mild hypothermia intervention have adopted a GL29680 medical cooling bed (purchased from Changchun Antai Electronic Products Co., Ltd.) to maintain anal temperature at 33°-35° with a cooling rate of 1° to 1.5°/h. The observation of the subject's body temperature and facial expression changes was completed once at an interval of 2 h. At the same time, blood pressure, pulse and limb circulation were monitored, if abnormalities are detected, the patient should be treated with appropriate treatment such as correction of water-electrolyte or acid-base imbalance and if necessary, vasoactive drugs may be considered. The rewarming method includes natural rewarming, as well as rewarming with the aid of electric blankets and bolometer. The rate of rewarming should be 1°/4 h, and the rewarming should be stopped when the subject's body temperature has returned to 37°. Postural intervention for those with cerebral edema, elevate the head by 15°; for those in shock, assist them to assume a foot-high, head-low position; for those in severe coma, assist them to assume a side-lying position. For those with cervical spine damage, assist them in a flat position and if there is axonal damage, elevation of the head is strictly prohibited. The nursing staff assisted the subject with knee flexion and lower leg elevation. In addition, regularly help the subject turn over daily, massage the local skin of the pressure area and maintain the hygiene and cleanliness of the bed sheets to avoid pressure sores. Compared the both groups on serum Calcitonin Gene-Related Peptide (CGRP), Myelin Basic Protein (MBP) and Brain-Derived Neurotrophic Factor (BDNF) levels, complications and prognosis. The outcome of the intervention was assessed using the National Institutes of Health Stroke Scale (NIHSS)[5] and the Glasgow Coma Scale (GCS)[6]. The former score is 0 to 42 points, with a high score indicating severe neurological deficit; the latter score is 3 to 15 points, with a high score indicating good consciousness. Serum CGRP, MBP and BDNF levels detection by collecting the specimens 1 d before the intervention and 2 w after the intervention before the morning meal. 4 ml of venous blood was drawn from all subjects and the serum was obtained by centrifugation. Serum CGRP and MBP levels were measured by Enzyme-Linked Immunosorbent Assay (ELISA) and the kit was selected from Beijing Dongge Boye Biotechnology Co., Ltd. BDNF levels were measured with the aid of a Senlon 8030 automatic biochemistry analyzer (purchased from Zhuhai Senlon Biotechnology Co., Ltd.). Complications included infection, ulceration and joint stiffness.

Prognosis was assessed using the Glasgow Outcome Scale (GOS)[7], with a score of 1 to 5 points, indicating death to good recovery, with a high score indicating a good prognosis. Adopted Statistical Package for the Social Sciences (SPSS) 24.0 software to process the data. The measurement data were described by ($\bar{x}\pm s$) and t-test was performed. The count data were described by [n, (%)] and the Chi-square (χ^2) test was performed. $p<0.05$ means that the difference is statistically significant. After 2 w of intervention, experimental group had lower NIHSS scores, but higher GCS scores than reference group (all $p<0.05$) as shown in Table 1. After 2 w of intervention, experimental group had higher serum CGRP and BDNF levels, but lower MBP level than reference group (all $p<0.05$) as shown in Table 2. The overall complication rate in the experimental group was lower than that in the reference group (10.00 % *vs.* 30.00 %) ($p<0.05$) as shown in Table 3. After 2 w of intervention, GOS scores were higher in both groups than before the intervention, and experimental group had higher scores than reference group (all $p<0.05$) as shown in Table 4. Intracranial infection is one of the more common complications of postoperative craniocerebral trauma, which can make clinical treatment more difficult and can even lead to disability or death, so clinical treatment of craniocerebral trauma pays particular attention to the prevention and treatment of intracranial infection[8]. Meropenem is one of the key drugs in the prevention and treatment of intracranial infections, especially against Gram-negative bacteria and can directly reduce the risk of intracranial infections after craniocerebral trauma surgery[9]. However, the prognosis of these patients is not only affected by intracranial infections, but also by appropriate and effective nursing interventions. Previous conventional nursing interventions focused on treatment outcomes, while care for patient's neurological recovery and prevention of complications was clearly lacking[10]. Mild hypothermia combined with postural care is a new model of care that have emerged in recent years and have shown some advantages in the postoperative care of patients with craniocerebral trauma. The results of this paper demonstrate that after 2 w of intervention, experimental group had lower NIHSS scores, but higher GCS scores than reference group. This is similar to the studies reported by Huang *et al.*[11] and Xiao *et al.*[12], suggesting a better effect of mild hypothermia combined with postural intervention on meropenem intervention in patients with craniocerebral trauma, which can promote neurological recovery. Mild hypothermia is mainly used to reduce oxygen consumption in brain tissue through physical cooling and to promote the improvement of cerebral edema, which protects brain tissue and reduces harmful factors, negatively regulates the synthesis and release of inflammatory factors and facilitates the control of local inflammatory response, thus reducing neuronal damage[13]. Postural interventions can reduce venous pressure through gravity, while increasing venous blood flow velocity and reducing intracranial blood volume, thus achieving good control of intracranial pressure and creating favorable conditions for patients to recover neurological function[14]. In addition, CGRP mediates the neuronal remodeling process and its expression level is influenced by the inflammatory response as well as the hypermetabolic state, which can effectively reflect the neurological function. BDNF is one of the common neurotrophic factors that mediates the process of neuronal survival and growth, and its elevated expression often indicates good recovery of damaged neuronal cells. MBP is a strongly basic membrane protein synthesized mainly from the central nervous system. When the central nervous system suffers damage, the blood-brain barrier is damaged, which leads to an increase in serum MBP levels, and can be used as a marker to assess neurological damage in patients. In this paper, the levels of these three serological parameters were compared before and after the intervention in both groups, which can provide objective quantitative data for related studies and is one of the innovative points of this study. After 2 w of intervention, experimental group had higher serum CGRP and BDNF levels, but lower MBP level than reference group. This confirms the significant neuroprotective effect of the intervention protocol in the experimental group. Considering the reasons, mild hypothermia intervention could improve the oxygen metabolism of brain tissue, reduce the release of oxygen free radicals or toxic metabolites, provide protection to brain tissue and blood-brain barrier and facilitate the repair and regeneration of nerve cells, which eventually led to the gradual return of the index levels to normal[15]. In addition, experimental

group had lower overall incidence of complications rate than reference group. This indicates that the intervention program in the experimental group reduced the risk of complications. The reason for this is that mild hypothermia combined with postural interventions were effective in preventing complications by improving the patient's condition, maintaining the stability of all vital signs and reducing the negative impact of the disease on other systems, thus effectively preventing complications. After 2 w of intervention, GOS scores were higher in both groups than before the intervention and experimental group had higher scores than reference group. This indicates that the intervention protocol in the experimental group can effectively improve the prognosis of patients with craniocerebral trauma. The reason for this may be that the postural intervention can effectively reduce intracranial pressure and maintain cerebral perfusion pressure, achieving good protection of brain cells and ultimately improving the prognosis. Mild hypothermia intervention can lower the intracranial pressure and reduce neurological damage by lowering the patient's temperature, thus reducing intracranial pressure and neurological damage, which can positively contribute to the patient's prognosis. In summary, mild hypothermia combined with postural interventions promotes better neurological recovery in patients receiving meropenem interventions for craniocerebral trauma and reduces the risk of complications and improves prognosis.

TABLE 1: COMPARISON OF NIHSS AND GCS SCORES BETWEEN BOTH GROUPS ($\bar{x}$±s, POINTS)

Group	Cases	NIHSS		GCS	
		Before intervention	After 2 w of intervention	Before intervention	After 2 w of intervention
Experimental	40	32.87±2.50	20.78±1.34	5.17±0.42	8.02±0.51
Reference	40	32.94±2.52	23.66±1.70	5.10±0.44	7.16±0.48
t value		0.125	8.415	0.728	7.766
p value		0.901	<0.001	0.469	<0.001

TABLE 2: COMPARISON OF SERUM CGRP, MBP AND BDNF LEVELS BETWEEN BOTH GROUPS ($\bar{x}$±s)

Group	Cases	CGRP (pg/ml)		MBP (mg/l)		BDNF	
		Before intervention	After 2 w of intervention	Before intervention	After 2 w of intervention	Before intervention	After 2 w of intervention
Experimental	40	141.52±18.29	182.35±24.12	16.23±2.49	5.38±1.03	4.28±0.33	6.72±0.75
Reference	40	140.77±18.41	170.48±20.60	16.31±2.60	6.14±1.24	4.31±0.34	5.80±0.66
t value		0.183	2.367	0.141	2.982	0.400	5.824
p value		0.855	0.020	0.889	0.004	0.690	<0.001

TABLE 3: COMPARISON OF COMPLICATIONS BETWEEN BOTH GROUPS [n, (%)]

Group	Cases	Infections	Ulcers	Stiffness of joints	Overall incidence rate
Experimental	40	1 (2.50)	1 (1.25)	2 (2.50)	4 (10.00)
Reference	40	3 (7.50)	4 (10.00)	5 (12.50)	12 (30.00)
χ^2 value					5
p value					0.025

TABLE 4: COMPARISON OF GOS SCORES BETWEEN BOTH GROUPS ($\bar{x}$±s, POINTS)

Group	Cases	Before intervention	After 2 w of intervention	t value	p value
Experimental	40	3.22±0.34	4.55±0.43	15.345	<0.001
Reference	40	3.25±0.37	4.01±0.40	8.821	<0.001
t value		0.378	5.815		
p value		0.707	<0.001		

Author's contributions:

Xueping Zhang and Zhifang Wang have contributed equally to this work.

Conflict of interests:

The authors declared no conflict of interests.

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