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Clinical Observation of Hyperbaric Oxygen Therapy in Patients with Craniocerebral Trauma

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ABSTRACT **Objective:** To review and analyze the clinical effect of hyperbaric oxygen therapy in the treatment of craniocerebral trauma, and to provide reference for the treatment of craniocerebral trauma. **Method:** From January 2009 to April 2014, we treated 287 cases of patients with craniocerebral trauma, on the basis of conventional treatment, the use of hyperbaric oxygen therapy and assessment for therapeutic effect. **Results:** After hyperbaric oxygen therapy, patients with GCS score and GOS levels were significantly improved, compared with before treatment, the difference was statistically significant ($p < 0.05$); effect of the treatment of patients with 2–3 courses of treatment was better than patients receive more than 3 courses of treatment ($p < 0.05$). **Conclusion:** Hyperbaric oxygen in the treatment of craniocerebral trauma can effectively improve patient's symptoms and signs, there are helpful in the recovery of the body function of patients. Hyperbaric oxygen treatment should be carry out as soon as possible with appropriate extending the duration of treatment, as well as reduce the severe disability, death and sequela.

KEYWORDS
Craniocerebral injury
Hyperbaric oxygen
Treatment effect

1. Introduction

Head injury is a direct or indirect effect on the head injury caused by the external violence. According to the damage of the brain tissue and the outside world are divided into open and closed injury. Common brain injury has scalp laceration, scalp avulsion injury, scalp hematoma, skull fracture, cerebral concussion, cerebral contusion, intracranial hematoma, etc. These caused different degrees of headache, vomiting, optic papilla edema and affecting consciousness, thinking, feeling and movement of the patients. In the verification of medical research, head injury is a direct or indirect effect on the head injury. In general, brain injury is complex and changing rapidly and required to took the precaution for prevention. Cerebral perfusion pressure, cerebral ischemia and hypoxia are the key factors to affect the brain injury. Once a serious complication, it is required to be operated on, to achieve relief of pain and recovery work. Because the disease itself has a rapid change in the trend, which can bring different aspects of the pain, and seriously affect the health of the body. More clinical practice shows that early treatment of cerebral ischemia and hypoxia by hyperbaric oxygen therapy can improve the cerebral blood oxygen saturation, which is of great significance for the treatment of traumatic brain injury and prognosis of patients [1,2]. Recent years in our hospital, the use of hyperbaric oxygen therapy for patients with craniocerebral trauma, and achieved a more ideal treatment effect.

2. Materials and methods

2.1. Research object

Department of Neurosurgery of our hospital from January 2009 to April 2014 were used in the hyperbaric oxygen chamber for 287 cases of craniocerebral injury were treated with, all patients were underwent CT or MRI for diagnosis. Within 287 patients, 182 were male and 105 female, aged (41.20 + 11.26) years old. The course of disease ranged from 1 days to 2.5 years. 64 cases were cerebral concussion, 54 cases of cerebral concussion, 58 cases of cerebral contusion, 47 cases of subdural hematoma, 44 cases of intracranial hematoma, 14 cases of skull fracture, 6 cases of others. 287 cases of hospitalized patients had different degrees of

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coma or disturbance of consciousness and complained of dizziness, headache, nausea, insomnia, memory loss, limb movement disorder, inattention typical craniocerebral injury symptoms or signs.

2.2. Treatment method

2.2.1. Based therapy

After admission, the patient was given conventional treatment, for example: hemostasis, anti-infection, head cooling, prevention of dehydration, etc., according to patient's situation to give sedative drugs, and it is necessary to perform emergency surgery.

2.2.2. Hyperbaric oxygen therapy

Instruments: Beijing Century pioneer Medical Instrument Co., Ltd. to provide the HAUX-STARMED-QUADRO medical air pressurized oxygen chamber and treatment pressure is (0.15 + 0.05 MPa), compression (20 + 3) min, wearing an oxygen mask inhalation of pure oxygen for 60 min, and normal inhalation for 10 min, hyperbaric oxygen treatment the total time for 2 h/time, 1 times a day, 10 times for a course of treatment general treatment 2–5 courses.

2.3. Observation index

2.3.1. Glasgow Outcome Scale (GOS)

Recorded at admission and hyperbaric oxygen treatment after 6 months after the Glasgow Come Score (GCS) score and after admission and treatment of 6 months were Glasgow Outcome Scale (GOS) standard to evaluate the patient's survival: good, mild disability, severe disability, vegetative living and death.

2.3.2. Effect evaluation criteria

Overall treatment effect was evaluated according to the following criteria: (1) Cure: symptoms, signs disappeared, recovery of life and work ability, CT review (2) Normal; improve: symptoms and signs are improved, life can take care of CT review tips the lesion disappeared; (3) Invalid: symptoms without improvement or aggravation, the plant state, CT review no change [3].

2.4. Statistical analysis method

The measurement data are expressed in the form of the standard deviation. The measurement data were analyzed by the *t* test of paired design. The rank data were analyzed by rank sum test, and the test level was 0.05.

3. Results

3.1. GCS score and GOS level

From Table 1, GCS score of 287 patients after treatment were significantly higher than those before treatment, and the difference was statistically significant ($p < 0.05$), while the GOS level of patients was significantly improved, and the rank sum test, compared with that before treatment, the difference was statistically significant ($p < 0.05$).

3.2. Different effects of hyperbaric oxygen therapy

The treatment effect of different hyperbaric oxygen therapy was compared with different duration and the total effective rate for 2–3 courses of treatment achieved 98.04% and total effective rate of >3 courses treatment achieved 89.16%. Which was statistically significant difference ($x^2 = 10.764$, $p = 0.001$) by chi square test. By rank sum test, the effect of the two groups was statistically different ($Z = -3.311$, $p = 0.001$), and the effect of 2–3 treatment was better than that of the >3 courses.

4. Discussion

Brain injury is usually caused by external forces that induce deformation in skull, brain, brain blood vessels and brain tissue. Mechanical deformation of the site and the severity of the brain injury is use for determine the different types of cerebral ischemia, cerebral ischemia, cerebral hematoma, brain swelling, brain edema, intracranial pressure. Although traumatic brain injury can be divided into different types of injury, it can be expressed as cerebral ischemia, hypoxia, cerebral edema, intracranial pressure,

Table 1. Patients with GCS score and GOS level before and after treatment.

Time	GCS score (mean + standard deviation)	GOS [cases (%)]				
		Good	Mild disability	Severe disability	Plant survival	Death
Before treatment	7.21 ± 0.32	11 (3.83)	137 (47.74)	112 (39.02)	27 (9.41)	0 (0.000)
After treatment	11.22 ± 2.71	126 (43.90)	109 (37.98)	37 (12.89)	11 (3.83)	4 (1.39)
t/Z	6.588			-10.737		
p	0.000			0.000		

Table 2. Effect of different hyperbaric oxygen treatment [cases (%)].

Course of treatment	Cases	Cure	Better	Invalid	Efficiency (%)
2–3 treatment	204	162 (79.41)	38 (18.63)	4 (2.14)	98.04
Over 3 courses	83	58 (69.88)	26 (13.90)	9 (10.84)	89.16

brain cell metabolic dysfunction. Therefore, to reverse the condition of cerebral ischemia and hypoxia at the same time recover the intracranial pressure, is a key step in the treatment of brain injury, and to improve the prognosis [4]. Treatment of mental disorders caused by brain injury in acute stage, mainly in the Department of Neurosurgery, handling of dangerous period after active treatment of psychiatric symptoms, but still has a disorder of consciousness should be careful with psychotropic drugs.

At present, the clinical treatment of traumatic brain injury is using high pressure oxygen treatment, clinical practice has proved that the method is effective. Under the high pressure (over atmospheric pressure) environment, breathing pure oxygen or high concentration of oxygen in the treatment of hypoxic disease and related disorders, was known as hyperbaric oxygen treatment. Hyperbaric oxygen therapy, was using high pressure to improve the blood circulation. High pressure condition mimic the effect of adrenaline by inducing vasoconstriction to reduce the local blood volume, and this relieve edema caused by meningoencephalocele, burns or injury. However some precaution should be taken that although the local blood supply is reduced, but the amount of oxygen in the blood is increased. After a long period of time, Some patients still possess functional disorder of autonomic nerve symptoms, which was the sequelae of concussion, and now known as the brain concussion syndrome or brain concussion after the plant nerve function disorder.

Through this study, we show that 287 patients with craniocerebral trauma treated in our hospital from January 2009 to April 2014 were treated with hyperbaric oxygen therapy, and the effect of hyperbaric oxygen therapy was evaluated on the basis of conventional therapy. Results: after hyperbaric oxygen therapy, patients with GCS score and GOS levels were significantly improved, compared with before treatment, the difference was statistically significant ($p < 0.05$); the effect of the treatment of patients with 2–3 was better than 3 course of treatment ($p < 0.05$). Thus, hyperbaric oxygen therapy for craniocerebral trauma can effectively improve the patient's symptoms and signs, help patients with physical function recovery.

The clinical practice of high pressure oxygen therapy in patients with craniocerebral trauma shows that this method can effectively improve patients' GCS score and improve patients' physical function. The mechanism may be as follows: first efficiently supply of oxygen increase the rate of vasoconstriction in cranial and reduce pressure within intracranial. To overcome this condition, body will increase the blood volume to increase oxygen partial pressure inside the brain, and indirectly recover the blood supply in the area of brain damage. After acquired the enough supply of blood, metabolism of brain's cell enhanced and improve the function of different organ. Besides it subsequently, improve and maintenance the function of sodium and potassium pump, and improve water retention condition within the cells At the same time it reduce meningoencephalocele and improve microcirculation and further increase the blood supply to the damage area and metabolism of cells that surrounded necrosis tissue able to restore.

There was a close relationship between the time of hyperbaric oxygen therapy, courses of treatment and the clinical effect of the treatment. At present, most of the scholars support: as long as when the patients with craniocerebral trauma, the vital signs are stable, it should be treated with hyperbaric oxygen as soon as possible, these shorter the course of disease, longer the therapeutic duration, and higher the cure rate [5]. There are also many clinical studies to support this view. But the results of this study show that: the effect of the treatment of 3 courses of treatment is more than the treatment of patients with 2–3. But this does not mean that the conflict with the above point of view, and may be the treatment of 2–3 patients with a treatment of the disease is generally mild, and the need for treatment of patients with more than three courses of illness is often more important.

In conclusion, the hyperbaric oxygen treatment of craniocerebral trauma, can effectively improve patient's body function and promote patient's recovery. If there was no contraindications, hyperbaric oxygen treatment should be carry out as soon as possible with appropriate extending the duration of treatment, as well as reduce the severe disability, death and sequela.

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