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EVALUATION OF THE EFFECTIVENESS OF HYPERBARIC OXYGEN THERAPY IN COMBINATION TREATMENT OF PATIENTS WITH CEREBRAL INFARCTION AT MILITARY HOSPITAL 103

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ABSTRACT

Objectives: *To evaluate the efficacy of combined hyperbaric oxygen therapy with other methods in the treatment of ischemic stroke patients.*

Subjects and methods: *An uncontrolled interventional study conducted on 30 ischemic stroke patients treated at the Department of Rehabilitation, Military Hospital 103, from September 2023 to August 2024. Muscle strength was assessed using the MRC scale. Independence in activities of daily living was evaluated using the Barthel scale. Neurological impairment was assessed using the NIHSS scale.*

Results: *The proportion of patients with muscle strength grade 1 (40.0%) and grade 2 (40.0%) before treatment significantly decreased after treatment (to 20% and 20%, respectively), with a p-value < 0.05. Patients' independence in daily activities before treatment (100% dependent; of which 40.0% were completely dependent, 60.0% partially dependent) showed statistically significant improvement. After treatment, no patients remained completely dependent; 66.7% were still partially dependent, 20% were independent, and 13.3% were fully independent (p < 0.05). The mean NIHSS score significantly decreased from 6.98 ± 2.12 before treatment to 4.23 ± 0.89 after treatment (p < 0.05).*

Conclusion: There was a positive improvement in muscle strength, daily activity function, and cognitive function according to the NIHSS in ischemic stroke patients receiving adjunctive hyperbaric oxygen therapy.

Keywords: Ischemic stroke, rehabilitation, hyperbaric oxygen therapy.

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1. INTRODUCTIONS

Cerebral stroke is a common disease in the elderly. The disease occurs suddenly, can cause rapid death or leave many severe neurological sequelae, seriously affecting the quality of life and function of the patient. According to statistics from the World Health Organization, globally in 2016, cerebral stroke had the second-highest mortality rate (11.3%) and the third-highest rate of causing long-term disability among diseases. In Vietnam, cerebral stroke has become a major issue for the neurology and emergency resuscitation sectors, with about 230,000 new cases each year; it is one of the ten leading causes of death in the elderly (accounting for 27%). Furthermore, with ischemic stroke, up to 50% of surviving patients after treatment experience sequelae ranging from mild to disabling, making ischemic and its consequences truly a burden for the patients themselves, their families, and society. However, recent advances in medicine, especially in the fields of neurology, vascular medicine, etc., have opened many new directions in intervention treatment and rehabilitation for ischemic stroke patients. Accordingly, the basic goals of the treatment and rehabilitation process recommended include protecting blood vessels, protecting nerves, stimulating angiogenesis, neurogenesis, and neural plasticity [4].

Studies have clearly shown that brain tissue is very sensitive to oxygen deprivation. If not supplied with enough oxygen for a short time, nerve cells in the brain will weaken and lose function. Therefore, early intervention and adequate oxygen supply are among the decisive factors in treating ischemic stroke. Hyperbaric oxygen therapy (HBOT) has been applied clinically for over 50 years and has shown very promising effectiveness in treating conditions such as carbon monoxide poisoning, gas embolism, gas gangrene, difficult-to-heal wounds… In recent years, this therapy has been proven effective for damaged

brain tissue by reducing the size of gas bubbles and increasing the partial pressure of oxygen in all tissues, especially oxygen-poor tissues. HBOT can also be combined with internal medicine methods and rehabilitation exercises to enhance the recovery effectiveness for patients. Globally, there have been many studies on the effectiveness of neurological rehabilitation in ischemic stroke patients using HBOT. However, in Vietnam, there are not many systematic studies on this issue. We conducted this study to evaluate the effectiveness of combining HBOT therapy in the treatment of ischemic patients at Military Hospital 103.

2. SUBJECTS AND METHODS

2.1. Subjects

30 ischemic stroke patients treated at the Department of Rehabilitation, Military Hospital 103, from September 2023 to August 2024.

- Inclusion criteria: patients aged 18 years or older, with CT or MRI showing ischemic lesions, diagnosed with ischemic in the recovery phase (after 24 hours to 6 months); patients with NIHSS score ≤ 10 points.

- Exclusion criteria: ischemic patients with hemorrhagic transformation or risk of cerebral hemorrhage; patients with pacemakers; patients with acute or chronic diseases affecting the evaluation criteria for recovery effectiveness; patients with contraindications to HBOT therapy; patients or their families who did not agree to participate in the study.

2.2. Methods

- Study design: uncontrolled clinical intervention.

- Sampling and sample size: convenience sampling.

- Treatment method: all patients were treated according to a general protocol, including internal medicine treatment, rehabilitation treatment, and combined HBOT therapy, at the Department of Rehabilitation, Military Hospital 103. HBOT therapy was performed according to the technical process guide for hyperbaric oxygen treatment, issued with Decision No. 2539/QD-BYT, dated June 19, 2019, by the Ministry of Health. A single-chamber procedure was applied, 60 minutes/session, once daily, for 14 days. Treatment started at 1.2 atm on the first day, increased by 0.1 atm/day, maintained at 1.6-1.8 atm.

- Study variables:

+ General characteristics of patients: age, gender, comorbidities, location of paralysis.

Treatment effectiveness: assessed through changes in indices of muscle strength; independence in daily activities; level of neurological function decline.

+ Assessment times: before HBOT treatment and 1 month after treatment.

+ Some adverse effects due to HBOT therapy.

- Criteria applied in the study:

+ Assessment of independence in daily living using the Barthel Index with 4 levels: totally independent (80-100 points), minimally independent (60-79 points), partially dependent (40-59 points), very dependent (20-39 points).

+ Assessment of muscle strength according to the MRC scale (Medical Research Council scale for muscle strength), with 6 levels: no muscle contraction (0 points); slight muscle contraction but no movement (1 point); movement possible without gravity (2 points); movement against gravity but no resistance (3 points); movement against moderate resistance (4 points); normal muscle strength, movement against maximal resistance (5 points).

+ Assessment of neurological function decline according to the NIHSS scale: no stroke (0 points); mild stroke (1-4 points); moderate stroke (5-15 points); severe stroke (16-21 points); very severe stroke (> 21 points).

- Ethics: the project was approved by the Ethics Committee of the Military Medical Academy (Decision No. 3389/QD-HVQY). All patient information was kept confidential and used only for research purposes.

- Data processing: using SPSS 22.0 software; presented as percentages (%), mean values. Chi-square test (χ^2) used for comparing 2 variables. Differences were considered statistically significant when $p < 0.05$.

3. RESULTS

3.1. General characteristics of study patients

- Gender: 19 male patients (63.3%) and 11 female patients (36.7%). Male/female ratio ≈ 1.7/1.

- Age: patients ranged from 44-82 years old, with an average age of 66.85 ± 8.93 years.

- Comorbidities:

+ No comorbidities: 5 patients (16.7%).

+ With comorbidities: 25 patients (83.3%), including hypertension: 19 patients (63.3%); diabetes mellitus: 12 patients (40.0%); dyslipidemia: 8 patients (26.7%); other diseases: 11 patients (36.7%).

- Distribution of patients by location of paralysis:

+ Left hemiplegia: 13 patients (43.3%).

+ Right hemiplegia: 17 patients (56.7%).

3.2. Treatment efficacy and adverse effects of HBOT therapy

Table 1. Evaluation of the efficacy of HBOT therapy when combined with treatment

Index		Before	After 1 month	p
		Number of patients	Number of patients	
MRC Scale	0	0	0	< 0.05
	1	12 (40.0%)	6 (20.0%)	
	2	12 (40.0%)	6 (20.0%)	
	3	6 (20.0%)	12 (40.0%)	
	4	0	6 (20.0%)	
	5	0	0	
Barth Scale	Very dependent	12 (40.0%)	0	< 0.05
	Partially dependent	18 (60.0%)	20 (66,7%)	
	Minimally independent	0	6 (20,0%)	
	Totally independent	0	4 (13,3%)	
NHISS Scale ($\bar{X}$ ± SD)		6.98 ± 2.12	4.23 ± 0.89	< 0.05

- Unwanted effects when combined with HBOT therapy:

+ Tinnitus: 8 patients (26.7%).

+ Feeling of suffocation: 3 patients (10.0%).

+ No cases experienced complications of oxygen poisoning, earache, headache, nausea, high blood pressure...

4. DISCUSSIONS

4.1. Characteristics of study patients

In our study, male patients (63.3%) outnumbered female patients (36.7%); the male/female ratio was ≈ 1.7/1. This result is similar to studies by Duong Van Hai (male patients 1.1 times more than female patients) and Le Thi Hong (male/female ratio 1.5/1) [8, 9].

Patients ranged from 44-82 years old, with an average age of 66.85 ± 8.93 years. This result is also similar to Duong Van Hai's studies (patients aged 40-83, average 64.8 years) and Chen-Yu Chen's (average patient age 61.3 years).

We encountered comorbidities in ischemic stroke patients such as hypertension (63.3%), diabetes mellitus (40.0%), dyslipidemia (26.7%).... This indicates that hypertension is a risk factor and a major cause of ischemic stroke. This result is consistent with the study by Chen-Yu Chen (hypertension is the leading risk factor in the pathogenesis of ischemic stroke, accounting for 50.0% of study patients) [8].

There were 56.7% of ischemic stroke patients with right hemiplegia and 43.3% with left hemiplegia; consistent with the research results of Le Thi Hong (rate of right hemiplegia patients was 54.17% and left hemiplegia was 45.83%) [10].

4.2. Effectiveness of combined HBOT therapy 1 month after patient discharge

Assessment according to MRC scale: Before treatment, the proportion of patients with muscle strength grade 1 and grade 2 were both 40.0%. After intervention, these proportions both decreased to 20.0%; patients with muscle strength grade 3 accounted for 40.0% and grade 4 accounted for 20.0%. The difference before and after treatment was statistically significant, with $p < 0.05$.

Independence in daily activities according to the Barthel Index: before treatment, 40.0% patients were completely dependent, 60.0% were partially dependent in daily activities. After treatment, no patient was completely dependent in daily activities; meanwhile, 66.7% of patients were partially dependent, 20.0% were partially independent (likely meaning "independent" based on scale definition), and 13.3% were completely independent in daily activities. The difference before and after treatment was statistically significant, with $p < 0.05$. This result differs somewhat from the study by Le Thi Hong (in the research group treated with combined HBOT therapy, after treatment, the independence rates at various levels were 79.2%, minimally dependent 8.3%, moderately dependent 10.4%, completely dependent 2.1%; in the control group without combined HBOT therapy, the corresponding rates were 52.4%; 16.7%; 26.3%; 4.7%). This might be because our study sample size was small, and we used convenience sampling, so it might not be sufficiently representative of a population.

NIHSS score: the average score before treatment was 6.98 ± 2.12 points, after treatment it was 4.23 ± 0.89 points, the difference before and after treatment was statistically significant with $p < 0.05$. This may indicate that using combined HBOT therapy with other methods helps improve the NIHSS score in ischemic stroke patients after treatment.

Adverse effects: The rate of encountering adverse effects and complications in this study was very low, including only 8 patients (26.7%) with tinnitus, 3 patients (10.0%) with a feeling of stuffiness (these symptoms usually only appeared in the first 2-3 hyperbaric oxygen sessions and did not reappear afterwards), no complications such as oxygen toxicity, ear pain, headache, nausea, hypertension were encountered. This result is consistent with Vu Van Huynh's study: common adverse effects of HBOT are tinnitus (75%), feeling hot, stuffy (35%), hypertension (12.5%).

Thus, it can be said that using combined HBOT with other methods in treating ischemic stroke patients helps to positively improve muscle strength, daily activity function, and disability level. Preliminary research has not recorded any serious adverse effects in ischemic stroke patients treated with combined HBOT.

5. CONCLUSIONS

Based on the study of 30 ischemic stroke patients treated with combined HBOT at Military Hospital 103 from September, 2023 to August, 2024, the conclusions are:

Regarding the combined treatment effectiveness of HBOT therapy: Before treatment, the proportion of patients with muscle strength grade 1 and grade 2 were both 40.0%; after treatment, the proportion of patients with muscle strength grade 1 and grade 2 both decreased to 20.0%; the difference before and after treatment was statistically significant, with $p < 0.05$. Before treatment, 100% of patients were dependent in daily activities (of which, 40.0% were very dependent, 60.0% were partially dependent); after treatment, no patient remained very dependent in daily activities, 66.7% of patients were partially dependent, 20.0% were minimally independent (likely 'independent'), 13.3% were totally independent in daily activities; the difference before and after treatment was statistically significant, with $p < 0.05$. There was an improvement in the NIHSS score before treatment (6.98 ± 2.12 points) and after treatment (4.23 ± 0.89 points), the difference was statistically significant, with $p < 0.05$.

Adverse effects of HBOT therapy: Encountered in 8 patients (26.7%) with tinnitus, 3 patients (10.0%) with a feeling of stuffiness; no complications such as oxygen toxicity, ear pain, headache, nausea, hypertension occurred.

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