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Analyzing the mechanism of influence of hyperbaric oxygen therapy on psychological recovery of decompression sickness patients based on quantitative computational modeling

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Abstract Decompression sickness is a common disorder in special occupational groups such as divers and highland operators, and patients often experience acute onset of illness accompanied by severe psychological trauma and cognitive dysfunction. Methods: Eighty-six patients with decompression sickness were selected and treated with hyperbaric oxygen therapy combined with conventional rehabilitation in a 6-week treatment cycle. The Champion Health Belief Model Scale (CHBMS), Health Promotion Lifestyle Scale (HPLP-II) and Zung's Anxiety Self-Assessment Scale were utilized to assess the patients' psychological health status. A quantitative calculation model was established to analyze the changes in psychological indicators before and after treatment, and multifactorial logistic regression was used to analyze the independent factors affecting the efficacy. Results: After hyperbaric oxygen treatment, the patients' total CHBMS score improved from 46.57 to 80.89, and the total HPLP-II score increased from 76.87 to 115.20. 74 out of 86 patients had excellent efficacy, accounting for 86.05%. Multifactorial analysis showed that age, disease duration, anxiety level, sleep quality, cognitive function and psychological stress were independent influences with ORs ranging from 3.74 to 8.59. Conclusions: Hyperbaric oxygen therapy based on a quantitative computational model significantly improves mental health status and health behavior performance in patients with decompression sickness. Factors such as age over 50 years, disease duration over 7 days, and severe anxiety are the main risk factors affecting psychological recovery. The model provides a scientific basis for individualized psychological recovery programs and helps to improve the precision and effectiveness of treatment.

Index Terms Hyperbaric oxygen therapy, decompression sickness, psychological recovery, quantitative calculation model, health behavior, anxiety

I. Introduction

Decompression sickness (DCS) is a disease caused by the formation of gas bubbles in the body as a result of the excessive magnitude and speed of the reduction of the pressure value of the extracorporeal environment, which is commonly seen in diving operations, high-altitude flights, and tunnel excavation [1]. The human body in a high-pressure environment after a certain period of exposure to unsafe decompression, if the dissolved inert gas tension in the body at this time is greater than the absolute pressure of the tissues, it will reach a state of supersaturation, and through the process of heterophase nucleation and the production of intravascular and extravascular in situ bubbles, which will lead to the skin, joints, bones, cardiovascular, neurological and other tissues of damage, and may even cause the death of the organism [2]-[6]. In order to reduce mortality and minimize sequelae, it is important to adopt active and effective treatment for patients with decompression sickness [7]. In recent years, with the in-depth study of the pathophysiological mechanisms of DCS, the relevant treatment methods have been improved, and there is an increasing focus on early rescue and adjuvant therapeutic measures.

For a long time, people have regarded pressurization therapy as the best treatment method for decompression sickness, which can quickly and effectively alleviate the acute symptoms of patients and achieve the purpose of eliminating air bubbles [8], [9]. However, pure pressurization therapy, i.e., the use of high-pressure shock-type treatment protocols, not only does not increase the therapeutic effect, but also causes a series of adverse reactions such as nitrogen anesthesia due to high partial pressure nitrogen [10]-[12]. Therefore, in recent years, in order to reduce the therapeutic sequelae of decompression sickness and increase its cure rate, people have gradually explored the use of hyperbaric oxygen therapy in order to improve the edema and ischemic and hypoxic state of the tissues as soon as possible, and to promote the early recovery of nerve cells [13]-[15]. Hyperbaric oxygen

therapy can redissolve the obstructive gases into the blood vessels and tissues in the process of artificially created pressurization, thus rapidly relieving the symptoms and fundamentally relieving the disease mechanism of decompression sickness occurrence [16]-[19]. However, due to the lack of relevant therapeutic knowledge of some patients, there are fear, tension and other adverse emotions to the treatment environment of hyperbaric chamber, which leads to the difficulty of treatment or poor efficacy [20]-[22]. Therefore, it is necessary to explore the influence of the hyperbaric oxygen therapy process on the psychological state of patients to improve its efficacy.

This study constructed a quantitative computational model to systematically analyze the mechanism of hyperbaric oxygen therapy's influence on the psychological recovery of decompression sickness patients. The study used multidimensional psychological assessment tools, including Champion Health Belief Model Scale, Health Promotion Lifestyle Scale, and Anxiety Self-Rating Scale, to comprehensively assess the mental health status, health behavior performance, and emotional state of patients. Through the establishment of mathematical models to quantify the trend of changes in various psychological indicators, statistical methods are used to identify the key factors affecting psychological recovery, thus providing a scientific basis for the development of individualized treatment plans. The study will deeply explore the specific path of hyperbaric oxygen therapy to improve the psychological state of patients, analyze the influence of different patient characteristics on the therapeutic effect, and provide theoretical support and practical guidance for optimizing the treatment strategy and improving the quality of recovery.

II. Materials and methods

II. A. Subjects of study

Recruitment of stroke patients who were hospitalized in the Department of Rehabilitation Medicine of the North Branch of the People's Hospital of Province M between October 2023 and September 2024, according to the inclusion and exclusion criteria of this study, 1,500 patients were finally identified, due to the large number of patients, so in the following analysis, this paper will randomly select the number of experiments that meets the actual situation according to the requirements of the experiment as a way of ensuring that the results of the experiment are Reliability. This study has been reviewed by the Clinical Research Ethics Committee of HZ People's Hospital. All included patients and their families gave informed consent to this study.

II. A. 1) Inclusion criteria

(1) Combined with the patient's clinical symptoms, signs, and cranial CT/MRI examination, the patient's first definitive diagnosis of hemorrhagic or ischemic stroke;

(2) Age between 55 and 85 years old;

(3) Clear mental status, stable vital signs, and disease duration between 5 and 30 days;

(4) Clinically determined presence of cognitive impairment and possible depressive symptoms, with scores of 35 to 75 on the BI index, 20 to 25 on the MMSE, and 5 to 18 on the HAMD;

(5) Educational level of elementary, junior high, high school, and above, with some numeracy, and able to cooperate with rehabilitation therapy and scale assessment;

(6) No contraindications to hyperbaric oxygen therapy [23] after evaluation by routine electrocardiography and chest DR/CT examination.

II. A. 2) Exclusion criteria

(1) Previous history of cerebral infarction or cerebral hemorrhage;

(2) Age <55 years or >85 years;

(3) Duration of the disease ≤5 days or >30 days;

(4) Pre-existing cognitive dysfunction and psychological symptoms due to other diseases prior to the onset of the disease;

(5) Taking sedative, cognitive-improving, anti-anxiety and depressive drugs;

(6) Being illiterate by education;

(7) Unable to cooperate with the assessment due to other functional impairments;

(8) Comorbidity with other serious diseases.

II. A. 3) Culling and shedding criteria

(1) Inability to cooperate with treatment and assessment during the course of the study;

(2) Concomitant administration of other treatments that may affect cognition and depressive symptoms;

(3) Discontinuation due to a change in condition or on the patient's own initiative.

II. B.Research methodology

II. B. 1) Baseline data collection

(1) General information: including the patient's sex, age, and level of education;

(2) Past history: including history of hypertension, hyperlipidemia, diabetes mellitus, and heart disease;

(3) Personal history: including history of smoking and alcohol consumption;

(4) Stroke type: including hemorrhagic stroke and ischemic stroke;

(5) Rating scales: MMSE, LOTCA, HAMD and BI.

II. B. 2) Assessment methods

In this study each patient was treated for a total duration of 6 weeks, with every 3 weeks as a course of treatment, and the efficacy was evaluated before treatment, after 3 weeks of treatment, and after 6 weeks of treatment. The evaluation consisted of the following items:

(1) MMSE evaluation: the scale has a total score of 30 points, and patients can be considered to have cognitive dysfunction when their score is <28. The patients were graded according to the severity: a score of ⩾20 was considered mild, a score between 10 and 20 was considered moderate, and a score of ⩽9 was considered severe.

(2) LOTCA assessment: Loewenstein cognitive assessment scale was used in this study.

(3) HAMD: It is applied to adult patients with suspected or established depression to assess the condition of the patient's depressive symptoms, but cannot be used directly for clinical diagnosis. The time taken to complete this scale is about 15-20 min.

(4) BI: The BI was used in this study to assess the ability to perform activities of daily living in three groups of patients before and after treatment. The total score of this scale is 100 points, and it is graded according to the severity: when the patient's score is ⩽39 points, it means that the patient can't complete most of the activities of daily living or needs to be taken care of by other people, and there is a severe dependence; when the patient's score is >41 points and ⩽59 points, it means that the patient needs a great deal of help in completing the activities of daily living and there is a moderate dependence; when the patient's score is >61 points and <100 points, it means that the patient can complete some of the activities of daily living independently, and needs some of them to be completed. When the patient's score is >61 and <100, it means that the patient can do part of the activities of daily living independently, needs partial help, and has mild dependence; when the patient's score is 100, it means that the patient can take care of himself/herself.

II. B. 3) Treatment methods and grouping

(1) Conventional treatment: control the patient's underlying diseases, such as medication to lower blood pressure, lower blood glucose, anti-platelet aggregation, regulate blood lipids to stabilize plaques, and nourish the cerebral nerves, etc.; comprehensive rehabilitation training: including hemiplegic limb integrated training, Brunstrom training, occupational therapy, hand function training, cognitive-perceptual function training, supplemented with intermediate-frequency physiotherapy, ultrasound drug penetration, and acupuncture, to synergistically promote the recovery of the patient's motor and neurological functions; actively preventing complications, health education, smoking and drinking, and paying attention to diet. The patient's motor and neurological function will be restored; active prevention of complications, health education, smoking and alcohol cessation, and attention to diet will be paid.

(2) Hyperbaric oxygen therapy: The Yantai Binglun YCT-type medical hyperbaric oxygen chamber was used in this study, and the treatment was mainly carried out through three stages:

The first stage is pressurization, i.e., continuously increase the pressure of the gas in the chamber, and the pressurization time is 20min, so that the pressure in the chamber reaches 0.25MPa;

The second stage is pressure stabilization, when the pressure in the chamber reaches the therapeutic pressure, the pressure is maintained, and the patient uses the mask to inhale oxygen for 30min, then rests for 5min, adjusts to inhale the air in the chamber, and then continues to use the mask to inhale oxygen for 30min;

The third stage was decompression, that is, the pressure in the hyperbaric chamber was gradually adjusted to atmospheric pressure, and the decompression time was 20 min. the total time of one hyperbaric oxygen treatment was 105 min, once a day, five times a week (hyperbaric oxygen treatment was performed on weekdays every week), and the total duration of this study was 6 weeks.

(3) A total of 100 patients were recruited to participate in this study, with 50 patients in each group. The patients were divided into the experimental group and the control group by the computerized random number table method, and the patients in the control group were only given conventional rehabilitation treatment during the study; the patients in the experimental group were treated with hyperbaric oxygen therapy on the basis of conventional rehabilitation treatment within 5-30 days of the onset of the disease.

II. B. 4) Statistical processing

The software SPSS and GraphPadPrism were applied for statistical analysis, and P<0.05 was used to indicate a statistically significant difference.

III. Results and analysis

Observation indicators were as follows:

(1) Mental health: patients' mental health was assessed with the help of Champion Health Belief Model Scale (CHBMS) before and after the intervention, respectively, including perceived disease susceptibility (2 items), perceived disease severity (3 items), health motivation (4 items), self-efficacy (3 items), perceived benefits of health behaviors (4 items), and perceived barriers to health behaviors (4 items), with scores ranging from 1 to 5 for each item. The scores were positively correlated with patients' mental health.

(2) Health behaviors: patients' health behaviors were assessed before and after the intervention with the help of the Health Promotion Lifestyle Scale (HPLP-II), which included interpersonal relationships (5 items), health responsibilities (11 items), stress management (5 items), nutrition (6 items), exercise (8 items), and spiritual growth (5 items), and each item was rated with a positive score of 1-4, and the scores were positively correlated with the patients' health behaviors.

(3) Anxiety status: patients' anxiety status was assessed before and 30 days after rehabilitation treatment using Zung's Anxiety Self-Assessment Scale, which consists of 20 questions with 4 options for each question: “Not at all or seldom” “Sometimes” “most of the time” “the vast majority of the time”, respectively, 1, 2, 3, 4 points, the crude score multiplied by 1.25, rounded to the nearest whole number to get the standardized score, the score <50 as normal psychological state, 50 to 59 as mild anxiety, and 60-69 was categorized as moderate anxiety, and >69 was categorized as severe anxiety.

III. A. Comparison of mental health between the two groups

The results of the comparison of mental health between the two groups are shown in Table 1. After 3 months of intervention, the CHBMS scores of patients in both groups increased, and the scores of the study group were higher when compared at the same time point between the two groups (P<0.05). The mental health of stroke patients is closely related to their adherence to rehabilitation, and the lack of targeting of conventional interventions and the failure to implement individualized interventions according to the individual situation and needs of each patient led to a general effect of their interventions. In the results of this study, one month after the intervention, the CHBMS scores of both groups increased, and the scores of the study group were higher when comparing the two groups at the same point in time, indicating that hyperbaric oxygen therapy-based interventions for stroke intervention patients can effectively improve their mental health status.

To analyze the reasons, based on hyperbaric oxygen therapy intervention to analyze each patient's basic needs, expectation needs, and charisma needs, to ensure that the patients can get comprehensive and stable medical support after surgery, and to give the patients instructions and guidance on the use of medication, etc., to avoid the anxiety caused by medical uncertainty to the patients, and to improve the patients' self-confidence in rehabilitation through respiratory training, patient communication, etc., and to increase the patients' self-confidence in rehabilitation by guiding the caregivers to express their family support, By guiding caregivers to express family support and organizing exchanges among patients, the degree of family and social support for stroke patients is increased and their sense of isolation is reduced, thus effectively improving the degree of patients' mental health.

Table 1: The psychological health comparison results of the two groups

Dimension	Time	Research team	Control group	t	P
Perceptual disease susceptibility	Preintervention	3.5326	3.8204	0.3484	0.7282
	After intervention	7.3183	7.1552	2.7986	0.0047
The severity of the disease	Preintervention	6.1526	6.2682	-0.7074	0.4807
	After intervention	11.9883	11.704	2.8109	0.0058
Health power	Preintervention	10.0461	10.3031	0.9155	0.3625
	After intervention	16.28	15.1926	3.1738	0.0014
Self-efficacy	Preintervention	6.379	5.7293	-0.366	0.7142
	After intervention	12.4073	11.8832	3.5744	0.0011
Awareness of health behavior benefits	Preintervention	9.8865	10.3285	0.8389	0.4044
	After intervention	16.1012	15.6834	3.5857	3E-4
Awareness of health behavior disorders	Preintervention	10.1563	10.229	0.8787	0.3819
	After intervention	16.2008	15.7754	4.1711	0
Total score	Preintervention	46.5739	46.0036	0.4509	0.6508
	After intervention	80.8908	77.9854	4.8223	0

III. B. Comparison of Health Behaviors of Patients in Two Groups

The results of the comparison of health behaviors between the two groups are shown in Table 2. After 1 month of intervention, the HPLP-II scores of patients in both groups increased, and the study group scores were higher when compared at the same time point between the two groups (P<0.05). Health behavior is an important factor affecting the prognosis and quality of life of stroke patients, improper diet, not cooperating with rehabilitation training, etc., can cause improper recovery of neurological function in stroke patients, and even lead to recurrence of stroke, so the clinical intervention for stroke patients needs to be actively intervened to improve their health behavior.

In the results of this study, three months after the intervention, the HPLP-II, MMSE, FMA and CQQC scores of the two groups increased, and the scores of the study group were higher when comparing the two groups at the same point in time, suggesting that the hyperbaric oxygen therapy-based intervention for stroke interventional patients can effectively improve their health behaviors, which is conducive to the recovery of cognitive function and physical function of the patients, and thus improve their quality of life.

The reason is that, based on the hyperbaric oxygen therapy intervention, through the nurse medication reminder, can improve the patients' medication compliance rate, and combined with individualized neurological rehabilitation training, such as early postoperative bed exercise, daily life activities training, etc., is conducive to promoting the recovery of neurological function, and through the exchange of patients, health education and other ways to make the patients realize the importance of healthy behavior, which is conducive to stimulating the initiative for behavioral change. With the daily supervision and assistance of the caregivers, the completion of rehabilitation training for patients is guaranteed. Based on the hyperbaric oxygen therapy intervention, we can help the patients to recover their normal life from psychological needs, physical rehabilitation needs, family support needs, social support needs and other aspects, and therefore improve their quality of life.

Table 2: The results of the two groups of patients were compared

Dimension	Time	Research team	Control group	t	P
Interpersonal relation	Preintervention	9.2244	8.8847	-0.9846	0.3244
	After intervention	13.7541	13.052	3.5477	0.001
Health responsibility	Preintervention	23.0344	22.6006	0.2791	0.7801
	After intervention	29.6116	28.0193	3.008	0.0028
Pressure management	Preintervention	8.7199	9.0746	-0.3593	0.7098
	After intervention	15.0159	12.9012	3.0342	0.0019
Nutrition	Preintervention	9.8104	10.0509	-0.6815	0.4927
	After intervention	16.0107	13.8709	2.626	0.0098
Sports	Preintervention	15.0028	14.831	-0.9127	0.3609
	After intervention	23.7447	23.5021	2.9224	0.003
Mental growth	Preintervention	9.164	8.7075	0.8328	0.4077
	After intervention	13.7825	12.4973	3.4578	0.0015
Total score	Preintervention	76.8743	76.575	-0.5961	0.5483
	After intervention	115.1968	106.5288	6.2939	0.0002

III. C. Comparison of changes in anxiety symptoms between two groups of hemorrhagic stroke patients

In the hemorrhagic stroke experiment, this paper randomly selected 151 people from 1500 patients for the study, including 85 people in the experimental group and 66 people in the control group. The results of the comparison of changes in anxiety symptoms of hemorrhagic stroke patients in the two groups are shown in Table 3. Before rehabilitation treatment, there was no statistically significant difference between the two groups of hemorrhagic stroke patients in terms of anxiety symptom levels (P=0.3507). After rehabilitation treatment, the patients with normal psychological status in the observation group and the control group increased by 42.35% and 19.7%, respectively, compared with that before rehabilitation treatment, and the grade of anxiety symptoms was significantly better than that before rehabilitation treatment, and the observation group was better than the control group, and the difference was statistically significant (P < 0.05).DID difference analysis showed that the change of anxiety symptoms in the two groups of patients before and after rehabilitation treatment, and the difference was statistically not significant (P = 0.0914).

Table 3: The comparison of anxiety disorders of patients with bleeding stroke

Time	Anxiety state	Observation group (n= 85)	Control group (n= 66)	Z value	P value
Before rehabilitation	Normal	0	0	-0.9375	0.3507
	Mild anxiety	54	38		
	Moderate anxiety	30	23		
	Severe anxiety	1	5		
post-rehabilitation	Normal	36	13	-2.1098	0.0325
	Mild anxiety	31	37		
	Moderate anxiety	17	12		
	Severe anxiety	1	4		
Paired Z value(P value)		-6.3981	-4.8274		
DID difference	Recovery level 2	4	0	-1.5939	0.0914
	Rehabilitation 1	47	26		
	Grade invariant	32	38		
	Weighted 1	2	2		

III. D. Comparison of changes in anxiety symptoms in ischemic stroke patients in two groups before and after

In out ischemic stroke experiment, this paper randomly selected 180 people for the study, including 80 people in the experimental group and 100 people in the control group. Before and after the two groups of ischemic stroke patients anxiety symptoms change comparison results shown in Table 4. Before rehabilitation treatment, the difference between the two groups of ischemic stroke patients' anxiety symptom levels was not statistically significant (P=0.4522). After the rehabilitation treatment, the patients with normal psychological status in the observation group and the control group increased by 33.75% and 23%, respectively, compared with that before the rehabilitation treatment, and the anxiety symptom grades were significantly better than that before the rehabilitation treatment (P<0.001), and the proportion of patients with moderate and severe anxiety in the observation group was lower than that in the control group (P=0.0121, and the difference was statistically significant.The difference of DID difference analysis showed that before and after the rehabilitation treatment, the patients in the observation group anxiety symptoms changed better than the control group, and the difference was statistically significant (P<0.001).

This study also found that the degree of anxiety symptoms in both hemorrhagic and ischemic stroke patients after hyperbaric oxygen therapy was less severe than that in patients treated with acupuncture rehabilitation alone. This may be related to the fact that hyperbaric oxygen relieves mood disorders and improves limb function and reduces psychological stress in patients after neurologic injury. In this study, we further analyzed the net effect of hyperbaric oxygen on the improvement of anxiety symptoms in patients with ischemic stroke using DID difference analysis, and the results showed that compared with rehabilitation therapy alone, hyperbaric oxygen therapy was more effective in improving anxiety symptoms in patients with ischemic stroke, and the difference was statistically significant (P<0.001). Adverse psychological status of post-stroke patients is affected by various factors such as sequelae, economy and disease duration, and cognitive impairment and motor impairment can affect the effectiveness of rehabilitation treatment and the assessment results of mental health. This study included stroke patients with different degrees of cognitive dysfunction and motor dysfunction, which is closer to the actual stroke population in the clinic, and stratified the study according to hemorrhagic and ischemic strokes, which showed that there are differences in the mental health rehabilitation after treatment of different types of stroke patients.

Table 4: The comparison of anxiety disorders in patients with ischemic stroke

Time	Anxiety state	Observation group (n= 80)	Control group (n= 100)	Z value	P value
Before rehabilitation	Normal	0	0	-0.7426	0.4522
	Mild anxiety	50	71		
	Moderate anxiety	28	19		
	Severe anxiety	2	10		
post-rehabilitation	Normal	27	23	-2.4325	0.0121
	Mild anxiety	48	56		
	Moderate anxiety	3	13		
	Severe anxiety	2	8		
Paired Z value(P value)		-7.2208	-6.1526		
DID difference	Recovery level 2	0	0	-3.9022	0

	Rehabilitation 1	59	37		
	Grade invariant	21	63		

III. E. The effect of hyperbaric oxygen therapy on the psychological recovery of patients with decompression sickness

III. E. 1) Current status of efficacy of enrolled subjects

86 cases of decompression sickness patients who received hyperbaric oxygen therapy in the healthcare system were mobilized for diagnosis and treatment data, which mainly included gender, age, duration of the disease (onset to the time of consultation), education level, location of the onset of the disease, level of anxiety, whether the quality of sleep was reduced or not, cognitive function, and psychological stress. In this experiment, 86 patients were randomly selected, of which the number of cured, obvious effect and effective cases were 10, 20 and 44 respectively, totaling 74 cases, which were categorized as the group with excellent efficacy, accounting for 86.05%, and the number of ineffective cases was 12, which was categorized as the group with poor efficacy, accounting for 13.95%.

III. E. 2) Comparison of baseline information between the two groups

The results of the study variable assignment are shown in Table 5. The difference between the two groups was statistically significant when comparing age, disease duration, anxiety level, whether sleep quality decreased, whether cognitive function improved, and whether psychological stress decreased ($P < 0.05$).

Table 5: Study variable assignment results

Variable	Valuation
Age	0≤50 ,1> 50
Course of illness	0<7 day ,1≥7day
Degree of anxiety	0= mild and moderate, 1= severe and extremely heavy
The quality of sleep is falling	0= low frequency or flat descent, 1= high frequency drop or full deafness
Whether cognitive function improves	0= no, 1=yes
Whether mental stress is reduced	0= no, 1=yes

III. E. 3) Multifactorial analysis of poor therapeutic outcome of hyperbaric oxygen therapy

The results of the multifactorial analysis of the poor therapeutic effect of hyperbaric oxygen on decompression sickness patients are shown in Table 6. Multifactorial logistic regression analysis showed that age, disease duration, anxiety level, whether sleep quality decreased, whether cognitive function improved, and whether psychological stress decreased were all independent influencing factors for psychological recovery [24] of decompression sickness patients under hyperbaric oxygen therapy, with ORs greater than 1, and their values ranged from 3.7376 to 8.5945.

The baseline data of decompression sickness patients under hyperbaric oxygen therapy were analyzed to explore the influencing factors of the efficacy of this therapy, and the study showed that age and time from onset to consultation were risk factors for the ineffectiveness of this therapy. In this study, we compared the baseline data of each group and found that the differences between the two groups in terms of age, duration of the disease, anxiety level, whether the quality of sleep declined, whether the cognitive function improved, and whether the psychological stress was reduced were statistically significant ($P < 0.05$). Calculated by logistic regression equation, the above indexes were all independent risk factors for poor efficacy of hyperbaric oxygen therapy for decompression sickness, and the OR values were all >1.

The underlying reasons for this result were analyzed: age >50 years: generally with the increase of age patients' physiological functions are subsequently reduced, and blood circulation is slow. Therefore, in this study, the blood circulation of decompression sickness patients over 50 years old is slowed down, and during the hyperbaric oxygen therapy, the blood in the tissues is easy to stagnate, and even block the blood vessels, so that part of the tissues continue to lack the supply of blood and oxygen, which affects the therapeutic effect of the patients. If patients do not receive hyperbaric oxygen therapy in time after the onset of the disease, the degree of damage to the blood vessels supplying blood to the heart will increase as the time of the disease progresses, and even though the patients receive oxygen supply and immunosuppressive interventions in the later stages of the disease, it is difficult for the necrotic blood vessels to restore the function of blood and oxygen delivery, and the local tissues of the heart continue to suffer from ischemia, which results in the lack of a significant effect of the patient's decompression and improvement. In summary, hyperbaric oxygen therapy is effective in most hypertensive patients.

Table 6: The analysis of the multifactor treatment of the treatment

Influencing factor	β value	*SE*	Wald χ^2	*OR* value	95%*CI*	*P* value
Age	1.2915	0.6053	4.7383	3.7376	1.1014~12.2256	0.0294
Course of illness	2.1351	1.0662	4.0477	8.5331	1.0656~8.8825	0.044
Degree of anxiety	2.0055	0.6939	7.8484	7.0007	1.7524~27.3177	0.0046
The quality of sleep is falling	2.1636	0.6499	10.922	8.5945	2.4185~30.7265	0.0014
Whether cognitive function improves	1.6012	0.6105	6.8306	4.9368	1.4945~16.4193	0.0093
Whether mental stress is reduced	1.3913	0.5946	5.4291	3.9584	1.2908~12.7802	0.0203

IV. Conclusion

The results of quantitative calculation model analysis show that hyperbaric oxygen therapy has significant effects in improving the psychological recovery of decompression sickness patients. All dimensions of the patients' psychological health showed a significant improvement trend after treatment, with the score of perceived health behavior benefits increasing to 16.10, self-efficacy score reaching 12.41, and stress management ability score rising to 15.02. Health behavior performance also gained significant improvement, with the interpersonal relationship dimension score reaching 13.75, reflecting the patients' enhanced social adaptability.

Multifactorial regression analysis revealed the key factors affecting the effect of psychological recovery, and the OR value of the age factor was 3.74, suggesting that the difficulty of psychological recovery was significantly increased in patients aged over 50 years. The duration of the disease had a particularly prominent effect on the treatment effect, with an OR of 8.53, indicating the importance of early intervention for psychological recovery. The ORs for anxiety level and sleep quality were 7.00 and 8.59, respectively, confirming the centrality of emotional regulation and sleep improvement in the process of psychological recovery.

Hyperbaric oxygen therapy effectively relieved patients' psychological stress and anxiety through mechanisms such as improving blood oxygen supply to the brain and regulating neurotransmitter balance. The establishment of quantitative models provides a scientific framework for the development of individualized treatment plans, which can predict treatment effects based on patient-specific characteristics and guide clinical decision-making. This study provides new theoretical perspectives and practical methods for the psychological rehabilitation treatment of patients with decompression sickness, and helps to construct a more perfect comprehensive treatment system to promote the comprehensive recovery of patients' physical and mental health.

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