Scholar Publishing Group
International Journal of Sports Technology
https://doi.org/10.38007/IJST.2021.020305
ISSN 2789-7141 Vol. 2, Issue 3: 49-60

Dynamic Changes of SOD Activity in Serum by Ice and Snow Sports Based on Animal Experiments

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Keywords: Ice and Snow Sports, SOD Activity, Defensive Enzymes, Oxygen Free Radicals

Abstract: Superoxide dismutase (SOD) is an important superoxide anion free radical (O2) scavenger, it is the most important defense enzyme for the body to protect against oxygen damage, which plays an important role in the oxidation and antioxidant balance of the body. In the case of damage to the body under hypoxic hypoxia or myocardial ischemia, there have been many reports, but all reported a single factor reaction, kllllll00aSD, the role of multiple factors reported rarely. Both the normal body and the diseased body may be in a cold and oxygen-deficient environment, such as plateaus, high altitudes, and severe cold, this article is under the corresponding conditions of simulation, to investigate the damage of normal and myocardial ischemic body caused by low temperature and low oxygen snow transportation. This paper through the ice and snow sports of mice and determination of plasma SOD activity during recovery, obtained the dynamic curve, and observed the activity of plasma SOD temporarily decreased during the exercise period, the, while it increased significantly during the recovery period, and increased significantly during recovery. This may be due to the duration of the exercise, in order to eliminate increased oxygen free radicals, the consumption of SOD increased, and the activity of plasma SOD decreased temporarily; During the recovery period, on the one hand, SOD is still compensatory increasing, On the other hand, the generation of oxygen free radicals is reduced, and the SOD consumption is lowered, so that the activity of plasma SOD is increased.

1. Introduction

Certain metabolites of oxygen and their derived oxygenates are converted directly or indirectly

from oxygen. Because they all contain oxygen and have more active chemical reaction characteristics, they are called active oxygen [1]. AOS includes superoxide ions, hydroxide ions, free radicals, hydrogen peroxide, singlet oxygen, and peroxide free radicals. They can cause membrane lipid peroxidation, base mutations, DNA strand breaks and protein damage [2]. Plants can also produce a small amount of 02- under normal growth conditions, which are mainly derived from the mitochondrial electron transfer system, photosynthesis, and some oxidoreductase products. However, under normal physiological conditions, active oxygen is continuously produced and continuously removed, so that free radical damage to the body is not caused. The removal of reactive oxygen species in plants is accomplished by protective enzymes and antioxidants [3]. The protective enzymes are mainly superoxide dismutase, catalase, peroxidase, etc., wherein SOD plays a major role; the antioxidant substances in plants mainly include ascorbic acid and vitamin E. SOD is a protein with specific biocatalytic function. It consists of proteins and metal ions. It is widely found in animals, plants and some microorganisms in nature [4].

Aerobic metabolism is indispensable for the normal life activities of aerobic organisms, and it is often accompanied by the production of reactive oxygen species. Reactive oxygen has a dual role in the body, and the amount of active oxygen in the body is usually in equilibrium [5-7]. However, when the living organism is under adverse conditions, if the active oxygen in the living body cannot be removed in time, it will accumulate in a large amount and cause certain damage to the body. For example, aquatic organisms will produce excessive reactive oxygen species when exposed to environmental stress, causing oxidative stress to be exacerbated. [8]. Aerobic organisms have a well-developed oxidative defense system to protect against oxidative stress. Superoxide dismutase is one of the antioxidant enzymes in this system. It is capable of scavenging superoxide anion radicals during biooxidation and is considered to be the first line of defense for antioxidant systems is ubiquitous in aerobic organisms [9].

Aging is a natural phenomenon in which the body's physiological function declines with age. Along with the occurrence of aging, the functions of various organs, tissues and cells in the body will be significantly reduced, which will induce the occurrence of various diseases [10]. In the process of aging, the increase of free radical production and the decrease of antioxidant enzyme activity play a key role; regular sports play an important role in reducing free radical production and increasing antioxidant enzyme activity. Long-term regular aerobic snow sports can significantly improve the body's antioxidant enzyme activity, and have a positive effect on delaying aging. Long-term moderate-intensity exercise can increase the activity of oxidase and reduce the production of free radicals in aged mice. However, the above research mainly focuses on continuous non-intermittent ice and snow sports, while the research on the impact of intermittent sports on related indicators is not much. Based on this, this study used D-galactose-induced aging mice as the research object to investigate the effects of 6w intermittent swimming exercise on free radical metabolism and antioxidant enzyme system in different tissues of aging mice.

2. Proposed Method

2.1. Mechanism of Action of Superoxide Dismutase

SOD removes oxygen free radicals generated during cell metabolism and other processes. All SOD catalytic centers contain a metal ion. According to different metal ions, the SOD family can be divided into four types: Cu/Zn-SOD, Fe-SOD, Mn-SOD and Ni-SOD. Two billion years ago, SOD appeared in two classes in prokaryotes: Cu/Zn-SOD and Fe/Mn-SOD. With the evolution of genes, Fe/Mn-SOD gradually evolved into Fe-SOD and Mn-SOD, and the three-dimensional structure and amino acid sequence are still very close. However, Cu/Zn-SOD and Fe-SOD, Mn-SOD show very

different differences in crystal structure and catalytic mechanism, which also supports the independent evolution hypothesis from the side. Cu/Zn-SOD is mainly found in eukaryotic cytoplasm, chloroplast and bacterial cytoplasm and periplasmic space. In bacteria, plants and animals, the genes encoding Cu/Zn-SOD are not the same. Mn-SOD is mainly found in the mitochondria of prokaryotes and eukaryotes. Fe-SOD is present in prokaryotes and a few plants. The gene sequence encoding Fe-SOD in prokaryotes and plant chloroplasts is highly similar. Many of the archaea-derived Fe-SOD and Mn-SOD are extremely heat-resistant (many optimum growth temperatures exceed 40 °C), presumably they originated in the early stages of speciation. Moreover, these extreme thermophilic SODs can exert catalytic activity over a wide temperature range, including room temperature. From a biochemical point of view, higher Tm values and a wide range of catalytic temperatures allow these enzymes to exist in a quasi-freezing state, without the need for large conformational changes during the reaction, and are easily adapted to moderate temperatures and act in moderate temperature environments. To date, the presence of Ni-SOD has been found only in Streptomyces and cyanobacteria, and research on Ni-SOD has been relatively rare. DuPont used public databases to analyze their sequences and found that these Ni-SODs are mostly found in marine life. 2.2SOD production methods There are currently four main production methods for SOD: (1) Using animal blood extraction method, which is the most commonly used method before the 1990s. This approach carries risks such as cross-infection and allergic reactions. The European Union issued a decree in 1999 prohibiting the use of SOD extracted from animal blood for human medical care and health care. (2) Extracted from plants. It has been reported that SOD is successfully extracted from garlic, mulberry leaves, sea buckthorn, cactus, corn and soybean. The extraction methods mainly include a stepwise salting out method, an organic solvent precipitation method, and a chromatography method. However, the plant has less SOD content and the extraction process is relatively complicated, which makes the SOD production cost relatively high. (3) Microbial fermentation produces SOD. It is a relatively effective method to breed high-yield strains of SOD for fermentation. In 1997, natural screening methods used a conventional screening method to screen out a strain of high-yield SOD. The enzyme activity can reach 600U/g wet cells, which is SOD. Industrial fermentation production has laid the foundation. Someone studied the methods and conditions for the production, extraction and purification of SOD from beer waste yeast, and obtained a SOD with a specific activity of 3048 U/mg. Microbial fermentation technology produces SOD, which not only has high yield, but also has a simple extraction process, which can greatly reduce the production cost of SOD. Due to the limited source of SOD, the immunogenicity of allogeneic proteins, which are affected by temperature and pH, are also limited in application. (4) Genetic engineering method is an effective way to obtain SOD products needed for application. In recent years, microbial genetic engineering products have been developed in the United States, Japan, the United Kingdom, and Germany, and clinical trials have been conducted. hCu/Zn-SOD and hMn-SOD cDNA by RT-PCR are obtained using human fetal liver tissue and human liver cell line (L02) as the template, and constructed the expression plasmid pETSOD and introduced it into E.coil cells. The expressions were 38% and 50%, respectively, and were highly active. At present, both domestic and international achievements in genetic engineering production of SOD have achieved gratifying results.

2.2. Detection Principle and Method

Glucose oxidase catalyzes the oxidation of glucose (GLU) in the specimen to gluconic acid to produce hydrogen peroxide. Under the peroxidase catalysis, hydrogen peroxide generates water and free oxygen, and dehydrogenates the chromogenic oxygen receptor 4-aminoantipyrine and phenol

to a red terpenoid (Trinder reaction). The amount of red terpenoids produced is directly proportional to the amount of glucose. The plasma GLU assay was performed on the Mindray BS2000 automatic biochemical analyzer of the Biochemical Laboratory of the Laboratory. The plasma GLU assay kit was purchased from Shenzhen Mindray Biotechnology Co., Ltd. Set the technical parameters of the automatic biochemical analyzer according to the instruction manual of the test kit. The blood sample GLU detection sampling and adding reagents are automatically carried out, and the same batch of specimen operation quality control is under control. The principle of plasma ALT determination is enzymatic rate colorimetry: under ALT catalysis, alanine + α-ketoglutaric acid = pyruvic acid + glutamic acid; LDH catalyzed, pyruvic acid + NADH = lactate + NAD; NADH in There is a specific absorption peak at 340 nm. Under the condition of excess LDH, the rate of decrease of absorbance at 340 nm colorimetric is calculated, and ALT activity can be calculated. Plasma ALT assay was performed on the Mindray BS2000 automatic biochemical analyzer of the Biochemical Laboratory of the Laboratory. The plasma ALT assay kit was purchased from Shenzhen Mindray Biotechnology Co., Ltd. Set the technical parameters of the automatic biochemical analyzer according to the instruction manual of the test kit. The blood sample ALT test sampling and adding reagents are automatically carried out, and the quality control of the same batch of specimens is under control. The principle of plasma CRE measurement is the sarcosine oxidase method: CRE in blood samples is catalyzed by creatinine to produce creatine. Creatine produces Creatine and Urea under catalyzed by Creatine. Under the catalysis of sarcosine oxidase, sarcosine is oxidized to glycine and hydrogen peroxide. Finally, the Trinder reaction mode is coupled. Colorimetric determination, absorbance A and creatinine concentration are proportional. The plasma CRE assay was also performed on the Mindray BS2000 automatic biochemical analyzer of the Biochemical Laboratory of the Laboratory. The plasma CRE assay kit was purchased from Shenzhen Mindray Biotechnology Co., Ltd. Set the technical parameters of the automatic biochemical analyzer according to the instruction manual of the test kit. The blood sample CRE test sampling and adding reagents are automatically carried out, and the same batch of specimen operation quality control is under control. The same blood sample was used for the CRE indicator determination and the ALT measurement. The principle of plasma CK determination is the enzymatic coupling rate method: CK of blood samples catalyzes the production of creatine and ADP to produce creatine and ATP. Hexokinase catalyzes the production of glucose-6-phosphate and ADP by ATP + glucose. Under the GPDH catalysis, 6-phosphate glucose and NADP produce 6-phosphogluconate and NADPH, and the activity of blood CK can be reflected by monitoring the change in absorbance of NADPH (absorption peak at 340 nm). The plasma CK assay was also performed on the Mindray BS2000 automatic biochemical analyzer of the Laboratory Biochemistry Laboratory [11]. The plasma CK assay kit was purchased from Shenzhen Mindray Biotechnology Co., Ltd. Set the technical parameters of the automatic biochemical analyzer according to the instruction manual of the test kit. The blood sample CK test sampling and adding reagents are automatically carried out, and the quality control of the same batch of specimens is under control. The same blood sample was used for CK index determination and ALT and CRE assays.

Principle of plasma SOD determination: SOD has a strong role in scavenging oxygen free radicals. Riboflavin is easily oxidized under aerobic conditions to form free oxygen. Nitrous oxide blue tetrazolium (NBT) produces blue formazan at 560 nm. There are absorption peaks. SOD can remove free oxygen, and the resulting blue formazan product decreases and the OD value decreases. The degree of decrease in OD of blue formazan is directly proportional to the activity of SOD. According to the SOD detection kit, the parameters of the automatic biochemical analyzer are set, and after the standard is scaled, the MDA concentration in the sample to be tested is automatically calculated. The plasma D-2G assay was performed on the fully automated biochemical analyzer

after anticoagulation and centrifugation of sodium citrate. The principle of measurement is latex-enhanced immunoturbidimetric turbidity method. The anti-D-2G monoclonal antibody is bound to the surface of latex microspheres (immuno-emulsion microspheres) and combined with the D-2G antigen antibody to be tested to form a latex turbidity precipitate in the immuno-latex. In the case of excessive microspheres, the turbidity of the solution is proportional to the D-2G to be tested. The content of the sample D-2G to be tested is calculated by detecting the turbidity (OD) of the sample to be tested, and the parameter setting of the automatic biochemical analyzer is referred to the specification of the plasma D-2G detection kit. In order to avoid the "band phenomenon" of the immunoassay, the high-concentration D-2G specimen is appropriately diluted and then operated.

2.3. The Effect of Ice and Snow Sports on the Body's Antioxidant Capacity

Antioxidant is also called antioxidant free radical. Any activity of the organism and external disturbances will affect the balance of free radicals in the body, including breathing, digestion and decomposition, limb movements, environmental pollution and radiation. Free radicals, also known as free radicals, are simply atomic groups containing unpaired electrons because of a chemical bond's cleavage—hetero-cracking, which leads to the existence of lone pairs of electrons. The chemical properties of free radicals are extremely active, and electrons are easily lost. Or the oxidation reaction, especially the oxidation reaction, is more obvious. Since Deham Harman first proposed the "free radical theory" in 1956, researchers have invested a lot of time and energy to study the connection between the free radicals and the health of the body and the mechanism of influence, while exploring ways to reduce and eliminate free radicals. In 1978, Dallard's study confirmed for the first time that the amount of lipid peroxide-pentane (C6H14) in the exhaled gas of the body was significantly increased after 1 hour of power cycling with 50% VO2MAX. The significance of Dallard's research is to introduce free radicals into exercise physiology for the first time. It opened the first place in sports antioxidant research. Lovlin shifted the focus of research to the relationship between exercise intensity and antioxidant free radicals. In 1987, his study concluded that when exercise intensity is greater than 20% VO2MAX, the body's lipid peroxidation is increased and increases with exercise intensity. Plasma MDA levels and blood lactate levels also increased; when exercise was less than 20% VO2MAX, lipid peroxidation was inhibited, which means that the intensity of exercise was positively correlated with the degree of lipid peroxidation. Lovlin's conclusion was later confirmed by many domestic and foreign researchers. The medium-strength or higher-intensity treadmill exercise, serum malondialdehyde the level was high; the activity of SOD was detected after exercise, and both of them increased first and then increased, while those with high exercise load above medium exercise load decreased significantly immediately after exercise, 24h and 48h before exercise. A large number of research conclusions have confirmed that there is a certain amount of free radicals in the living body, which has no negative effect on the normal metabolism of the body. On the contrary, it is because the lone pair of electrons of free radicals play a role in promoting electron transfer and accelerating chemical reactions. Advanced organisms themselves can rely on endogenous free radical scavenging systems to maintain the balance of free radicals in the body and maintain normal metabolism. Endogenous free radical scavenging systems include active enzymes (internal enzymes such as SOD, GSH, and CAT), antioxidants such as C and E vitamins and carotene. These endogenous antioxidant free radical scavengers themselves have the ability to weaken free radical binding and can be combined with them to convert them into stable chemicals for defensive purposes. However, if the body generates a large amount of free radicals under the conditions of exercise stress, it exceeds the defense threshold of the endogenous free radical scavenging system, destroying the balance of free

radicals, and the accumulated free radicals will have a negative impact on the body and damage the body tissues. Affect the metabolic rate [12].

Many studies have confirmed that exhaustive ice and snow sports can cause decreased glycogen and muscle glycogen content in the body, decreased the activity of various antioxidant enzymes, and increased MDA content in various tissues, and the activity and quantity of SOD and GSH-PX decreased significantly. Finally, it is easy to cause damage to skeletal muscle cell membrane and liver cell membrane, affecting the normal transportation of substances and energy. It is well known that MDA is a representative product of lipid peroxidation and is the most sensitive indicator for measuring free radical content in organisms. Experiments have shown that a one-time short-term exhaustive exercise stimulation does not cause free radical surge, because the free radicals produced by one-time short-time exhaustive exercise may not exceed the activation threshold of endogenous free radical scavenging system, short-term intense exercise. At the same time, it causes the increase of free radicals, and also promotes the endogenous antioxidant enzymes to enhance the activity, accelerate the catalysis, and increase the efficiency of free radical scavenging. And Li Ye's animal exhaustive ice and snow sports experiment found that progressive exhaustive exercise significantly increased the MDA content of liver and blood tissue, in addition to serum SOD and T-AOC with the increase of exercise intensity and time, its content Sharply reduced. Moderate endurance training causes the body to generate free radicals. These free radicals are within the threshold of the free radical scavenging ability of the endogenous antioxidant system. The body system itself can effectively remove the free radicals generated by the appropriate amount of ice and snow sports, and the right amount of endurance exercise produces In turn, free radicals can activate the activity of anti-endogenous oxidase, increase the synthesis rate and synthesis amount of the enzyme, decompose and reduce the LPO level, or combine the conversion and degradation oxidizing ability level to achieve the purpose of improving the body's antioxidant level. A large number of studies have confirmed that elderly people or athletes who have participated in physical exercise for a long time have higher serum SOD and T-AOC activities than those who do not participate in physical exercise. In the early experiments of rats in Quitanilha, it was found that the erythrocyte hemolysis in rats after long-term moderate endurance training was significantly reduced, and the content and activity of SOD and GSH-PX in the serum of rats were significantly higher than those in the quiet group. Antioxidant enzymes slow down the LPO. Studies have found that manganese-superoxide dismutase (Mn-SOD), zinc-superoxide dismutase (Zn-SOD), CAT and GSH messenger RNA in rat cardiomyocytes after 9 weeks of endurance training in rats the levels of (mRNA) were increased to varying degrees, especially when GSH was more sensitive, and the mRNA expression level was increased by 138% when it was quieter. Endurance training and anti-oxidation have been the focus of sports physiology research for a long time. Short-term endurance exercise, the body's free radical production and extinction rate are in dynamic equilibrium. As the exercise time increases, the amount of free radicals generated by the body also increases. When the amount of free radicals reaches the endogenous free radical scavenging system At the critical threshold, the dynamic balance is broken. A large number of studies have shown that long-term endurance exercise, although the body's own antioxidant enzymes have increased the amount and activity, such as SOD and GSH-PX antioxidant enzyme activity, but actually resist The degree of increase in oxidase activity is generally lower than the degree of oxidation of the body. The sprinter's progressive incremental load movement found that the total anti-oxidation water level (T-AOC) of the sprinter decreased 5 minutes after exercise, and even after 20 hours of exercise, it still did not return to the quiet level, step-by-step incremental load endurance training. A large amount of free radicals are generated during the body movement and during the recovery period. Even though the body's own free radical defense system increases the activity of antioxidant enzymes, it does not promptly and

efficiently scavenge free radicals. At the same time, there are also opinions that the generation and elimination of free radicals are closely related to the duration of exercise and the interval of exercise. Many researchers have confirmed through experiments that proper exercise interval during endurance training can help the body's own antioxidant system to recover. Intermittent exercise provides valuable acquisition time for the large amount of free radicals generated during the digestion and activation of activated antioxidant enzymes. It is suggested that intermittent rest is the reason for the fitness of the body.

3. Experiments

60 Balb/c female mice were purchased from the animal experiment center, 3 months old, weighing 23~30g. Feeding in the laboratory, room temperature 25 °C, good ventilation, natural light, keep the laboratory and mouse growing environment clean and dry. The mice were caged and fed freely, and all mice consumed the same feed. After 7 days of routine feeding, they were randomly divided into normal saline injection group (AC group, 10) and aging model group (50 rats). Animal modeling: All mice were in good health before the modeling, and the hair color was shiny and the reaction was rapid. 50 model subjects were intraperitoneally injected with 5% D-galactose solution prepared with physiological saline, each time given 120 mg / (kg ·d), continuous injection for 6w. The mice in the AC group were intraperitoneally injected with physiological saline for 6 weeks at the same dose. After the injection of D-galactose, the health status of the mice gradually changed, which was characterized by a series of aging traits such as dull coat, hair loss, tiredness and unresponsiveness. In the AC group, there were no obvious changes in body hair and movement during the experiment. Main reagents and instruments: malondialdehyde (MDA) test kit, superoxide dismutase (SOD) test kit, glacial acetic acid, absolute ethanol, D-galactose, physiological saline, and the like. Main instruments: visible spectrophotometer (V1s-723N), 800 centrifugal precipitator, electronic weighing scale (Ds-671), homogenizer (C-MAGHS4), electric thermostatic water bath (HWS28), pallet torque balance (TN-100), Rongsheng refrigerator (BCD-203A), syringe, 5th needle, blood collection needle, animal surgical instruments.

Experimental method: After the aging model was successfully produced, the mice were subjected to 4 days of adaptive swimming training, and 20 mice suitable for ice and snow swimming were selected and randomly divided into aging control group (OC group) and intermittent swimming exercise. Group (OS group). The exercise plan is as follows: 1AC group, OC group do not do any regular exercise, normal feeding 6w. 2OS group: 3 hours of non-weight-bearing swimming at the same time every day, 20 minutes each time, 5 minutes after each swim, 6 days of exercise per week, a total of 6w. After 6 w of sample preparation, all mice were sera from the orbital blood to determine the content of MDA and SOD. The MDA content was detected by thiobarbital method and SOD activity was detected by xanthine oxidase method. The mice in each group were weighed, and then the mice were sacrificed by cervical dislocation in a quiet state. The gastrocnemius muscles were taken out, soaked and washed in physiological saline, the blood was removed, dried with filter paper, and then weighed separately. Store at -20 ℃. Finally, the MDA content and SOD activity in the gastrocnemius muscle of each group were determined. Statistical methods were performed using SPSS 13.0 software t test.

4. Discussion

The changes of serum MDA content and SOD activity in the two groups before and after modeling were significantly increased in the aging model group, and the SOD activity was significantly decreased. The difference was statistically significant ($P<0.05$). There was no

significant difference in MDA content and SOD activity before and after injection (P>0.05), as shown in Table 1. The low temperature swimming movement of the OS group is shown in Fig. 1.

Table 1. Changes of serum MDA and SOD in aging model group and AC group before and after modeling (x±s)

Group	n	MDA(nmol/ml)		SOD(U /ml)	
		Before modeling	After modeling	Before modeling	After modeling
AC group	10	4.98±0.54	5.13±0.66	55.27±5.83	53.67±5.52
Aging model group	50	4.98±0.54	12.86±2.55	55.27±5.83	40.15±6.28

Figure 1. Comparison of animal swimming at low temperatures

Before and after exercise, the weight of each group was significantly lower than that of the AC group (P<0.05). It shows that as the body ages, the animal's weight gradually declines. After 6 weeks of intermittent swimming training, the body weight of OC and OS groups decreased, and was significantly lower than that of AC group (P<0.05), but there was no significant difference compared with the same group before exercise (P>0.05), shown in Figure 2.

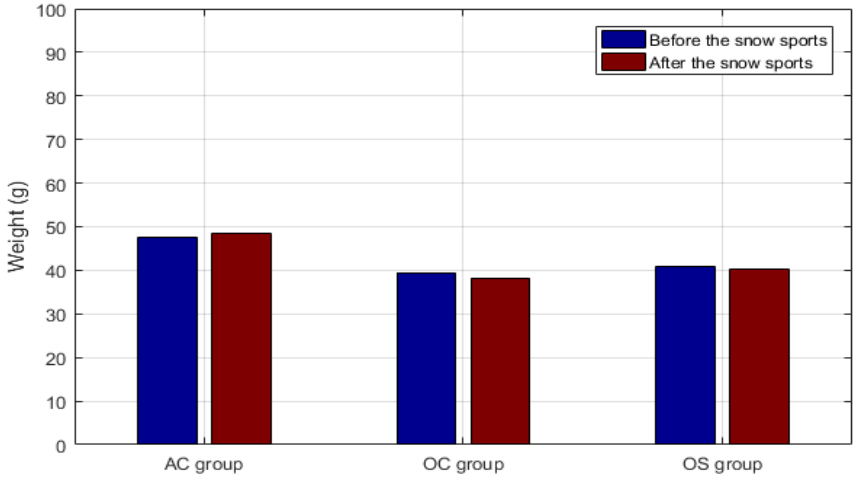

Figure 2. Changes in body weight before and after exercise in different groups (x±s, n=10, g)

The changes of MDA content in each group before and after exercise: Compared with the AC group, the MDA content of the gastrocnemius muscle in the OC group and the OS group was significantly increased (P<0.01). After 6 weeks of swimming training, the MDA content in OC and OS groups was significantly higher than that before exercise (P<0.05), and the OC group was significantly higher than the AC group after exercise (P<0.05), as shown in Figure 3. The changes of SOD activity in each group before and after exercise: Compared with the AC group, the SOD activity of the gastrocnemius muscle in the OC and OS groups was significantly decreased (P<0.01). After 6 weeks of swimming training, the activity of SOD in OS group was significantly lower than that before exercise (P<0.05), and the activity of SOD in OC group was significantly decreased (P<0.05), and the activity of SOD in OC group was significantly lower than that in exercise group after exercise (P<0.05). <0.05), see Figure 4. The continuous aging of D-galactose resulted in the most similar mechanism of aging and natural aging in mice. After injection of D-galactose, the free radical production in the body increased significantly, and the activity of antioxidant enzymes decreased significantly, leading to cell damage and aging. In the process of aging, a series of physiological structural and functional changes occur in the organs and tissues of the body, and the more obvious change is the weight loss. Under the attack of free radicals, the body's protein and polypeptide chains will break, resulting in atrophy of muscle fibers and muscle cells and a decrease in the number of muscle fibers. The organs and tissues will shrink in morphology, leading to a decrease in the quality of various organs and a change in the overall weight of the body. In this study, swimming exercise has little effect on the weight of aging mice. The reason may be that the intensity of intermittent swimming is too large. The energy metabolism in mice is mainly anaerobic exercise, resulting in less fat consumption. The weight loss during the experiment was mainly caused by natural aging. Long-term moderate exercise can reduce the MDA content in the tissue, but the movement to reduce the MDA content is related to the exercise mode, duration of exercise and intensity. Swimming exercise reduced the degree of MDA content in mouse tissues with the duration of exercise (weeks and time of each exercise); the same exercise intensity, the longer the exercise time, the more obvious the decrease of MDA content.

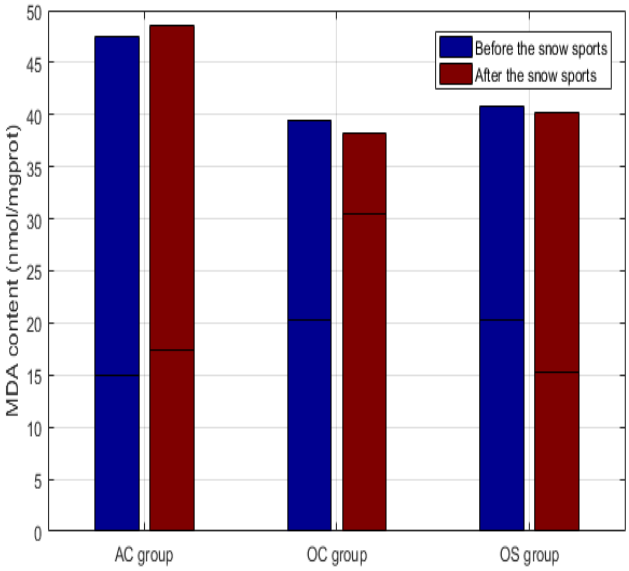

Figure 3. Changes in MDA content before and after exercise in different groups (x±s, n=10, nmol/mgprot)

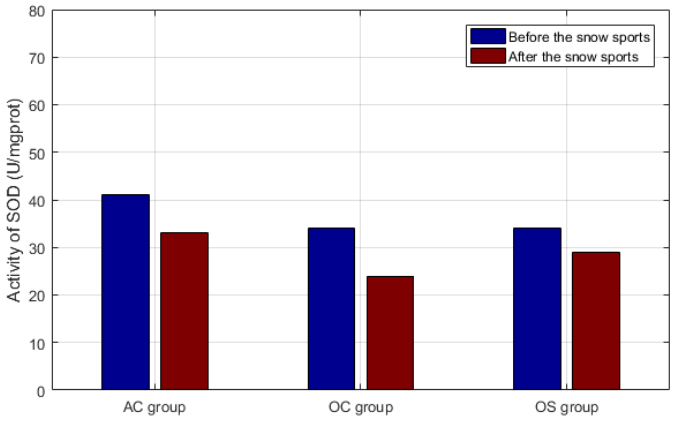

Figure 4. Changes in SOD activity before and after exercise in different groups (x±s, n=10, U/mgprot)

In addition, the degree of MDA content reduction in the elderly after 1 year of exercise was significantly higher than that in the 6 months after exercise. In this study, MDA content in aging model mice increased significantly after exercise, but the increase in OC group was greater. Analysis of the reasons: (1) after the injection of D-galactose, the concentration of galactose in the body increased, coupled with exercise intervention, resulting in a significant increase in MDA content in the tissue, despite the exercise of the body's antioxidant defense system stress The level is strengthened, but it cannot be completely removed, which leads to the increase of oxidative damage in the tissue; (2) The movement time of the mice in this experiment is short, and the time to cause a significant decrease in MDA content has not been reached. There is a certain controversy about the impact of exercise on tissue SOD activity. Most studies suggest that moderate exercise, especially aerobic exercise, can increase the activity of SOD in tissues to a certain extent. The mechanism is that the generation of free radicals increases during exercise, the oxygen consumption of the body increases, and the body appears to be resistant to oxidation due to increased free radicals. The adaptive change in enzyme activity, that is, the increase in antioxidant enzyme activity. However, some studies have suggested that exercise has little effect on SOD activity and does not significantly increase SOD activity, which may be related to exercise patterns, exercise intensity, duration, and duration of exercise. This study shows that during the aging process, the body's antioxidant system function gradually declines, and under the stimulation of exercise, the body's antioxidant system function is improved to a certain extent. However, in this study, the effect of exercise on increasing SOD activity has certain limitations. Under this type of exercise, the SOD activity of mice still has a certain degree of decline. Therefore, this paper believes that the intermittent exercise of 6w has no obvious effect on improving the MDA content and SOD activity in the gastrocnemius of aging mice, and it is necessary to further explore more effective exercise modes or exercise combinations.

5. Conclusion

A large number of oxygen free radicals after myocardial ischemia can cause severe damage to cardiomyocytes, mainly because oxygen free radicals are a kind of highly active substance, which can oxidize unsaturated fatty acids on cell membranes to form MDA, so MDA content can be

Indirectly reflects the degree of lipid peroxidation, reflecting the content of oxygen free radicals in the body. Endothelin (ET) is mainly released into the blood by endothelial cells or some tissue cells under the condition of injury, hypoxia, etc. The increase of ET content can in turn aggravate myocardial damage [so the amount of ET in plasma reflects the tissue involvement. Superoxide dismutase (SOD) can eliminate oxygen free radicals in the body and counteract the damage of MDA to cardiovascular disease. The higher the SOD activity, the stronger the anti-oxidation and anti-oxidation ability, the more effective the protection effect. Significantly, the low content indicates that the oxygen radicals are too much, so that the amount of SOD consumed is too large, and the cardiovascular protection is weakened. From the above experimental results, it can be shown that both low-temperature hypoxic ice-snow movement or myocardial ischemia can make the content of ET and MDA in the body significantly higher than that in the normal body, and then stimulated by hypothermia and hypoxia after myocardial ischemia, and the damage of myocardial cells. It is much more serious than normal body under low temperature and low oxygen. It is also more serious than the body that is only myocardial ischemia and not stimulated by low temperature and low oxygen, which leads to increased free radicals and increased ET, which further aggravates myocardial cell damage. From the content of SOD in plasma, the acute hypothermia hypoxia group, the normal temperature normoxia myocardial ischemia group and the acute hypothermia hypoxia myocardial ischemia group were lower than the normal temperature normoxia control group, which means that the protection of the myocardium was reduced. Especially in the acute hypothermia hypoxia sports myocardial ischemia group, it is much less than other groups, further indicating that the animals after myocardial ischemia are under the condition of hypothermia and hypoxia at the same time, the damage to the myocardium is very serious, even It is fatal. These suggest that in patients with myocardial ischemia, in the process of rescue and treatment, the patient should not be placed in a low temperature environment, and oxygen should be given properly, so as to avoid more serious damage to the patient's heart and create a patient's recovery. Advantageous conditions to improve the survival rate of patients.

Funding

This article is not supported by any foundation.

Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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