

## Review

### New points of exercise therapy for hypertension

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#### Abstract

patients, stabilizing blood pressure from non-related systemic physical and pharmacologic, pharmacologic mental disease with a complex to surgical treatment (e.g., some pathogenesis. The blood recalcitrant hypertension) pressure itself has the requires a comprehensive, characteristics of complexity, three-dimensional, and dynamic non-linearity, and dynamics in intervention that not only refers the formation mechanism, to evidence-based medical which leads to more challenges evidence, but also to in hypertension-related research, individualized, unconsolidated, and there is still a long way to and uniform models of go for clinical prevention and hypotension. Due to the control. For most hypertensive individual differences in age, gender, body mass index, heredity, lifestyle, cultural

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background, economic role. Exercise therapy is not differences, psychological only an important non-demands, hypertension pharmacological treatment but classification, risk stratification, also a basic link of and so on, the pathways to hypertension prevention and maximize antihypertensive control. In the face of the benefits vary among serious situation of the hypertensive patients. For youthfulness of hypertension example, most patients with and the high incidence of pre-hypertension can achieve hypertension, strengthening the good results through non-national fitness exercise is the pharmacological treatments best choice. However, there is such as lifestyle improvement, no fixed method for rational exercise, psychological hypertension patients to counseling, and so on. For most exercise. We should not only hypertensive patients with consider the evidence from target organ damage, the above-evidence-based medicine, but mentioned non-pharmacological also vary depending on time treatment is also a basic and place to achieve the antihypertensive measure and greatest benefit//risk ratio. To an important guarantee for better guide the exercise antihypertensive drugs to play a treatment of hypertension, the

authors offer some new ideas and perspectives.

# **Keyword**

hypertension; exercise therapy; aerobic exercise

**1. The exercise method should be based on oxygen exercise and physical activity based on aerobic exercise should be advocated.**

From a physiological point of view, there is a close interaction and fine coordination mechanism between the cardiovascular system and the respiratory system.

Dynamic cardiopulmonary coupling is essential not only to ensure effective blood oxygen supply, but also to ensure stable heart rate and blood pressure. High

cardiopulmonary adaptation

coupling has been shown to

prevent the progression of

prehypertension to hypertension,

as well as future deaths from

coronary heart disease and all

causes, even in people with

hypertension or other

cardiovascular risk factors [1-2].

The effect of different

respiratory patterns on blood pressure is based on

cardiopulmonary interaction

and fine regulation [3]. It can

be said that any exercise is a

combined cardiorespiratory

exercise. Cardiopulmonary

Exercise Test (CPET) can

evaluate the upper limit of

individual cardiopulmonary

function and give individual

exercise prescriptions

accordingly. The application of CPET in hypertension is helpful to the accurate formulation of individualized exercise rehabilitation prescription of moderate-intensity [4]. Exercise therapy advocating aerobic exercise has always been the basic principle, the so-called aerobic exercise, refers to the body in the oxygen supply when the aerobic metabolism-based exercise, generally prolonged (more than 30 minutes) exercise, moderate-intensity ( $40\%\sim 60\%VO_{2max}$ ), the main muscles of the body involved, the body through breathing oxygen intake and consumption of oxygen to achieve dynamic balance. At present, most studies [5-9] recommend low-and medium-intensity aerobic exercise, which can improve lung function and play an effective antihypertensive effect under the maximum safety factor. In particular, moderate-intensity aerobic exercise is superior to low-intensity and sustained high-intensity exercise in preventing and assisting in lowering blood pressure [5-9]. Of course, intensity classification is an artificially defined range but also has individual differences. At present, the commonly used moderate-intensity exercise is based on the heart rate. 60% to 70% of the maximum heart rate ( $220-age$ ) is usually considered as high-intensity exercise [5-9].

<p>Cardiorespiratory</p> <p>adaptations will further improve when exercise is sustained. Studies [10-11] showed that patients with good cardiorespiratory adaptations had fewer new episodes of hypertension than those with poor health status. Furthermore, in addition to the unconscious cardiopulmonary autonomic coupling, subjects can also adjust their breathing pattern consciously, such as deep breathing (also known as abdominal breathing), changing the respiratory frequency, and so on. The study [12] shows that respiratory training can restore the autonomic nervous regulation function, improve the dynamic balance of</p>	<p>sympathetic/parasympathetic</p> <p>nerve, reduce heart rate and peripheral vascular resistance, and improve heart rate variability, thus lower blood pressure in hypertensive patients. Other studies [13-14] have shown that abdominal breathing can increase tidal volume through diaphragm movement. To stimulate pulmonary detrusor reflex, aortic arch, carotid sinus pressure receptor reflex, aortic body and carotid body chemoreceptor reflex, improve cardiovascular autonomic regulation and decrease heart rate and blood pressure. In addition, aerobic exercise based on cardiopulmonary dynamic coupling can activate</p>
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neuromuscular junction [15] and mitochondrial function [16], which may partly explain the improvement of functional autonomy. "stillness". Many studies [17-19] have confirmed that the above "quiet" exercises can reduce the excitability of the cerebral cortex, affect the

**2. The exercise therapy should be static.** neuroendocrine system, and then improve autonomic

Since it is exercise therapy and the combination of movement and stillness, it seems to be a logical paradox, but in fact it is not.. Because the stillness mentioned here is active stillness, it is a kind of "external stillness" and "internal movement", "mental calmness" and "pneumatic" movement, such as Taijiquan, relaxation training, meditation, Qigong, meditation, and so on. This is completely different from the passive sedentary nervous regulation, reduce heart rate and blood pressure, and improve blood pressure variability. This type of exercise is much safer. The disadvantage is that it requires special guidance and training, and the cumulative effect of a certain period of time. In general, exercise therapy is an active and absolute mode of dynamic activity, such as running, swimming, mountain climbing, rope skipping, pedaling, and so on. This kind

of exercise has high exercise intensity and high oxygen consumption. Most of them have significant post-exercise hypotension [11, 20], which is mainly suitable for normal people, mild hypertension, young and middle-aged hypertensive patients, and hypertensive patients with mild target organ damage [21-22]. The disadvantage is that some elderly patients with hypertension, especially those with weakness, are often difficult to tolerate [9], and there will be a sharp increase in blood pressure during exercise, inducing and/or aggravating various complications of hypertension, and so on. Many studies have discussed the optimal training mode for this kind of sport (including intensity, frequency, time, type, combination form, etc.), which is mainly due to significant individual differences. This is also related to the significant differences in the subjects of the study, the difficulty of randomization, and other factors. According to Levine et al. [25], most exercises contain dynamic components and static components. Dynamic exercise components can promote the increase of blood flow, which mainly leads to left ventricular volume overload, while static exercise components lead to pressure overload. The primary risk factor for hypertension is age, and the prevalence rate of

hypertension increases with age. The results of the China Hypertension Survey (CHS) [26] showed that the prevalence rate of hypertension in Chinese adults aged 18 years was 23.2%; the Chinese Longitudinal Healthy Longevity Survey (CLHLS) [27] showed that the prevalence of hypertension in Chinese 80-year-olds was 56.5%. With the increase of age, the body weakens, the blood vessels gradually age, the arterial stiffness increases physiologically, and the blood pressure increases in varying degrees, so it can be said that hypertension is a kind of arterial degenerative disease. Exercise has a wide range of short-term and long-term effects, involving prevention of immunity, functional improvement, treatment and rehabilitation, anti-aging, etc. [28]; similarly, active "meditation" exercise also has these effects [17-19]. Therefore, exercise therapy should be a balanced combination of dynamic and static development.

**3. The movement method, and body and body exercise therapy should move the body and body together.**

In a fundamental sense, most diseases are physical and mental diseases, and mental health and physical health are one of two aspects that affect each other, and hypertension is just the same. Therefore, physical and mental co-



movement is also advocated for improving anxiety and diseases that are suitable for depression, while the exercise therapy. Competitive psychological stress caused by sports are generally more competitive sports may intense, athletes have greater counteract this benefit. mental stress, and the effects on Therefore, exercises hypertension and its prescription must pay attention complications may be two-way, to entertainment, from taking that is to say, strenuous exercise as a means of reducing exercise may lead to an increase blood pressure, and then in the risk of cardiovascular and forming a love of exercises, other events [29-30]. But the developing habits, and conclusions of related studies persevere. In China, some [25,31-32] are also traditional fitness sports, such as Wuqian Opera and Baduanjin, controversial as these studies have been re-concerned and have found that athletes may have increased life expectancy. sought after in recent years, and Some studies [24,33-34] some studies have found that advocate autonomous, they can reduce blood pressure recreational and purposeful [35]. In addition, square dance exercise as having a greater is very popular in China in neuroendocrine impact and recent years. It has even formed

a socio-cultural phenomenon, restore the dynamic balance of and some studies have found it cardiovascular regulation, to have a hypotensive effect improve neuroendocrine [36]. These sports have obvious regulation, enhance immunity, characteristics of the and improve the overall simultaneous movement of physical and mental health. body and mind, of course, the With the development of way and intensity of exercise society, increasing mental work, are different, and the influence and the incidence of on the mental state of athletes is hypertension in cities is on the also different. According to the rise, which has exceeded that in study by Lind et al. [37], self-rural areas in China, which selective exercise intensity is seems to be related to the "heart helpful to establish a stable and and brain" moving and "body" positive emotional state, which sedentary [38]. In fact, it is not. can keep it close to but below The main reason may be that the ventilation threshold, thus most mental workers are under playing a more effective role in mental stress load, often at the reducing blood pressure. Long- cost of non-benign work and term exercise can promote the rest, lack of exercise, and remodeling of the structure and unreasonable diet, which leads function of all body systems, to heart rate disorder, blood

pressure fluctuation and gradual increase. For most manual workers, who mainly work in a stressful, task-oriented, purposeless manner and lack emotion and recreation, and their physical exercise is either in an overload state or in a stereotyped mode. Not only does it fail to achieve effective exercise, but it also tends to cause chronic fatigue or chronic strain on the musculoskeletal system, which in turn leads to metabolic disorders and causes or aggravates hypertension.

body is also based on tissue structure mechanics and neuroendocrine. The human body is also a holographic fractal system with mainly open closed-loop control, which can reflect the whole, and the whole can also be shown as a local response. During exercise, fast and slow response information is transmitted through muscle, skeletal, fascia, neuroendocrine and other systems, and the effects of local exercise will cause systemic reactions through neurohumoral mechanisms and vice versa. The prevalence of hypertension is proportional to age and is often associated with different degrees of cervical spondylosis, lumbar disc herniation, bone

#### **4. Dynamic integration and department**

The human body is not only a biomechanical system, but also a biochemical system, and the effect of exercise on the

and joint degenerative balance and improve inflammatory lesions, which neuroendocrine regulation, will limit the intensity, which is supported by most frequency, and mode of studies. Some studies [41] have exercise and increase the suggested that the probability of fall [39-40]. At antihypertensive effect of rapid the same time, most patients intermittent high-intensity with hypertension have whole-body exercise is more autonomic nervous regulation obvious than that of low-disorders such as high heart rate, intensity and medium-intensity decreased heart rate variability, whole-body exercise, but the and poor vascular reactivity. As population included in the study vascular disease progresses, this was limited to grade 1 will inevitably lead to 4 hypertension, and there was no impaired stress responses in long-term follow-up. After all, hypertensive patients. Therefore, blood pressure can often rise to whole-body exercise is suitable 2-3 times that of resting blood for almost all patients with pressure during exercise, and hypertension, especially "low to the increase may be more moderate intensity" whole-body pronounced in patients with endurance exercise, which can high blood pressure, especially regulate human mechanical in systemic high-intensity

endurance exercise and antihypertensive effect can be resistance exercise, such as achieved.

running, swimming, and **5. The combination of active exercise and passive exercise should be considered in the exercise test and motion knot exercise therapy.**

Hypertension is a systemic disease, but local lesions can also induce or aggravate hypertension, such as arterial stenosis or occlusion of limbs or organs. In recent years, many studies [43-44] have also begun to pay attention to the combination of local exercise and systemic exercise, such as isometric resistance training, limb traction exercise, and general endurance exercise such as swimming and running, and found that a better

At present, most traditional training methods are active sports, such as running, swimming, playing football, and so on. In recent years, with the help of some tools, such as treadmills, power bicycles, robots, and other auxiliary sports have been accepted by some people. This exercise belongs to the combination of active and passive exercise, which mainly has three advantages: 1. It can be carried out at home and gym without

the influence of external rehabilitation techniques or environment such as rain and external counterpulsation snow, haze, crowding, etc.; 2. It therapy, which is not only can assist in exercise to avoid conducive to the improvement abrupt termination of exercise; of limb motor function, 3. It is suitable for some people prevention, and treatment of with limited activities, which complications but also are conducive to the smooth conducive to the stable control control of blood pressure. The of blood pressure [47]. In China, study [45-46] confirmed that some traditional Chinese this kind of exercise has the medicine techniques can be same antihypertensive effect as used in the treatment of active exercise, and has high hypertension, such as massage safety. There are also some combined with passive limb patients with hypertension who traction [48], including passive are mainly passive exercises, exercise, but its true such as some patients with limb effectiveness needs to be motor dysfunction caused by confirmed by large-scale stroke, bedridden patients clinical evidence-based caused by various reasons, and research.

elderly weak people. They need **6. The quantification and**  
to receive specific **quality of exercise therapy**

**should follow the evidence guide, and should be based on the real world.**

Exercise therapy is not only a lifestyle intervention but also a natural therapy practice, which is different from drugs. Exercise therapy takes more time and requires a certain amount of perseverance, and lack of perseverance is often the main reason why most people are sedentary. Long-term and strenuous exercise not only needs the support of objective conditions but also needs higher subjective perseverance to endure fatigue and pain. Due to the pressure of survival, many people get up early and return late, or work three shifts, or the living

environment is limited, so they do not have sufficient conditions for exercise. On the

other hand, many patients with hypertension have chronic fatigue or other complications of different degrees and/or levels (such as ischemic heart disease, degenerative inflammation of the bone and joint, etc.), which can't tolerate higher exercise intensity. It will

lead to the prescription of exercise therapy can not being individualized and quantified.

The physical exercise guidelines for patients with

2020ESC exercise Cardiology and Cardiovascular Disease [49]

recommend that all healthy adults do at least 150min moderate-intensity aerobic

exercises every week, or pressure control, it is 75mm/-week high-intensity recommended to temporarily aerobic exercise; hypertensive restrict participation in patients should do at least competitive sports, except for 30min moderate-intensity skillful sports. For high-risk aerobic exercises (walking, groups, including target organ damage (such as left ventricular hypertrophy, diastolic insufficiency, hypertensive retinopathy, ultrasound showing participate in high-intensity arterial wall thickening or exercise, you need to assess the atherosclerotic plaques), and cardiovascular condition to renal insufficiency, even if the determine whether there are blood pressure is well exercise-induced symptoms, controlled, discuss/javelin, shot excessive blood pressure put and weightlifting are not response to exercise, and target recommended, and you can organ damage; if systolic blood participate in other competitive pressure is > 160mmHg, it sports. The author believes that should be postponed until the although the guide has put blood pressure is under control; forward some specific for people with poor blood suggestions on exercise



quantification, it is still insufficient in guiding real-world sports practice, especially for people with special sports hobbies, such as those who like Taijiquan, Baduanjin, yoga, and other forms of exercise. The curative effect of this form of exercise can't be evaluated only by time and the degree of fatigue, what is more, important is its exercise quality, which comes more from the subjective feeling and internal experience of the athlete, which varies greatly and has the certain fuzziness. It's hard to quantify objectively.

### **Conclusion**

The current situation of hypertension is worrying, and the situation of prevention and

control is very serious. Lack of exercise is an important risk factor for hypertension.

According to statistics, at present, residents in many places around the world have the characteristics and trend of lack of physical activity [50]. It is also estimated that by 2025, 30% of the world's adults will suffer from hypertension, and the likelihood of lack of exercise will increase in the future [51]. In particular, intractable hypertension, which accounts for about 10% of all hypertensive patients responds poorly to medications, and

exercise therapy is effective [52]. It is noteworthy that there are still 20% to 25% of hypertension patients whose

blood pressure is not reduced as a result of acute or chronic exercise [53]. Some people even experience elevated blood pressure as a result of exercise training, although this is not common and not consistently reported. However, under the premise of optimizing the benefit/risk ratio, the higher the blood pressure, the more the benefits of exercise therapy, and the greater the decrease of blood pressure; while under the premise of ensuring aerobic exercise, the greater the exercise intensity, the greater the range of blood pressure reduction. In conclusion, encouraging the whole population to exercise and keep fit is an important measure to

reduce the incidence of hypertension and achieve the cardiovascular health for all.

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