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Research Article

Analysis of PETCT Imaging Diagnosis of Heart Failure Improved by Intelligent Sensor in Exercise

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The incidence of cardiovascular disease is closely related to the heart, and the quality of the heart function directly affects the health of the cardiovascular system. At present, the prevention and treatment of diseases no longer rely solely on drug treatment, and people are increasingly aware of the importance of exercise. Therefore, it is very important to find an economical and effective way to improve cardiovascular function in patients with heart failure. The purpose of this paper is to analyze and discuss the PETCT imaging diagnosis of heart failure improved by Tai Chi exercise based on intelligent sensors. First, it summarizes the origin, characteristics, and exercise rules of simplified Taijiquan, introduces the basic etiology and pathophysiology of cardiac insufficiency, studies the pathogenesis of chronic cardiac insufficiency, and understands the influence of exercise therapy on chronic cardiac insufficiency, combining information fusion and smart sensors to observe the effect of Taijiquan's short-term intervention on mild to moderate chronic cardiac insufficiency and the diagnosis of nuclear medicine PET and CT. The results of the experiment showed that there were 317 cases of Taijiquan group III patients before treatment and 413 cases after treatment. Tai Chi can not only improve the health-related quality of life of CHF patients but also can effectively improve the restricted activities of CHF patients. Exercise endurance is significantly improved. According to the clinical treatment principles and rules of CHF, it is an excellent auxiliary treatment method. The significance of auxiliary Taijiquan therapy is not only to improve heart function and quality of life but also to have a positive impact on the patient's mental state, which meets the needs of the bio-psycho-social medical model, and also inspires and assists the research progress of other diseases.

1. Introduction

Heart failure has become one of the major causes of death in the world, and the number of heart failure patients in the world has reached 23 million. Although the diagnosis and treatment of heart failure have made great progress in recent years, the 5-year mortality of heart failure is still as high as 45%-60%. Chronic heart failure has become an important problem in the prevention and treatment of cardiovascular disease, which is a heavy medical and social burden. It is a complex group of clinical syndromes caused by structural or functional abnormalities of the heart that impair the ability of the ventricle to fill or eject blood. Accompanied by compensatory cardiac enlargement or hypertrophy and other compensatory mechanisms, the initial symptoms develop slowly and are easy to ignore. Because the development of chronic heart failure is irreversible, objective staging diagnosis of the course of chronic heart failure, including early diagnosis, is of great significance to improve its prognosis. However, the existing clinical detection and diagnosis methods lack the diagnosis of chronic heart failure from the perspective of cardiac detection and cannot provide an objective basis for the diagnosis of heart failure staging [1].

Aerobic exercise is a very healthy lifestyle. Studies have found that exercise can help better control blood pressure, improve blood lipids, and increase insulin sensitivity. Regular aerobic exercise can also significantly reduce the deposition of harmful substances in the blood vessels produced by the body with age. Fitness must first strengthen the heart. The heart is the driving force for the function of the circulatory system. It undertakes the task of providing sufficient blood volume to the organs and tissues of the whole body

and supplying the required nutrients to the tissues. Take away the metabolites to maintain the normal metabolic function of the whole body cells, so the quality of the heart function directly affects the health of all functions of the whole body [2]. The purpose of this paper is to analyze and discuss the PETCT imaging diagnosis of heart failure improved by Tai Chi exercise based on intelligent sensors. In order to make some contributions in improving heart failure in Taijiquan, Faraz et al. used near infrared spectroscopy (NIRS) to study the effect of exercise on microcirculation in patients with CHF. Sixteen consecutive stable CHF patients (male, $n = 10$; mean age $= 50 \pm 12$ years) participated in a three-month rehabilitation program (three times a week). Before and after the procedure was completed, all patients were tested on the circulatory dynamometer with limited symptoms and incremental slope cardiopulmonary exercise. The first-order slope (VO2/T slope) of VO2 in the first minute of recovery was measured. Near infrared spectroscopy (NIRS) was used to occlude the vessels of the thenar muscles for 3 minutes before and after rehabilitation treatment. Oxygen reperfusion rate (%/min) and vascular reactivity (from 27 ± 13%/min to 39 ± 21%/min, $P = 0.006$) increased significantly after rehabilitation (450 ± 105 to 532 ± 151, $P = 0.004$) [3, 4]. Wenger studied whether exercise training (EXT) can normalize the enhanced peripheral chemical reflex function of CHF rabbits and the possible mechanism of this effect. EXT made the renal sympathetic base line activity (RSNA) and the responses of RSNA to hypoxia partially (but not completely) return to normal. The results also showed that compared with CHF rabbits, the concentration of no and the expression of nNOS protein in the CBS of ext + CHF rabbits increased [5, 6].

In this study, Taijiquan was used to intervene the patients with chronic heart failure. On the basis of using conventional antiheart failure drugs, Taijiquan was compared with walking exercise. SF-36 and 6-minute walking test were used as observation indexes to observe the influence of Taijiquan on the improvement of quality of life, exercise tolerance, and heart function of CHF patients. The results show that Taijiquan can not only improve the health-related quality of life of patients with CHF but also effectively improve the activity limitation caused by CHF, and exercise tolerance is significantly improved [7]. It is an excellent adjuvant therapy in accordance with the clinical treatment principles and rules of CHF. The significance of Taijiquan-assisted therapy is not only to improve the heart function and quality of life but also to have a positive impact on the psychological state of patients, which is in line with the needs of bio-psycho-social medical model, and also plays an enlightening and auxiliary role in the research progress of other diseases [8].

The innovations of this paper are as follows. (1) The origin, characteristics, and exercise rules of simplified Taijiquan are introduced. (2) The causes of cardiac insufficiency are also analyzed. (3) The pathogenesis of chronic cardiac insufficiency is analyzed. (4) The effect of exercise therapy on chronic heart failure was analyzed. (5) Finally, the PETCT imaging diagnosis of heart failure based on intelligent sensor Tai Chi exercise was experimentally explored.

2. Proposed Method

2.1. Origin, Characteristics, and Movement Rules of Simplified Taijiquan. After the founding of the People's Republic of China, Wushu has been inherited and improved as an excellent national cultural heritage, making Wushu as a sports project to move in the direction of national, scientific, and public. Taijiquan has the functions of bodybuilding, health preservation, education, entertainment, and national cultural exchange, which makes national leaders pay attention to and promote the development of Taijiquan, and promotes the formation of simplified Taijiquan. Simplified Taijiquan is one of the traditional boxing techniques, which belongs to the simple Taijiquan routines implemented after the founding of the People's Republic of China. Taijiquan originated in China. It is a synthesis of various boxing methods of the past dynasties, combined with ancient Daoyin and breathing techniques. It is a gentle, slow, and light boxing technique formed by absorbing classical philosophy and traditional Chinese medicine theory.

Simplified Taijiquan is simplified and rearranged on the basis of traditional Yang Style Taijiquan [9]. In traditional Taijiquan, there are many repetitions, complicated routes, and right frame is emphasized. The practice time is about one-minute long, which is not conducive to popularization. It simplifies the layout of Taijiquan and reduces nearly half of the repetitions. The routes are two repetitions on two points and one line, including straight forward, straight backward, side line, and turning, The whole set of practice time is about one minute in two back and forth routes. The first back and forth work includes the basic footwork in the two directions of forward and backward. The second back and forth movement includes turning, side walking, and inserting kicking and downward momentum independently [10]. The main points of the practice are to relax the mind and body, to be round, lively and coherently, to distinguish between the virtual and the actual, and to breathe naturally. The movement characteristics are consistent with the traditional Yang Style Taijiquan, which is soft, even, moderate, and stable, according to the principle of simplicity before complexity, ease before difficulty, from shallow to deep, and step by step, the whole set of compact structure is easy to learn and practical. Since its popularization, it has become a compulsory course in Taijiquan teaching, and it is an introduction routine for Taijiquan practitioners [11].

2.2. Cardiac Insufficiency. Cardiac insufficiency refers to a pathological state in which the blood discharged from the heart is not enough to maintain the metabolism of various tissues under the condition of normal blood return. With the deepening of basic and clinical research on cardiac insufficiency, cardiac insufficiency is no longer considered to be a simple hemodynamic disorder. More importantly, due to the participation of a variety of neurohumoral factors, the clinical syndrome promotes the continuous development of cardiac insufficiency. Clinically, it is characterized by insufficient cardiac output, decreased tissue blood flow, and pulmonary circulation and/or systemic circulation venous

congestion, also known as heart failure [12, 13]. It is a kind of clinical syndrome with complicated and diverse causes. All kinds of cardiovascular diseases, due to the long-term overload of the heart and the damage of the heart muscle, lead to the decrease of the systolic force and the poor diastolic function and finally lead to the insufficiency of the heart function. According to its occurrence process, it can be divided into two types: acute and chronic. According to symptoms and signs, it can be divided into left heart failure, right heart failure, or total heart failure [14, 15]. Chronic heart failure (CHF) is also known as congestive heart failure because it is often accompanied by congestion (or blood stasis) in various organs. Clinically, left heart failure is the most common, while right heart failure alone is rare. The clinical manifestations of left heart failure are exertive dyspnea, acute pulmonary edema, cough, expectoration, hemoptysis, fatigue, and so on. Chronic cardiac insufficiency is the last "pathway" of various cardiac diseases, often accompanied by loss of function and life threatening, with high incidence rate and mortality rate of [16]. The central insufficiency has a variety of classification criteria, according to its development process can be divided into acute cardiac insufficiency and chronic cardiac insufficiency. According to the location of the attack, it can be divided into left ventricular insufficiency, right ventricular insufficiency, and global cardiac insufficiency. According to the basic principle of occurrence, it can be divided into systolic cardiac insufficiency and diastolic cardiac insufficiency.

2.2.1. Basic Etiology. The most common causes of congestive heart failure in adults are coronary atherosclerotic heart disease, hypertensive heart disease, valvular disease, cardiomyopathy, and pulmonary heart disease. Other causes include myocarditis and congenital heart disease. The rare causes that are easy to be ignored include pericardial disease, hyperthyroidism or hypothyroidism, anemia, arteriovenous fistula, metabolic disease, connective tissue disease, atrial myxoma and other cardiac tumors, plateau disease, and rare endocrine disease [17]. Diagnosis is based on clinical manifestations and related examinations. The diagnosis of left-sided heart failure is based on the signs of preexisting heart disease and the performance of pulmonary circulation congestion. The diagnosis of right-sided heart failure is based on the signs of the original heart disease and the performance of systemic congestion, and most patients have a history of left-sided heart failure.

2.2.2. Pathophysiology

(1) Because the ultimate and fundamental problem of cardiac systolic dysfunction caused by various reasons is the decrease of cardiac output, which leads to hemodynamic dysfunction, the change of cardiac dysfunction has generally gone through three stages: compensatory stage, asymptomatic heart failure stage, and congestive heart failure stage

Compensatory period: in the early stage of myocardial systolic dysfunction, through the functional regulation of neuroendocrine system, including the mild activation of sympathetic nerve, adrenaline system and renin-angiotensin system, the cardiac contractility is enhanced, the heart rate is accelerated, peripheral blood vessel is contracted, the cardiac output per stroke is compensated, and the circulation and perfusion of important tissues and organs are maintained. However, the maintenance of this compensatory function of the heart is limited. The long-term increase of neuroendocrine activity, peripheral vasoconstriction, and the increase of the load before and after the heart all promote the myocardial remodeling and ventricular remodeling and ultimately lead to heart failure.

Asymptomatic heart failure: with the further development of the disease, the systolic function of the heart muscle begins to decrease, unable to maintain normal circulation and perfusion of important tissues and organs. There is evidence that the cardiac output has decreased (ejection fraction < 50%), and the ventricular filling pressure has increased, but there is no manifestation of heart failure. This stage can last for months to years.

Congestive heart failure: the development of heart failure further reduces cardiac output and increases ventricular filling pressure, leading to congestive heart failure such as pulmonary circulation, systemic circulation congestion, and water and sodium retention.

(2) Myocardial remodeling, ventricular remodeling: at present, it is believed that the basic mechanism leading to the occurrence and development of cardiac dysfunction is ventricular remodeling. In the process of heart failure, the structure, function, and configuration of the heart muscle are changed under the joint action of many factors. The clinical manifestations are as follows : the increase of the weight and volume of the heart muscle and the change of the shape of the heart muscle (the transverse diameter increases into a ball)

There are five main changes of cardiac blood vessels during ventricular remodeling: hypertrophy of individual myocardial fibers, increase of contractility; decrease of central myocytes in the whole myocardial tissue, occurrence of various pathological changes and functional abnormalities; myocardial fibrosis; enlargement of the heart; and hyperplasia of smooth muscles in peripheral arterioles, arterial contraction, and even arteriosclerosis. The common symptoms of cardiac insufficiency include palpitations, shortness of breath, fatigue, dyspnea, venous engorgement, hepatomegaly, oliguria, and edema.

2.3. Pathogenesis of Chronic Cardiac Insufficiency

2.3.1. Understanding of Chronic Heart Failure in Modern Medicine. Chronic heart failure is the ultimate destination of many cardiovascular diseases. Because of the long-term overload of the heart and the damage of the heart, the contractile force of the heart muscle is weakened, and the diastolic function is poor, which eventually leads to heart failure. Its pathogenesis mainly includes the following aspects: (1) mechanism neuroendocrine mechanism: in the early stage of compensation, when cardiac contractile

dysfunction and cardiac output decrease, the activation of sympathetic nervous system (SNS) and renin-angiotensin-aldosterone system (RAAS) can enhance cardiac contractility, heart rate, peripheral blood vessel contraction, and compensatory increase of output per stroke, it can basically maintain circulation and perfusion of important tissues and organs. (2) Ventricular remodeling: it is a typical manifestation of the heart from compensatory stage to decompensated stage. With the overactivation of neuroendocrine system, the aggravation of cardiac preload and the combined action of many factors, the structure, function, and configuration of myocardium are changed, including myocardial hypertrophy and apoptosis. (3) Oxidative stress response: ROS increased in the failed cardiomyocytes, which can lead to DNA and mitochondrial damage, and activate apoptosis signal kinase to promote cardiomyocyte apoptosis; it can also lead to the loss of endogenous nitric oxide (N0) and further promote left ventricular remodeling and dysfunction. (4) Inflammatory mechanism: when heart failure occurs, a large number of inflammatory mediators are activated in the local myocardium and the peripheral blood of the body, especially tumor necrosis factor (TNF) and interleukin-6 (IL-6). Among them, TNF is an important medium for the occurrence and development of heart failure. Under the effect of pressure load, by adjusting myocardial remodeling and repair, it leads to ventricular dysfunction. TNF-a can directly act on cardiomyocytes, induce cardiomyocytes apoptosis, inhibit their contractile function, and reduce sarcomere protein of cardiomyocytes. IL-6 and its related cytokines can promote compensatory cardiac hypertrophy, protect myocardium, and promote the formation of new blood vessels. (5) Apoptosis: through a variety of factors (oxidative stress, inflammatory factors, etc.) to induce apoptosis, cardiomyocytes continue to lose, resulting in cardiac dysfunction, and eventually heart failure. B-type natriuretic peptide (BNP) is a kind of compensatory heart-protective factor secreted by the ventricle when the heart function is damaged. Its physiological functions mainly include the following: inhibiting renin secretion and aldosterone synthesis, diuresis and sodium excretion, and vasodilation and hypotension, and delaying ventricular remodeling. The change of its content is closely related to the condition of CHF patients, which can reflect the change of ventricular function sensitively and specifically. It plays an important role in screening the patients with heart failure, judging the prognosis of heart failure and guiding the clinical drug treatment of heart failure. The 6-minute walking test (6MWT) is similar to the daily exercise, which is considered to be a simple, economic, and safe test and easy to be accepted by patients. It can not only evaluate the exercise tolerance of patients' daily exercise but also predict the prognosis of patients.

2.3.2. The Relationship between Taijiquan and Five Zang Organs. The heart controls the blood and mind. Deficiency of heart blood or poor operation can affect the function of heart. Taijiquan requires to guide Qi with will, move Qi at will, move the body with Qi, and move the body at will, so as to promote the movement of blood around the body, so that the Qi and blood can move smoothly and peacefully; at the same time, it requires to calm down and nourish Qi, so as to nourish the mind and spirit, and achieve the role of nourishing and protecting the heart.

The lung is towards the hundred veins, which controls the Qi and breath. It has the function of publicizing and descending. Lung loss in xuanjiang is manifested as cough, asthma, phlegm, dyspnea, and so on. Taijiquan requires "deep, long, thin and even" natural respiration, and then "air sinks into Dantian." This can not only exercise respiratory muscles and improve chest movement but also maintain lung tissue elasticity and increase lung capacity. At the same time of rhythmic breathing, it is required to stretch the movement and relax the chest, consciously make the breathing and the movement cooperate, so as to facilitate the smooth of the Qi mechanism, and make the lung xuanjiang and chaobaimai function operate normally. The liver can store the blood and dredge, which can make the Qi of the viscera and meridians run smoothly.

Taijiquan requires "Qi sinks into Dantian", which is a kind of diaphragmatic breathing, so that the diaphragm between the chest and abdomen moves continuously with the deep and long breath, which can massage the liver regularly, so as to eliminate the congestion of the liver, improve the liver function, smooth the adjustment of the body's Qi, and achieve a state of balance of ascending and descending.

The spleen is responsible for promoting clearing and transporting, while the stomach is responsible for receiving. The spleen and stomach are the source of blood and blood biochemistry of human body, and also the foundation of postnatal. The harmony of spleen and stomach can make water and valley get together, Qi rise and fall together, and Yin and Yang dry and wet together. This breathing form of Taijiquan makes the diaphragm keep moving, which not only massage the liver but also the spleen and stomach and promote the blood circulation and gastrointestinal peristalsis of the abdominal cavity.

The kidney stores essence, water, and Qi. The kidney is the foundation of nature. Kidney disease is the imbalance of Yin and Yang Qi and blood, which affects the growth, development, and reproductive function of human body. Taijiquan requires that "the tail is in the middle and dominates the waist." The rotation movement centered on the waist is beneficial to the health of the kidney. At the same time, it is combined with breathing to make the acquired Qi full and then replenish the innate Qi, so as to achieve the role of pupil guidance after practice.

2.4. Effect of Exercise Therapy on Chronic Cardiac Insufficiency

2.4.1. The Effect of Exercise on Chronic Cardiac Insufficiency. The first symptom of CHF patients is that they cannot complete physical activity freely, that is to say, exercise tolerance has become an important index of heart failure diagnosis and treatment. The change of peripheral skeletal muscle is the basis of dyskinesia, especially in submaximum activity. During exercise, the cardiac output of CHF patients decreased, while the oxygen consumption

of limbs increased, which led to the increase of muscle lactate level faster than that of normal people, resulting in exercise restriction and imbalance of skeletal muscle blood flow perfusion and nutrition metabolism.

The traditional confined bed rest therapy can reduce the circulatory load by limiting physical activity, but it can lead to the decrease of exercise ability, disability, mortality, and quality of life. In recent years, the exercise rehabilitation training for CHF patients confirmed the feasibility of exercise therapy. Proper sports training can promote the increase of muscle strength and strength, improve the perfusion and metabolism of muscle, increase the density of mitochondria of skeletal muscle, improve the structure of skeletal muscle from the cell level, so as to increase the energy storage of exercise, and effectively improve the exercise endurance of CHF patients. Because exercise tolerance depends on the condition of skeletal muscle and peripheral tissue, graded exercise can improve the abnormal condition of skeletal muscle and peripheral circulation and improve the quality of life of patients with cardiac insufficiency. For patients with mild to moderate heart failure, exercise training can reduce the risk of hospitalization caused by heart failure and significantly improve the health-related quality of life compared with conventional nursing.

2.4.2. The Influence of Taijiquan on Chronic Cardiac Insufficiency. Based on the theory of Yin and Yang, Taijiquan emphasizes the balance of Yin and Yang, the integration of body and mind, and the cultivation of body and spirit. Taijiquan is shaped by martial arts, with internal mind, spirit, meaning, and Qi. Especially, its empty and round exercise theme makes internal Qi move between the limbs, moistens the internal organs, and makes people who practice Taijiquan have sensitive nerve feeling, empty mind, and harmonious muscles. As a kind of soft and gentle exercise, Taijiquan has good health-care and medical effect on the cardiovascular system, respiratory system, nervous system, digestive and absorption system, and sports system.

Taijiquan is based on the theory of Yin And Yang, the theory of meridians and collaterals of traditional Chinese medicine, the guiding technique, the Tuina technique, and the comprehensive martial arts technique. Therefore, practicing Taijiquan can calm Yin and Yang, regulate the nervous system, and comprehensively improve the physiological functions of the human body's respiratory system, circulatory system, digestive system, sports system, and reproductive system, thus playing the role of disease prevention, treatment, and fitness. The influence of Taijiquan on the cardiovascular system is under the control of the central nervous activity. Taijiquan makes the muscles in the chest, abdomen, septum, waist, and back contract and relax regularly and rhythmically through the action of relaxing, rising, and falling and the coordination of opening, closing, and bulging of internal Qi. This guiding method can strengthen the circulation of blood and lymph and reduce the congestion in the body. It is a good method to eliminate blood stasis in the body and make blood flow smooth. It has good preventive and health-care effects on various heart diseases and arteriosclerosis. Many studies have confirmed that the formation of collateral circulation is induced by many factors, such as ischemic stimulation and vasodilative stimulation caused by exercise.

Taijiquan has a significant effect on the prevention and treatment of hypertension, and it is suitable for patients with hypertension in all stages. Taijiquan stresses that gentle movement and muscle relaxation can relax blood vessels and promote blood pressure drop. Moreover, it can guide the movement with the mind, make the mind calm and free and concentrate, help to eliminate the bad stimulation of the mental tension factor to the human body, and help to reduce the blood pressure. Taijiquan also pays attention to good coordination and balance. Patients with hypertension can also get improvement in Taijiquan practice.

2.5. Smart Sensor. Intelligent sensor (intelligentsensor) is a sensor with information processing function. The smart sensor has a microprocessor and has the ability to collect, process, and exchange information. It is the product of the integration of the sensor and the microprocessor. Compared with general sensors, smart sensors have the following three advantages: high-precision information collection can be achieved through software technology, and low cost; it has certain programming automation capabilities; and its functions are diversified. Its main application is shown in Figure 1.

In a nutshell, the main functions of smart sensors are as follows: (1) with self-calibration, self-calibration, and self-correction functions; (2) with automatic compensation; (3) with automatic data collection and data preprocessing; (4) it can automatically carry out inspection, self-selecting range, and self-finding; (5) it has the functions of data storage, memory, and information processing; (6) it has the functions of two-way communication, standardized digital output or symbol output; and (7) it has the functions of judgment and decision-making.

A good "smart sensor" is a set of sensors and meters driven by a microprocessor and has functions such as communication and on-board diagnostics. An intelligent sensor is a computer detection system with a microprocessor as the core and extended peripheral components. Compared with ordinary sensors, intelligent sensors have the following remarkable characteristics: improve the accuracy of the sensor, improve the reliability of the sensor, improve the cost performance of the sensor, and promote the multifunction of the sensor.

Smart sensors can store various physical quantities detected and process these data in accordance with instructions to create new data. Intelligent sensors can communicate information, decide which data should be transmitted, discard abnormal data, and complete analysis and statistical calculations. At the same time, as a wide range of front-end sensing devices in the system, smart sensors can not only promote the upgrading of traditional industries, for example, the upgrading of traditional industries and the intelligent upgrading of traditional household appliances. It can also promote innovative applications, such as robotics, VR/AR (virtual reality/augmented reality), drones, smart homes, smart medical care, and elderly care.

Intelligent sensor system is a modern comprehensive technology, a high-tech new technology that is developing rapidly in the world today, but it has not yet formed a

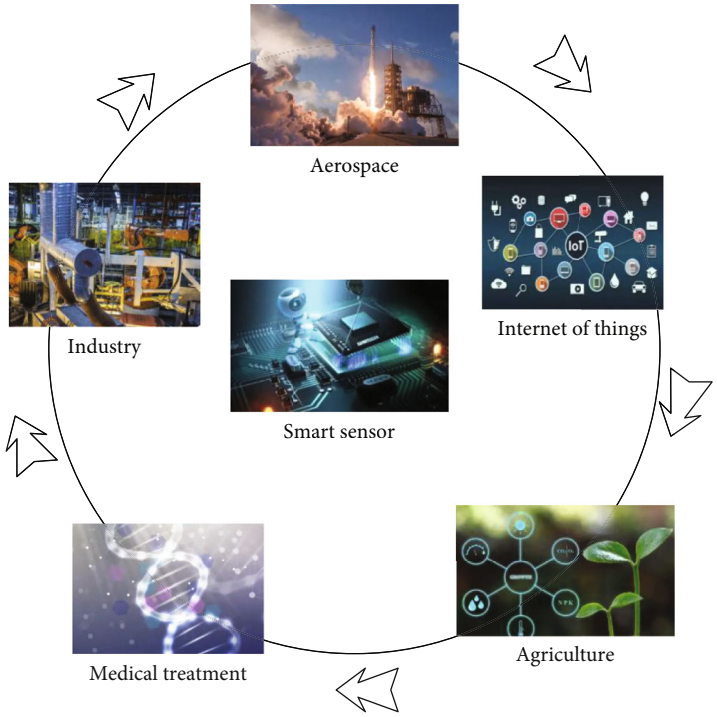

Figure 1: Application of smart sensors.

Table 1: Age grouping of the two groups of patients.

	Under 20	20~30	30~40	40~50	50~60	Over 60
Tai Chi Group	2	4	9	10	3	2
Walking group	1	5	7	13	5	2

standardized definition. In the early days, people simply and mechanically emphasized the close integration of the sensor and the microprocessor in the process, thinking that "the sensor's sensitive components and its signal conditioning circuit and the microprocessor are integrated on a chip to be a smart sensor." Smart sensors have been widely used in various fields such as aerospace, aviation, national defense, science and technology, and industrial and agricultural production. For example, it has broad application prospects in the field of robotics. Intelligent sensors enable robots to have human-like facial features and brain functions and can perceive various phenomena and complete various actions.

Regarding the Chinese and English titles of smart sensors, there has not yet been a unified statement. John Brignell and Nell White believe that "Intelligent Sensor" is the British name for smart sensors, and "Smart Sensor" is the common name for smart sensors in the United States. In the article "Integrated Smart Sensor", Johan H. Huijsing is called "Smart Sensor" and "Integrated Smart Sensor" according to the degree of integration. The Chinese translation of "Smart Sensor" has been translated as "smart sensor" or "smart sensor".

3. Experiments

3.1. Case Grouping. According to the inclusion criteria, 63 patients were randomly divided into two groups, 30 in the Taijiquan group and 33 in the walking group. There were 7 cases of rejection, abscission, and discontinuation caused by various reasons, and 56 cases were counted finally. There were 28 cases in the Taijiquan group and 28 cases in walking group.

Table 2: Gender grouping of the two groups of patients.

	Male	Female
Tai Chi Group	17	13
Walking group	19	14

3.2. Treatment

3.2.1. Basic Drug Treatment. According to the patient's condition and history, the conventional antiheart failure drugs (hydrochlorothiazide, furosemide, lisinopril, benazepril, metoprolol, carvedilol, etc.) were selected for treatment, and the conventional oral dosage was still used as the basic treatment. The age group and gender group are shown in Table 1 and Table 2.

3.2.2. Taijiquan-Assisted Therapy. The Taijiquan group added Taijiquan auxiliary treatment on the basis of drug treatment.

(1) Practice Method. In the evening of each day, under the guidance of the instructor, the subjects practiced 24

Table 3: The distribution of syndrome types of the two groups of patients.

	Heart blood stasis	Condensation	Turbid phlegm internal resistance	Heart-qi deficiency syndrome	Heart-kidney yin deficiency syndrome	Heart-kidney yang deficiency syndrome
Tai Chi Group	18	4	6	10	5	9
Walking group	16	2	4	8	6	10

simplified Taijiquan exercises. From the preparation activity, the practice activity (from the beginning of the rise, to the end of the closing) to the end of the activity, practice it once.

(2) Power Method. A wild horse is divided into mane (three times), a white crane with bright wings and knees, a step (three times), a Pipa with one hand, an inverted roll, a unified left tail, a right tail, a single whip, a cloud hand, a single whip, a high horse, a right foot, a pair of wind through the ears, a turn around, a left foot, a right foot, an independent right down, a left-right shuttle, a submarine needle, a flash through arm, a turn around, a mallet is like a closed cross hand, a closing.

(3) Training Time and Intensity. Training time: first one week of basic training, to accurately grasp the action essentials after the experiment. Exercise 5 times a week, 30 minutes each time, 5-6 p.m. Practice for 12 weeks.

Exercise intensity: it should be noted to keep the appropriate amount of exercise for the exerciser. The monitoring indicators are as follows: slightly sweating during exercise, slightly faster breathing but not affecting speech (take talk test for the exerciser), feeling comfortable when getting up in the morning, no continuous fatigue and other discomfort, and the heart rate is similar to or slightly slower than the previous day. If the patient does not induce the above symptoms and the heart rate increases less than 20 beats/min, it is a normal response. If the heart rate increases more than 20 times/min or any adverse reactions occur, exercise should be stopped temporarily. Continue after stabilization. During the exercise, according to the actual situation of different patients, adjust the height of the posture to adjust the intensity and amount of exercise.

3.3. Observation Items and Evaluation. SF-36, also known as simplified 36 medical outcome study scale, is a health status questionnaire. SF-36 health scale was used to evaluate the total score of SF-36 in both groups. Before treatment and at the end of treatment, the patients were assessed once, respectively. The participants were medical psychologists trained by the scale system.

The SF-36 scale in Chinese version was used for measurement. One week after the subjects joined the group and at the end of the treatment, they were given out. Before filling in the form, they were interviewed with the subjects to eliminate their concerns. Then, using a unified guide, the investigators explained the questions to those who could not understand due to their low education level and asked one by one for the consent of the offspring to fill in. All investigators were trained and the recovered forms were used for quality control. The feasibility, reliability, and validity of SF-36 were evaluated.

The data were processed by SPSS18.0. Data were presented by $\bar{X} \pm s$, t-test, one-way ANOVA, and covariance analysis ($P < 0.05$).

4. Discussion

4.1. Comparison of SF-36 Scores in Different Fields between the Two Groups before and after Treatment

4.1.1. Syndrome Differentiation and Typing. As shown in Table 3, there were 18 cases of central blood stasis, 4 cases of condensation, 6 cases of turbid phlegm in the Taijiquan group, 10 cases of heart-qi deficiency syndrome, 5 cases of heart-kidney yin deficiency, and 9 cases of heart-kidney yang deficiency;

In the walking group, there were 16 cases of central blood stasis, 2 cases of cold coagulation in the heart, 4 cases of turbid phlegm, 8 cases of weak heart-qi, 6 cases of heart and kidney yin deficiency, and 10 cases of heart and kidney yang deficiency.

Then draw it as shown in Figures 2 and 3.

There was no significant difference between the two groups ($P > 0.05$).

4.1.2. Cardiac Function Grading. According to NYHA cardiac function classification, as shown in Table 4.

According to NYHA cardiac function classification, as shown in Table 5 and Figure 4.

As shown in Table 6 and Figure 5, before treatment, there was no significant difference in SF-36 scores of the two groups ($P > 0.05$), which was consistent with the principle of homogeneity of the experiment; before and after treatment, the SF-36 scores of the Taijiquan group were significantly reduced ($P < 0.05$) except for physical pain and mental health, suggesting that the practice of Taijiquan can improve patients' symptoms and quality of life in general. There was no significant difference in the walking group ($P > 0.05$). After treatment, the SF-36 scores of the two groups were significantly different (corpse < 0.05). It can be seen that the improvement effect of Taijiquan exercise was significantly better than that of walking exercise.

4.2. Comparison of 6-MWT Assessment Results between the Two Groups before and after Treatment. According to the 6-MWT walking test, after the intervention of Taijiquan exercise and walking exercise, the classification of exercise tolerance in the two groups changed: the classification of the Taijiquan group and walking group moved to level 3 and level 4, which was more obvious in the Taijiquan group than in walking group.

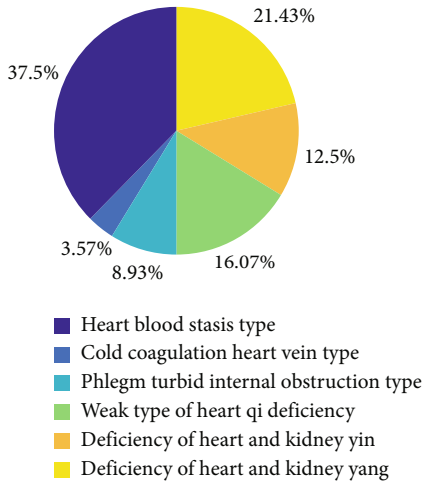

Figure 2: Distribution of syndrome types in two groups.

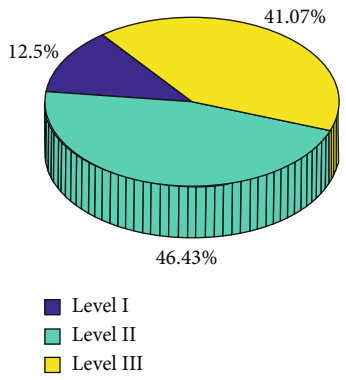

Figure 3: Distribution of syndrome types in two groups.

Table 4: The distribution of syndrome types of the two groups of patients.

	Class I	Class II,	Class III
Tai Chi Group	3	12	13
Walking group	4	14	10

The Taijiquan group has 3 cases of grade I, 12 cases of grade II, and 13 cases of grade III. Walking group has 4 cases of grade I, 14 cases of grade II, and 10 cases of grade III. Then draw it as shown in Figure 3.

Table 5: Scores of SF-36 before and after treatment in the Taijiquan group and walking group.

	PF	RP	BP	GH	VT	SF	RE	MH
Before walking therapy	57	43	49	42	37	49	35	38
After walking therapy	76	64	51	59	51	74	53	50
Before Taijiquan treatment	57	43	49	42	37	49	35	38
After Taijiquan treatment	87	63	65	61	73	84	50	56

According to the 6-MWT walking test, there was a significant difference ($P < 0.01$) in the increase of walking distance between the Taijiquan group and walking group

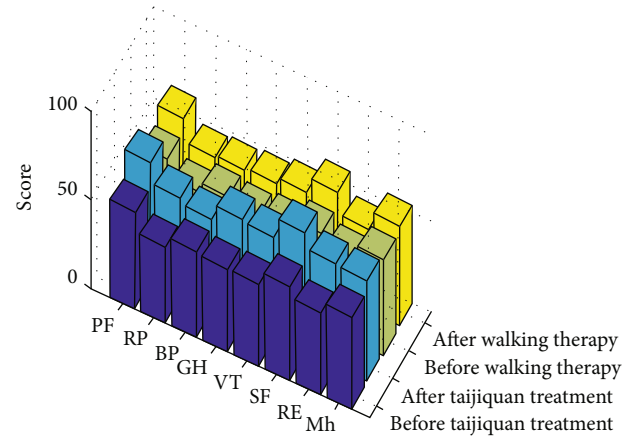

Figure 4: Scores of SF-36 before and after treatment in the Taijiquan group and walking group.

before and after treatment ($P < 0.01$). It is suggested that Taijiquan exercise is better than the walking group in improving exercise tolerance and intervening heart function in grade II and III patients ($P < 0.01$).

It can be seen from our research results that practicing Taijiquan combined with conventional antiheart failure drugs to treat chronic heart failure is better than walking training combined with conventional antiheart failure drugs to treat chronic heart failure.

Practicing Taijiquan can not only improve the health-related quality of life (HRQOL) assessed by SF-36 but also improve the exercise tolerance assessed by 6-MWT. There was a significant difference between the two groups ($P < 0.01$). Therefore, Taijiquan can not only improve patients' health-related quality of life and exercise tolerance but also effectively improve patients' heart function.

According to the evaluation results of treatment effect of SF-36, before and after treatment, the scores of SF-36 in all fields of the Taijiquan group were significantly lower than those of the walking group except for physical pain and mental health ($P < 0.05$). It is suggested that Taijiquan exercise can improve the symptoms and quality of life of patients in general, while walking exercise has little effect on the improvement of symptoms.

According to the evaluation results of 6-MWT walking test, the increase of walking distance in the Taijiquan group (grade II and III patients with heart function) before and after treatment was significantly different ($P < 0.01$), which was significantly better than that in the walking group. It is suggested that the exercise of Taijiquan on the basis of conventional antiheart failure drug treatment can improve the exercise tolerance of the patients, especially for the patients with grade II and III heart function. It shows that Taijiquan has a positive correlation with the improvement of heart function and quality of life in CHF patients. At the same time, it was found that 6-MWT had a better evaluation effect on patients with grade II and III cardiac function, but a little worse for patients with better cardiac function (patients with grade I cardiac function). The reason may be that the more serious the heart failure is, the closer the daily activities are to the maximum exercise amount of the patients, and the

Table 6: 6-MWT walking before and after treatment in the Taijiquan group and walking group.

Group (number of columns)		Walking distance, m	
		Before treatment	After treatment
Taijiquan group (28)	NYHA I	473	511
	NYHA II	408	506
	NYHA III	317	413
Walking group (28)	NYHA I	469	492
	NYHA II	416	451
	NYHA III	298	338

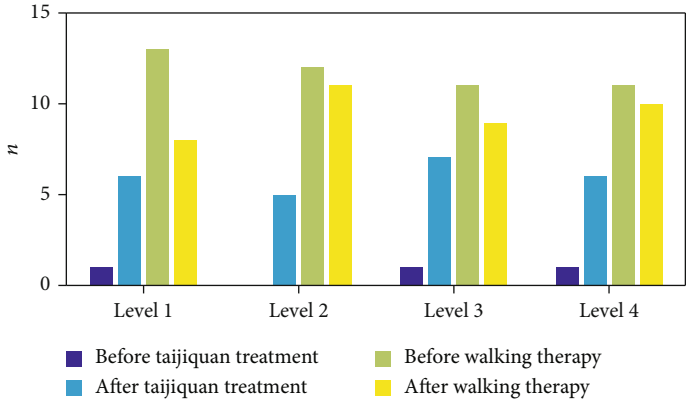

Figure 5: Grade distribution of 6-MWT walking distance before and after treatment in the Taijiquan group and walking group.

6-MWT is closer to the maximum exercise experiment for the patients with more serious heart failure.

From the results we can see that Taijiquan as a means of rehabilitation is better than walking therapy. It can be speculated that isometric contraction of the lower limb muscles and abdominal breathing exercise are the main reasons for the superiority of Taijiquan. In addition, the patient's trust in Taijiquan is higher than that of walking. In the process of practicing Taijiquan, there is a positive communication between the patients and the guide. When the patients go home, they will figure out the core points of Taijiquan, while walking, as a routine exercise, will not have a placebo effect on the psychology of the subjects. Exercise can improve the body's oxygen tolerance and improve cardiac systolic and diastolic capacity. In patients with stable heart failure, moderate aerobic exercise training can reduce symptoms, improve exercise capacity and quality of life, and can effectively reduce disability, hospitalization, and mortality through exercise training.

5. Conclusions

This paper analyzes and discusses the PETCT imaging diagnosis of heart failure improved by Taijiquan based on intelligent sensors, finds that the effect of Taijiquan on heart failure has improved, tracks the latest progress of clinical and experimental research on chronic cardiac insufficiency, and systematically summarizes the understanding and etiology of chronic cardiac insufficiency, In the discussion on the mechanism, clinical manifestations, diagnostic criteria, and treatment methods, the treatment direction of CHF patients is to apply exercise therapy on the basis of drug treatment to reduce symptoms as much as possible, prolong life, and improve quality of life. Therefore, on the basis of Qigong research, the clinical research on the treatment of chronic cardiac insufficiency with Tai Chi combined with drugs has dried up.

This article uses SF-36 and 6-minute walk test as the evaluation indicators of clinical trials to evaluate the clinical symptoms, quality of life, exercise tolerance, and cardiac function of CHF patients from Tai Chi exercises and combines information fusion and smart sensors. To explore its application mechanism, on the basis of conventional anti-heart failure drugs, Taijiquan was used to intervene in CHF patients and compared with walking exercises. Using SF-36 and 6-minute walking test as the observation indicators, we observed Taijiquan's effects on the clinical symptoms and symptoms of CHF patients. The impact of quality of life, exercise tolerance and improvement of heart function, and the clinical effect of Tai Chi on CHF patients were evaluated.

The results show that Tai Chi can not only improve the clinical symptoms of CHF patients and improve their health-related quality of life but also can effectively improve the restriction of activities caused by CHF and improve the patients' exercise endurance. Chronic cardiac insufficiency is located in the heart. Tai Chi intervention mainly focuses on nourishing the heart and improving the targeted function

of the heart. Through the coordination of other organs, meridians, muscles and bones of the body, it can increase the oxygen supply of the heart, enhance the contractility of the heart, reduce the resistance of peripheral blood vessels, reduce the burden on the heart, and improve heart function. At the same time, the improvement effect of Tai Chi has a very positive guiding effect on the psychological state of CHF patients, which is in line with the needs of the bio-psycho-social medicine model. This study broadens the nondrug. The scope of application of therapeutic Tai Chi provides a scientific basis for its further promotion. However, due to the limitation of time and technical conditions, we have not conducted in-depth research on it, and we will further conduct in-depth research on the performance of smart sensors in the future.

Data Availability

This article does not cover data research. No data were used to support this study.

Conflicts of Interest

The author declares no conflicts of interest.

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