

# Acupuncture in Traditional Chinese Medicine: A Complementary Approach for Cardiovascular Health

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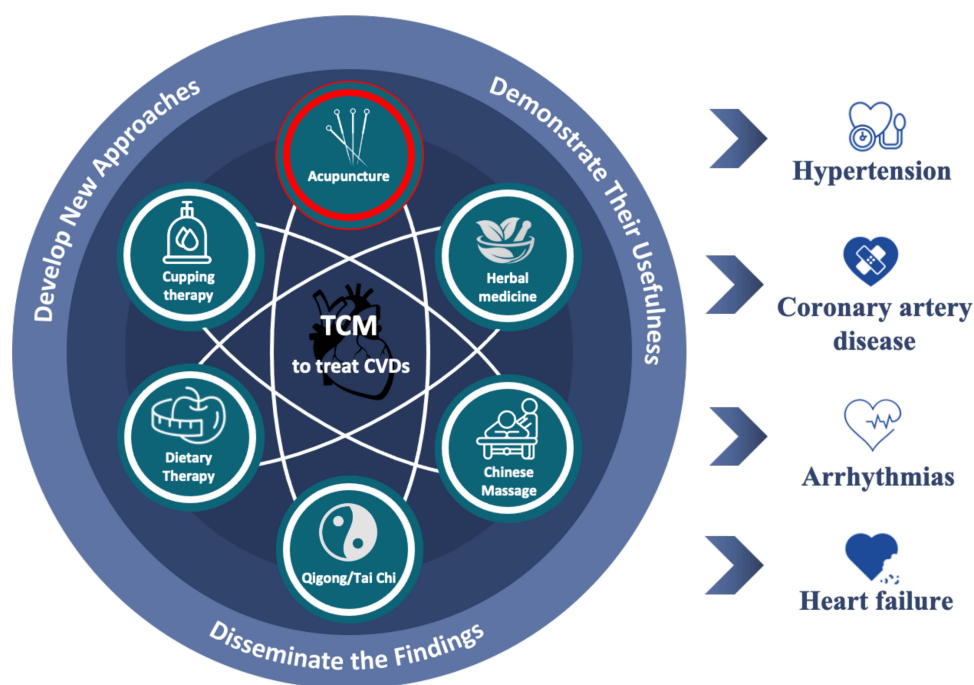
**Abstract:** Cardiovascular diseases (CVDs) are increasingly prevalent in clinical settings. With the continuous improvement of people's living standards, the gradual acceleration of the pace of life, and the deterioration of the living environment in recent years, the incidence of CVDs is increasing annually. The prevalence of CVDs among individuals aged 50 and above is notably elevated, posing a significant risk to patients' well-being and lives. At this juncture, numerous clinical treatment choices are available for managing CVDs, with traditional Chinese medicine (TCM) therapy standing out as a practical, safe, and reliable option. Over the recent years, there has been growing acknowledgement among both medical professionals and patients. With the expanding integration of TCM in the treatment of various clinical conditions, the use of TCM in managing CVDs has gained significant attention within the medical community, potentially emerging as an efficacious approach for addressing cardiovascular diseases. This article conducts a comprehensive review of the TCM approach, particularly acupuncture, as a supplementary treatment for CVDs, highlighting its ability to effectively lower blood pressure, decrease coronary artery events, mitigate arrhythmias, and enhance cardiac function when used alongside conventional medication. The review underscores the promise of acupuncture in enhancing cardiovascular health, although variations in research methodologies necessitate standardized applications.

**Keywords:** cardiovascular diseases, traditional Chinese medicine, acupuncture, clinical treatment

## Introduction

Cardiovascular disease (CVD) stands as the foremost cause of global mortality, accounting for 17.9 million deaths annually, or 31% of all global deaths, according to the World Health Organization.<sup>1-4</sup> The urgent need for innovative and effective therapies to manage and prevent CVD is paramount.<sup>5</sup> Amidst growing interest in complementary and alternative medicine, traditional Chinese medicine (TCM) has emerged, boasting centuries of application in treating various cardiovascular conditions.<sup>6</sup>

TCM therapies such as acupuncture, herbal medicine, and cupping therapy have gained attention for their potential benefits in cardiovascular health (Figure 1).<sup>7-9</sup> Acupuncture, a cornerstone of TCM, is believed to enhance blood flow, reduce inflammation, and alleviate pain, offering promising implications for cardiovascular management.<sup>10-17</sup> Specifically, acupuncture has shown efficacy in conditions like hypertension and coronary artery disease.<sup>18-20</sup> potentially through mechanisms involving nitric oxide regulation and neurovascular bundle modulation.



**Figure 1** Traditional Chinese Medicine (TCM) used in treating CVDs.

**Note:** The red circle highlights acupuncture, which is known for its efficacy in CVD treatment.

Importantly, acupuncture's application in CVD management underscores its minimal adverse effects and capacity to alleviate symptoms effectively.<sup>21,22</sup> However, these therapies should complement conventional medical treatments and be administered under professional guidance. Individuals with CVD are advised to consult healthcare providers before incorporating TCM therapies into their treatment regimens.

This review explores current literature on acupuncture's role in managing CVD, highlighting its potential as an adjunctive therapy in cardiovascular care.

## Understanding the Causes and Symptoms of Cardiovascular Diseases from a TCM Perspective

### The Concept of Qi and Blood in TCM and Its Relationship to Cardiovascular Health

TCM has a unique and holistic approach to understanding health and disease. TCM views the body as a network of interconnected systems and recognises the importance of maintaining balance and harmony within this network to achieve optimal health. One of the key concepts in TCM is Qi and blood. Understanding the role of Qi and blood in cardiovascular health is crucial to understanding the TCM approach to treating and preventing cardiovascular disease.

In TCM, Qi and blood are two of the most essential substances in the body. Qi, often translated as “vital energy”, is responsible for the body's movement, transformation, and protection. It drives physiological processes and maintains the body's dynamic balance. Blood, in contrast, nourishes the body's tissues and organs, supplying them with the necessary nutrients and oxygen for optimal function. Qi and blood work synergistically to maintain the body's health and well-being. Proper circulation and balance of both Qi and blood are crucial for sustaining health, preventing disease, and promoting recovery.

The relationship between Qi and blood is not just fundamental but also deeply interconnected with cardiovascular health. The heart, our body's tireless pump, requires a significant amount of energy in the form of Qi. In Traditional Chinese Medicine (TCM), the heart is considered the “ruler” of the blood, ensuring smooth and even blood flow throughout the body. An imbalance in Qi, or blood, can have a profound impact on heart health, potentially leading to

cardiovascular disease. This highlights the importance of understanding and maintaining the balance between Qi and blood for our overall well-being.

Several factors can contribute to an imbalance in Qi and blood, thereby increasing the risk of cardiovascular disease. Emotional factors such as stress and anxiety can disrupt the flow of Qi, causing stagnation that impairs blood flow and heightens cardiovascular risk.<sup>23–25</sup> Poor diet and lifestyle habits also contribute to Qi and blood imbalances. For example, a diet high in saturated fats and processed foods can lead to cholesterol accumulation in the blood vessels, obstructing blood flow and increasing cardiovascular disease risk.<sup>26–28</sup>

TCM offers a range of treatments aimed at restoring balance to Qi and blood to prevent or treat cardiovascular disease. Acupuncture and herbal medicine are commonly used to enhance circulation and promote cardiovascular health.<sup>29,30</sup> Additionally, dietary and lifestyle modifications, such as consuming a healthy diet and engaging in regular exercise, are effective in preventing cardiovascular disease.<sup>31,32</sup> These TCM treatments, when used in conjunction with conventional medical approaches, provide a comprehensive strategy for maintaining cardiovascular health.

The concept of Qi and blood is central to the TCM approach to treating and preventing cardiovascular disease. Maintaining balance and harmony between Qi and blood is essential to promoting cardiovascular health and preventing disease. By addressing imbalances in Qi and blood through acupuncture, herbal medicine, and lifestyle changes, individuals can improve their cardiovascular health and reduce their risk of disease.

## How Emotional Imbalances Can Lead to Cardiovascular Disease in TCM

TCM views the mind and body as interconnected, with emotions playing a significant role in physical health. Emotional imbalances, such as stress and anxiety, can disrupt the flow of Qi (life force energy) and blood, contributing to cardiovascular disease.

In TCM, emotions are considered a type of Qi, affecting the balance and circulation of Qi and blood in the body. For instance, stress and anxiety can cause Qi stagnation, impairing blood flow and increasing the risk of cardiovascular disease.<sup>28</sup> Emotions such as anger and frustration can cause Qi to rise, leading to high blood pressure and an increased risk of heart disease.<sup>28,33,34</sup>

According to TCM theory, the heart is responsible for controlling the mind and emotions. When the mind is overactive, or emotions are excessive, the heart can become overwhelmed and weakened, potentially causing physical symptoms such as chest pain, palpitations, and shortness of breath, which are indicative of cardiovascular disease risk.<sup>24,35</sup>

To address emotional imbalances and support cardiovascular health, TCM emphasizes maintaining a healthy lifestyle, including a balanced diet, regular exercise, and stress reduction techniques such as acupuncture, meditation, and herbal medicine. By addressing both the physical and emotional aspects of cardiovascular health, TCM offers a comprehensive approach to preventing and treating heart disease.

## The Role of Diet and Lifestyle Factors in TCM's Understanding of Cardiovascular Health

One of the key principles of Traditional Chinese Medicine (TCM) is that food is medicine, and the right diet can help prevent and treat disease. In TCM, a healthy diet is balanced, diverse, and based on whole foods. This involves avoiding processed and refined foods and focusing on fresh fruits and vegetables, whole grains, lean proteins, and healthy fats.<sup>36</sup>

One study discussed the importance of diet and lifestyle modifications in preventing and managing cardiovascular disease. The study found that TCM interventions such as acupuncture, herbal medicine, and dietary and lifestyle modifications can effectively improve cardiovascular health outcomes.<sup>36</sup>

Another study examined the relationship between a traditional Chinese dietary pattern and the risk of cardiovascular disease, finding that adherence to this dietary pattern was associated with a lower risk of cardiovascular disease.<sup>37</sup> Similarly, a study investigating dietary patterns and cardiovascular disease risk in Chinese adults found that a healthy dietary pattern characterized by a high intake of fruits, vegetables, whole grains, and legumes was linked to a reduced risk of cardiovascular disease.<sup>38</sup>

In addition to diet, lifestyle factors such as exercise, stress management, and sleep are also considered crucial for maintaining cardiovascular health in TCM. Regular physical activity is believed to help circulate Qi and blood while reducing stress and promoting relaxation.<sup>39,40</sup>

Proper sleep is also considered essential for cardiovascular health in TCM. In TCM, it is believed that the body repairs and rejuvenates itself during sleep, and that chronic sleep deprivation can lead to imbalances in Qi and blood.<sup>41,42</sup>

Overall, TCM offers a holistic approach to cardiovascular health that emphasises the importance of diet, lifestyle, and emotional well-being. By adopting these principles, individuals can support their cardiovascular health and improve their overall quality of life.

## Identifying Early Warning Signs of Cardiovascular Disease from a TCM Perspective

In TCM, identifying early warning signs of cardiovascular disease is crucial for preventing the development of serious health problems. TCM practitioners believe that the early detection of imbalances in the body's Qi and blood can help individuals take steps to restore balance and prevent the progression of disease.<sup>43</sup>

One early warning sign of cardiovascular disease from a TCM perspective is chest discomfort or pain.<sup>28,44</sup> This discomfort is often described as a “stuffy” or “oppressed” feeling in the chest, and may be accompanied by a feeling of fullness or tightness. Other early warning signs of cardiovascular disease in TCM include shortness of breath, palpitations, and fatigue.<sup>44</sup>

In addition to physical symptoms, TCM also emphasises the importance of paying attention to emotional and psychological symptoms as potential early warning signs of cardiovascular disease.<sup>25,45</sup> Emotional imbalances such as anxiety, depression, and irritability can be indicative of an underlying imbalance in the body's Qi and blood, and may signal an increased risk of cardiovascular disease.<sup>25,46</sup>

TCM practitioners also pay close attention to changes in the appearance of the tongue and complexion as potential early warning signs of cardiovascular disease.<sup>47,48</sup> A previous study used TCM tongue diagnosis to investigate the differences in tongue characteristics between patients with acute ischemic stroke and healthy individuals. The study found that patients with acute ischemic stroke exhibited a significantly higher prevalence of tongue coating and changes in tongue body color compared to healthy individuals. For example, a purple or bluish tongue may indicate poor circulation, while a pale or yellowish complexion may signal an imbalance in the body's Qi and blood.<sup>49,50</sup> These findings reiterate the potential of tongue diagnosis, indicating it could be a powerful tool for detecting early warning signs of cardiovascular disease and preventing stroke. Additionally, the study highlights the importance of integrating TCM tongue diagnosis into conventional diagnostic approaches for a more comprehensive assessment of cardiovascular health.

## The Role of Pulse Diagnosis in TCM's Diagnosis of Cardiovascular Disease

Pulse diagnosis is a valuable tool for diagnosing cardiovascular disease. According to TCM theory, the pulse provides information about the flow of Qi and blood in the body, as well as the overall condition of the organs and tissues.<sup>51,52</sup>

Several studies have explored the application of pulse diagnosis in identifying cardiovascular disease within the framework of TCM.<sup>53–56</sup> For example, one study found that pulse diagnosis can accurately identify patients with cardiovascular disease and differentiate between different types of heart disease based on pulse characteristics.<sup>55</sup>

Another study found that pulse diagnosis combined with other diagnostic techniques, such as tongue diagnosis and symptom analysis, can improve the accuracy of TCM diagnosis of cardiovascular disease.<sup>57,58</sup> Additionally, pulse diagnosis has proven useful for monitoring the progression of cardiovascular disease and assessing the efficacy of TCM treatments.<sup>55</sup>

Pulse diagnosis involves palpating the radial artery at the patient's wrist to assess the qualities of the pulse, such as its strength, rhythm, and depth.<sup>59</sup> TCM practitioners use a system of pulse diagnosis that involves feeling the pulse at six different positions on each wrist, and using this information to identify any imbalances or disruptions in the flow of blood.<sup>60</sup>

Research has demonstrated that pulse diagnosis can be an effective tool for identifying cardiovascular disease in both symptomatic and asymptomatic patients. One study found that pulse diagnosis had a sensitivity of 70% and a specificity of 90% in diagnosing coronary artery disease (CAD).<sup>61,62</sup>

TCM practitioners may also use pulse diagnosis as a means of monitoring the progress of cardiovascular disease and the effectiveness of treatment. By regularly feeling the pulse and noting any changes in its qualities, TCM practitioners can track improvements, and adjust treatment plans as necessary.<sup>63,64</sup> Pulse diagnosis is a crucial diagnostic tool in TCM for understanding and diagnosing cardiovascular disease. By evaluating the flow of Qi and blood through the pulse, TCM practitioners can detect imbalances and disruptions contributing to cardiovascular health issues and formulate targeted treatment plans.

## The Role of Acupuncture in Treating CVDs

Acupuncture, a form of Traditional Chinese Medicine (TCM), involves inserting fine needles into specific points on the body to promote healing and alleviate pain.<sup>65</sup> This practice, which has been used for thousands of years, is now recognized as a complementary therapy in many parts of the world.<sup>66</sup>

Research indicates that acupuncture can positively affect the cardiovascular system by regulating blood pressure, improving circulation, and reducing inflammation.<sup>67,68</sup> It is suggested that acupuncture may achieve these benefits by stimulating the release of neurotransmitters and hormones that help regulate cardiovascular function.<sup>69,70</sup> Additionally, acupuncture may have a calming effect on the nervous system, helping to reduce stress and anxiety, which are known contributors to cardiovascular problems.<sup>71</sup>

Acupuncture is often used as a complementary therapy for cardiovascular disease, either alone or in combination with other treatments such as medication and lifestyle changes. It is important to emphasize that acupuncture should not replace conventional medical care but rather serve as an adjunct therapy to support overall cardiovascular health.

## The Mechanisms of Acupuncture in Treating CVDs

Acupuncture involves inserting thin needles into specific points on the body, known as acupuncture points, to stimulate the body's natural healing processes.<sup>67,72</sup> Research has shown that acupuncture can effectively treat a range of CVDs, including hypertension, angina, and arrhythmia.<sup>8,73–77</sup> The mechanisms by which acupuncture exerts its therapeutic effects on the cardiovascular system are complex and multifactorial. Here, we will explore some of the key mechanisms underlying the use of acupuncture in cardiovascular disease.

### Modulation of the Autonomic Nervous System

The autonomic nervous system (ANS) is crucial in controlling cardiovascular functions such as heart rate, blood pressure, and vascular tone.<sup>78</sup> Imbalances in the ANS have been linked to the development of various cardiovascular diseases (CVDs).<sup>79</sup> Research indicates that acupuncture can regulate the ANS, thereby enhancing cardiovascular function<sup>80</sup> (Figure 2).

Evidence from multiple studies suggests that acupuncture reduces sympathetic nervous system activity while boosting parasympathetic activity. This dual effect can lower heart rate, blood pressure, and vascular tone, offering significant benefits to patients with cardiovascular conditions.<sup>71</sup>

### Anti-Inflammatory Effects

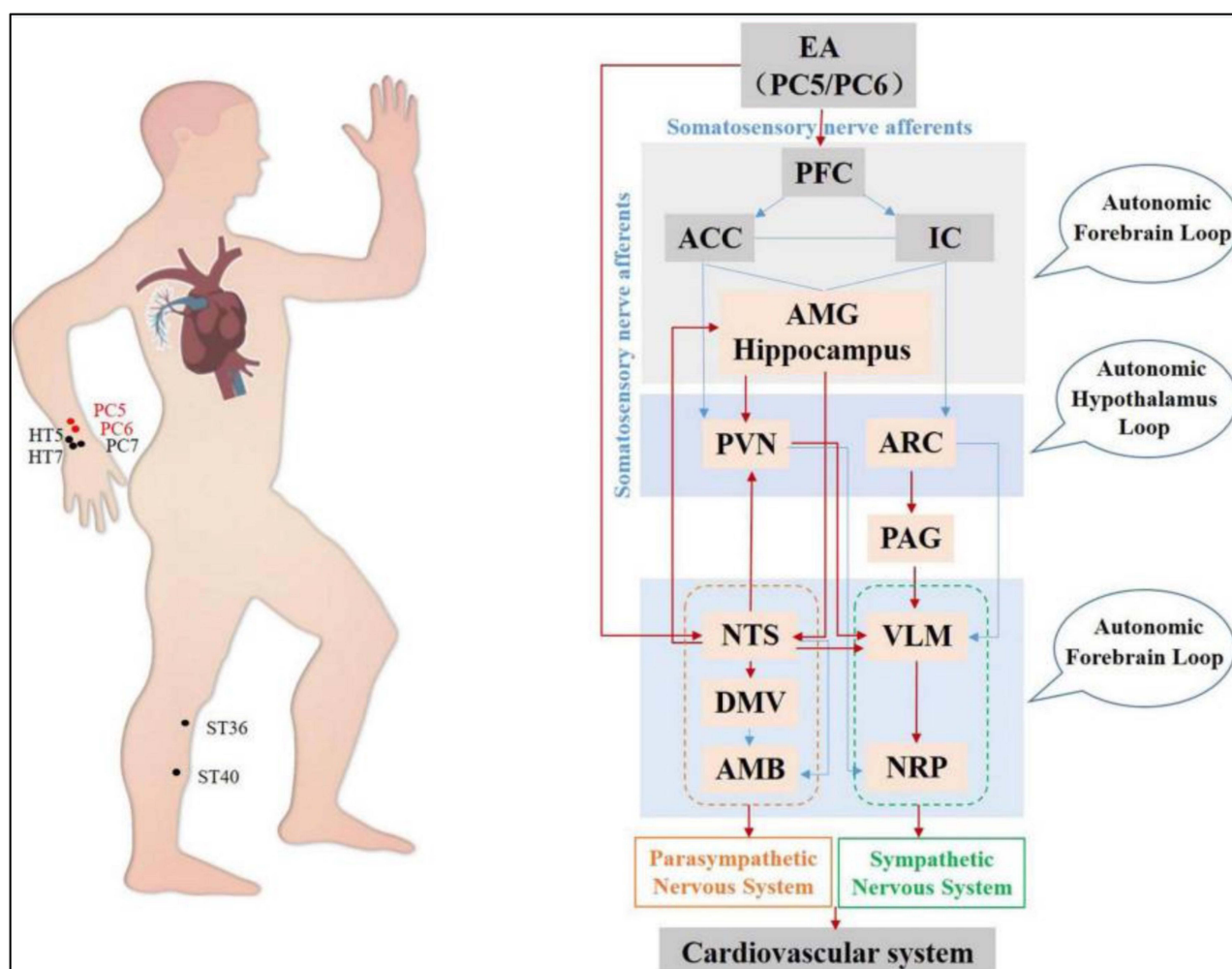
Inflammation plays a pivotal role in the advancement of cardiovascular diseases (CVDs), encompassing conditions like atherosclerosis and heart failure. Acupuncture exhibits anti-inflammatory properties, potentially mitigating the risk of cardiovascular disease.<sup>81,82</sup>

Multiple investigations have evidenced that acupuncture diminishes the levels of pro-inflammatory cytokines like TNF- $\alpha$  and IL-6 while concurrently elevating anti-inflammatory cytokines such as IL-10. This dual action contributes to inflammation reduction and may impede the progression of cardiovascular disease.<sup>83–86</sup>

### Improvements in Endothelial Function

The endothelium, comprising a layer of cells lining the blood vessels, plays a crucial role in regulating vascular tone and blood flow.<sup>87</sup> Dysfunction in endothelial function is implicated in the onset and progression of cardiovascular disease.<sup>88</sup> Acupuncture has been found to enhance endothelial function, potentially offering preventive or therapeutic benefits for cardiovascular disease.<sup>89</sup>





**Figure 2** A diagram depicting the potential central nervous system pathways through which acupuncture may influence cardiovascular function via the autonomic nervous system.<sup>80</sup>

**Notes:** The red line represents autonomic neural pathways that have been shown to influence the effects of acupuncture, while the blue line represents known autonomic neurophysiological pathways that are likely to mediate the effects of acupuncture but have not yet been confirmed.

**Abbreviations:** EA, electroacupuncture; ACC, anterior cingulate cortex; I.C., insular cortex; PFC, prefrontal cortex; AMG, amygdala; PVN, paraventricular nucleus; ARC, arcuate nucleus; PAG, periaqueductal gray; DMV, dorsal motor nucleus of the vagus nerve; VLM, ventrolateral medulla; NTS, nucleus tractus solitarius; AMB, nucleus ambiguus; NRP, nucleus raphes pallidus.

Several investigations have highlighted that acupuncture can elevate levels of nitric oxide (NO), a pivotal regulator of endothelial function.<sup>90–93</sup> NO facilitates vasodilation, enhances blood flow, and diminishes inflammation, all of which confer advantages for patients grappling with cardiovascular disease.<sup>94,95</sup>

### Reduction in Oxidative Stress

Oxidative stress significantly contributes to the initiation and progression of cardiovascular disease, arising from an imbalance between reactive oxygen species (ROS) production and the body's antioxidant defenses.<sup>96</sup> Acupuncture has demonstrated efficacy in diminishing oxidative stress, potentially offering avenues for preventing or treating cardiovascular disease.<sup>97–100</sup>

Various studies have illustrated that acupuncture can augment antioxidant levels, such as superoxide dismutase (SOD) and glutathione (GSH), while concurrently reducing ROS levels.<sup>101–103</sup> This dual action may culminate in reduced oxidative stress, potentially slowing the progression of cardiovascular disease.<sup>101</sup>

## Modulation of Neurotransmitters

Neurotransmitters act as chemical messengers facilitating communication between neurons and other cells throughout the body. They play a pivotal role in regulating cardiovascular function, encompassing heart rate and blood pressure.<sup>104,105</sup> Acupuncture has been evidenced to modulate neurotransmitter levels, consequently enhancing cardiovascular function.<sup>71,106,107</sup>

Multiple studies have indicated that acupuncture can elevate levels of neurotransmitters, such as serotonin and norepinephrine, while concurrently reducing levels of others, like neuropeptide Y.<sup>106–109</sup> This modulation can result in decreased sympathetic nervous system activity and increased parasympathetic nervous system activity, yielding beneficial effects for patients with cardiovascular disease.<sup>71,110</sup>

## Acupuncture Points for Cardiovascular Health

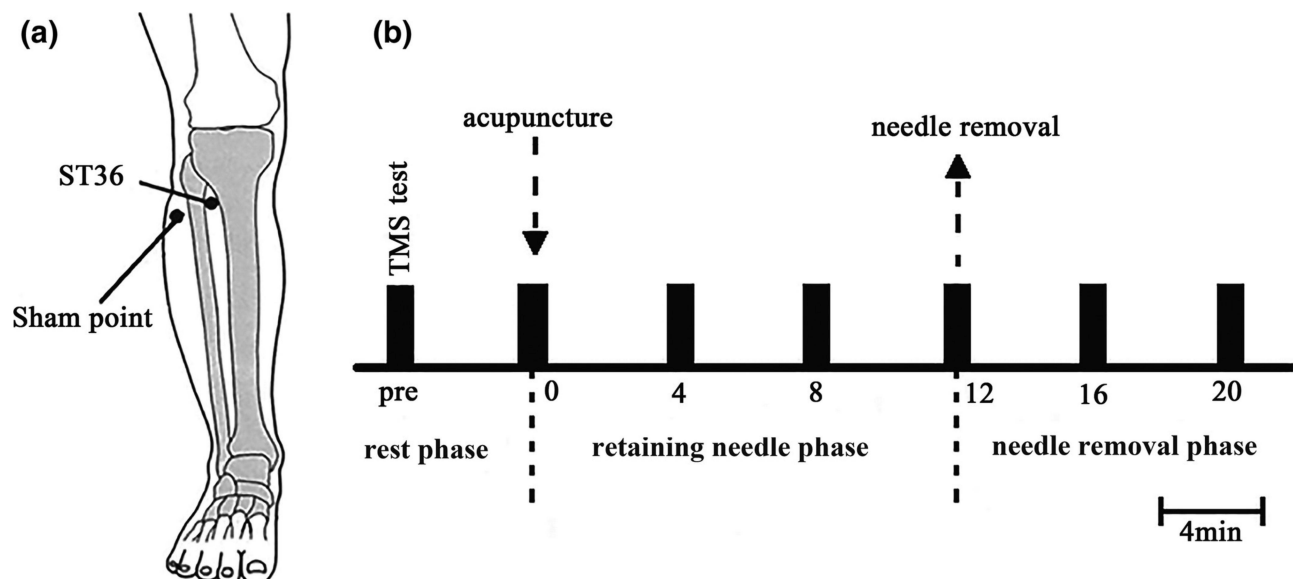
In this section, we'll look at some of the major acupuncture sites that can promote cardiovascular health.

### Neiguan (PC6)

The Neiguan (PC6) acupoint is situated on the inner forearm, approximately two inches above the wrist crease, between the flexor carpi radialis and palmaris longus tendons.<sup>111</sup> This acupoint is commonly utilized to alleviate symptoms associated with heart diseases, such as chest pain, nausea, palpitations, or vomiting.<sup>92,112</sup> Research investigations have shown that stimulating the Neiguan acupoint can reduce both blood pressure and heart rate, rendering it a valuable therapeutic approach for managing hypertension and other cardiovascular conditions.<sup>113–115</sup>

### Zusanli (ST36)

The Zusanli point, also known as ST36, is located on the lower leg, just below the knee.<sup>116,117</sup> This point is commonly used to treat digestive issues, but it can also help improve blood circulation and reduce inflammation, which can benefit the heart.<sup>118,119</sup> Research indicates that stimulating the Zusanli point can effectively lower blood pressure and enhance heart function, thus presenting a beneficial treatment option for hypertension, angina, and various other cardiovascular conditions (Figure 3).<sup>116,120,121</sup>



**Figure 3** The location of Zusanli (ST36) and the experimental procedure as follows: (a) Zusanli (ST36) was located in the tibialis anterior muscle, approximately four finger breadths below the kneecap of the subject. It was positioned one finger breadth laterally from the anterior crest of the tibia. A sham point, located approximately 3 cm next to ST36, was also selected, serving as a control. (b) The experimental procedure involved assessing Motor Evoked Potential (MEP) amplitudes at seven different time points.<sup>120</sup>

**Notes:** These time points were as follows: before acupuncture (Pre), during acupuncture (T0), 4 minutes after acupuncture (T4), 8 minutes after acupuncture (T8), needle removal (T12), 4 minutes after needle removal (T16), and 8 minutes after needle removal (T20). T0, T4, and T8 represented the retaining needle phase, while T12, T16, and T20 represented the needle removal phase.

### Taichong (LR3)

The Taichong point, also referred to as LR3, is situated on the dorsum of the foot, precisely between the big toe and the second toe.<sup>122</sup> This point is commonly used to treat liver disorders, but it can also help improve blood flow and reduce inflammation, which can benefit the heart.<sup>123–125</sup> Research has demonstrated that stimulating the Taichong point can effectively lower blood pressure and enhance heart function, thereby offering a valuable therapeutic approach for managing hypertension and other cardiovascular conditions.<sup>122,124,126</sup>

### Hegu (LI4)

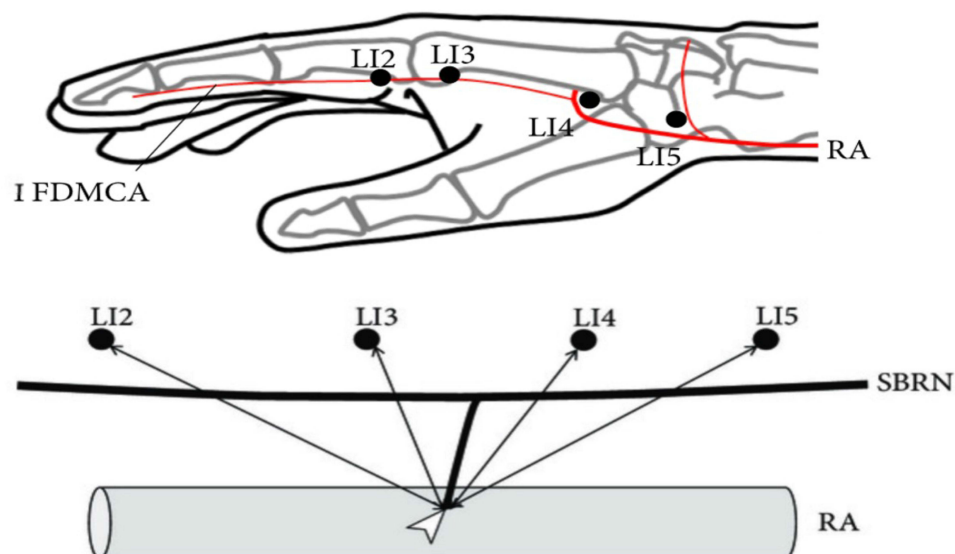
LI4 is located in the area supplied by the superficial branch of the radial nerve (SBRN) on the hand, positioned between the thumb and the index finger, near the radial artery or the first dorsal metacarpal artery, which stems from the radial artery (Figure 4).<sup>127</sup> Research findings indicate that the stimulation of the Hegu acupoint has been associated with blood pressure reduction and improvement in heart function. As a result, it has demonstrated its potential as a valuable treatment option for hypertension and various cardiovascular conditions.<sup>128–130</sup>

## Clinical Studies on Acupuncture and Cardiovascular Diseases

Acupuncture has undergone extensive clinical investigation as a potential therapeutic approach for CVDs. Numerous studies have delved into its efficacy in addressing conditions such as hypertension, coronary heart disease, and heart failure.<sup>14–17</sup>

Encouraging results have emerged from controlled studies examining acupuncture's role in managing heart disease, particularly in cases of psychosomatic heart disorders like cardiac neurosis. In the context of coronary heart disease, various authors have reported positive outcomes with acupuncture, notably in relieving angina pectoris. These findings have been substantiated by evidence from coronary arteriography.<sup>8,131,132</sup>

Independent investigations across diverse disciplines, including cardiology, neurophysiology, and psychology, have suggested that acupuncture can enhance heart function in patients with angina pectoris and activate cardiovascular regulatory mechanisms in healthy individuals.<sup>133</sup> Moreover, controlled trials have indicated that acupuncture improves symptoms and cardiac function beyond the effects of placebo or conventional medications.<sup>134,135</sup>



**Figure 4** Diagrams of anatomical measurements. Schematic of acupuncture points Hegu in the LI4; R.A., radial artery.<sup>127</sup>

**Note:** The white arrowhead indicates the point where the VBs reached the arteries.

**Abbreviations:** FDMCA, first dorsal metacarpal artery; SBRN, superficial branch of radial nerve.



Interestingly, acupuncture-induced coronary artery dilation has shown comparable efficacy to pharmacological interventions such as isosorbide dinitrate.<sup>133</sup> Furthermore, acupuncture has demonstrated superiority over conventional medications in improving left ventricular function in patients with coronary heart disease.<sup>136,137</sup>

Among the acupuncture points, PC6 emerges as a commonly utilized option for heart disease treatment, with some clinical studies also exploring its concurrent use with other points like ST36 for managing hypertension.<sup>89,113,138–141</sup>

Anatomically, the location of PC6 on the forearm surface corresponds to the anatomical pathway of the median nerve, suggesting a potential physiological link between acupoint stimulation and observed cardiovascular changes.<sup>142,143</sup>

Research employing serial equilibrium radionuclide angiography has underscored the positive effects of acupuncture on the PC6 point.<sup>138</sup> Additionally, acupuncture has shown promise in improving hemorheological parameters, thereby enhancing microcirculation.<sup>144</sup> However, caution is warranted in the treatment of heart disease to prevent adverse events. Acupuncturists must exercise vigilance in distinguishing between angina pectoris and acute myocardial infarction. The mechanism underlying acupuncture's efficacy in heart disease management is proposed to involve increased blood supply to coronary arteries via collateral circulation, mediated by alterations in the impedance of correlated meridians.<sup>145</sup>

## Hypertension

A meta-analysis encompassing 23 randomized controlled trials (RCTs) with 1788 patients indicated that acupuncture, when used as an adjunctive therapy to medication, might be more effective in reducing systolic and diastolic blood pressure (SBP and DBP) than sham acupuncture combined with medication.<sup>146</sup>

Additionally, a 2018 meta-analysis evaluated the efficacy and safety of acupuncture therapy in patients with Hypertension by examining 30 RCTs. The combined results demonstrated that acupuncture, when used alongside antihypertensive drugs, was more effective in lowering both SBP and DBP than antihypertensive drugs alone. However, the study found no significant difference in blood pressure reduction between acupuncture alone and antihypertensive drugs alone. Furthermore, acupuncture alone did not differ significantly from sham acupuncture alone, and electroacupuncture did not significantly differ from antihypertensive drugs in reducing SBP and DBP.<sup>15</sup>

In a recent study, Chinese researchers conducted a systematic search of various databases to identify randomized controlled trials (RCTs) examining acupuncture therapy for grade 1 hypertension. The meta-analysis included 10 RCTs involving a total of 1196 patients. The findings indicated that acupuncture was more effective than placebo in treating grade 1 hypertension.<sup>10</sup>

Based on their systematic reviews, the researchers concluded that inadequate evidence supports using acupuncture therapy for treating hypertension. The researchers emphasized the necessity for further studies with larger sample sizes and higher-quality RCTs to better elucidate the precise effects and safety profile of acupuncture therapy for hypertension.

## Coronary Artery Disease

In 2019, a meta-analysis was conducted to evaluate the effectiveness of acupuncture as an adjunctive treatment for angina associated with coronary artery disease (CAD). The researchers performed a comprehensive literature search and identified 24 randomized controlled trials (RCTs) involving 1916 CAD patients who received acupuncture in combination with either Western medicine or traditional Chinese medicine (TCM). The meta-analysis demonstrated that patients who received adjunctive acupuncture treatment had a significantly higher effectiveness rate compared to those who received standard treatment alone. This evidence supports the positive impact of acupuncture as an adjunctive therapy for patients with angina due to CAD.<sup>11</sup>

## Arrhythmias

Studies have demonstrated that acupuncture is both safe and effective in alleviating Atrial fibrillation (A.F.) symptoms and reducing the recurrence rate following procedures such as early radiofrequency catheter ablation (RFCA) and electrical cardioversion.<sup>76,147</sup> Additionally, acupuncture has been found to positively affect sleep quality, anxiety, and depression in A.F. patients, thereby enhancing their overall quality of life.<sup>147</sup>

A systematic review and meta-analysis investigated the impact of combining conventional drugs with acupuncture therapy on the conversion of sinus rhythm in patients with atrial fibrillation (AF). The study included 11 papers and found that acupuncture significantly improved the successful conversion rates in patients with AF (RR = 1.208, 95% CI:

1.123, 1.298,  $P < 0.001$ ). Subgroup analysis revealed that acupuncture did not significantly affect persistent AF but was more effective for paroxysmal AF. The most favorable outcomes were observed when acupuncture sessions were limited to less than 20 minutes ( $RR = 1.510$ , 95% CI 1.25, 1.82). This suggests that acupuncture could serve as a complementary therapy for AF resuscitation, particularly with shorter treatment durations.<sup>12</sup>

Another study analyzed 11 RCTs involving 804 patients up to June 2022 to assess the effectiveness of combining acupuncture with oral traditional Chinese medicine (TCM) for treating arrhythmia. The findings indicated that this combination significantly improved clinical effectiveness compared to oral TCM alone, reduced the number of premature beats within 24 hours, enhanced the conversion rate, and increased the left ventricular ejection fraction. Notably, the combined treatment did not lead to a significant increase in adverse events.<sup>148</sup>

## Heart Failure

Numerous clinical studies have investigated the use of acupuncture in treating HF.<sup>149–153</sup> Although acupuncture has been combined with conventional HF treatments, the evidence regarding its effectiveness and safety remains limited. A review of randomized controlled trials (RCTs) on acupuncture for HF highlighted methodological flaws in most of the seven included studies. Despite some positive findings, such as reduced ICU stay and readmission risk in acute HF, improved hemodynamic parameters, and enhanced exercise capacity and quality of life in chronic HF,<sup>154</sup> the overall effectiveness of acupuncture as a therapy for HF remains inconclusive. Therefore, further large-scale and rigorous clinical trials are necessary to establish its clinical utility.

A systematic review and meta-analysis involving 32 RCTs and 2499 patients assessed the efficacy of acupuncture and moxibustion in HF treatment. The experimental group, which received acupuncture and moxibustion, demonstrated higher efficacy rates and significant improvements in heart function parameters such as left ventricular ejection fraction, cardiac output, and the 6-minute walk test compared to the traditional treatment group. However, the overall evidence was deemed inconclusive due to methodological limitations and inadequate reporting of adverse events.<sup>13</sup> Consequently, further large-scale and well-designed RCTs are required to validate the potential of acupuncture and moxibustion as adjunctive therapies for HF.

## Conclusions

This review underscores the promise of acupuncture as a feasible complementary approach for managing cardiovascular diseases (CVDs). When used in conjunction with conventional medication, acupuncture has demonstrated its ability to effectively lower blood pressure in individuals with hypertension, decrease the occurrence of coronary artery events, mitigate Arrhythmias, and enhance cardiac function in heart failure patients. Nonetheless, variations in research methodologies have resulted in a need for standardized applications for specific conditions. Further research is crucial to substantiate its effectiveness and facilitate its integration into clinical care.

## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

## Disclosure

The author declares no conflicts of interest in this work.

## References

1. Liu Y, Ding W, Wang J, et al. Non-coding RNA-mediated modulation of ferroptosis in cardiovascular diseases. *Biomed. Pharmacother.* 2023;164:114993. doi:10.1016/j.biopha.2023.114993
2. Gaidai O, Cao Y, Loginov S. Global cardiovascular diseases death rate prediction. *Curr Prob Cardiol.* 2023;48(5):101622. doi:10.1016/j.cpcardiol.2023.101622

3. Akkaif MA, Chelu MG, Birnbaum Y, et al. The Impact of CYP2C19 Genotype on the Platelet Reactivity Index (PRI) among Chronic Coronary Syndromes (CCS) Patients Undergoing Percutaneous Coronary Intervention (PCI): affectability of Rapid Genetic Testing. *Cardiovasc Drugs Ther.* 2024;38(1):1–10. doi:10.1007/s10557-024-07543-7
4. World Health Organization. Cardiovascular diseases (CVDs). 2022; Available from: [https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)). Accessed July 9, 2024.
5. Akkaif MA, Sha'aban A, Daud NAA, et al. Coronary Heart Disease (CHD) in elderly patients: which drug to choose, ticagrelor and clopidogrel? A systematic review and meta-analysis of randomized controlled trials. *J Cardiovasc Develop Dis.* 2021;8(10):123. doi:10.3390/jcdd8100123
6. Tang Y, Garg H, Geng Y-J, et al. Nitric oxide bioactivity of traditional Chinese medicines used for cardiovascular indications. *Free Radic Biol Med.* 2009;47(6):835–840. doi:10.1016/j.freeradbiomed.2009.06.024
7. Li D-Z, Zhou Y, Yang Y-N, et al. Acupuncture for essential hypertension: a meta-analysis of randomized sham-controlled clinical trials. *Evid Based Complement Alternat Med.* 2014;2014:1–7. doi:10.1155/2014/279478
8. Yang M, Sun M, Du T, et al. The efficacy of acupuncture for stable angina pectoris: a systematic review and meta-analysis. *Euro J Prevent Cardiol.* 2021;28(13):1415–1425. doi:10.1177/2047487319876761
9. Chung JW, Yan V, Zhang H. Effect of acupuncture on heart rate variability: a systematic review. *Evid Based Complement Alternat Med.* 2014;2014:1–19. doi:10.1155/2014/819871
10. Zhang M, Zhu Y, Wang J, et al. Association between acupuncture and grade 1 hypertension: a systematic review and meta-analysis. *Complementary Therapies in Clinical Practice.* 2022;49:101649. doi:10.1016/j.ctcp.2022.101649
11. Huang X, Guo S, Li F, et al. Acupuncture as an adjunctive treatment for angina due to coronary artery disease: a meta-analysis. *Med Sci Monit.* 2019;25:1263. doi:10.12659/MSM.913379
12. Li Y, Song J, Wu B, et al. Acupuncture versus pharmacological conversation in treatment of atrial fibrillation in a randomized controlled trial: a systemic review and meta-analysis. *Eur J Med Res.* 2022;27(1):110. doi:10.1186/s40001-022-00738-4
13. Liang B, Yan C, Zhang L, et al. The effect of acupuncture and moxibustion on heart function in heart failure patients: a systematic review and meta-analysis. *Evid Based Complement Alternat Med.* 2019;2019:6074967. doi:10.1155/2019/6074967
14. de Lima Pimentel R, Duque AP, Moreira BR, et al. Acupuncture for the treatment of cardiovascular diseases: a systematic review. *J Acupunct Merid Stud.* 2019;12(2):43–51. doi:10.1016/j.jams.2018.07.005
15. Chen H. Efficacy and safety of acupuncture for essential hypertension: a meta-analysis. *Med Sci Monit.* 2018;24:2946–2969. doi:10.12659/MSM.909995
16. Zhou M, Bu H, Wang D, et al. An overview of systematic reviews: acupuncture in the treatment of essential hypertension. *Int J Gen Med.* 2022;15:8093–8109. doi:10.2147/IJGM.S387490
17. Zhu F, Yin S, Zheng G, et al. Acupuncture for heart failure: a Bayesian network systematic review and meta-analysis protocol. *Ann Palliat Med.* 2021;10(10):11148–11155. doi:10.21037/apm-21-2131
18. Dan Y. Assessment of acupuncture treatment of hypertension by ambulatory blood pressure monitoring. *Chinese Journal of Integrated Traditional and Western Medicine.* 1998;18(1):26–27.
19. Wu C-X. Scalp acupuncture in treating hypertension in the elderly. *Int J Clin Acupunct.* 1997;8:281–284.
20. Melzack R. Phantom limb pain: implications for treatment of pathologic pain. In: *The Journal of the American Society of Anesthesiologists*. The American Society of Anesthesiologists; 1971.
21. Chang S. Hypertension: a comparative review based on fractal wave theory of continuum. *Adapt Med.* 2011;3(2):91–98.
22. Chang S. The meridian system and mechanism of acupuncture—a comparative review. Part 2: mechanism of acupuncture analgesia. *Taiwanese J Obstetrics Gynecol.* 2013;52(1):14–24. doi:10.1016/j.tjog.2013.01.004
23. Hao P, Jiang F, Cheng J, et al. Traditional Chinese medicine for cardiovascular disease: evidence and potential mechanisms. *Journal of the American College of Cardiology.* 2017;69(24):2952–2966. doi:10.1016/j.jacc.2017.04.041
24. Jiang Y, Zhao Q, Li L, et al. Effect of Traditional Chinese Medicine on the Cardiovascular Diseases. *Front Pharmacol.* 2022;13:806300. doi:10.3389/fphar.2022.806300
25. Yang Y. Effect of traditional Chinese medicine emotional therapy on post-stroke depression: a protocol for systematic review and meta-analysis. *Medicine.* 2021;100(14):2.
26. Zhang X, Shu L, Si C, et al. Dietary patterns and risk of stroke in adults: a systematic review and meta-analysis of prospective cohort studies. *J Stroke Cerebrovascular Dis.* 2015;24(10):2173–2182. doi:10.1016/j.jstrokecerebrovasdis.2015.05.035
27. Sharifi-Rad J, Rodrigues CF, Sharopov F, et al. Diet, lifestyle and cardiovascular diseases: linking pathophysiology to cardioprotective effects of natural bioactive compounds. *Int J Environ Res Public Health.* 2020;17(7):2326. doi:10.3390/ijerph17072326
28. Wang XR, Song -D-D, Tao T-Q, et al. Qi-regulating and blood circulation-promoting therapy improves health status of stable angina pectoris patients with depressive symptoms. *Evid Based Complement Alternat Med.* 2021;2021:7319417. doi:10.1155/2021/7319417
29. Xu J, Wu H. Chinese herbal medicine and acupuncture for the treatment of cardiovascular disease. *J Geriatr Cardiol.* 2009;6:56–61.
30. Layne K, Ferro A. Traditional Chinese medicines in the management of cardiovascular diseases: a comprehensive systematic review. *Br J Clin Pharmacol.* 2017;83(1):20–32. doi:10.1111/bcp.13013
31. Yu E, Malik VS, Hu FB. Cardiovascular disease prevention by diet modification: JACC health promotion series. *J Am Coll Cardiol.* 2018;72(8):914–926. doi:10.1016/j.jacc.2018.02.085
32. Franklin BA, Myers J, Kokkinos P. Importance of lifestyle modification on cardiovascular risk reduction: counseling strategies to maximize patient outcomes. *J Cardiopul Rehabil Prevent.* 2020;40(3):138–143. doi:10.1097/HCR.0000000000000496
33. García-Vera MP, Sanz J, Labrador FJ. Blood pressure variability and stress management training for essential hypertension. *Behav Med.* 2004;30(2):53–64. doi:10.3200/BMED.30.2.53-64
34. Kapke B. Find a Massage Therapist or Bodyworker, in *Massage & Bodywork* magazine. 2003.
35. Wang XQ, Pi Y-L, Chen P-J, et al. Traditional Chinese exercise for cardiovascular diseases: systematic review and meta-analysis of randomized controlled trials. *J Am Heart Assoc.* 2016;5(3):e002562. doi:10.1161/JAHA.115.002562
36. Wang W, Russell A, Yan Y. Traditional Chinese medicine and new concepts of predictive, preventive and personalized medicine in diagnosis and treatment of suboptimal health. *Epm j.* 2014;5(1):4. doi:10.1186/1878-5085-5-4

37. Sun J, Buys N, Shen S. Dietary patterns and cardiovascular disease-related risks in Chinese older adults. *Front Public Health*. 2013;1:48. doi:10.3389/fpubh.2013.00048
38. Shi Z, Ganji V. Dietary patterns and cardiovascular disease risk among Chinese adults: a prospective cohort study. *Eur. J. Clin. Nutr.* 2020;74(12):1725–1735. doi:10.1038/s41430-020-0668-6
39. Liang H, Luo S, Chen X, et al. Effects of Tai Chi exercise on cardiovascular disease risk factors and quality of life in adults with essential hypertension: a meta-analysis. *Heart Lung*. 2020;49(4):353–363. doi:10.1016/j.hrtlng.2020.02.041
40. Schuler G, Adams V, Goto Y. Role of exercise in the prevention of cardiovascular disease: results, mechanisms, and new perspectives. *Eur Heart J*. 2013;34(24):1790–1799. doi:10.1093/eurheartj/ehf111
41. Guo J, Huang W, Tang C-Y, et al. Effect of acupuncture on sleep quality and hyperarousal state in patients with primary insomnia: study protocol for a randomised controlled trial. *BMJ open*. 2016;6(3):e009594. doi:10.1136/bmjopen-2015-009594
42. Zou L, Sasaki JE, Wang H, et al. A systematic review and meta-analysis of baduanjin qigong for health benefits: randomized controlled trials. *Evid Based Complement Alternat Med*. 2017;2017:4548706. doi:10.1155/2017/4548706
43. Gan Z, Zhang D, Huang Z. Study on the design of Traditional Chinese Medicine apoplexy screening and early warning information system. In 2018 3rd International Conference on Advanced Robotics and Mechatronics (ICARM). IEEE; 2018.
44. Xianzhao F. Immune regulation of “nourishing yin and qi, activating blood circulation and detoxifying” in elderly diabetic patients complicated with coronary heart disease. *Science*. 2020;8(6):161–167.
45. Rozanski A, Blumenthal JA, Kaplan J. Impact of psychological factors on the pathogenesis of cardiovascular disease and implications for therapy. *Circulation*. 1999;99(16):2192–2217. doi:10.1161/01.CIR.99.16.2192
46. Watkins LL, Koch GG, Sherwood A, et al. Association of anxiety and depression with all-cause mortality in individuals with coronary heart disease. *J Am Heart Assoc*. 2013;2(2):e000068. doi:10.1161/JAHA.112.000068
47. Hu M-C, Lan K-C, Fang W-C, et al. Automated tongue diagnosis on the smartphone and its applications. *Comput Methods Programs Biomed*. 2019;174:51–64. doi:10.1016/j.cmpb.2017.12.029
48. Liang K, Huang X, Chen H, et al. Tongue diagnosis and treatment in traditional Chinese medicine for severe COVID-19: a case report. *Ann Palliat Med*. 2020;9(4):2400–2407. doi:10.21037/apm-20-1330
49. Huang YS, Wu H-K, Chang -H-H, et al. Exploring the pivotal variables of tongue diagnosis between patients with acute ischemic stroke and health participants. *J Tradit Complement Med*. 2022;12(5):505–510. doi:10.1016/j.jtcm.2022.04.001
50. Hsu P-C, Wu H-K, Huang Y-C, et al. Gender-and age-dependent tongue features in a community-based population. *Medicine*. 2019;98(51):e18350. doi:10.1097/MD.00000000000018350
51. Wang YY, Wang S-H, Jan M-Y, et al. Past, Present, and Future of the Pulse Examination (mài zhěn). *J Tradit Complement Med*. 2012;2(3):164–185. doi:10.1016/S2225-4110(16)30096-7
52. Shuna S, Zhensu S. A new interpretation of TCM pulse diagnosis based on quantum physical model of the human body. *Digit Chin Med*. 2022;5(4):360–366. doi:10.1016/j.dcm.2022.12.009
53. Li F. Application of the HHT & time domain method to the wrist-pulse-signal analysis in patients of coronary heart disease. *Chin J Cardiovasc Rev*. 2008;6(4):244–246.
54. Guo R. Study of traditional Chinese medicine pulse signals in patients with coronary heart disease based on recurrence quantification analysis. *J Chinese Integrative Med*. 2011;9(11):1226–1233. doi:10.3736/jcim20111111
55. Xu W. Objective study for pulse diagnosis of traditional Chinese medicine: pulse signal analysis of patients with coronary heart disease. in 11th IEEE International Conference on Control & Automation (ICCA). IEEE; 2014.
56. Cui J, Song L. Wrist pulse diagnosis of stable coronary heart disease based on acoustics waveforms. *Comput Methods Programs Biomed*. 2022;214:106550. doi:10.1016/j.cmpb.2021.106550
57. Ren Q, Zhou X-W, He M-Y, et al. A quantitative diagnostic method for phlegm and blood stasis syndrome in coronary heart disease using tongue, face, and pulse indexes: an exploratory pilot study. *J Altern Complementary Med*. 2020;26(8):729–737. doi:10.1089/acm.2020.0008
58. O'Brien KA, Abbas E, Zhang J, et al. Understanding the reliability of diagnostic variables in a Chinese medicine examination. *J Altern Complementary Med*. 2009;15(7):727–734. doi:10.1089/acm.2008.0554
59. Walsh S, King E. *Pulse Diagnosis E-Book: A Clinical Guide*. Elsevier Health Sciences; 2007.
60. Wang D, Lu G. Period segmentation for wrist pulse signal based on adaptive cascade thresholding and machine learning. in 2014 International Conference on Medical Biometrics. IEEE; 2014.
61. Tang AC, Chung JW, Wong TK. Validation of a novel traditional Chinese medicine pulse diagnostic model using an artificial neural network. *Evid Based Complement Alternat Med*. 2012;2012:685094. doi:10.1155/2012/685094
62. Guo R, Wang Y, Yan H, et al. Analysis and recognition of traditional Chinese medicine pulse based on the Hilbert-Huang transform and random forest in patients with coronary heart disease. *Evid Based Complement Alternat Med*. 2015;2015:8. doi:10.1155/2015/895749
63. Tang ACY. Review of traditional Chinese medicine pulse diagnosis quantification. *Complement Ther Contem Healthc*. 2012;2:61–80.
64. Dharmananda S. The significance of traditional pulse diagnosis in the modern practice of Chinese medicine; 2004.
65. Chon TY, Lee MC. Acupuncture. In: *Mayo Clinic Proceedings*. Elsevier; 2013.
66. Price KN, Thompson AM, Shi VY. 28 - *Complementary and Alternative Medicine, in a Comprehensive Guide to Hidradenitis Suppurativa*. Shi VY, Editors. Philadelphia: Elsevier; 2022:273–282.
67. Li J, Sun M, Ye J, et al. The mechanism of acupuncture in treating essential hypertension: a narrative review. *Int J Hyperten*. 2019;2019:1–10. doi:10.1155/2019/8676490
68. Zijlstra FJ, van den Berg-de Lange I, Huygen FJPM, et al. Anti-inflammatory actions of acupuncture. *Mediators Inflammation*. 2003;12(2):59–69. doi:10.1080/0962935031000114943
69. Li N. The anti-inflammatory actions and mechanisms of acupuncture from acupoint to target organs via neuro-immune regulation. *J Inflamm Res*. 2021;14:7191. doi:10.2147/JIR.S341581
70. Gomes LR, Leão P. Recent approaches on signal transduction and transmission in acupuncture: a biophysical overview for medical sciences. *J Acupunct Merid Stud*. 2020;13(1):1–11. doi:10.1016/j.jams.2019.11.003
71. Li QQ, Shi G-X, Xu Q, et al. Acupuncture effect and central autonomic regulation. *Evid Based Complement Alternat Med*. 2013;2013:267959. doi:10.1155/2013/267959



72. Patil S. The role of acupuncture in pain management. *Curr Pain Headache Rep.* 2016;20(4):1–8. doi:10.1007/s11916-016-0552-1
73. Li J-L, Wang L-Q, Zhang N, et al. Acupuncture as an adjunctive therapy for arrhythmia: a Delphi expert consensus survey. *Cardiovasc Diagnosis Ther.* 2021;11(5):1067. doi:10.21037/cdt-21-201
74. Fan H. The hypotensive role of acupuncture in hypertension: clinical study and mechanistic study. *Front Aging Neurosci.* 2020;12:138. doi:10.3389/fnagi.2020.00138
75. Zhao H. Efficacy and safety of acupuncture for hypertension: an overview of systematic reviews. *Complement Ther Clin Pract.* 2019;34:185–194. doi:10.1016/j.ctcp.2018.12.003
76. Fei Y, Fei R, Zhang J, et al. Systematic evaluation of efficacy and safety of acupuncture treatment for patients with atrial fibrillation. *Open Access Maced J Med Sci.* 2019;7(3):461. doi:10.3889/oamjms.2019.036
77. Olex S. Cardioversion of atrial fibrillation with acupuncture. *Med Acupuncture.* 2021;33(3):235–239. doi:10.1089/acu.2021.0022
78. Matušková L, Javorka M. Adrenergic receptors gene polymorphisms and autonomic nervous control of heart and vascular tone. *Physiol Res.* 2021;70(Suppl 4):S495.
79. Amiya E, Watanabe M, Komuro I. The relationship between vascular function and the autonomic nervous system. *Ann Vasc Dis.* 2014;7(2):109–119. doi:10.3400/avd.ra.14-00048
80. Li YW, Li W, Wang S-T, et al. The autonomic nervous system: a potential link to the efficacy of acupuncture. *Front Neurosci.* 2022;16:1038945. doi:10.3389/fnins.2022.1038945
81. Alfaddagh A, Martin SS, Leucker TM, et al. Inflammation and cardiovascular disease: from mechanisms to therapeutics. *Am J Prev Cardiol.* 2020;4:100130. doi:10.1016/j.ajpc.2020.100130
82. Sorriento D, Iaccarino G. Inflammation and cardiovascular diseases: the most recent findings. *Int J Mol Sci.* 2019;20(16):3879. doi:10.3390/ijms20163879
83. Wen C-K, Lee T-Y. Electroacupuncture prevents white adipose tissue inflammation through modulation of hypoxia-inducible factors-1 $\alpha$ -dependent pathway in obese mice. *BMC Complement Alter Med.* 2015;15(1):1–8. doi:10.1186/s12906-015-0977-9
84. Greenberg AS, Obin MS. Obesity and the role of adipose tissue in inflammation and metabolism. *The American Journal of Clinical Nutrition.* 2006;83(2):461S–465S. doi:10.1093/ajcn/83.2.461S
85. Liaw JJ, Peplow PV. Differential effect of electroacupuncture on inflammatory adipokines in two rat models of obesity. *J Acupunct Merid Stud.* 2016;9(4):183–190. doi:10.1016/j.jams.2016.02.002
86. Liaw JJ, Peplow PV. Effect of electroacupuncture on inflammation in the obese Zucker fatty rat model of metabolic syndrome. *J Acupunct Merid Stud.* 2016;9(2):73–79. doi:10.1016/j.jams.2015.08.004
87. Galley HF, Webster NR. Physiology of the endothelium. *Br J Anaesth.* 2004;93(1):105–113. doi:10.1093/bja/aeh163
88. Widmer RJ, Lerman A. Endothelial dysfunction and cardiovascular disease. *Glob Cardiol Sci Pract.* 2014;2014(3):291–308. doi:10.5339/gcsp.2014.43
89. Park J-M, Shin A-S, Park S-U, et al. The acute effect of acupuncture on endothelial dysfunction in patients with hypertension: a pilot, randomized, double-blind, placebo-controlled crossover trial. *J Altern Complementary Med.* 2010;16(8):883–888. doi:10.1089/acm.2009.0427
90. Kim JH, Choi KH, Jang YJ, et al. Electroacupuncture acutely improves cerebral blood flow and attenuates moderate ischemic injury via an endothelial mechanism in mice. *PLOS ONE.* 2013;8(2):e56736. doi:10.1371/journal.pone.0056736
91. Tsuchiya M, Sato EF, Inoue M, et al. Acupuncture enhances generation of nitric oxide and increases local circulation. *Anesthesia Analg.* 2007;104(2):301–307. doi:10.1213/01.ane.0000230622.16367.fb
92. Fu S-P, He S-Y, Xu B, et al. Acupuncture promotes angiogenesis after myocardial ischemia through H3K9 acetylation regulation at VEGF gene. *PLOS ONE.* 2014;9(4):e94604. doi:10.1371/journal.pone.0094604
93. Ma SX. Nitric oxide on pathophysiology of SARS-CoV 19: toward possible role of acupuncture treatment. *Int J Biomed Sci.* 2021;17(4):40–45. doi:10.59566/IJBS.2021.17040
94. Raddino R. Nitric oxide and cardiovascular risk factors. *Heart Int.* 2007;3(1):18. doi:10.1177/1826186807003001-203
95. Dos Santos Baião D, Margaret Flosi Paschoalin V, Margaret Flosi Paschoalin V. A narrative review on dietary strategies to provide nitric oxide as a non-drug cardiovascular disease therapy: beetroot formulations—A smart nutritional intervention. *Foods.* 2021;10(4):859. doi:10.3390/foods10040859
96. Sharifi-Rad M, Revell VL, Cook TJ, et al. Lifestyle, oxidative stress, and antioxidants: back and forth in the pathophysiology of chronic diseases. *Front Physiol.* 2020;11:11. doi:10.3389/fphys.2020.00011
97. Zhao Y, Zhou B, Zhang G, et al. The effect of acupuncture on oxidative stress: a systematic review and meta-analysis of animal models. *PLoS One.* 2022;17(9):e0271098. doi:10.1371/journal.pone.0271098
98. Dhalla NS, Temsah RM, Netticadan T. Role of oxidative stress in cardiovascular diseases. *J Hyper.* 2000;18(6):655–673. doi:10.1097/00004872-200018060-00002
99. Dubois-Deruy E, Peugnet V, Turkieh A, et al. Oxidative Stress in Cardiovascular Diseases. *Antioxidants.* 2020;9(9):864. doi:10.3390/antiox9090864
100. Senoner T, Dichtl W. Oxidative stress in cardiovascular diseases: still a therapeutic target? *Nutrients.* 2019;11(9):2090. doi:10.3390/nu11092090
101. Su X-T, Wang L, Ma S-M, et al. Mechanisms of acupuncture in the regulation of oxidative stress in treating ischemic stroke. *Oxid Med Cell Longev.* 2020;2020:7875396. doi:10.1155/2020/7875396
102. Yu Y-P, Ju W-P, Li Z-G, et al. Acupuncture inhibits oxidative stress and rotational behavior in 6-hydroxydopamine lesioned rat. *Brain Res.* 2010;1336:58–65. doi:10.1016/j.brainres.2010.04.020
103. Yilmaz S, Kaya E, Yilmaz E, Kavakli A, Gurbuz S, Ozkaraca M. Effect of acupuncture therapy on fracture healing in rats with femur fractures. *J Traditional Chin Med.* 2020;40(2):275–283.
104. Teleanu RI, Niculescu A-G, Roza E, et al. Neurotransmitters-key factors in neurological and neurodegenerative disorders of the central nervous system. *Int J Mol Sci.* 2022;23(11):5954. doi:10.3390/ijms23115954
105. Gordan R, Gwathmey JK, Xie LH. Autonomic and endocrine control of cardiovascular function. *World J Cardiol.* 2015;7(4):204–214. doi:10.4330/wjc.v7.i4.204
106. Li P, Longhurst JC. Neural mechanism of electroacupuncture's hypotensive effects. *Auton Neurosci.* 2010;157(1–2):24–30. doi:10.1016/j.autneu.2010.03.015



107. Zhou W, Longhurst JC. Neuroendocrine mechanisms of acupuncture in the treatment of hypertension. *Evid Based Complement Alternat Med*. 2012;2012:1–9. doi:10.1155/2012/878673
108. Zhang R, Lao L, Ren K, et al. Mechanisms of acupuncture–electroacupuncture on persistent pain. *Anesthesiology*. 2014;120(2):482–503. doi:10.1097/ALN.0000000000000101
109. Cui J, Song W, Jin Y, et al. Research progress on the mechanism of the acupuncture regulating neuro-endocrine-immune network system. *Vet Sci*. 2021;8(8). doi:10.3390/vetsci8080149
110. Passatore M, Roatta S. Influence of sympathetic nervous system on sensorimotor function: whiplash associated disorders (WAD) as a model. *Eur J Appl Physiol*. 2006;98(5):423–449. doi:10.1007/s00421-006-0312-8
111. Asgari MR, Mosaviinejad SS, Ebrahimi A, et al. The effects of acupressure on the symptoms severity and function status and electro-diagnostic findings in patients with carpal tunnel syndrome. *Complementary Ther Med*. 2020;51:102420. doi:10.1016/j.ctim.2020.102420
112. Yang J, Jiang Y, Chen Y, et al. Acupressure the PC6 point for alleviating postoperative nausea and vomiting: a systematic review protocol. *Medicine*. 2019;98(33):e16857. doi:10.1097/MD.00000000000016857
113. Li P, Tjen-A-Looi SC, Cheng L, et al. CME Article: long-lasting reduction of blood pressure by electroacupuncture in patients with hypertension: randomized controlled trial. *Med Acupunct*. 2015;27(4):253–266. doi:10.1089/acu.2015.1106
114. Chang YC, Chen C-M, Lay I-S, et al. The dosage effect of laser acupuncture at pc6 (Neiguan) on heart rate variability: a pilot study. *Life*. 2022;12(12):1951. doi:10.3390/life12121951
115. Fan H, Rivas-Santisteban R, Reyes-Resina I, et al. The Hypotensive role of acupuncture in hypertension: clinical study and mechanistic study. *Front Aging Neurosci*. 2020;12:12. doi:10.3389/fnagi.2020.00012
116. Geng W-Y, Liu Z-B, Song -N-N, et al. Effects of electroacupuncture at Zusanli (ST36) on inflammatory cytokines in a rat model of smoke-induced chronic obstructive pulmonary disease. *J Integr Med*. 2013;11(3):213–219. doi:10.3736/jintegrmed2013024
117. Feng Y, Fang Y, Wang Y, et al. Acupoint therapy on diabetes mellitus and its common chronic complications: a review of its mechanisms. *Biomed Res Int*. 2018;2018:1–9. doi:10.1155/2018/3128378
118. Song Q, Hu S, Wang H, et al. Electroacupuncture at Zusanli point (ST36) attenuates pro-inflammatory cytokine release and organ dysfunction by activating cholinergic anti-inflammatory pathway in rat with endotoxin challenge. *Afr J Traditional, Complementary Altern Med*. 2014;11(2):469–474. doi:10.4314/ajtcam.v11i2.35
119. Oh JE, Kim SN. Anti-inflammatory effects of acupuncture at ST36 point: a literature review in animal studies. *Front Immunol*. 2021;12:813748. doi:10.3389/fimmu.2021.813748
120. Sun ZG, Pi Y-L, Zhang J, et al. Effect of acupuncture at ST36 on motor cortical excitation and inhibition. *Brain Behav*. 2019;9(9):e01370. doi:10.1002/brb3.1370
121. Michikami D, Kamiya A, Kawada T, et al. Short-term electroacupuncture at Zusanli resets the arterial baroreflex neural arc toward lower sympathetic nerve activity. *Am J Physiol Heart Circ Physiol*. 2006;291(1):H318–H326. doi:10.1152/ajpheart.00975.2005
122. Yang Y. Heart rate variability during acupuncture treatment of lumbosacral pain. *OBM Integrat Compl Med*. 2020;5(1):1–13.
123. Huang C. Immediately decreased effect of blood pressure by acupuncture on essential hypertension. *J Integrat Chin Western Med*. 2004;6(1):29–40.
124. Wang J, Tang C-Z, He Z-Q, et al. Effect of moderate acupuncture-stimulation of “Taichong” (LR 3) on blood pressure and plasma endothelin-1 levels in spontaneous hypertension rats. *Acupunct Res*. 2011;36(1):36–39.
125. Liu W, Gong C. Acupuncture for Hypertension. *Int J Clin Acupunct*. 2016;25(2):2.
126. Lin G-H, Chang W-C, Chen K-J, et al. Effectiveness of acupressure on the Taichong acupoint in lowering blood pressure in patients with hypertension: a randomized clinical trial. *Evid Based Complement Alternat Med*. 2016;2016:1–9. doi:10.1155/2016/1549658
127. Umemoto K, Naito M, Tano K, et al. Acupuncture point “hegu” (LI4) is close to the vascular branch from the superficial branch of the radial nerve. *Evid Based Complement Alternat Med*. 2019;2019:6879076. doi:10.1155/2019/6879076
128. Zhou W, Benharash P. Effects and mechanisms of acupuncture based on the principle of meridians. *J Acupunct Merid Stud*. 2014;7(4):190–193. doi:10.1016/j.jams.2014.02.007
129. Ernst M, Lee MH. Sympathetic vasomotor changes induced by manual and electrical acupuncture of the Hoku point visualized by thermography. *Pain*. 1985;21(1):25–33. doi:10.1016/0304-3959(85)90073-9
130. Omole FS, Lin JS, Chu T, et al. Raynaud’s phenomenon, cytokines and acupuncture: a case report. *Acupuncture Med*. 2012;30(2):139–141. doi:10.1136/acupmed-2011-010107
131. Wang J-S. Acupuncture on treating angina pectoris: a systematic review. *Medicine*. 2020;99(2):1.
132. Tu M, Jiang Y, Yu J, et al. Acupuncture for treating chronic stable angina pectoris associated anxiety and depression: a systematic review and meta-analysis. *Complement Ther Clin Pract*. 2021;45:101484. doi:10.1016/j.ctcp.2021.101484
133. World Health Organization. *Acupuncture: Review and Analysis of Reports on Controlled Clinical Trials*. World Health Organization; 2002.
134. Zhao L, Li D, Zheng H, et al. Acupuncture as adjunctive therapy for chronic stable angina: a randomized clinical trial. *JAMA Intern Med*. 2019;179(10):1388–1397. doi:10.1001/jamainternmed.2019.2407
135. Yu C, Ji K, Cao H, et al. Effectiveness of acupuncture for angina pectoris: a systematic review of randomized controlled trials. *BMC Complement Altern Med*. 2015;15(1):90. doi:10.1186/s12906-015-0586-7
136. Hao -P-P, Jiang F, Chen Y-G, et al. Traditional Chinese medication for cardiovascular disease. *Nat Rev Cardiol*. 2015;12(2):115–122. doi:10.1038/nrcardio.2014.177
137. Xu L, Xu H, Gao W, et al. Treating angina pectoris by acupuncture therapy. *Acupunct Electro Ther Res*. 2013;38(1–2):17–35. doi:10.3727/036012913X13831831849457
138. Cai Y, Zhang CS, Liu S, et al. Acupuncture for premature ventricular complexes without ischemic or structural heart diseases: a systematic review and meta-analysis of clinical and pre-clinical evidence. *Front Med*. 2022;9:1019051. doi:10.3389/fmed.2022.1019051
139. Liu Y, Park J-E, Shin K-M, et al. Acupuncture lowers blood pressure in mild hypertension patients: a randomized, controlled, assessor-blinded pilot trial. *Complementary Ther Med*. 2015;23(5):658–665. doi:10.1016/j.ctim.2015.06.014
140. Kim H-M, Cho S-Y, Park S-U, et al. Can acupuncture affect the circadian rhythm of blood pressure? A randomized, double-blind, controlled trial. *J Altern Complementary Med*. 2012;18(10):918–923. doi:10.1089/acm.2011.0508

141. Yin C, Seo B, Park H-J, et al. Acupuncture, a promising adjunctive therapy for essential hypertension: a double-blind, randomized, controlled trial. *Neurological Res.* **2007**;29(sup1):98–103. doi:10.1179/016164107X172220
142. Li P, Pitsillides KF, Rendig SV, et al. Reversal of reflex-induced myocardial ischemia by median nerve stimulation: a feline model of electroacupuncture. *Circulation.* **1998**;97(12):1186–1194. doi:10.1161/01.CIR.97.12.1186
143. Tjen-A-Looi SC, Li P, Longhurst JC. Role of medullary GABA, opioids, and nociceptin in prolonged inhibition of cardiovascular sympathoexcitatory reflexes during electroacupuncture in cats. *Am J Physiol Heart Circ Physiol.* **2007**;293(6):H3627–H3635. doi:10.1152/ajpheart.00842.2007
144. Liu Q. Effects of acupuncture on hemorheology, blood lipid content and nail fold microcirculation in multiple infarct dementia patients. *J Trad Chin Med.* **2004**;24(3):219–223.
145. Chang S. The Meridian system and mechanism of acupuncture: a comparative review. Part 3: mechanisms of acupuncture therapies. *Taiwanese J Obstetrics Gynecol.* **2013**;52(2):171–184. doi:10.1016/j.tjog.2013.04.005
146. Zhao X-F. Is acupuncture effective for hypertension? A systematic review and meta-analysis. *PLoS One.* **2015**;10(7):e0127019. doi:10.1371/journal.pone.0127019
147. Liu F-G. Efficacy and safety of scalp acupuncture for insomnia: a systematic review and meta-analysis. *Evid Based Complement Alternat Med.* **2021**;2021:1.
148. Ning S, Yan L, Li Y, et al. Efficacy of acupuncture combined with oral Chinese medicine in the treatment of arrhythmia: a meta-analysis. *Medicine.* **2023**;102(12):e33174. doi:10.1097/MD.00000000000033174
149. Kristen AV, Schuhmacher B, Strych K, et al. Acupuncture improves exercise tolerance of patients with heart failure: a placebo-controlled pilot study. *Heart.* **2010**;96(17):1396–1400. doi:10.1136/hrt.2009.187930
150. Middlekauff HR, Hui K, Yu JL, et al. Acupuncture inhibits sympathetic activation during mental stress in advanced heart failure patients. *J Card Fail.* **2002**;8(6):399–406. doi:10.1054/jcaf.2002.129656
151. Liu D. Curative observation of adopting high frequency electro-acupuncture at Neiguan to treat heart failure complicated by acute myocardial infarction. *J Sichuan Tradit Chin Med.* **2014**;32:146–148.
152. Li Z, Lao M, Pan Q. Effect of acupuncture on Hemodynamics and cardiac function in patients with chronic heart failure. *Shanghai J Acu-Mox.* **2012**;31:480–482.
153. Qu X, Yang K, Shen Y. Effects of acupuncture about heart rate variability on chronic heart failure patients. *Shaanxi J Tradit Chin Med.* **2015**;36:912–914.
154. Lee H, Kim T-H, Leem J. Acupuncture for heart failure: a systematic review of clinical studies. *Int J Cardiol.* **2016**;222:321–331. doi:10.1016/j.ijcard.2016.07.195

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