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Research Progress on Acupuncture Treatment for Primary Hypertension

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Abstract: ***Primary hypertension is one of the risk factors for cardiovascular disease, and current treatment methods have certain side effects, so there is an urgent need for a new and effective alternative therapy. Acupuncture, as a relatively fluid therapy, has a good antihypertensive effect and is popular among patients with primary hypertension. The latest research shows that acupuncture exerts its antihypertensive effect through multiple regulatory effects. Therefore, while briefly describing the treatment methods related to acupuncture for primary hypertension, this review summarizes the specific mechanism of action of acupuncture in treating primary hypertension, in order to provide new ideas for the clinical application of acupuncture in treating primary hypertension.***

Keywords: Acupuncture, Primary hypertension, Mechanism of action, Review.

1. Introduction

Primary hypertension also known as hypertensive disease, accounts for up to 90% of patients with high blood pressure and is one of the most common cardiovascular diseases in clinical practice. This condition is mainly manifested by abnormally elevated systemic arterial pressure and may be accompanied by various cardiovascular risk factors or not, thereby forming a syndrome, and it is one of the important factors leading to death in patients with cardiovascular diseases [1]. The latest epidemiological survey results indicate that among the population aged 18 and above in our country, the prevalence of hypertension is 46.9%, the treatment rate is 40.7%, and the control rate is 15.3% [2]. According to relevant statistics from the U.S. National Institutes of Health (NIH), the global prevalence of hypertension ranges from 14.7% to 20.8%, and China has already become one of the countries with the highest incidence of hypertension in the world. Given that the number of patients with essential hypertension in our country is increasing year by year, the resulting economic burden is extremely heavy. Therefore, the clinical treatment of essential hypertension still faces great challenges and a long road ahead.

Currently, in the clinical treatment process for hypertension, blood pressure regulation is mainly achieved with antihypertensive drugs. Although these drugs can effectively lower blood pressure, they face numerous challenging clinical situations. Specifically, issues related to drug side effects are quite prominent, some patients have poor adherence to medication treatment, and there are also some cases of resistant hypertension that are difficult to manage properly. In light of the above circumstances, the medical field urgently needs to find an alternative or adjunctive therapy that is both safe and effective, and can complement existing treatment methods. This research direction is of crucial significance for improving the clinical treatment of hypertension and enhancing patient outcomes, and has already become a key focus of current medical research.

Acupuncture, as a key component of traditional Chinese medicine, demonstrates unique advantages in the prevention and treatment of hypertension due to its holistic regulatory approach and multi-target synergistic interventions. This therapy is firmly based on the theory of meridians in traditional Chinese medicine. By needling acupoints, it can help to unblock the flow of Qi and blood through the meridians, harmonize the yin and yang of the internal organs, and thereby promote the body to restore a healthy state of yin-yang balance. In recent years, numerous clinical and basic research studies have achieved remarkable results. These studies not only provide solid evidence confirming the definite efficacy of acupuncture in lowering blood pressure but also initially explore the specific mechanisms through which it exerts its antihypertensive effects, namely by regulating autonomic nervous system functions and improving vascular endothelial cell function through various pathways. This review aims to comprehensively and systematically summarize the clinical research progress of acupuncture therapy in the treatment of primary hypertension in recent years, and to explore its intrinsic mechanisms in depth. It is intended to provide a valuable theoretical basis for the widespread promotion and application of acupuncture therapy in clinical practice, as well as for more in-depth scientific research in the future.

2. Traditional Chinese Medicine's Understanding of Primary Hypertension and the Theoretical Basis of Acupuncture Treatment

2.1 The Traditional Chinese Medicine Name, Causes, and Pathogenesis of Primary Hypertension

Ancient traditional Chinese medical literature does not explicitly mention the term "essential hypertension", but the symptoms and signs of this condition were described early on, and contemporary physicians categorize it under the terms "dizziness" and "headache". The earliest descriptions in ancient texts can be traced back to the Yellow Emperor's Internal Classic. In Lingshu · Hailun, it is stated: "If the sea of marrow is insufficient, the brain turns and ears ring, the legs ache and there is dizziness and dizziness, and the eyes cannot see; one feels lethargic and prefers to lie down." This

introduced the term ‘dizziness and vertigo’ as a disease name, believing that the condition is often due to a deficiency of the sea of marrow, with clinical manifestations including dizziness, tinnitus, soreness of the waist and knees, blurred vision, fatigue, and lack of strength.

The etiology and pathogenesis of primary hypertension are extremely complex. The main causes include emotional disturbances, insufficient congenital endowment, excessive work or leisure, and irregular diet, which disrupt the balance of Qi, blood, yin, and yang in the body, interfere with the normal circulation and metabolism of body fluids, and subsequently lead to the generation of pathological factors such as wind, phlegm, fire, and blood stasis. From the perspective of the affected organs, primary hypertension mainly involves the heart, liver, spleen, and kidneys. Its symptoms can be categorized into two dimensions: deficiency and excess. Deficiency syndromes are mostly caused by insufficiency of qi, blood, yin, and yang, specifically including types such as liver and kidney yang deficiency, liver and kidney yin deficiency, and heart and spleen deficiency. Excess syndromes are primarily due to pathological factors such as wind, fire, phlegm, and blood stasis. In clinical practice, deficiency and excess syndromes often do not appear in isolation but rather coexist and contribute to the disease together. Expert Consensus on Traditional Chinese Medicine Diagnosis and Treatment of Hypertension (2019 Edition) [3] is specifically divided into four main syndrome types: liver-yang rising, phlegm-fluid retention, kidney-yin deficiency, and internal blood stasis, providing an important reference for clinical diagnosis and treatment.

2.2 Acupuncture Treatment Principles and Commonly Selected Points for Primary Hypertension

The principles of acupuncture treatment for patients with primary hypertension are to calm the liver and subdue yang, nourish the liver and kidneys, resolve phlegm and remove blood stasis, and regulate qi and blood. Currently, a large number of studies have been conducted on acupuncture point selection for primary hypertension, and it has been found that acupoints on the Hand Yangming Large Intestine Meridian, the Foot Yangming Stomach Meridian, and the Foot Jueyin Liver Meridian are commonly used. The Yangming meridian is rich in both qi and blood, and acupuncture can enhance the circulation of qi and blood [4]. The Foot Jueyin Liver Meridian ascends to the top of the head, and acupuncture can improve symptoms such as dizziness and a heavy-headed feeling in patients. Using the Yangming and Jueyin meridians together can regulate the imbalance of yin and yang in patients with primary hypertension. For excess patterns, LR3, LI11, ST36, ST9, and LI4 are used together to clear liver fire and guide the blood downward; for deficiency patterns, GV20, SP6, GB20, and KI3 are combined to nourish the kidney and liver, guiding the fire back to the source.

3. Acupuncture Treatment for Primary Hypertension

Acupuncture is one of the most widely used forms of non-pharmacological treatment. According to the latest clinical research, acupuncture has shown good effectiveness in lowering blood pressure, which has led to increasing attention to its use and combined applications. The study found that after acupuncture treatment, 24-hour systolic and diastolic blood pressure in patients with mild hypertension decreased (from 145.10±9.28 mmHg to 140.70±9.59 mmHg ($P<0.0001$) and from 88.35±7.92 mmHg to 85.86±7.95 mmHg ($P=0.0024$), respectively), and the circadian blood pressure rhythm improved [5].

3.1 Simple Acupuncture

Simple acupuncture treatment is one of the traditional Chinese medicine therapies and has a good effect on improving patients’ clinical symptoms and lowering their blood pressure. Currently, the commonly used acupuncture points for treating primary hypertension are: BL18, KI1, GB20, BL15, ST36, GV20, Blood Pressure Point, PC6, and LV3. These points have the effects of calming the liver and subduing Yang, soothing the liver and clearing heat, benefiting the head and eyes, nourishing Yin and strengthening the kidneys, and raising Yang to augment Qi. They work by reducing peripheral resistance, improving cardiac function, and increasing cardiac output, thereby lowering peripheral resistance and ultimately reducing blood pressure. For patients with primary hypertension of the phlegm-damp obstruction type, Sun et al. [6] applied acupuncture to bilateral ST40 and ST37 points in patients with primary hypertension of the phlegm dampness obstructing type, which can effectively improve clinical symptoms such as dizziness, a heavy head feeling, and abdominal distension and discomfort. Chen et al. [7] also treated primary hypertension patients based on syndrome differentiation, primarily using the acupoints GB20, LI11, KI3, LR3, and SP6. After treatment, they found that both the antihypertensive and symptomatic effects in the acupuncture group were superior to those in the Western medicine group, and the adverse reactions in the acupuncture group were also lower than those in the Western medicine group.

3.2 Electroacupuncture

Electric currents of different intensities also have a certain effect on the expression of tissue-related factors in vascular endothelial cells. Studies have shown [8] that low-frequency, low-intensity electroacupuncture can reduce sympathetic nervous activity in about 70% of hypertensive patients, thereby helping to maintain the blood pressure reduction achieved after discontinuation of medication in patients with mild to moderate essential hypertension. Electroacupuncture at the ST9 acupoint can reduce the protein and mRNA expression of AT1R in the medulla within the renin-angiotensin-aldosterone system, as well as the level of angiotensin II (AngII) in serum, achieving a better blood pressure-lowering effect than simple acupuncture at the ST9 acupoint [9]. Chen et al. [10] applied electroacupuncture stimulation to the ST36 and LI11 points in spontaneously hypertensive rats, finding a significant blood pressure-lowering effect. It was also discovered that electroacupuncture can improve kidney function and regulate the renin-angiotensin system. In addition, studies have shown that while lowering blood pressure, electroacupuncture can also effectively improve insulin resistance and reduce blood lipids [11].

3.3 Combination of Acupuncture and Medication

It mainly includes the combined application of acupuncture and western medicine, as well as the combined application of acupuncture and traditional Chinese medicine. Researchers' studies on the combination of acupuncture and western medicine mainly focus on patients with refractory hypertension. Shen et al. [12] added acupuncture treatment focusing on the ST9 acupoint to the oral antihypertensive medication for patients with refractory hypertension. 24-hour ambulatory blood pressure monitoring was performed before and after treatment. After 90 days of treatment, the blood pressure of the patients decreased, with a total effective rate of 83.71%. This suggests that the prescription combining acupuncture at ST9 acupoints with medication has significant efficacy in treating refractory hypertension. Jing et al. [13] applied the acupuncture technique of "regulating qihai, adjusting blood pressure", selecting LI11, LI4, ST9, ST36, and LR3 points in combination with antihypertensive medication to treat patients with liver-fire hyperactivity type hypertension. The results showed a significant decrease in blood pressure values, and the dosage of antihypertensive medication could be reduced. Han et al. [14] conducted a meta-analysis on 7 randomized controlled trials involving 722 patients with hypertension. The results showed that acupuncture and moxibustion combined with Tianma Gouteng Yin had an advantage in treating hypertension, significantly improving the clinical efficacy rate.

3.4 Acupuncture Combined with Behavioral Therapy

For patients with grade 1 hypertension, as they have not yet experienced damage to important organs and have relatively few risk factors, behavioral therapy can be implemented to guide patients to improve their lifestyle and eliminate behaviors and habits that are detrimental to their psychological and physical health, in order to reduce the risk of primary hypertension and other cardiovascular diseases. In related studies, Sun Jian et al. [15] randomly divided mild primary hypertension patients with liver yang hyperactivity into an acupuncture treatment combined with lifestyle adjustment group and a simple lifestyle adjustment group for treatment. After treatment, it was found that the total effective rate of the acupuncture treatment combined with lifestyle adjustment group reached 93.18%, and the performance of this group in traditional Chinese medicine syndrome efficacy was significantly better than that of the simple lifestyle adjustment group.

4. The modern mechanism of Acupuncture for Lowering Blood Pressure

4.1 Regulating the Central Nervous System

The hypothalamus is an important part of the central nervous system and medulla oblongata, which can regulate blood pressure through various pathways [16]. The paraventricular nucleus (PVN) and arcuate nucleus (ARC) of the hypothalamus play important roles in regulating cardiovascular function [17]. The rostral ventrolateral medulla (RVLM) plays a central role in maintaining normal blood pressure. ARC can secrete glutamate, acetylcholine, and other neurotransmitters, and ARC is rich in beta endorphinergic neurons [18-19]. Research has found that β - endorphins may be involved in the inhibitory process of electroacupuncture on cardiovascular excitatory response in arcuate neurons [20]. In addition, the activation of ARC also regulates PVN opioid receptors and reduces the activity of RVLM. Electroacupuncture reduces the activity of RVLM by lowering the opioid mechanism rich in endorphinergic fibers and μ- opioid receptors in PVN, thereby long-term inhibiting cardiovascular reflex response [21]. The inhibition of neuronal function in RVLM can directly lead to a significant decrease in blood pressure, highlighting its key role in blood pressure regulation. Cheng et al. [22] found that electroacupuncture at ST36, ST37, PC5, and PC6 could activate neurons in ARC, the ventrolateral gray matter surrounding the midbrain aqueduct, and the raphe nucleus of the medulla oblongata, while inhibiting the activity of pre motor sympathetic neurons in the RVLM to lower blood pressure. Furthermore, further research has shown that opioid drugs and gamma aminobutyric acid (GABA) in RVLM are specific neurotransmitters that regulate cardiovascular function; Glutamate, opioid drugs, GABA, and endogenous cannabinoids in the medulla oblongata also participate in the anti hypertensive response of electroacupuncture [5]. Other studies have pointed out that the complex interaction between the autonomic nerve center of the brain stem and anti opiates and other chemical mediators determines the degree of influence of acupuncture and moxibustion on blood pressure [23]. Therefore, acupuncture and moxibustion therapy plays an antihypertensive role by activating PVN and ARC, and jointly inhibiting RVLM activity. This mechanism provides a theoretical basis of neurobiology for the treatment of hypertension by acupuncture and moxibustion.

4.2 Improve Endothelial Function of Blood Vessels

Research has found that endothelial dependent diastolic vascular damage in animal models of hypertension suggests that endothelial dysfunction may be one of the causes of hypertension [24]. The dynamic balance of nitric oxide (NO) and endothelin (ET) produced by endothelial cells is crucial for maintaining normal vascular tension. If the dynamic balance of NO and ET is disrupted, it can lead to vascular tension disorder and elevated blood pressure [25]. Acupuncture and moxibustion can improve endothelial dysfunction and vasodilation function, and effectively control blood pressure. Animal studies show that acupuncture and moxibustion can reduce blood pressure and vascular resistance by reducing ET-1 and increasing NO [26]. Kim et al. [27] treated ST36 with electroacupuncture, and found that the expression of endothelial nitric oxide synthase (eNOS), neuronal nitric oxide synthase (nNOS) and the production of NO were increased, and confirmed that the activation of nitric oxide synthase (NOS) may be one of the mechanisms of acupuncture and moxibustion to reduce blood pressure. It has also been found that acupuncture and moxibustion can regulate the NOS function of vascular endothelial cells, promote the production of NO, and reduce vascular resistance [28].

4.3 Regulating the Renin Angiotensin Aldosterone System (RAAS)

The renin angiotensin aldosterone system (RAAS) is involved

in regulating blood pressure homeostasis, vascular injury, and repair response, and is associated with inflammation, fibrosis, and target organ damage. Acupuncture and moxibustion reduces blood pressure by reducing renin secretion and activity, which proves that part of the hypotensive effect is due to the reduction of renin secretion [29-30]. AngII increases blood pressure by constricting blood vessels, which is catalyzed by renin and angiotensin in the converting enzyme (ACE). Numerous studies have found that acupuncture lowers blood pressure by reducing the levels of ACE and AngII receptors (AT1R, AT2R), thereby lowering AngII levels [31-32]. AngII can also promote the secretion of aldosterone to regulate blood volume. For example, acupuncture can reduce renin activity and the concentrations of angiotensin and aldosterone in patients with primary hypertension, thereby lowering blood pressure [5]. And Hao et al. [33] also found that electroacupuncture can reduce the levels of AngII and aldosterone in the plasma of hypertensive rats in ST9 and LI11, alleviate vascular remodeling, and thus lower blood pressure.

4.4 Antioxidant Stress Response

Waziri et al. [34] reported that oxidative stress caused by depletion of glutathione (GSH) resulted in a significant increase in blood pressure. Conversely, antioxidant therapy can lower elevated blood pressure, but has no effect on the blood pressure of healthy rats; this proves that oxidative stress is considered a mechanism of hypertension. NADPH oxidase homologs (NOX) are key enzymes in oxidative stress response and the main source of reactive oxygen species (ROS). Acupuncture regulates NOX activity, improves antioxidant capacity, and thus exerts a blood pressure lowering effect [35-36]. Liu et al. [37] found that needling ST9 can reduce NOX and inhibit oxidative stress. A meta-analysis study showed that acupuncture can increase the activity of superoxide dismutase (SOD) through the Nrf2/HO-1 pathway, improve oxidative stress, inhibit ROS generation, reduce inflammatory cell infiltration, and alleviate tissue damage and functional impairment caused by inflammation [38].

4.5 The Impact on Inflammatory Factors

Inflammation is involved in the pathogenesis of hypertension and interacts with it. C-reactive protein (CRP) is a biomarker of inflammation and is believed to be closely associated with the occurrence and progression of hypertension [39]. Research has found that CRP can reduce the production of NO by endothelial cells, upregulate the expression of AT1R, and downregulate the expression of AT2R, thereby affecting RAAS and leading to hypertension [5]. Moreover, CRP can also induce the expression of adhesion molecules in endothelial cells, increasing the production of inflammatory responses. Cottone et al. [40] found that patients with primary hypertension have higher levels of CRP, intercellular adhesion molecule-1 (ICAM-1), vascular adhesion molecule-1 (VCAM-1), and tumor necrosis factor alpha (TNF-α). Acupuncture reduces the release of inflammatory factors and lowers the inflammatory response, thereby lowering blood pressure.

5. Summary and Prospect

Acupuncture exerts its antihypertensive effect through multiple targeted pathways such as regulating the central nervous system, endothelial function, anti-inflammatory, oxidative stress, and renin angiotensin aldosterone system, demonstrating its overall regulatory advantages. At present, relevant clinical studies, especially multiple high-quality randomized controlled trials and meta-analyses, have preliminarily confirmed the effectiveness and safety of acupuncture as an independent or adjuvant therapy in reducing blood pressure, improving clinical symptoms, and enhancing quality of life. The selection of acupoints in the treatment plan is mainly based on the liver meridian, kidney meridian, and Yangming meridian acupoints, emphasizing the combination of syndrome differentiation and disease differentiation. In the future, we should focus on conducting randomized controlled trials with more rigorous designs, multiple centers, and large sample sizes, and attach importance to long-term efficacy evaluation; actively utilizing modern scientific technologies such as neuroimaging, genomics, proteomics, etc., to deeply reveal the essence of acupuncture from a systems biology perspective. At the same time, we will strengthen the application of data mining and artificial intelligence technology, optimize and verify the acupuncture treatment plans for different syndromes of hypertension based on large-scale clinical data, and promote the accuracy and standardization of acupuncture and moxibustion. Finally, explore the path of effectively integrating acupuncture into the management system of hypertension and chronic diseases, in order to fully leverage its advantages of simplicity, convenience, effectiveness, and affordability. In summary, acupuncture treatment for primary hypertension has shown broad application prospects, and its multi-target and holistic regulatory characteristics are in line with modern hypertension prevention and treatment concepts. Despite facing challenges, with the continuous innovation of research methods and the accumulation of evidence, acupuncture is expected to play a more important role in the comprehensive prevention and treatment system of primary hypertension.

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