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Acupuncture in the Treatment of Resistant Hypertension: A Narrative Review of Efficacy and Safety

Yanasta Yudo Pratama[1]*, Vica Hilda Amelia[2], Muhammad Hamza Mubarak[2], Muhammad Luthfi Adnan[3]
[1] Universitas Negeri Yogyakarta, Yogyakarta, Indonesia
[2] Universitas Islam Indonesia, Yogyakarta, Indonesia
[3] Nusa Medika Clinic, Indonesia

*Correspondence Address: yanastayudopratama@uny.ac.id

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ABSTRACT

Resistant hypertension (RH) is a critical concern due to persistent uncontrolled blood pressure despite multiple medications, and its association with severe cardiovascular and renal complications. This narrative review aims to critically analyze existing research on acupuncture as an adjunctive treatment for RH, synthesizing evidence on its mechanisms and effects on clinical outcomes like blood pressure control and quality of life. A literature search was conducted from April to May 2025 across Google Scholar, PubMed, and ScienceDirect, using variations of keywords combination: resistant hypertension, acupuncture, electro-acupuncture, management, antihypertension, blood pressure. We found there is limited evidence for acupuncture application for RH management, even application for hypertension has been widely studied. Acupuncture is safety for hypertension management and has limited adverse event. In conclusion, acupuncture is a promising, generally safe complementary treatment for resistant hypertension, offering benefits beyond blood pressure reduction and improving quality of life, particularly for patients facing medication challenges. However, further rigorous, standardized research is needed to fully establish its role alongside conventional therapies.

INTRODUCTION

Resistant hypertension (RH) refers to a condition where blood pressure remains uncontrolled despite the use of three different classes of antihypertensive drugs, one of which is a diuretic, or when four or more medications are required to achieve adequate control (Carey et al., 2018). This condition is linked to a higher incidence of cardiovascular complications, kidney impairment, and increased mortality, making it a critical concern in clinical practice (Zoccali et al., 2024). As many as 10 – 20% of the hypertensive population develops RH, but the true prevalence of RH cannot be determined due to differences in standardization of the exact definition (Brant et al., 2022) Despite following multi-drug treatment protocols that include diuretics, many patients fail to reach target blood pressure levels and increases the potential for side effects, and low adherence level (Arvanitis et al., 2024). Consequently, conventional

strategies frequently result in poor adherence and not achieve blood pressure target, prompting interest in alternative or integrative treatments.

Acupuncture an essential modality in traditional Chinese medicine (TCM) involves inserting thin needles into specific body points to influence physiological processes (Yunshan et al., 2025). While historically applied for conditions like chronic pain and sleep disturbances, acupuncture is now being explored for cardiovascular disease as one of complementary and alternative therapy (Wang et al., 2024). Early research indicates it may help regulate blood pressure by affecting neurohormonal systems and autonomic balance (Wang et al., 2024). Due to its relatively low risk profile, acupuncture is increasingly considered as a supportive option in hypertension management (Wang et al., 2024). In recent decades, acupuncture has been widely applied in Western medicine in combination with pharmacological therapy in clinical trials for hypertension management, but existing research is limited to essential hypertension and primary hypertension, which are the most common types of hypertensions in real-world settings (Wang et al., 2024, 2021).

Currently, more updated device-based RH management such as ultrasound renal denervation (RDN) and baroreflex amplification therapy (BAT) are some of the options that have been approved by the Food and Drug Administration, but there are challenges in its global application due to complicated procedures and technological challenges (Tolu-Akinnawo et al., 2024). On the other hand, although acupuncture has been generally accepted as a complementary therapy in the management of cardiovascular disease, its application in RH management is still limited due to the small number of studies so that its therapeutic effects are little discussed. This review aims to provide a critical analysis of existing research regarding the use of acupuncture as an adjunctive treatment for resistant hypertension (Fan et al., 2023). By highlighting current evidence and identifying limitations in the literature, the review also outlines future research priorities to help define acupuncture's role within an integrative approach to managing resistant hypertension (Li et al., 2019).

METHODS

In this study, we performed narrative review as limited studies on acupuncture for resistant studies. Literature search were performed from April – May 2025 using three electronic databases (Google Scholar, PubMed, ScienceDirect). Search terms included variations of keywords combination: resistant hypertension, acupuncture, electro-acupuncture, management, antihypertension, blood pressure. We included any human or animal study which focused on resistant hypertension and performed acupuncture therapy for lowering blood pressure. Any available full-text published from 2000 – 2025 were included for this review. Non-available full-text and study were not performed for resistant hypertension or hypertension were excluded for this review.

RESULTS

Mechanisms Acupuncture for Lowering Blood Pressure

Acupuncture significantly influences the autonomic nervous system, a key regulator of cardiovascular function (Li et al., 2022) Acupuncture at focused points LI4 and ST36 has significant effect on increases parasympathetic tone, promoting relaxation and lowering heart

rate, while reducing sympathetic activity to decrease stress hormones like adrenaline (Figure 1). Targeting specific acupoints promote reestablish the equilibrium between the sympathetic and parasympathetic branches, which is often disrupted in resistant hypertension due to excessive sympathetic activity (Foley and Litscher, 2022). Experimental evidence shows that acupuncture lowers sympathetic nerve discharge and reduces the release of catecholamines, resulting in vasodilation and decreased peripheral resistance (Li et al., 2022). At the same time, it enhances parasympathetic activity, slowing the heart rate and improving baroreceptor reflexes, which supports effective blood pressure control (Hamvas et al., 2023). These autonomic changes have been observed in both animal experiments and clinical settings, highlighting acupuncture's crucial role in normalizing cardiovascular regulation, especially in RH patients with increased sympathetic tone.

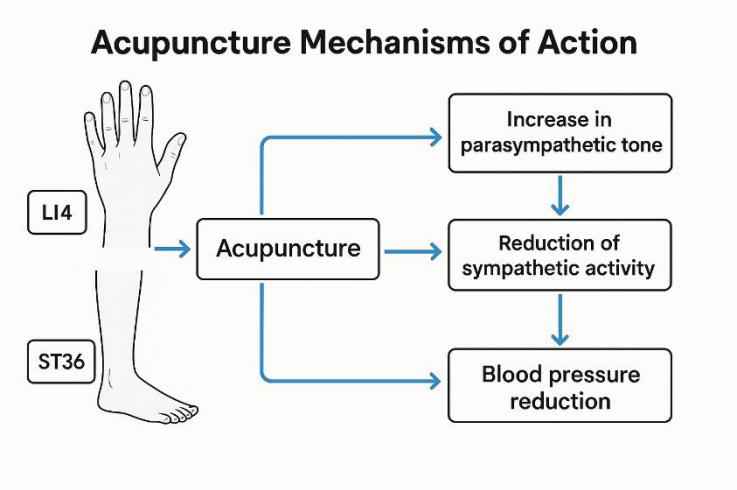

Figure 1. Mechanism of Acupuncture on Blood Pressure.

Acupuncture modulates essential pathways involved in blood pressure control, particularly the renin-angiotensin-aldosterone system (RAAS) and nitric oxide (NO) synthesis, both vital for maintaining vascular tone and fluid homeostasis (Liu et al., 2022). Studies suggest acupuncture can inhibit RAAS hyperactivity by lowering plasma renin levels, angiotensin II, and aldosterone secretion, which helps reduce vasoconstriction and salt retention, primary factors contributing to resistant hypertension (Liu et al., 2022). Concurrently, acupuncture improves endothelial function by increasing the production and availability of nitric oxide, a powerful vasodilator that enhances blood vessel flexibility and decreases vascular resistance (Liu et al., 2022). This combined effect of suppressing RAAS and boosting NO-mediated vasodilation works synergistically to lower blood pressure, underscoring acupuncture's complex role in cardiovascular regulation and its promise as a complementary approach for RH treatment.

Acupuncture may contribute to enhancing baroreceptor sensitivity, an essential mechanism for short-term regulation of blood pressure that is often impaired in resistant hypertension (Zhou et al., 2024). Baroreceptors, located in regions such as the carotid sinus and aortic arch, detect fluctuations in arterial pressure and trigger reflex adjustments in heart rate and vascular tone to maintain circulatory stability (Shanks and Ramchandra, 2021). In patients with RH, diminished baroreflex responsiveness leads to persistent sympathetic activation and elevated blood pressure. Evidence indicates that stimulation of specific acupuncture points can improve baroreflex function by influencing central autonomic pathways (Biffi et al., 2024). This

enhancement of baroreceptor sensitivity results in better modulation of blood pressure variations, reduced sympathetic nervous system overactivity, and improved cardiovascular stability (Biffi et al., 2024). This mechanism is likely a key contributor to the antihypertensive effects observed with acupuncture, particularly in cases where autonomic dysregulation is present (Biffi et al., 2024)

Acupuncture in the Management of Resistant Hypertension

Although the application of acupuncture has been recommended as an alternative in lowering blood pressure in hypertensive populations, the existing evidence is still inadequate due to the lack of clinical trials in the RH population (Carey et al., 2018). Based our literature search, only three studies have tested the effect of acupuncture on RH with results showing significant effect on lowering blood pressure with one other study being a case report that focused on the application of Transcutaneous electric nerve stimulation in subjects with RH (Table 1) (Giollo-Junior et al., 2023; Jacobsson et al., 2000; Li et al., 2010).

Table 1. Type of Acupuncture Trials on Resistance Hypertension Study.

Author (Year)	Subject (Number of participant)	Type of acupuncture	Acupoint	Main result
Jacobsson et al (2000)	Human (12 subject with RH)	Transcutaneous electric nerve stimulation (TENS) at two acupoints on both fore arms for 30 min twice daily during 4 weeks	Dorsal web between the first and second metacarpal bones and at the proximal portion of the brachioradial muscle bilater ally	Significant reduction of systolic blood pressure from 161.9 ± 23.2 mmHg to 155.6 ± 19.9 mmHg and diastolic blood pressure from 102.4 ± 10.9 mmHg to 99.1 ± 11.4 mmHg in 4 weeks
Li et al (2010)	Rats (6 animals)	Electroacupuncture	Nei guan and Jianzhi point (located 1.5–2.0 and 2.5–3.0 cm above the wrist between the ligaments of the flexor carpi radialis and the palmaris longus)	EA reduce BP less than 10 mmHg in each animal.
Giollo-Junior et al (2023)	Human (1 subject with RH)	Transcutaneous electric nerve stimulation (TENS)	Cervical-thoracic ganglion region, located between the vertebral processes C7 and T4, three times a week for 40 min for a total period of 4 weeks.	Significant reductions of the office SBP from 146.6 mmHg to 126.8 mmHg and DBP from 98.3 to 92.7 in 4 weeks.

Although existing studies are of limited quality, acupuncture has potential as a complementary therapy in the management of hypertension. One study by Silverdal et al (2012) showed the benefits of Transcutaneous electrical nerve stimulation (TENS) at the LI4 and LI10 acupuncture points had a blood pressure-lowering effect after four weeks of intervention in a population of stage 1 HT with a single anti-HT medication. However, when compared to the group with CCB medication, there was no significant difference in BP reduction (Silverdal et al., 2012). Another RCT study by Emara et al (2025) which focused on primary HT subjects with stable treatment showed the benefits of TENS as an additional therapy to reduce blood pressure significantly (more than 10% in SBP and 8% in SBP) compared to medication alone (Emara et al., 2025).

Acupuncture Safety and Side Effects in Resistance Hypertension Treatment

In comparison with conventional drug therapies for resistant hypertension, acupuncture generally shows a better safety margin (Fan et al., 2023). Acupuncture-related side effects are mostly minor, localized, and temporary, including slight bruising or discomfort at the needle sites, with serious complications being rare when performed by trained practitioners (Xu et al., 2023). The most frequent side effects are usually mild and short-lived, such as minor bruising, slight pain, or discomfort where the needles are inserted, and occasionally minor bleeding (Xu et al., 2023). These reactions generally resolve on their own without any need for additional treatment. Severe complications are uncommon, particularly when hygienic practices and anatomical knowledge are properly followed (Huang et al., 2024). Due to this favorable safety profile, acupuncture is considered a viable complementary option for managing resistant hypertension, especially for patients who cannot tolerate or have contraindications to medication (Fan et al., 2023).

Although acupuncture is mostly safe, serious adverse events can occur, albeit rarely, if proper hygiene or technique is neglected (Huang et al., 2024). Possible risks include infections at needle insertion points, often caused by the use of non-sterile needles or inadequate skin preparation (Kim et al., 2023). More critical complications like pneumothorax a lung collapse due to accidental needle penetration of the chest cavity have been documented, mainly with treatments near the thorax (Kim et al., 2023). Other infrequent complications include nerve damage, excessive bleeding, or allergic reactions to needle materials (Kim et al., 2023). These risks highlight the necessity for acupuncture to be performed by trained professionals who follow strict safety standards (Huang et al., 2024). When applied correctly, serious side effects remain very uncommon, supporting acupuncture as a relatively safe adjunct therapy for resistant hypertension (Huang et al., 2024).

While acupuncture is generally safe, specific contraindications and cautions must be observed, particularly in patients with resistant hypertension. Absolute contraindications include bleeding disorders, severe thrombocytopenia, or those on anticoagulant medications due to the increased risk of bleeding or hematoma at needle insertion sites (Huang et al., 2024). Patients with implanted electronic devices, such as pacemakers, require caution because electro acupuncture might interfere with device function (Huang et al., 2024). Additionally, for RH patients with unstable cardiovascular status or advanced organ damage, close monitoring during acupuncture sessions is crucial to prevent worsening symptoms (Huang et al., 2024). It is also important to evaluate for secondary hypertension causes, such as renal artery stenosis or pheochromocytoma, which necessitate targeted medical treatment (Zhang et al., 2024).

DISCUSSION

Acupuncture is gaining recognition as a supportive therapeutic option in cases of hypertension that do not respond well to conventional medical treatments (Fan et al., 2023). Based on the principles of traditional Chinese medicine, acupuncture aims to stimulate specific body points to restore homeostasis and promote natural healing mechanisms (Li et al., 2021). A growing body of research suggests that acupuncture can influence cardiovascular function by dampening sympathetic activity and enhancing parasympathetic responses—both of which are integral to the regulation of blood pressure (Li et al., 2021). Moreover, it may aid in the modulation of neurohormonal pathways and improve endothelial function, which together contribute to better vascular tone and lower peripheral resistance (Li et al., 2021). These effects may enhance the efficacy of pharmacologic therapies while potentially allowing for lower dosages or fewer medications (Wang et al., 2021). Given its relatively low risk of adverse effects, acupuncture represents a promising adjunct in managing difficult-to-control hypertension, including RH, and merits further examination through high-quality clinical research.

Beyond its capacity to reduce blood pressure, acupuncture may also improve the quality of life and overall health outcomes for patients with resistant hypertension (Huang et al., 2022). Individuals with hypertension often face diminished physical and mental well-being due to ongoing symptoms, side effects from medications, and the complexity of their treatment regimens (Huang et al., 2022). Research has shown that acupuncture can enhance sleep quality, reduce stress levels, stabilize mood, and boost general vitality (Zheng and Zhou, 2022). These improvements are thought to result from acupuncture's influence on autonomic nervous system modulation and its anti-inflammatory effects, which not only help regulate physiological functions but also promote emotional and functional wellness (Li et al., 2021). Improved quality of life may, in turn, foster better adherence to prescribed treatments, indirectly supporting more favorable clinical results (Zheng and Zhou, 2022). Although evidence regarding long-term endpoints such as cardiovascular events or mortality remains limited, current data indicate that incorporating acupuncture into RH management may offer holistic benefits that extend beyond mere blood pressure control.

Although research on acupuncture's effects in resistant hypertension shows encouraging results, several limitations restrict the broad applicability and robustness of these findings. A notable issue is the small number of participants in many trials, which reduces statistical reliability and increases the chance of false-negative results (Tolu-Akinnawo et al., 2024). Additionally, considerable differences exist among studies in acupuncture techniques, including variations in the acupoints chosen, needling methods, frequency of treatments, and total duration, making it challenging to compare outcomes and reproduce results. Because clinical studies of acupuncture as a treatment option for resistant hypertension are still limited, conducting large-scale, rigorously designed randomized controlled trials is essential. While existing data are promising, they suffer from limitations such as small cohorts, insufficient blinding, and heterogeneous treatment protocols. Well-powered RCTs are required to precisely evaluate acupuncture's efficacy, ideal dosing regimens, and long-term safety when used alongside standard therapies. These studies should implement uniform acupuncture procedures, carefully defined patient populations, and suitable controls like sham interventions to minimize biases and placebo influences (Zhou et al., 2022). Incorporating objective

assessments, such as ambulatory blood pressure monitoring and vascular function biomarkers, will further strengthen evidence quality. Generating high-grade clinical evidence through such trials is critical for informing practice guidelines and potentially incorporating acupuncture into routine care for resistant hypertension (Zhou et al., 2022). Future studies on acupuncture in resistant hypertension should aim to overcome existing research gaps and deepen insights into its therapeutic mechanisms and clinical value. Longitudinal follow-ups are important to evaluate the durability of blood pressure control, impact on cardiovascular events, and patient-centered outcomes like quality of life. Economic evaluations may further support acupuncture's inclusion in standard treatment pathways.

CONCLUSION

RH incidence still limited reported because difference understanding between international guideline. RH developed from complex pathophysiology from hormon and neuronal imbalance and increase CVD complication. Device-based therapy has been studied for their effectivity for RH management, including acupuncture. Acupuncture may be a useful complementary treatment for RH, influencing blood pressure regulation, autonomic balance, and reducing inflammation. Even acupuncture has been widely studied as complementary therapy for hypertension, their application on RH management still limited.

While studies show beneficial effects, there is limited studies on acupuncture as complementary therapy for RH. Lack of quality studies, non-randomization, and limited sample of clinical RH population contributed to limited evidence for acupuncture application in RH management. Further studies are needed to confirm effectiveness and long-term benefits of acupuncture for RH management.

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