

ACUPUNCTURE AND HYPERTENSION

About hypertension

Hypertension is a major risk factor for stroke (both ischaemic and haemorrhagic), myocardial infarction, heart failure, chronic kidney disease, peripheral vascular disease, cognitive decline and premature death worldwide.(Kearney 2005) If the condition is untreated, there is a progressive rise in blood pressure, which often results in a treatment resistant state due to vascular and renal damage (itself caused by the untreated hypertension).(NICE 2011)

At least 25% of the adult population in the UK have hypertension (i.e. a blood pressure of 140/90mmHg or more), and over half of those over the age of 60 years are affected.(NICE 2011) The prevalence is strongly influenced by age and lifestyle factors. Raised systolic pressure is the more dominant feature of hypertension in older patients, while raised diastolic pressure is more common in younger patients (i.e. those under 50 years of age).(NICE 2011) Because routine periodic screening for high blood pressure is commonplace in the UK, the diagnosis, treatment and follow-up of patients with hypertension is one of the most common interventions in primary care; it actually accounts for around 12% of consultations in general practice.(NICE 2011)

Lifestyle interventions to lower blood pressure include reducing salt, caffeine and alcohol intake, taking regular exercise, stopping smoking and relaxation therapies (e.g. meditation, yoga). Approximately £1 billion was spent on drugs for hypertension in the UK in 2006.(NICE 2011) Drugs used to treat hypertension include angiotensin-converting enzyme (ACE) inhibitors, angiotensin receptor blockers (ARBs), calcium-channel blockers, diuretics and beta-blockers.

References

Kearney PM et al. Global burden of hypertension: analysis of worldwide data. *Lancet* 2005; 365: 217–23.

National Clinical Guideline Centre. Hypertension. The clinical management of primary hypertension in adults. Clinical Guideline 12. August 2011. Available: <http://www.nice.org.uk/nicemedia/live/13561/56007/56007.pdf>

How acupuncture can help

This Factsheet focuses on the evidence for acupuncture in the treatment of hypertension.

Three systematic reviews, one of moxibustion (Kim 2010a) and two of acupuncture (Kim 2010b; Lee 2009) all concluded that there were too few trials, and that the existing trials were not of high enough quality and had had results that were too mixed, to be able to draw any firm conclusions about the effects of acupuncture on hypertension. Randomised controlled trials published since these reviews suggest that acupuncture could be beneficial in the treatment of hypertension, although all have been small or very small studies. One found that acupuncture was more effective than the antihypertensive drug valsartan. (Chen 2010a). Two found that acupuncture reduced blood pressure, probably by its effects on vascular endothelial dysfunction (Chen 2010b; Park 2010). Another two looked at electroacupuncture, and one found it to have long-term antihypertensive effects (Yang 2010), while the other found that it reduced systolic but not diastolic blood pressure (Zhang 2009). Finally, one trial found that TCM-based acupuncture reduced 24-hour ambulatory blood pressure (Brinkhaus 2008).

In general, acupuncture is believed to stimulate the nervous system and cause the release of neurochemical messenger molecules. The resulting biochemical changes influence the body's homeostatic mechanisms, thus promoting physical and emotional well-being.

Research has shown that acupuncture treatment may specifically help to lower blood pressure by:

- Regulating endothelium-derived vasoconstrictors (endothelin-1) and vasodilators (calcitonin gene-related peptide, nitric oxide and nitric oxide synthase) (Wang 2011a; Wang 2011b; Pan 2010; Hwang 2008; Kim 2006)
- Acting on areas of the brain known to reduce sensitivity to pain and stress, as well as promoting relaxation and deactivating the 'analytical' brain, which is responsible for anxiety and worry (Hui 2010; Hui 2009);
- Increasing the release of adenosine, which has antinociceptive properties (Goldman 2010);
- Reducing inflammation, by promoting release of vascular and immunomodulatory factors (Kavoussi 2007).

About the British Acupuncture Council

With over 3000 members, the British Acupuncture Council (BAcC) is the UK's largest professional body for traditional acupuncturists. Membership of the BAcC guarantees excellence in training, safe practice and professional conduct. To find a qualified traditional acupuncturist, contact the BAcC on 020 8735 0400 or visit

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The evidence

Research

Conclusion

Systematic reviews

Kim JI et al. Moxibustion for hypertension: a systematic review. *BMC Cardiovasc Disord* 2010a; 10: 33.

A systematic review that included four randomised controlled trials of moxibustion as a treatment for hypertension. Two of the trials failed to report favourable effects of moxibustion on blood pressure (BP) compared to the control (antihypertensive drug treatment alone). A third trial showed significant effects of moxibustion as an adjunct to antihypertensive drug therapy compared to drug therapy alone. The fourth trial addressed the immediate blood pressure-lowering effects of moxibustion compared to no treatment. The reviewers concluded that there is insufficient evidence to suggest that moxibustion is an effective treatment for hypertension.

Kim LW, Zhu J. Acupuncture for essential hypertension. *Altern Ther Health Med* 2010b; 16: 18-29.

A review that pooled data from 20 trials comparing acupuncture with sham acupuncture, antihypertensive drugs, Chinese herbal medicine, or exercise for the treatment of essential hypertension. Acupuncture arms achieved significant effect modification on blood pressure compared with control arms (19 comparisons: systolic blood pressure [SBP]: mean difference -4.23 mmHg, 95% confidence intervals -6.47 to -1.99; diastolic blood pressure [DBP]: -2.53, -3.99 to -1.08). In high-quality trials, blood pressure was significantly lower with acupuncture plus antihypertensive drugs than with sham-acupuncture plus anti-hypertensives (two comparisons: SBP: -5.72 mmHg, -8.77 to -2.68; DBP: -2.80, -5.07 to -0.54). In trials that used the principles of TCM syndrome differentiation, the reviewers found a significant blood pressure reduction with acupuncture compared to controls (11 comparisons: SBP: -6.46 mmHg, -8.04 to -4.87; DBP: -3.07, -4.17 to -1.96). In contrast, in trials not using the principles of syndrome differentiation, no significant reduction in blood pressure was seen with acupuncture compared to controls (eight comparisons: SBP: -1.55 mmHg, -5.39 to 2.29; DBP: -2.12, -4.97 to 0.73), with significant heterogeneity. The researchers concluded that, because of the paucity of rigorous trials and the mixed results, their findings provide limited conclusions.

Lee H et al. Acupuncture for lowering blood pressure: systematic review and meta-analysis. *Am J Hypertens*. 2009; 22: 122-8.

A systematic review including 11 randomised controlled trials that estimated the effect of acupuncture on blood pressure (BP) in hypertensive patients. Data from three sham-controlled trials were pooled: systolic BP (SBP) change was not statistically significant (mean difference -5 mm Hg, 95% CI (-12, 1), $P = 0.12$) and acupuncture only marginally reduced diastolic BP (DBP) by 3 mm Hg (95% CI (-6, 0), $p=0.05$). When given with antihypertensive medication, acupuncture significantly reduced SBP (-8 mm Hg, 95% CI (-10, -5), $p<0.00001$) and DBP (-4 mm Hg, 95% CI (-6, -2), $p<0.0001$). In four studies, acupuncture was

found to be noninferior to antihypertensive medication. Other studies comparing acupuncture with various control procedures had inconsistent findings. The reviewers concluded that, considering the limitations of the four noninferiority studies and the results of the meta-analysis of the three sham-controlled studies, the notion that acupuncture may lower high BP is inconclusive.

Randomised controlled trials

Chen NY et al. Observation on therapeutic effect of acupuncture in the treatment of German hypertension patients [Article in Chinese]. *Zhen Ci Yan Jiu* 2010a; 35: 462-6.

A randomised controlled trial that compared the clinical effects of acupuncture and medication (valsartan) in the treatment of 80 patients with hypertension. A total of 18 (45.0%) of the patients on valsartan and 27 (67.5%) of those treated with acupuncture experienced marked improvement in the reduction of blood pressure; 14 (35.0%) and 11 (27.5%) were improved, 8 (20.0%) and 2 (5.0%) failed, with the effective rates being 80.0% and 95.0%, respectively. The therapeutic effect of the acupuncture group was significantly superior to that of the medication group in improving hypertension ($p < 0.05$). The researchers concluded that acupuncture is superior to valsartan in relieving hypertension.

Chen J et al. Therapeutic effect on essential hypertension treated with combined therapy of acupuncture and medication [Article in Chinese]. *Zhongguo Zhen Jiu* 2010b; 30: 896-8.

A randomised controlled trial that compared acupuncture plus medication (felodipine) with medication alone in 60 patients with essential hypertension. Blood pressure declined in both groups. The total effective rate in the combined treatment group was 86.7% (26/30), which was superior to that of 73.3% (22/30) in the medication alone group. After treatment, the plasma e-selectin (an endothelial leukocyte adhesion molecule associated with raised levels in hypertension patients) content in both groups decreased (both $P < 0.01$), although more in the combination group than the medication only group ($p < 0.01$). Endothelial nitric oxide synthetase (eNOS, a vasodilator) increased in the combination group only ($P < 0.01$). The researchers concluded that the mechanism of acupuncture on blood pressure probably relies on the improvements in vascular endothelial cellular function.

Yang DH. Effect of electroacupuncture on Quchi (LI 11) and Taichong (LR 3) on blood pressure variability in young patients with hypertension [Article in Chinese]. *Zhongguo Zhen Jiu* 2010; 30: 547-50.

A randomised controlled trial that compared the therapeutic effects of electroacupuncture and medication (captopril) on blood pressure variability in 60 young patients with hypertension. Electroacupuncture reduced systolic pressure and diastolic pressure ($p < 0.01$), as did captopril ($p < 0.05$), with no significant difference between the two groups. The researchers concluded that electroacupuncture has long-term antihypertensive effects and improves day-night rhythm variation in young patients with hypertension.

Park JM 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 Complement Med* 2010; 16: 883-8.

A double-blind placebo-controlled randomised controlled trial that assessed whether acupuncture improves endothelial dysfunction in patients with hypertension and compared the effects of different acupoints. Fifteen patients with essential hypertension were included. Flow-mediated dilation (FMD) and blood pressure were assessed before and after acupuncture

treatment. FMD significantly improved with the acupuncture treatment at ST 36 (0.266 mm to 0.306 mm, $p=0.003$) and ST 36 plus PC 6 (0.284 mm to 0.332 mm, $p<0.001$). In contrast, FMD was unchanged after the acupuncture treatment at PC 6 or the placebo treatment. Both the ST 36 and combined ST 36 + PC 6 treatments were significantly better than placebo. The researchers concluded that the acute treatment of acupuncture in hypertensive patients improves endothelial dysfunction, which could be of clinical importance to prevent the progression of cardiovascular diseases in hypertensive patients.

Zhang J et al. Effects of electrical stimulation of acupuncture points on blood pressure. *J Chiropr Med.* 2009 Mar;8(1):9-14.

A randomised controlled trial that investigated the effects of electrical stimulation of acupuncture points on blood pressure in 27 people with normal or elevated blood pressure. Systolic blood pressure decreased significantly in the electrical acupuncture group, from 117.8 mm Hg before treatment to 110.1 mm Hg after treatment ($p<0.05$). The mean diastolic blood pressure fell, but not significantly, from 78.1 mm Hg before treatment to 74.8 mm Hg ($p>0.05$) after treatment. Neither systolic nor diastolic blood pressures fell in the control group. The researchers concluded that electrical stimulation of acupuncture points reduced systolic blood pressure but not the diastolic blood pressure in people with normal or elevated blood pressure.

Brinkhaus B. Acupuntura en pacientes con hipertensión arterial. *Revista Internacional de Acupuntura* 2008; 2: 39-40.

A single-blind randomised controlled clinical trial that investigated whether traditional Chinese medicine acupuncture is able to lower blood pressure in 160 patients with uncomplicated arterial hypertension.. In the active acupuncture group, mean 24-hour ambulatory systolic and diastolic blood pressures decreased significantly after treatment by 5.4 mm Hg (95% CI, 3.2 to 7.6) and 3.0 mm Hg (95% CI, 1.5 to 4.6), respectively. The sham acupuncture control group showed no significant response and at the end of the course it was 6.4 mm and 3.7 mm higher than the active group for systolic and diastolic readings. At 3 and 6 months, mean systolic and diastolic blood pressures returned to pre-treatment levels in the active treatment group. The researchers concluded that acupuncture according to traditional Chinese medicine, but not sham acupuncture, significantly lowered mean 24-hour ambulatory blood pressures after 6 weeks of treatment.

Possible mechanisms of acupuncture

Wang L et al. Effects of reinforcing and reducing methods by twirling and rotating the needle on contents of CGRP and NO in rats with stress-induced hypertension [Article in Chinese]. *Zhongguo Zhen Jiu* 2011a; 31: 337-41.

A randomised controlled animal study that found acupuncture increased the contents of calcitonin gene-related peptide (CGRP) and nitric oxide (NO) in rats with stress-induced hypertension, thereby causing a fall in blood pressure.

Wang JY et al. Effect of moderate acupuncture-stimulation of "Taichong" (LR 3) on blood pressure and plasma endothelin-1 levels in spontaneous

A randomised controlled animal study that found moderate-stimulation of Liv 3 can lower blood pressure and plasma endothelin (ET-1) levels in rats with spontaneous hypertension. The reduced level of plasma ET-1 may be one of its

hypertension rats [Article in Chinese].
Zhen Ci Yan Jiu 2011b; 36: 36-9.

mechanisms underlying improving hypertension.

Pan P et al. Effects of electro-acupuncture on endothelium-derived endothelin-1 and endothelial nitric oxide synthase of rats with hypoxia-induced pulmonary hypertension. *Exp Biol Med* 2010; 235: 642-8.

An animal study that investigated whether electro-acupuncture on bladder-13 and -15 points can protect against chronic hypoxia-induced pulmonary hypertension (PH) by regulating endothelium-derived endothelin (ET)-1 and endothelial nitric oxide synthase (eNOS). The results indicated that treatment with electro-acupuncture could protect against hypoxia-induced PH, possibly by regulating the balance of endothelium-derived vasoconstrictors and vasodilators.

Goldman N et al. Adenosine A1 receptors mediate local anti-nociceptive effects of acupuncture. *Nat Neurosci* 2010; May 30.

A study showing that the neuromodulator adenosine, which has anti-nociceptive properties, was released during acupuncture in mice, and that its anti-nociceptive actions required adenosine A1 receptor expression. Direct injection of an adenosine A1 receptor agonist replicated the analgesic effect of acupuncture. Inhibition of enzymes involved in adenosine degradation potentiated the acupuncture-elicited increase in adenosine, as well as its anti-nociceptive effect. The researchers concluded that their observations indicate that adenosine mediates the effects of acupuncture and that interfering with adenosine metabolism may prolong the clinical benefit of acupuncture.

Hui KK et al. Acupuncture, the limbic system, and the anticorrelated networks of the brain. *Auton Neurosci* 2010; 157: 81-90.

Studies have shown that acupuncture stimulation, when associated with sensations comprising deqi, evokes deactivation of a limbic-paralimbic-neocortical network, as well as activation of somatosensory brain regions. These networks closely match the default mode network and the anti-correlated task-positive network. The effect of acupuncture on the brain is integrated at multiple levels, down to the brainstem and cerebellum and appears to go beyond either simple placebo or somatosensory needling effects. Needling needs to be done carefully, as very strong or painful sensations can attenuate or even reverse the desired effects. Their results suggest that acupuncture mobilises the functionally anti-correlated networks of the brain to mediate its actions, and that the effect is dependent on the psychophysical response. They discuss potential clinical application to disease states including chronic pain, major depression, schizophrenia, autism, and Alzheimer's disease.

Hui K.K.-S. The salient characteristics of the central effects of acupuncture needling: limbic-paralimbic-neocortical network modulation. *Human Brain Mapping* 2009; 30: 1196-206.

This study assessed the results of fMRI on 10 healthy adults during manual acupuncture at 3 acupuncture points and a sham point on the dorsum of the foot. Although certain differences were seen between real and sham points, the hemodynamic and psychophysical responses were generally similar for all 4 points. Acupuncture produced extensive deactivation of the limbic-paralimbic-neocortical system. Clusters of deactivated regions were seen in the medial prefrontal cortex, the temporal lobe and the posterior medial cortex. The sensorimotor cortices, thalamus and occasional paralimbic structures such as the insula and anterior middle cingulate cortex showed activation. The researchers concluded that their results provided additional evidence that acupuncture modulates the limbic-paralimbic-neocortical network. They hypothesised that acupuncture may

mediate its analgesic, anti-anxiety, and other therapeutic effects via this intrinsic neural circuit that plays a central role in the affective and cognitive dimensions of pain.

Hwang HS et al. Electroacupuncture Delays Hypertension Development through Enhancing NO/NOS Activity in Spontaneously Hypertensive Rats. Evid Based Complement Alternat Med 2008 Oct 7.

An animal study that found electroacupuncture (EA) could reduce early stage hypertension in rats by enhancing NO/NOS activity in the mesenteric artery.

Kavoussi B, Ross BE. The neuroimmune basis of anti-inflammatory acupuncture. Integr Cancer Ther 2007; 6: 251-7.

Review article that suggests the anti-inflammatory actions of traditional and electro-acupuncture are mediated by efferent vagus nerve activation and inflammatory macrophage deactivation.

Kim DD et al. Acupuncture reduces experimental renovascular hypertension through mechanisms involving nitric oxide synthases. Microcirculation 2006; 13: 577-85.

An animal study that found electroacupuncture on St 36 in a hamster model reduced blood pressure by activating nitric oxide synthase signalling mechanisms.
