

ACUPUNCTURE AND ARRHYTHMIAS AND HEART FAILURE

About arrhythmias and heart failure

A cardiac arrhythmia is a problem with the rate or rhythm of the heartbeat: the heart can beat too fast (tachycardia), too slow (bradycardia) or with an irregular rhythm (National Heart, Lung and Blood Institute 2014). Most arrhythmias are harmless, but some can be serious or even life threatening. During an arrhythmia, the heart may not be able to pump enough blood to the body, and result in a lack of blood flow to the brain, heart and other organs; arrhythmias increase mortality and diminish quality of life (National Heart, Lung and Blood Institute 2014).

Premature beats are the most common type of arrhythmia. They are harmless most of the time and often cause no symptoms. When symptoms do occur, they usually feel like fluttering in the chest or a feeling of a skipped heartbeat. Usually, premature beats need no treatment, especially in healthy people.

Supraventricular arrhythmias are the commonest tachycardia, with atrial fibrillation being the most common arrhythmia of this type. Atrial fibrillation is associated with an increased risk of stroke and heart failure.

Ventricular arrhythmias are a less common type of tachycardia but may lead to myocardial infarction and heart failure.

In adults, a heart rate slower than 60 beats per minute is considered to be bradycardia. Some people, particularly those who are very fit, naturally have a slow heartbeat and it does not cause any problems. In other people, bradycardia can be caused by a serious disease, such as a heart attack, an underactive thyroid gland, an imbalance of certain chemicals in the blood or certain medicines.

Conventional treatments for arrhythmias include lifestyle changes, drugs (for example, beta blockers, calcium antagonists, digoxin, warfarin), devices or surgery that will regulate the heartbeat.

Heart failure occurs if the heart cannot pump enough blood to meet the body's needs, usually because the heart muscle has become too weak or stiff to work properly. Common causes are hypertension and coronary heart disease (both the subject of other Fact Sheets), arrhythmias, cardiomyopathy and heart valve disease. An estimated 900,000 people in the UK have heart failure (NICE 2010). People with mild heart failure may have no symptoms, but as the condition worsens, it can cause breathlessness, fatigue and swollen ankles (NHS Choices 2014).

Conventional treatments for heart failure include lifestyle changes, drugs (for example, ACE inhibitors, digoxin, diuretics), devices or surgery that will improve heart function or help the body get rid of excess water (NHS Choices 2014).

References

National Heart, Lung and Blood Institute. What is an arrhythmia? [online Available: <http://www.nhlbi.nih.gov/health/health-topics/topics/arr/>] [Accessed 7 July 2014]

National Institute for Health and care Excellence (2010). Chronic heart failure: Management of chronic heart failure in adults in primary and secondary care. [online] Available: <http://www.nice.org.uk/guidance/CG108/>

NHS Choices. Heart failure. [online] Available: <http://www.nhs.uk/conditions/heart-failure/pages/introduction.aspx> [Accessed 7 July 2014]

How acupuncture can help

This fact sheet looks at the evidence for acupuncture in the treatment of arrhythmias, including atrial fibrillation, and heart failure. There are related fact sheets on hypertension, stroke, and coronary heart disease.

There is one systematic review to date of randomised controlled trials (RCTs) on acupuncture for arrhythmias (Kim 2011). In the 10 included studies, acupuncture was found to be at least equivalent in effect to medication and superior to the other control interventions used. Nevertheless, larger and better quality trials are needed before the evidence can be said to be conclusive.

Some examples of recent arrhythmia RCTs are summarised here and further details provided in the table below. Most have been carried out in China with acupuncture compared to medication. One found that acupuncture plus moxibustion was more effective than conventional drug treatment in patients with cardiac arrhythmias (Zou 2009). Another found acupuncture to be more effective than amiodarone for the conversion of paroxysmal atrial fibrillation (AF) and atrial flutter (Xu 2007), and a third found that wrist-ankle acupuncture was more effective than diltiazem in the treatment of paroxysmal supraventricular tachycardia (Wu 2006). An Italian trial demonstrated that acupuncture could prevent arrhythmic recurrence after cardioversion in patients with persistent AF, similar to amiodarone but superior to sham acupuncture or no treatment (Lomuscio 2011). In an uncontrolled study, the same team showed that it could substantially reduce symptoms in patients with paroxysmal AF (Lombardi 2012).

For heart failure, there is much less acupuncture research. One trial found that acupuncture given alongside conventional treatment may improve exercise tolerance in patients with chronic heart failure, potentially by improving skeletal muscle function. (Kristen 2010)

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 benefit arrhythmias and heart failure, and help cardiovascular function overall, by:

- minimising myocardial injury, probably partially by reducing serum cardiac troponin (integral to heart muscle contraction and a marker for damage to the muscle) and C-reactive protein (a marker of inflammation) levels (Ni 2012);

- regulating MAPK (mitogen-activated protein kinase) signalling pathways (e.g. p38 and JNK) that are involved in cardiovascular pathogenesis such as cardiac hypertrophy, and modulating the upstream neuroendocrine factors that control these pathways (Wang 2012, Li 2012, Wu 2012);
- reducing plasma levels of adrenaline, noradrenaline (Wang 2009) and vasoactive intestinal peptide (Fan 2010), so suppressing tachycardia;
- regulating the autonomic nervous system (the main controller for heart rate and rhythm) (Yue 2008, Middlekauf 2002), partly via opiate receptors in the hypothalamus (Zhong 2009);
- mediating heart rate variability (low HRV is associated with various cardiac pathologies) (Wang 2013);
- inhibiting cardiovascular function (heart rate, blood pressure) by activating baroreceptor sensitive neurons in the nucleus tractus solitarius (specific to auricular, not body, acupuncture) (Gao 2011);
- affecting activation of the brain cortex and hence heart function (Kim 2008);
- 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);
- reducing inflammation, by promoting release of vascular and immunomodulatory factors (Kavoussi 2007).

About traditional acupuncture

Acupuncture is a tried and tested system of traditional medicine, which has been used in China and other eastern cultures for thousands of years to restore, promote and maintain good health. Its benefits are now widely acknowledged all over the world, and in the past decade traditional acupuncture has begun to feature more prominently in mainstream healthcare in the UK. In conjunction with needling, the practitioner may use techniques such as moxibustion, cupping, massage or electro-acupuncture. They may also suggest dietary or lifestyle changes.

Traditional acupuncture takes a holistic approach to health and regards illness as a sign that the body is out of balance. The exact pattern and degree of imbalance is unique to each individual. The traditional acupuncturist's skill lies in identifying the precise nature of the underlying disharmony and selecting the most effective treatment. The choice of acupuncture points will be specific to each patient's needs. Traditional acupuncture can also be used as a preventive measure to strengthen the constitution and promote general wellbeing.

An increasing weight of evidence from Western scientific research (see overleaf) is demonstrating the effectiveness of acupuncture for treating a wide variety of conditions. From a biomedical viewpoint, acupuncture is believed to stimulate the nervous system, influencing the production of the body's communication substances - hormones and neurotransmitters. The resulting biochemical changes activate the body's self-regulating homeostatic systems, stimulating its natural healing abilities and promoting physical and emotional wellbeing.

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 www.acupuncture.org.uk

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The evidence

Heading	Heading
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Systematic review

Kim TH et al. Acupuncture treatment for cardiac arrhythmias: A systematic review of randomized controlled trials. <i>Am J Cardiol</i> 2011; 149(2):263-5	A systematic review including 10 randomised controlled trials that looked at acupuncture treatment for cardiac arrhythmias. Two studies of the immediate effects on alleviating paroxysmal supraventricular tachycardia found acupuncture equivalent to medication, though it was superior in one long-term study. Three trials on ventricular premature beat showed equivalence to drugs. Two for atrial fibrillation found acupuncture to be better than sham or medication. One each on sinus tachycardia and ventricular systole also found acupuncture to be effective. Despite these encouraging results the small size and poor quality of the trials persuaded the reviewers to conclude that there was not conclusive evidence in support of acupuncture treatment for cardiac arrhythmias.
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Clinical studies

Lombardi F et al. Acupuncture for paroxysmal and persistent atrial fibrillation: An effective non-pharmacological tool? <i>World J Cardiol.</i> 2012 Mar 26;4(3):60-5.	A review of two clinical studies on acupuncture (using P6, He7 and Ren15) for atrial fibrillation (AF). The first was a randomised controlled trial with patients with persistent AF who had had electrical cardioversion to restore sinus rhythm. Details of this trial are given below (Lomuscio 2011). The second was an observational study with 31 patients with frequent paroxysmal AF. Acupuncture resulted in a significant reduction in the number and duration of symptomatic AF episodes. The researchers concluded that acupuncture at the Neiguan point was associated with an antiarrhythmic effect, which was evident in patients with both persistent and paroxysmal AF.
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Lomuscio A et al. Efficacy of acupuncture in preventing atrial fibrillation recurrences after electrical cardioversion. <i>J Cardiovasc Electrophysiol</i> 2011;22:241-7.	A randomised controlled trial that evaluated whether acupuncture might prevent or reduce the rate of arrhythmia recurrences in 80 patients with persistent atrial fibrillation (AF), after cardioversion. Twenty-six patients already on amiodarone treatment constituted the reference group. The remaining patients were randomly allocated to acupuncture, sham acupuncture, or neither acupuncture nor antiarrhythmic therapy (control group). During 12-month follow-up, AF recurred in 35 patients. Cumulative AF recurrence rates in the amiodarone, acupuncture, sham, and control groups were 27%, 35%, 69% and 54% respectively (p=0.0075). Recurrence rates were similar in the acupuncture and amiodarone groups (hazard ratio: 1.15, 95% CI 0.38 to 3.49; p=0.801) but significantly higher in the sham (hazard ratio: 3.77, 95% CI 1.39 to 10; p=0.009) and control groups (hazard ratio: 3.15, 95% CI 1.23 to 8.06; p=0.017) after adjustment for ejection
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	<p>fraction, hypertension, and left atrial diameter using Cox modelling. The researchers concluded that their data showed that acupuncture treatment prevents arrhythmic recurrence after cardioversion in patients with persistent AF and is safe and well tolerated.</p>
<p>Kristen AV et al. Acupuncture improves exercise tolerance of patients with heart failure: a placebo-controlled pilot study. <i>Heart</i>. 2010 Sep;96(17):1396-400.</p>	<p>A randomised trial that looked at the therapeutic potential of acupuncture for life-threatening diseases. It included 17 patients with stable chronic heart failure (New York Heart Association class II-III, ejection fraction <40%) receiving optimised heart failure medication. They were randomised to verum acupuncture (VA) or placebo acupuncture (PA). There were no improvements of the cardiac ejection fraction or peak oxygen uptake, but 6 minute walking distance was increased in the VA group (+32+/-7 m) but not the PA group (-1+/-11 m; p<0.01). Post-exercise recovery after maximal exercise and ventilatory efficiency were improved after VA but not PA. Also, heart rate variability increased after VA, but decreased after PA. The researchers concluded that acupuncture may become an additional therapeutic strategy to improve the exercise tolerance of patients with chronic heart failure, potentially by improving skeletal muscle function.</p>
<p>Zou M. Clinical observation on therapeutic effect of combination of acupuncture and ginger-partition moxibustion for treatment of patients with cardiac arrhythmia. [Article in Chinese]. <i>Zhongguo Zhen Jiu</i>. 2009 Nov;29(11):876-8.</p>	<p>A randomised controlled trial that compared the therapeutic effect of acupuncture plus ginger-partition moxibustion with conventional medicine (e.g. metoprolol, propafenone and aspirin) in 75 patients with cardiac arrhythmia. The total effective rate was higher in the acupuncture group than in the control group (97.4% vs. 81.1%, p<0.05), while the serious recurrence rate and number of complications were lower (both p<0.05). The researcher concluded that the therapeutic effect of acupuncture plus ginger-partition moxibustion in patients with cardiac arrhythmia is better than that of conventional medicine.</p>
<p>Xu HK, Zhang YF. Comparison between therapeutic effects of acupuncture and intravenous injection of amiodarone in the treatment of paroxysmal atrial fibrillation and atrial flutter. [Article in Chinese]. <i>Zhongguo Zhen Jiu</i>. 2007 Feb;27(2):96-8.</p>	<p>A randomised controlled trial that assessed the feasibility of acupuncture in the conversion of paroxysmal atrial fibrillation and atrial flutter in 80 patients. The patients were randomised to acupuncture or an intravenous injection of amiodarone. The total effective rate was better in the acupuncture group than the amiodarone group (85.0% vs. 67.5%, p<0.01). The average conversion time was (39.6 +/- 13.7 min) in the acupuncture group and (50.1 +/- 14.8 min) in the amiodarone group, with a significant difference between the two groups (p<0.01). No adverse effects were seen in the acupuncture group. The researchers concluded that acupuncture is a safe and effective therapy for conversion of paroxysmal atrial fibrillation and atrial flutter.</p>
<p>Wu RD, Lin LF. Clinical observation on wrist-ankle acupuncture for treatment of paroxysmal supraventricular tachycardia. [Article in Chinese]. <i>Zhongguo Zhen Jiu</i>. 2006 Dec;26(12):854-6.</p>	<p>A randomised controlled trial that looked at the therapeutic effect and prognosis of wrist-ankle acupuncture for the treatment of paroxysmal supraventricular tachycardia. A total of 95 patients were allocated to wrist-ankle acupuncture group or diltiazem. The total effective rate was better in the acupuncture group than the diltiazem group (81.8% vs. 54.0%), with a significant difference between the two groups (p<0.05). The long-term therapeutic effect was better in the acupuncture group than the diltiazem group. The researchers concluded that wrist-ankle acupuncture has a</p>

therapeutic effect on paroxysmal supraventricular tachycardia.

Physiological studies

Wang H et al. Effects of acupuncture on heart rate variability in beagles; preliminary results. *Evid Based Complement Alternat Med.* 2013;2013:419212.

An animal study that measured heart rate variability in beagles and the effects of acupuncture. Electrocardiograms were recorded during bilateral body acupuncture on the Neiguan point. The researchers' findings showed that acupuncture can mediate the heart rate variability even after pharmaceutical blocking of autonomic function.

Ni X et al. Cardioprotective effect of transcutaneous electric acupoint stimulation in the pediatric cardiac patients: a randomized controlled clinical trial. *Paediatr Anaesth.* 2012;22(8):805-11.

A randomised controlled trial that looked at the effects of transcutaneous electric acupoint stimulation (TEAS) on acute myocardial injury from paediatric open-heart surgery. It included 70 children, aged 2-12 years, with congenital heart defects scheduled for surgical repair. They were allocated to TEAS or a control group. Compared with the control group, the mean 24hour serum cardiac troponin I (cTnI) levels (the primary end point) were significantly lower in the TEAS group at 8 hours ($p=0.043$) and 24 hours ($p=0.046$) after aortic unclamping. The duration of ventilation ($p=0.004$) and length of ICU stay ($p=0.032$) were significantly longer in the control group than in the TEAS group. There was a significant difference in the release of C-reactive protein at 8 hours ($p=0.039$) between the two groups, whereas the values for cytokines were not significant. The researchers concluded that TEAS is effective for minimising myocardial injury in children having cardiac surgery. The beneficial effects may be partially associated with reduced cTnI and C-reactive protein levels in the early postoperative period.

Li J et al. Electroacupuncture at PC6 (Neiguan) improves extracellular signal-regulated kinase signaling pathways through the regulation of neuroendocrine cytokines in myocardial hypertrophic rats. *Evid Based Complement Alternat Med.* 2012:792820.

An animal study that investigated the effects of EA on the signalling pathways of myocardial hypertrophy (MH) in rats randomly divided into a normal, a model, a Neiguan and a Hegu groups. The rats in the Neiguan and Hegu groups received EA for 14 days. The results showed that EA can improve cardiac function in rats with myocardial hypertrophy by modulating upstream neuroendocrine cytokines that regulate the extracellular signal-regulated kinase signalling pathways.

Wang H et al. Effects of electroacupuncture at neiguan (PC6) on c-Jun NH2-terminal kinase signaling pathways in hypertrophic myocardial cells. [Article in Chinese] *Zhongguo Zhong Xi Yi Jie He Za Zhi.* 2012;32(8):1099-102.

An animal study of the effects of electroacupuncture (EA) at Neiguan (PC6) on c-Jun NH₂-terminal kinases (JNK) signalling pathways in hypertrophic myocardial cells in rats. Compared with the model group, left ventricular weight index (LVWI) and heart weight index (HWI), the content of angiotensin II (Ang II) in the cardiac muscular tissue, and the protein expressions of JNK and phosphorylated JNK (p-JNK) in cardiocytes were significantly higher in the EA group ($p<0.05$). The researchers concluded that EA at PC6 could prevent and treat cardiac hypertrophy possibly by regulating JNK signalling pathways, and by regulating its upstream neuroendocrine factors.

Wu S et al. Effects of electroacupuncture at "Neiguan" (PC 6) on p38 MAPK signaling pathway in rats with cardiac hypertrophy. [Article

A study that looked at the mechanisms of electroacupuncture at Neiguan point on the p38 MAPK signalling pathway in rats with cardiac hypertrophy. The rats were randomly divided into four groups: a normal group, a model group, a model plus p38 MAPK

in Chinese]. Zhongguo Zhen Jiu. 2012 Feb;32(2):145-8.

inhibitor group, a model plus electroacupuncture group, ten rats in each group. Compared with the normal group, the contents of TNF-alpha, IL-1beta, p38 MAPK, p-p38 MAPK were significantly increased in the model group (all $p < 0.01$). The contents of TNF-alpha, IL-1beta, p38 MAPK, p-p38 MAPK were significantly decreased in the model plus p38 MAPK inhibitor group and the model plus electroacupuncture group, compared with model group (all $p < 0.05$) and the normal group ($p < 0.05$ and $p < 0.01$ respectively) There was no significant difference between the model plus p38 MAPK inhibitor group and the model plus electroacupuncture group ($p > 0.05$). The researchers concluded that electroacupuncture at Neiguan can prevent the phosphorylation of p38 MAPK of myocardial hypertrophy, and the mechanism maybe adjustment of the p38 MAPK signalling pathway by inhibiting the expression of TNF-alpha and IL-1beta.

Gao XY et al. Acupuncture-like stimulation at auricular point Heart evokes cardiovascular inhibition via activating the cardiac-related neurons in the nucleus tractus solitarius. Brain Res. 2011;1397:19-27.

An animal study that investigated the role of baroreceptor sensitive neurons of the nucleus tractus solitarius in the regulation of cardiovascular inhibition during acupuncture at the auricular Heart point. The researchers concluded that their results showed that acupuncture at the auricular Heart point regulates cardiovascular function by activating baroreceptor sensitive neurons in the nucleus tractus solitarius in a similar manner to the baroreceptor reflex in cardiovascular inhibition.

Hui KK et al. Acupuncture, the limbic system, and the anticorrelated networks of the brain. Auton Neurosci. 2010; 157(1-2): 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.

Fan Z et al. Influence of electroacupuncture of "Daling"(PC 7) on heart rate, duration of arrhythmia and plasma vasoactive intestinal peptide contents in ventricular tachycardia rats. [Article in Chinese]. Zhen Ci Yan Jiu. 2010 Apr;35(2):124-8.

An animal study that looked at the effect of electroacupuncture (EA) on heart rate (HR), arrhythmia duration and plasma vasoactive intestinal peptide (VIP) level in rats with ventricular tachycardia (VT) rats. Following intravenous injection of CsCl, HR increased significantly in the model, EA on PC7 point group and EA-on LU9 group ($p < 0.05$). Compared with the model group, HR at 5 min, 10 min and 15 min after intravenous CsCl and the duration of arrhythmias in the EA-PC7 group decreased considerably ($p < 0.01$). No significant differences were seen between the EA-LU9 and model groups in HR and the duration of arrhythmia ($p > 0.05$). Compared with the normal group, the content of plasma vasoactive intestinal polypeptide (VIP) in the model group decreased ($p < 0.05$) but this was reversed in the EA-PC7 group

	(p<0.01). The researchers concluded that EA (PC7) can effectively suppress CsCl-induced tachycardia, which may be closely associated with its effect in reducing plasma VIP level.
Wang H et al. Effect of electroacupuncture of "Neiguan" (PC 6) on heart rate and plasma catecholamine contents in ventricular tachycardia rats [Article in Chinese]. Zhen Ci Yan Jiu. 2009 Jun;34(3):180-2, 187.	An animal study that looked at the effect of electroacupuncture (EA) at the Neiguan point on heart rate (HR) and plasma catecholamine (CA) levels in ventricular rats with tachycardia (VT). Compared with the normal control group, plasma NE and E contents in the model group increased (p<0.01). Compared with the model group, heart rate and plasma noradrenaline and adrenaline content in EA-Neiguan group fell significantly (p<0.01), while those in the EA-LU7 group did not change (p>0.05). The researchers concluded that EA at Neiguan can down-regulate heart rate and plasma CA level in rats with VT, which may contribute to its effect in relieving tachycardia.
Zhong H, Li GZ. Study on the mechanism of electroacupuncture of "Neiguan" (PC 6) in inhibiting ventricular arrhythmia induced by hypothalamic electrostimulation in the rabbit [Article in Chinese]. Zhen Ci Yan Jiu. 2009 Feb;34(1):43-7.	An animal study that looked at whether opiate receptors in the hypothalamic arcuate nuclei (ARC) participate in the inhibitory effect of electroacupuncture (EA) at the Neiguan point on ventricular arrhythmia in rabbits. Electric stimulation of the hypothalamic midline region can induce continuous heart ventricular extrasystole (HVE). After EA, its occurrence rate decreased significantly (p<0.01). Following an ARC region lesion, the effect of EA in inhibiting HVE disappeared. After microinjection of morphine into the ARC region, the occurrence rate of HVE reduced (p<0.01), while after microinjection of naloxone, the inhibitory effect of EA vanished. No significant changes were found in the occurrence rate and the inhibitory rate of HVE after microinjection of naloxone or normal saline in the absence of EA (p>0.05). The researchers concluded that hypothalamic ARC and its opiate receptors participate in the inhibitory effect of EA on HVE in rabbits.
Kim AS et al. The effect of acupuncture at PC-6 on the electroencephalogram and electrocardiogram. Am J Chin Med. 2008;36(3):481-91.	A study that looked at the effect of acupuncture stimulation of the Neiguan point and a non-acupuncture point on electroencephalograms (EEGs) and electrocardiograms (ECGs) in 10 healthy people. The aim was to see the effect on cortical activation during acupuncture stimulation. There were marked differences of amplitude in EEG power between acupuncture point and non-acupuncture point stimulation. EEG signals increased considerably after acupuncture stimulation; in each frequency band, the average amplitude was higher after acupuncture stimulation; ECG heart rates were faster by at least 10% after acupuncture stimulation.
Yue J et al. Effects of acupuncture at Neiguan (PC 6) on function of sinoatrial node. [Article in Chinese]. Zhongguo Zhen Jiu. 2008 Sep;28(9):639-41.	A randomised controlled trial that assessed the effects of acupuncture at the Neiguan point on sinoatrial node function, so as to inform the clinical application of Neiguan in the treatment of heart diseases. A total of 50 patients with heart disease were randomised to either a no-blocking group or a blocking group. In the no-blocking group, sinoatrial node recovery time (SNRT), sinoatrial conduction time (SACT), sinoatrial node effective refractory period (SNERP) and heart rate (HR) were determined by using the oesophagus-left cardiac atrium regulating pulsation technique before and after acupuncture. In the blocking group, the

vegetative nerve was blocked by intravenous injection of propranolol and atropine, and then SNRT, SACT, SNERP and intrinsic heart rate (IHR) were detected before and after acupuncture. In the no-blocking group there were significant differences in SACT, SNERP and HR (all $p < 0.05$) and no significant difference in SNRT ($p > 0.05$) before and after acupuncture. In the blocking group, there were no significant differences in SNRT, SACT and SNERP and a significant difference in IHR before and after acupuncture ($p < 0.05$). The researchers concluded that acupuncture at Neiguan has a significant effect on function of sinoatrial node, and the mechanism is possibly related to the bidirectional regulative action of acupuncture at Neiguan on the autonomic nerve in the sinoatrial node.

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.

Middlekauff HR et al. Acupuncture inhibits sympathetic activation during mental stress in advanced heart failure patients. *J Card Fail*. 2002 Dec;8(6):399-406.

A randomised controlled trial that tested the hypothesis that acupuncture is sympathoinhibitory in people with heart failure. Patients with advanced heart failure were subjected to acute mental stress testing before and during either "real" acupuncture (n=10), non-acupoint acupuncture (n=10), or no-needle acupuncture (n=10). Resting muscle sympathetic nerve activity (MSNA) was no different before and after acupuncture (52 +/- 22 vs. 50 +/- 21 bursts/min, $p = \text{NS}$). During mental stress, sympathetic nerve activity increased significantly. This increase was eliminated after real acupuncture (mean change in MSNA 149 +/- 171 pre-acupuncture vs. -169 +/- 130 post-acupuncture, $p = 0.03$), but not after non-acupoint or no-needle acupuncture. The changes in blood pressure and heart rate during mental stress were not attenuated in any group. The researchers concluded that acute acupuncture attenuates sympathoexcitation during mental stress in patients with advanced heart failure.