

# A Review of the Current Acupuncture Mechanisms of Action from Both an Eastern and Western Perspective

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## INTRODUCTION

Acupuncture is a Chinese medical technique that utilizes stimulation of anatomical points on the body through a variety of techniques, although it has been synonymously identified with the use of thin, metallic needles. It has been historically practiced in China several millennia, and has been gaining popularity in the United States over the past few years [1]. In 2015, National Health Statistic Reports from the National Health Interview Survey published a report, which included a comprehensive survey on the use of complementary health approaches by Americans; roughly 3.4 million U.S. adults had used acupuncture in 2012 [2].

Traditionally, acupuncture has been used to treat a wide range of health conditions such as chronic lower back pain, nausea, headache, among others. However scientific evidence regarding its efficacy has been limited due to the difficulty of performing double-blinded studies given the nature of the procedure and appropriate sham placebo treatments [3-5].

From a Western perspective, acupuncture is typically used to treat a medical diagnosis. The desired response is a change in the body's natural processes through biochemical and physiological effects. Eastern theory for acupuncture, in contrast, is based on the idea that bodily dysfunction is caused by non-homeostatic flow of Qi/Chi through the body in channels called meridians. Still, there remains significant controversy and mystery regarding the mechanisms of how acupuncture works. For the purposes of this article, we will review current Eastern and Western theories regarding acupuncture's mechanism of action, including a literature search of recent scientific literature.

## **METHODOLOGY**

A search of databases including PubMed and Health line were performed including the key search words: Acupuncture, electro acupuncture, mechanism of action, inflammation, opioid, endorphin, blood flow, vasodilatation, functional MRI, SPECT, PET, imaging and neurotransmitters.

## **EASTERN MECHANISM OF ACTION FOR ACUPUNCTURE**

In order to understand the eastern mindset regarding acupuncture, it is important that we discuss Traditional Chinese Medicine (TCM) theory. While it is not possible cover all aspects of TCM given the vast amount of information and history, we will briefly touch upon the basics.

It is believed that Taoism helped shape the practice of Chinese medicine, which is based on belief that everything is interdependent and mutually interactive in the universe. In turn, the body communicates with the universe or environment; when changes occur and the body fails to adapt, then disease is likely to occur [6].

Compared to Western medicine, Eastern philosophy of medicine involves numerous interweaving ideas that may be considered foreign or non-scientific in nature. Concepts such as Qi/Chi (innate vital substance or energy), Yin-Yang Theory, Eight Principles (Interior/Exterior, Hot/Cold, Full/Empty, Yin/Yang), Five-Element Theory, Meridian system, and several others are abstract ideas that were used to explain relationships and patterns that occurred in nature [6]. There are no Western equivalents to these ideas, which may contribute to the unfamiliarity and slow acceptance of TCM outside of Asia.

From the TCM perspective, the body is considered as a whole, made of parts interconnected; parts that can depend and/or restrict each other physiologically and pathologically. The five organs (yin organs) make up the core units of the body and are linked through various meridians, or channels, which are interrelated to yang organs. Although meridians work as a complex system which carries and distributes qi and blood, they are not blood vessels and have no anatomical channel structure; nor are they visible [6]. The idea is similar to how a river flows, with obstruction along the river channels producing illness further downstream in the body. Acupuncture is therefore able to help restore the flow and return the body to normal through stimulation of points on the meridian system.

**Table 1:** The five organ systems of the body [7].

Organ	Paired organs
Heart	Small intestine
Liver	Gall bladder
Spleen	Stomach
Lung	Large intestine
Kidney	Bladder

Meridians are classified into two groups which correlate with Yin and Yang organs. They are further delineated with 3 arm yin, 3 arm yang, 3 leg yin, and 3 leg yang meridians.

**Table 2:** The Meridian System [8].

Channels	Organ	Pathway
3 Yin Meridians of the Hand	Lung, Heart, Pericardium	Chest to Hand
3 Yang Meridians of the Hand	Large Intestine, Small Intestine, Triple Burner	Hand to Face
3 Yang Meridians of the Foot	Stomach, Bladder, Gallbladder	Face to Foot
3 Yin Meridians of the Foot	Spleen, Kidney, Liver	Foot to Chest

The triple burner and the pericardium do not refer to anatomical structures, but are functional units in TCM [9]. The triple burner is considered to be representative of energy centers in the chest (heart and lungs), abdomen (stomach and spleen), and pelvis (liver, kidney, large intestine, small intestine, and bladder). It does not refer to the physical location of the organ, but rather where energy is produced and supplies the rest of the organs [10].

Acupuncture theory involves a system of differentiating disease patterns in the body. It is generally believed that diseases can be treated when the affected meridians or the affected organs are cleared. Acupuncture is used as a tool to help move Qi by utilizing meridian points on the body which are believed to aid in returning the body to its normal state of balance [9].

## WESTERN MECHANISM OF ACTION FOR ACUPUNCTURE

Although acupuncture is just one component of traditional Chinese medicine, its precise effects on the human body remains an area on ongoing investigation. From a Western perspective acupuncture induces effects on neuropeptides, local circulation, inflammation, and the Central Nervous System (CNS).

## NEUROTRANSMITTERS

Multiple neurotransmitters have been implicated in acupuncture's mechanism of action from a Western perspective. The main neurotransmitters mechanisms for acupuncture include an increase in endogenous opioids and a decrease in substance P.

## Endogenous Opioids

An increase in endogenous opioids in plasma or cerebrospinal fluid has been observed in humans who receive electro acupuncture [11]. Analgesic relief involves the activation of endogenous opioid systems and mu-opioid receptors (MOR) has also been shown in animal models[5,12,13]. Furthermore, part of the response to electro acupuncture is antagonized by the opioid receptor antagonist naloxone [14]. Han further deciphered that low-frequency (2 Hz) electro acupuncture induces the activation of mu- and delta-opioid receptors via the release of enkephalin, beta-endorphin, and endomorphin in in supraspinal CNS regions, whereas the effects of high-frequency (100 Hz) electro acupuncture involve the actions of dynorphin on kappa opioid receptors in the spinal cord [15]. Studies performed by Harris et al, have shown that acupuncture therapy evoked not only short-term increases in MOR binding potential, but also long-term increases in multiple pain and sensory processing regions of the brain. These effects on MOR binding potentials were absent in the sham acupuncture group [5].

## Substance P

Substance P (SP) exists in primary afferents that respond to painful stimuli and appears to transmit pain information into the central nervous system [16,17]. Electro Acupuncture (EA) and moxibustion have been shown to down regulate expressions of abnormally increased colonic mucosa-associated neuropeptide SP in patients with irritable bowel syndrome [17]. Immuno fluorescence studies of SP in the spinal cord, and dorsal root ganglion tissues in rats also suggest a possible involvement of the primary SP-positive sensory neurons in the transmission of acupuncture stimulation signals [19].

## Other Possible Neuropeptides involved in Acupuncture's Mechanism of Action

Animal studies on the effect of acupuncture and moxibustion interventions in depression rats suggest an up-regulation response of 5-hydroxytryptamine (5-HT)/ hydroxyindole acetic acid (5-HIAA), and down-regulation of tryptophan content in the frontal cortex [20]. Another mechanism by which acupuncture has been reported in the literature is through the up-regulation of the Glutamate receptor 1 in the amygdala [21].

## Direct CNS Effects

Increases in both regional cerebral blood flow and glucose metabolism in the central nervous system have occurred following both manual acupuncture and electro acupuncture [22,23]. Studies performed within the last decade have shown that acupuncture induces different effects on the human brain as displayed through the use of a Functional Magnetic Resonance Imaging machine (FMRI) [24,25]. Acupuncture while utilizing FMRI, Single-Photon Emission Computed Tomography (SPECT), and Positron Emission Tomography (PET) showed acupuncture altered brain activity, increased cerebral blood flow, and increased glucose metabolism [26].

## Increase in Local Blood Flow

Acupuncture has been shown to increase the nitric oxide levels in treated regions, resulting in increased local blood circulation [27-30]. In a RCT acupuncture increased nitric oxide activity along meridians and the change in circulation was associated with reduced pain [28]. The vasodilatory effects were not seen in noninvasive sham-acupuncture treatments [28]. In another study, acupuncture stimulation was used on patients and showed increase in local blood flux through the use of laser Doppler flowmetry before, during and after the acupuncture stimulation [31]. Indocyanine green perfusion imaging has also confirmed the vasoactive effect of acupuncture [32].

## Anti-inflammatory Mechanism of Action

Acupuncture can reduce swelling and local inflammation [33,34]. In animal studies, electroacupuncture has been shown to reduce chronic inflammatory pain and is hypothesized to be related to up regulation of MrgprC gene expression which can modulate neurogenic inflammation [33]. Clinical evidence suggests that acupuncture improves allergic inflammation and symptoms of allergic rhinitis [35]. This modulation appears to be associated with down-regulation of allergen specific IgE for house dust mite [36].

Recent animal studies also suggest that electrical acupuncture at ST36 might be a useful and promising therapeutic for allergic inflammatory as well as Th1-mediated inflammation response [35]. One study suggests that the therapeutic effects of acupuncture may be mediated through vagal modulation of inflammatory responses in internal organs via production of TNF- $\alpha$  and c-Fos [37]. In another recent animal study, acupuncture treatment significantly decreased the levels of pro-inflammatory cytokines in the hippocampus, prefrontal cortex, and serum suggesting that that acupuncture's mechanism of action involves the inhibition of pro-inflammatory cytokines [38].

## CONCLUSION

Acupuncture remains an area where several questions remain to be answered. It's variety of effects on the human body are challenging to explain from one perspective. By looking at both the Eastern and Western proposed mechanisms for acupuncture, we believe one can obtain a better understanding of ways in which acupuncture likely exerts its effects.

While Western mechanisms are mainly focused on endogenous opioid response, a reduction in inflammation, increased peripheral blood flow, and metabolic and vascular CNS effects, the Eastern mechanism focuses on the flow of Qi through meridians. Although without the scientific rigor, the Eastern (Qi) mechanism of action provides an interesting contrasting perspective that does not have Western equivalents. Some studies have provided some insight into the mechanisms of acupuncture, but one can only obtain a holistic view of its mechanism of action by looking at both the Western and Eastern perspectives.

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