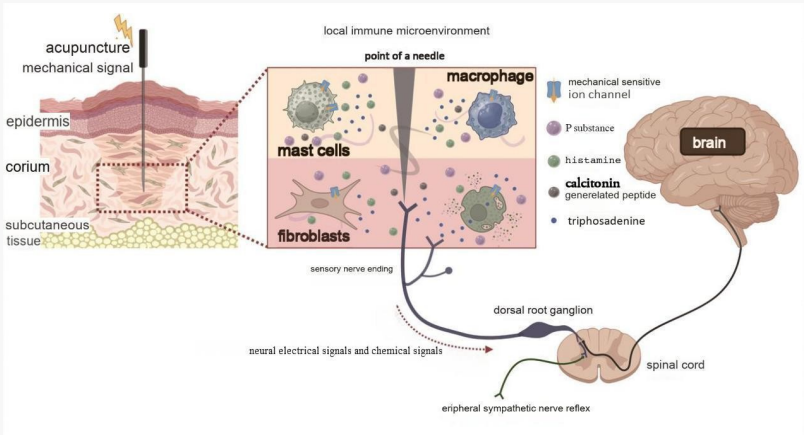
How acupuncture rewires neuro-immune circuits to treat disease at its root

GA, UNITED STATES, May 12, 2026 /EINPresswire.com/ -- Acupuncture has long been used to restore physiological balance, yet its biological basis has remained elusive. Recent research reveals that acupuncture operates through neuro-immune regulatory circuits rather than isolated local effects. Mechanical stimulation at acupoints is converted into neural electrical and biochemical signals, reshaping local immune microenvironments and triggering coordinated responses across the nervous system. These signals engage somatosensory pathways, autonomic nerves, and the gut–brain axis to recalibrate immune homeostasis at both local and systemic levels. By mapping how physical stimulation is encoded into neural activity and translated into immune regulation, the research reframes acupuncture as a form of targeted neuromodulation with broad relevance for inflammatory and immune-related diseases.



The molecular network of the transduction of mechanical signals from acupuncture into neural electrical signals and chemical signals.

Traditional explanations of acupuncture often emphasize direct acupoint–organ relationships, focusing on local stimulation or endpoint physiological changes. However, such linear relations overlook the complex neural and immune intermediates involved. With the rapid development of neuroscience and immunology, the research on acupuncture's regulation of somatic sensory-autonomic reflex mechanisms is undergoing a revolution. These discoveries change the cognition of the long-standing separation between nervous and immune systems and call for integrative frameworks capable of explaining systemic regulation. In this context, understanding how acupuncture activates somatosensory–autonomic reflexes and orchestrates immune balance has become increasingly important. Based on these challenges, deeper investigation into acupuncture-driven neuro-immune mechanisms is required.

Researchers from Fudan University and the China Academy of Chinese Medical Sciences published a comprehensive review in Acupuncture Research in May 2025. The study

systematically synthesizes recent experimental and translational evidence showing that acupuncture regulates immune function through defined neural circuits. By integrating neuroanatomy, immunology, and systems biology, the authors demonstrate how acupoint stimulation activates somatosensory neurons, autonomic pathways, and enteric networks to achieve coordinated immune modulation across multiple organs.

The article shows that acupuncture begins with mechanical stimulation at acupoints, where forces are transduced into neural signals via mechanosensitive receptors and connective tissue interactions. These signals activate specific sensory neurons in dorsal root and trigeminal ganglia, which relay information to the spinal cord and brainstem. Central integration then engages autonomic outputs, including vagal, sympathetic, and hypothalamic–pituitary–adrenal pathways, enabling precise temporal and spatial immune regulation.

At the local level, acupuncture rapidly remodels the immune microenvironment by inducing controlled neurogenic inflammation, increasing blood flow, and coordinating interactions among sensory nerves, mast cells, fibroblasts, and immune mediators. Systemically, vagus nerve–dependent anti-inflammatory pathways suppress excessive inflammatory factor release, while sympathetic dynamically adjust immune cell activity depending on disease stage. The study also highlights the role of the enteric nervous system, showing how acupuncture strengthens gut barrier integrity and modulates microbiota–neuropeptide interactions to influence whole-body immunity.

Importantly, stimulus parameters such as intensity, frequency, and depth determine which neural circuits are engaged, explaining acupuncture's bidirectional and context-dependent effects. Together, these findings establish a structured "mechanical stimulation–neural coding–immune response" framework that translates traditional holistic concepts into modern neurobiological language.

The authors note that these findings reposition acupuncture within contemporary neurobiology. Rather than acting as a generalized placebo or local intervention, acupuncture functions as a form of programmable neuromodulation that influence sensory nerves and autonomic pathways. By decoding how different stimulation parameters activate specific neural circuits, acupuncture can be aligned with emerging bioelectronic medicine strategies. This mechanistic clarity, they emphasize, provides a scientific foundation for integrating acupuncture-inspired approaches into modern treatment paradigms for immune and inflammatory disorders.

Understanding acupuncture as a circuit-based neuro-immune intervention opens new translational possibilities. The findings support the development of precision acupuncture protocols and bioelectronic devices. Such approaches could offer non-pharmacological alternatives for managing chronic inflammation, autoimmune diseases, pain, and gut-related disorders. More broadly, the work bridges traditional medicine and modern systems neuroscience, demonstrating how ancient therapeutic principles can inform next-generation neuromodulation technologies. As multi-omics data and artificial intelligence are integrated into

this framework, acupuncture may help shape personalized, circuit-targeted therapies that restore immune balance rather than merely suppress symptoms.

References

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Lucy Wang
BioDesign Research
email us here