International Journal of General Medicine

Dovepress
Taylor & Francis Group

Open Access Full Text Article

REVIEW

A Review of Acupuncture for Allergic Disorders: Modulation of Mast Cell Regulation via Inflammatory Pathway Suppression and Cytokine Balance

Yuan Li[1,*], Ying Meng[2,*], Chen Chen[3], Kexin Jiang[4], Ji Li[1]

[1]School of Basic Medical Science, Heilongjiang University of Chinese Medicine, Harbin, Heilongjiang, 150040, People's Republic of China; [2]Personnel Department, Beidahuang Group General Hospital, Harbin, Heilongjiang, 150036, People's Republic of China; [3]Department of the Ward 5 of Acupuncture and Moxibustion, The Second Affiliated Hospital of Heilongjiang University of Traditional Chinese Medicine, Harbin, Heilongjiang, 150040, People's Republic of China; [4]Graduate School, Heilongjiang University of Chinese Medicine, Harbin, Heilongjiang, 150040, People's Republic of China

*These authors contributed equally to this work

Correspondence: Ji Li, School of Basic Medical Science, Heilongjiang University of Chinese Medicine, Harbin, Heilongjiang, 150040, People's Republic of China, Email j1906956088@163.com

Objective: Mast cells drive allergic diseases (asthma, rhinitis, dermatitis) via degranulation and pro-inflammatory mediator release. This review explores acupuncture's role in modulating mast cells to alleviate allergic symptoms.

Methods: We screened PubMed and Embase databases from January 2010 to January 2025 to search for published studies. The search keywords used are as follows: ["acupuncture" or "electroacupuncture"], ["allergic disease" or "asthma" or "allergic rhinitis" or "dermatitis" or "urticaria"], ["mast cell"]. 365 peer-reviewed studies on human/animal models were included, and articles that did not meet the requirements were excluded.

Results: Acupuncture inhibited mast cell degranulation, reducing histamine and IgE levels. It downregulated pro-inflammatory cytokines (TNF-α, IL-4, IL-5, IL-13) and upregulated anti-inflammatory IL-10, via suppressing NF-κB, MAPK (p38, ERK), and TLR4/MyD88 pathways. Clinically, it improved asthma (FEV1/PEF elevation), allergic rhinitis, and atopic dermatitis. Preclinically, it reduced eosinophil infiltration and inhibited NLRP3/caspase-1-mediated pyroptosis, further mitigating inflammation.

Conclusion: Acupuncture alleviates allergic disorders by targeting mast cells and inflammatory cascades, supporting its potential as a safe, effective therapeutic option.

Keywords: acupuncture, mast cells, allergic diseases, allergic asthma, traditional Chinese medicine, immune system

Introduction

Allergic diseases refer to a category of disorders caused by abnormal immune responses, typically characterized by hypersensitivity to common environmental substances such as mold, insects, pollen, dust mites, and food.[1] These diseases primarily include allergic rhinitis, allergic asthma, atopic dermatitis, food hypersensitivity, and others. The pathogenesis of allergic diseases is complex, involving multiple factors such as genetic, environmental, and immunological influences.[2] With changes in modern lifestyle, the incidence of allergic diseases has shown an upward trend, significantly impacting patients' quality of life. These conditions not only cause physical discomfort but may also trigger psychological issues such as anxiety and depression, further affecting patients' daily life and social capabilities.[3,4]

The pathogenesis of allergic diseases primarily involves immunoglobulin E (IgE)-mediated allergic reactions and non-IgE-mediated responses. IgE-mediated reactions typically involve mast cell activation and degranulation, leading to the release of histamine and other inflammatory mediators, which trigger a series of allergic symptoms.[5] Additionally, mast cells contribute to the maintenance of chronic inflammation in allergic reactions, promoting the chronicity of allergic diseases.[6,7] Abnormal activation of mast cells is not only associated with the development of allergic diseases but

Received: 8 November 2025
Accepted: 13 December 2025
Published: 22 December 2025

may also exacerbate other immune system disorders. Therefore, targeting mast cell regulation has become a key direction in the treatment of allergic diseases.

Acupuncture, a traditional Chinese medical therapy with a long history, has increasingly gained recognition in modern medicine.[8] Its fundamental theory involves stimulating specific acupoints to regulate the body's qi and blood, thereby achieving the goal of disease treatment.[9] In recent years, a growing body of research has demonstrated that acupuncture exhibits significant effects in modulating immune responses and reducing inflammation. Especially in the treatment of allergic diseases, acupuncture is believed to alleviate allergic symptoms by regulating mast cell function and reducing their degranulation response.[10,11] Needling Yingxiang (LI20) or sphenopalatine ganglion acupuncture alleviates AR's nasal symptoms and reduces recurrence, while its anti-allergic mechanisms involve rebalancing Th1/Th2 cytokines (upregulating IFN-γ, downregulating IL-4/IL-5), lowering serum IgE (inhibiting mast cell activation), and suppressing NFκB-mediated inflammation.[12–16]

Current research on acupuncture and allergic diseases indicates that acupuncture not only improves symptoms of conditions such as allergic rhinitis and allergic asthma but may also exert anti-allergic effects by regulating the number and function of mast cells and influencing the expression of related cytokines.[7,17] For example, studies have found that acupuncture can significantly reduce serum IgE levels in patients with allergic diseases and inhibit mast cell degranulation, providing strong scientific evidence for its application in treating allergic conditions.[6,18] However, despite the growing recognition of acupuncture's potential in allergic disease therapy, more clinical trials and mechanistic studies are still needed to further validate its efficacy and safety.

Method

Search Strategy

We screened PubMed and Embase databases from January 2010 to January 2025 to search for published studies. The search keywords used are as follows: ["acupuncture" or "electroacupuncture"], ["allergic disease" or "asthma" or "allergic rhinitis" or "dermatitis" or "urticaria"], [["mast cell"]. We only search for English publications. Preliminary screening is conducted using search engines provided by various databases. After deleting 128 duplicate records, we identified 1025 related articles.

Study Selection

Before reading the full texts of the selected papers, we used Endnote software to identify references relevant to the topic. Among them, 32 articles lacked full-text abstracts, 156 were irrelevant to acupuncture and allergic diseases, 253 were reviews or meta-analyses, and 219 clinical research articles. Finally, 365 full-text original research papers relevant to the topic were included. The flowchart of the search process is shown in Supplementary Figure 1.

Data Extraction

Given the overlapping nature of the research content, this study adopted a targeted approach to select representative literature and focused on extracting key data on how acupuncture treats allergic diseases through mast cell regulation. A predefined data extraction form was used to systematically collect information, which included the types of allergic diseases, intervention details (treatment protocols, acupoint selection, and acupuncture parameters), and outcome metrics (inflammatory phenotypes and mechanism-specific assays). Data extraction was first conducted by the primary author and then cross-checked by other authors. Through double verification, we ensured data integrity and reliability, laying the foundation for subsequent analyses of efficacy and mechanisms.

Pathophysiological Mechanisms of Allergic Diseases

The pathophysiological mechanisms of allergic diseases involve complex immune responses and the participation of multiple cell types. An allergic reaction is typically triggered by the immune system's excessive response to harmless environmental substances such as Mold, insects, pollen and dust mites.[19] Allergic reactions can be classified into four types, with the IgE-mediated type I reaction being the most common. This reaction involves the production of specific

IgE antibodies, which bind to mast cells and basophils, leading to the release of histamine and other inflammatory mediators from these cells upon re-exposure to allergens, thereby triggering allergic symptoms.[20]

The immune system plays a central role in allergic reactions, particularly involving immune cells such as T cells, B cells, mast cells, and basophils.[21] When an allergen first enters the body, B cells produce specific IgE antibodies that bind to high-affinity IgE receptors (FcεRI) on the surface of mast cells. Upon re-exposure to the same allergen, the allergen cross-links these IgE antibodies, triggering mast cell degranulation and the release of histamine, leukotrienes, and other inflammatory mediators, which in turn initiate allergic reactions.[20,22] Additionally, cytokines such as IL-4 and IL-13 play critical roles in promoting T cell differentiation into Th2 cells and regulating IgE synthesis, further exacerbating the development of allergic responses.[23]

In allergic reactions, mast cells and basophils serve as the primary mediator cells.[24] Through binding IgE via their surface FcεRI receptors, mast cells act as the primary effector cells in allergic reactions. Upon exposure to allergens, they rapidly release various bioactive substances such as histamine, peptides, and cytokines, leading to vasodilation, smooth muscle contraction, and recruitment of inflammatory cells.[25,26] Basophils also participate in allergic reactions, releasing mediators that exacerbate inflammatory responses and cause tissue damage. Additionally, dendritic cells initiate allergic reactions by capturing and presenting allergens to activate T cells during the early stage, further driving the progression of allergic responses.[27]

The clinical manifestations of allergic diseases are diverse, commonly including allergic rhinitis, asthma, atopic dermatitis, and food hypersensitivity.[28] Symptoms of these conditions can range from mild manifestations such as nasal congestion, runny nose, and sneezing to severe symptoms like dyspnea, skin itching, and abdominal pain.[29,30] Based on the duration and severity of symptoms, allergic diseases are classified into acute and chronic categories. Acute allergic reactions typically present with rapidly emerging symptoms such as urticaria and anaphylactic shock, whereas chronic allergic conditions like allergic rhinitis and asthma are characterized by long-term symptoms and recurrent episodes.[31,32] Management of these conditions typically requires comprehensive consideration of patients' allergens, symptoms, and their severity to develop individualized treatment plans.

Biological Characteristics of Mast Cells

Mast cells are a critical type of immune cell, primarily originating from hematopoietic stem cells in the bone marrow.[33] They are generated by the yolk sac and embryonic liver during early embryonic development, subsequently replaced by bone marrow-derived progenitor cells.[34] Mast cells exhibit extensive distribution throughout the body, primarily localized in tissues such as the skin, respiratory tract, gastrointestinal tract, and perivascular areas.[35] Their tissue-specific localization is closely associated with their functions, particularly in orchestrating allergic reactions and immune responses. Studies indicate that the number and activity of mast cells in different tissues are influenced by multiple factors, including the local microenvironment, inflammatory status, and their interactions with other immune cells.[25,36]

Mast cells express FcεRI, C-KitR, toll-like receptors (TLRs), recombinant purinergic receptor P2X, ligand gated lon channel 7 (P2RX7), and other receptors on their surface. Mast cells exert their functions only after activation, which primarily occurs through two pathways: IgE-mediated and non-IgE-mediated.[37] IgE-mediated activation occurs when specific antigens bind to FcεRI on mast cell surfaces, leading to a rapid increase in intracellular calcium ion concentration and thereby triggering degranulation to release bioactive substances such as histamine and cytokines.[37,38] Non-IgE-mediated activation pathways include pathogen-associated molecular patterns (PAMPs) (eg, endotoxin) and products derived from the innate immune system (eg, complement components, cytokines, and endogenous peptides).[39] Studies have shown that calcium ionophores can promote the opening of calcium release-activated calcium (CRAC) channels, increasing intracellular Ca^{2}+ concentration to activate mast cells.[40] Additionally, TLR activation typically triggers mast cell activation, with some TLRs also inducing the release of lipid mediators. Similarly, activation of adenosine A3 receptors and ATP-gated P2X7 receptors on mast cells triggers the release of inflammatory mediators. Recent research has identified that Mas-related G protein-coupled receptor X2 (MRGPRX2) plays a critical role in non-IgE-mediated mast cell activation, providing new insights into understanding drug-induced pseudoallergic reactions.[41,42] Furthermore, both endogenous and exogenous stimuli can activate mast cells through different receptors, thereby regulating their functions and mediator release.[42,43]

Mast cells play a central role in allergic reactions. By releasing mediators such as histamine, leukotrienes, and prostaglandins, they rapidly induce local and systemic inflammatory responses, leading to the emergence of allergic symptoms like urticaria and asthma. Activation of mast cells triggers two critical events: first, phosphorylation of phospholipase Cγ1 (PLC-γ1) mediates an increase in intracellular calcium levels, leading to the release of proteases, proteoglycans, and neuropeptides stored in mast cell granules;[44] second, activation of NF-κB mediates the secretion of lipid mediators and cytokines, which enhance the expression of numerous inflammation-related genes and influence endothelial, epithelial, and smooth muscle cells, thereby contributing to the pathogenesis of asthma.[36,41,45] Additionally, mast cells regulate the intensity and nature of immune responses through interactions with other immune cells, impacting the progression of allergic diseases. As illustrated in Figure 1, these findings provide potential targets and insights for developing novel allergic treatment strategies.

Regulation of Acupuncture on Mast Cells

Acupuncture, a core therapeutic modality of traditional Chinese medicine and an internationally recognized form of complementary and alternative medicine, is widely used globally. Clinical studies have shown that key acupoints for treating allergic diseases include Danzhong (RN17), Zhongfu (LU1), Zusanli (ST36), Dingchuan (EX-B1), Dazhui (GV14), and Fengmen (BL12).[46–48] These acupoints are primarily distributed along the Lung Meridian (LU), Conception Vessel (CV), Stomach Meridian (ST), and Bladder Meridian (BL), which are highly consistent with data from TCM clinical meta-analyses and practical applications. In addition to these commonly used points, auxiliary

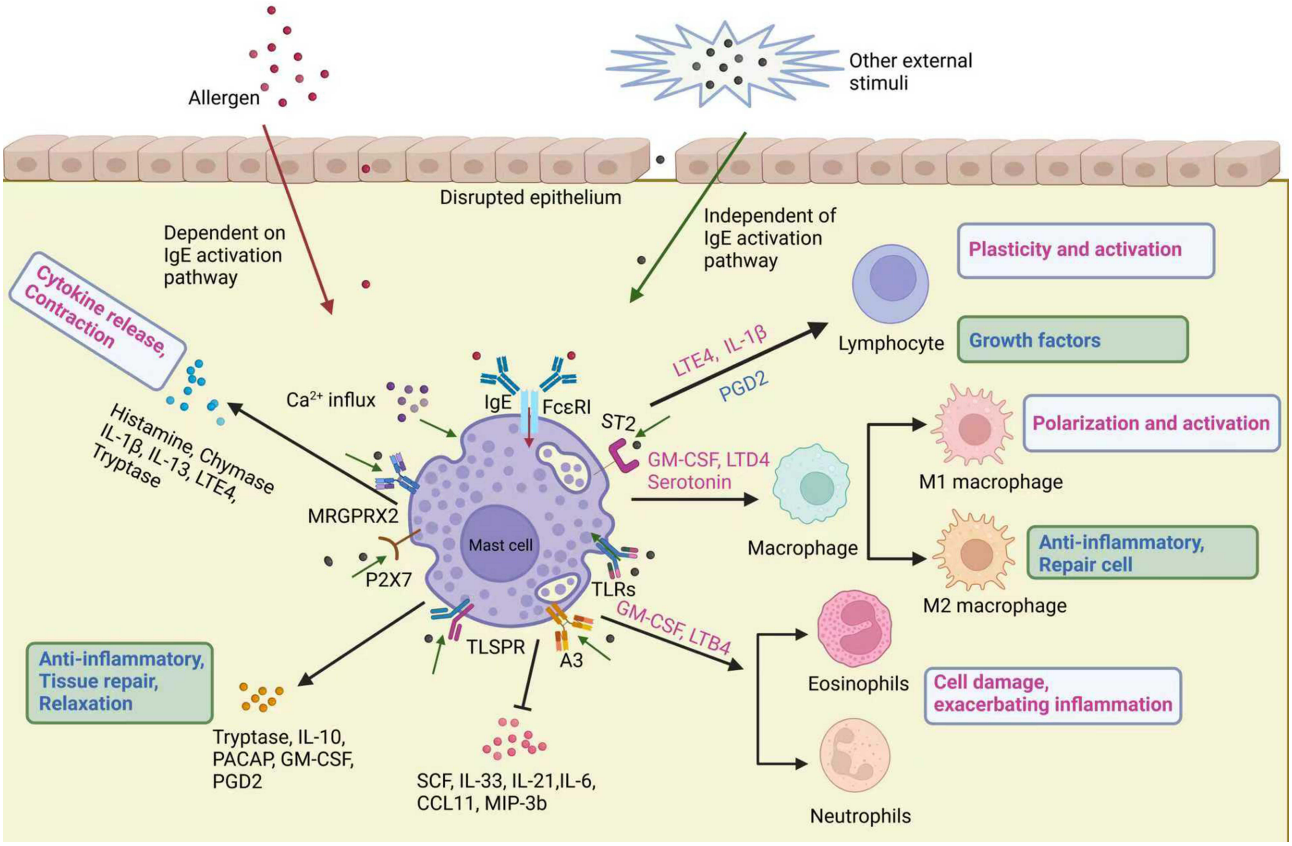

Figure 1 The role of mast cells in allergic reactions. Mast cells have a bidirectional effect. On the one hand, mast cells release multiple mediators after activation, which exacerbate inflammation by activating other cells (pink). On the other hand, mast cells regulate their own activation and protease production, which can inactivate pro-inflammatory cytokines and control airway inflammation. They also participate in repairing the airway epithelial barrier by releasing growth factors and promoting anti-inflammatory M2 macrophage polarization (blue). The red dots represent allergens; The dark gray origin represents other external stimuli; The purple origin represents calcium ions; The yellow dots represent anti-inflammatory factors; Pink dots represent pro-inflammatory factors.

Abbreviations: GM-CSF, Granulocyte-Macrophage Colony Stimulating Factor; LTB4, Leukotriene B4; LTD4, Leukotriene D4; LTE4, Leukotriene E4; PGD2, Prostaglandin D2; CCL11, C-C Motif Chemokine Ligand 11; MIP-3b, Macrophage Inflammatory Protein 3 beta; PACAP, Pituitary Adenylate Cyclase-Activating Polypeptide; SCF, Stem Cell Factor.

acupoints such as Fuliu (KI7), Bishu (BL20), Yuji (LU10), Lieque (LU7), Fenglong (ST40), and Feishu (BL13)[49–51] also play important roles in relieving allergic symptoms, with their anatomical locations concentrated on the back and limbs (Supplementary Figure 2).

In recent years, the mechanism by which acupuncture exerts therapeutic effects through immune system regulation has become a research hotspot in this field. Studies have shown that acupuncture stimulation can significantly affect the activity of mast cells.[52] Mast cells are widely distributed throughout the body, particularly in tissues such as the skin and mucous membranes, where they play a critical role in immune and allergic responses. Acupuncture stimulation activates mechanosensitive channels in mast cells (eg, TRPV1, TRPV2, and TRPV4), promoting their degranulation and leading to the release of bioactive substances such as histamine and adenosine triphosphate (ATP). These substances exert important physiological functions in the local microenvironment.[18,53] Additionally, acupuncture stimulation can enhance the body's immune response and anti-inflammatory capacity by altering the microenvironment of local tissues, thereby promoting mast cell proliferation and activity.[54] These mechanisms provide a scientific basis for the application of acupuncture in pain management and anti-inflammatory therapy.

Acupuncture not only activates mast cells but also regulates the mediators they release. Studies have found that following acupuncture stimulation, the release of mediators such as histamine, serotonin, and adenosine from mast cells increases significantly, which play a key role in pain transmission and inflammatory responses.[53,55] For example, acupuncture induces the release of more serotonin from mast cells by stimulating specific acupoints. This substance not only participates in pain modulation but also enhances local blood flow and immune responses through interaction with neural receptors, thereby exerting analgesic effects.[56] Additionally, acupuncture can reduce the release of inflammatory mediators by regulating the degranulation process of mast cells, further alleviating pain and discomfort caused by chronic inflammation.[18]

Acupuncture influences mast cell function through multiple signaling pathways. Studies have shown that acupuncture stimulation can activate multiple intracellular signaling pathways in mast cells, including NF-κB, MAPK, and ERK, which play a central role in regulating mast cell activity and mediator release.[10,11] For example, acupuncture promotes mast cell degranulation and the release of growth factors by activating the MAPK signaling pathway, thereby enhancing local immune responses and anti-inflammatory capacity.[18] Additionally, acupuncture can modulate intracellular calcium ion concentration to affect mast cell signal transduction, thereby regulating their function and mediator release.[11,53] These mechanisms provide new perspectives and theoretical foundations for the application of acupuncture in treating allergic and inflammatory diseases.

Clinical Application of Acupuncture in Allergic Diseases

Analysis of Therapeutic Effect of Acupuncture on Asthma

Acupuncture has demonstrated promising therapeutic effects in asthma treatment, as shown in Table 1. Recent studies on acupuncture mediated asthma management through immune system regulation emphasize that Th cell imbalance plays a key role in the development of asthma. Within the respiratory system, Th2 cells secrete cytokines including IL-3, IL-4, IL-5, and IL-6, which activate eosinophils to combat extracellular pathogens and stimulate B-cell proliferation for antibody production. However, inappropriate immune responses triggered by such pathways can lead to conditions like allergies and asthma.[57] Multiple studies have demonstrated that acupuncture can alleviate airway inflammation and improve symptoms in asthma patients by modulating immune responses. For instance, acupuncture effectively reduces airway hyperresponsiveness, decreases bronchial inflammation, and enhances pulmonary function indices such as forced expiratory volume in one second (FEV_1) and peak expiratory flow (PEF).[50]

Additionally, acupuncture exerts anti-inflammatory effects by regulating the Th1/Th2 cell balance and inhibiting the release of allergic mediators.[67] Studies have shown that acupuncture stimulation of the GV14, BL12, and BL13 acupoints upregulates IL-2, IL-12, the Treg marker Foxp3, and IL-10, while downregulating IL-4, IL-5, IL-13 and IL-17A in lung tissues. This shifts the asthma model from a Th2/Th17-dominated phenotype to a Th1/Treg-dominated state. Additionally, Th1 cells further induce T-cell proliferation, and acupuncture mitigates airway inflammation in allergic asthma by stimulating this regulatory cascade. In murine asthma models, further upregulation of Treg cytokines and downregulation of Th17 cytokines have been confirmed to protect pulmonary function, reduce airway inflammation, and

Table 1 Investigation of Acupuncture in the Treatment of Allergic Asthma

Reference	Model	Interventions	Acupoints	Acupuncture Parameters	Biochemical Measurements	Conclusion
Carneiro ER, 2010[58]	Rats	EA	GV14, BL13, EX-B1, LU1, RN17, ST36, SP6	Every other day for 2 weeks	IL-1↑, IFN-γ↑, IL-4↑, NO↓, IL-10↓, LTB↓	The beneficial anti-inflammatory effect of EA on asthma is related to the balance of Th1/Th2 response and the reduction of LTB4 and NO.
Wei Y, 2015[59]	Mice	MA	GV14, BL13, BL12	Every other day for 4 weeks	IL-17A↓, IL-17F↓, IL-22↓, IgE↓, IL-17R↓, RORγt↓, p65↓, IKKα↓	MA may treat asthma by regulating Th17, Treg activity and NF-κB pathway
Wei Y, 2017[60]	Mice	MA	GV14, BL12, BL13	30min /every other day for 4 weeks	TNF-α↓, IL-1β↓, IL-5↓, eotaxin↓, Tol↓, Neu↓, Lym↓, Eos↓	Acupuncture can alleviate airway inflammation and regulate HPA axis and immune function in OVA induced mouse asthma model.
Dong M, 2018[61]	Rats	MA	GV14, BL12, BL13	Manual manipulations every 10 min in 30 min	TNF-α↓, IL-1β↓, IL-33↓, sST2↑	MA can effectively protect lung function and reduce airway inflammation in OVA induced asthma mouse model.
Nurwati I, 2018[62]	Rats	MA	BL13, ST36	15 min x3/ week, 6 weeks from 21st day after modeling	Neutrophil↓, Eosinophil↓	MA can reduce inflammatory reaction and prevent airway remodeling in chronic asthma mouse model.
Liu YL, 2018[63]	Rats	MA	BL13	3 weeks	ChAT↓, AchE↑, mAchRs M1-M3↑	MA may treat allergic asthma by inhibiting the synthesis and release of Ach signal
Dong M, 2019[64]	Rats	MA	GV14, BL12, BL13	30 min x3/week for 4 weeks.	IL-10↑, IL-5↓, IL- 13↓, IL-17↓, p-p38↓, p-p44/ 42↓	MA can alleviate allergic airway inflammation by enhancing the activities of Th1 and Treg, thus regulating the balance of CD4+T cell subtypes in experimental asthma mice.
Cui J, 2021[65]	Rats	MA	GV14, BL12, BL13	Twisted 360°, 60 times/min, 5 times, 20 min	IL-5↓, IL-9↓, IL-13↓, IL-25↓, IL-33↓, sST2↑	The inhibition of acupuncture on ILC2 may be related to the IL-33/ST2 signaling pathway and the level of IL-25, thus preventing asthma related airway inflammation.
Zhao H, 2021[66]	Mouse	MA	GV14, BL13, ST36	Every other day for 13 days	ATG5↓, Beclin-1↓, p62↓, LC3B↓, p-PERK↓, p-IRE-1↓, Grp78↓, ATF6↓, IFN-γ↑, IL-4↓, IL-17↓, TGF-β↓	Regulating endoplasmic reticulum stress and CD4+T lymphocyte differentiation by inhibiting ATG5 mediated autophagy, thereby reducing airway inflammation and AHR in asthma.
Tang W, 2022[67]	Rats	MA	GV14, BL12, BL13, GB30	Twisted 360°, 60 times/minx 4 times for 20 min	IL4↓, IL13↓, non-haem Fe^{2+} level↓	MA can alleviate the deterioration related to iron death in airway inflammation.

(*Continued*)

Table 1 (Continued).

Reference	Model	Interventions	Acupoints	Acupuncture Parameters	Biochemical Measurements	Conclusion
Yu Y, 2023[68]	Rats	MA	GV14, BL12, BL13	Once every other day	p-p38MAPK↓	Inhibit the proliferation of ASMCs
Qiao Y, 2024[69]	Rats	MA	BL13, EX-B1, LU6, LU10	30min x 7/ weeks for 2 weeks	TNF-α↓, ET-1↓, cGMP↓, cAMP↑	Relieve airway smooth muscle spasms.
Miao XY, 2025[15]	Rats	MA	GV14, GV12	20min x 7/ weeks for 20 days	IgE↓, IL-4↓, IL-5↓, PI3K/AKT↓	Inhibit airway remodeling and delay epithelial mesenchymal transition in allergic asthma rats.

Notes: ↑: Increased expression/level; ↓: Decreased expression/level.
Abbreviations: MA, Manual acupuncture; EA, Electroacupuncture; CV22, Tiantu; EX-HN9, Neiyingxiang; GV12, Shenzhu; GV14, Dazhui; BL12, Bilateral Fengmen; BL13, Feishu; BL20, Bishu; BL23, Shenshu; RN17, Danzhong; ST36, Zusanli; EX-B1, Dingchuan; LU1, Zhongfu; LU5, Chize; SP6, Sanyinjiao; GB30, Huantiao; ST40, Fenglong; Tol, Total leukocyte; Neu, neutrophil; Lym, lymphocyte; Eos, eosinophil; ChAT, Synthetase; Ach, Acetylcholine; AchE, Ach hydrolase; mAchRs, Muscarinic receptors; IKKα, NF-κB kinase-α; ASMCs, Airway smooth muscle cells.

decrease mucus secretion.[64] The regulatory effects of acupuncture on Th cells can also be mediated through the IL-33/ST2 pathway. Studies have demonstrated that acupuncture stimulation of the GV14, BL12, and BL13 acupoints upregulates soluble ST2 (sST2), thereby inhibiting the binding of IL-33 to the ST2L receptor and downregulating the levels of TNF-α, IL-1β, and IL-33 in the respiratory tissues.[61] Notably, acupuncture also suppresses the expression of innate lymphoid cells type 2 (ILC2) by upregulating sST2, which subsequently downregulates IL-33 and IL-25 levels. This mechanism alleviates ovalbumin-induced epithelial damage in asthma models, significantly inhibiting airway inflammation and mucus secretion.[65]

As integrative research on acupuncture and medicine deepens, some researchers hypothesize that acupuncture may guide pharmacological agents to target specific organs for asthma treatment. However, due to the undefined underlying principles and mechanisms, the synergistic effects of acupuncture combined with drug therapy in asthma management require further validation.

Analysis of Therapeutic Effect of Acupuncture on Allergic Rhinitis

Allergic rhinitis, a commonly encountered allergic disorder in clinical practice, has seen growing attention toward the therapeutic value of acupuncture in its management in recent years. Table 2 summarizes research findings from the past decade on acupuncture interventions for allergic rhinitis, with multiple clinical evidences indicating that acupuncture significantly improves nasal symptoms such as congestion, rhinorrhea, and sneezing. Systematic evaluations of clinical trials comparing auricular and body acupuncture have demonstrated that the acupuncture treatment group was significantly superior to the control group in both nasal symptom scoring and quality of life improvements.[70] From a mechanistic perspective, acupuncture may alleviate nasal allergic reactions by regulating immune system function, reducing serum IgE levels, and inhibiting inflammatory cell infiltration.[71] Multiple systematic reviews further indicate that acupuncture exhibits a certain level of superiority in efficacy compared to conventional Western medical therapies.[72]

Regarding acupoint selection, acupuncture treatment for allergic rhinitis primarily uses Yintang (GV29), Fengchi (GB20), Hegu (LI4), and Zusanli (ST36) as main acupoints, with additional syndrome differentiation-based point selection tailored to individual patient symptoms in clinical practice.[81] Gellrich et al demonstrated that acupuncture effectively inhibits the release of eosinophil chemokines and nonspecific pro-inflammatory cytokines such as IL-1β, IL-8, IP-10, MIP-1β, and MCP-1, thereby significantly reducing nasal symptom scores in patients.[78] Animal studies in murine models of allergic rhinitis have shown that acupuncture intervention significantly inhibits the expression of IgE and IL-4.[85] Notably, a meta-analysis involving 454 participants demonstrated that acupuncture not only significantly reduced symptom scores but also had a significantly lower incidence of adverse events compared to the conventional pharmacotherapy group.[86]

https://doi.org/10.2147/IJGM.S579576

Table 2 Investigation of Acupuncture in the Treatment of Allergic Rhinitis

Reference	Model	Interventions	Acupoints	Acupuncture Parameters	Biochemical Measurements	Conclusion
Chen Q, 2014[73]	Human	MA	LI20, LI4, LI11, ST36, EX-NH3	30min x 3/week for 4 weeks	IgE↓, Mast cells↓	MA reduces mast cells in nasal mucosa glands.
McDonald JL, 2016[74]	Human	MA	LI20, LI4, ST36, GV23	20min x 2/week for 8 weeks	IgE↓, SP↓	MA modulated mucosal immune response in the upper airway in adults with persistent allergic rhinitis.
Yang S, 2018[75]	Rats	CIAA	LI20, ST36	14 consecutive days	IL-4↓, IgE↓, IFN-γ↑	CIAA can effectively alleviate allergic symptoms and inflammatory parameters in AR rat models.
Tu W, 2020[76]	Rats	AAT	DU14, BL12, BL13, BL20	28 days	NGF↓, IL-4↓, IL-5↓, IL-13↓, IgE↓, IFN-γ↑	AAT can alleviate allergic inflammation by inhibiting the expression of NGF and its downstream pathways.
Gong Z, 2021[77]	Rabbits	INA	EX-HN9	20 min, once every other day for 7 days.	IL-4↓, IgE↓, IFN-γ↑	INA treatment can relieve symptoms of AR in AR rabbits.
Gellrich D, 2022[78]	Human	MA	LI4, LI11, LI20, MH-N-3, GB20, SP6, ST36, BL13	2/week for 4 weeks	IL-1b↓, IL-8↓, IP-10↓, MIP-1b↓, MCP-1↓	MA reduces the intranasal unspecific inflammation.
Li Y, 2022[79]	Human	MA, INA	EX-HN9, LI20, GV23, LI4, Biqiu	7/week for 2 weeks	IL-4↓, IL-6↓, IL-10↑	MA can effectively alleviate the symptoms of allergic rhinitis, and IA and moxibustion is more effective.
Wang Z, 2023[80]	Human	MA	Xinwu, Xiaguan	2/week for 2 weeks	Histamine↓, IgE↓	MA at Xinwu acupoint combined with loratadine and fluticasone propionate can deliver a powerful efficacy on AR and alleviate the clinical symptoms, without increasing adverse reactions.
Liu LL, 2023[81]	Human	MA	EX-HN9, Biqiu	20 min x 3/ week for 2 weeks	NR	Intranasal acupuncture has good efficacy and safety in the treatment of PAR. Acupuncture has a good effect on improving nasal congestion, olfactory function and sleep.
Sun D, 2023[82]	Human	WA	MH-N-3, LI20, GB20, LI4, Baihui, Taiyang, Shangyingxiang	20 min x 7/ week	IgE↓, IL-6↓, IL-8↓, TNF-α↓	Warm needle therapy can effectively improve the clinical symptoms of AR patients with lung qi deficiency and cold type, reduce inflammation, and enhance immune function.
Tian MH, 2024[83]	Rats	MA	BL13, BL23, DU14	10 days	IgE↓, OVA-sIgE↓, IL-4↓, IL-17↓, GATA-3↓, TLR4↓, MyD88↓, NF-κB↓, IFN-γ↑, IL-10↑	Acupuncture can alleviate the symptoms of allergic rhinitis in rats and inhibit the inflammation of nasal mucosa, which may be related to the inhibition of TLR4/MyD88/NF-κB signal transduction and the balance of Th1/Th2 and Treg/Th17 cytokine levels as well as T-bet/GATA-3.
Dong BY, 2024[84]	Human	MA	GV20, EX-HN1, PC7, HT7, GV24, LI20	20 min x 7/ week for 2weeks	IgE↓, EOS↓, SP↓	MA can improve the nasal symptoms of AR patients by reducing EOS and IgE.

Notes: ↑: Increased expression/level; ↓: Decreased expression/level.

Abbreviations: MA, Manual acupuncture; WA, Warm Acupuncture; INA, intranasal acupuncture; AAT, Acupoint application therapy; NR, No report; CIAA, Catgut implantation at acupoint; LI11, Quchi; EX-HN9, Neiyingxiang; LI20, Yingxiang; PC7, Daling; HT7, Shenmen; MH-N-3, Yintang; GV23, Shangxing; GV24, shenting; GB20, Fenchi; LI4, Hegu; DU14, Dazhui; BL12, Fengmen; BL13, Feishu; BL20, Pishu; BL23x, Shen shu; ST36, Zusanli; EX-B1, Dingchuan; SP6, Sanyinjiao; EX-HN1, Sishencong; EX-NH3, Yingtang; SP, Proinflammatory neuropeptide substance P; NGF, Nerve growth factor.

Collectively, evidence from multiple studies indicates that acupuncture, as a safe and effective intervention, offers multiple advantages in the clinical management of allergic rhinitis, including alleviating nasal symptoms, improving quality of life, reducing medication dependence, and enhancing patient satisfaction. Its efficacy and safety have been supported by evidence-based medicine.

Application of Acupuncture in Skin Allergy

In the clinical management of skin allergies, acupuncture therapy has demonstrated significant potential for application. Clinical studies have confirmed that this therapy is effective in alleviating symptoms of common allergic skin diseases such as urticaria and atopic dermatitis. As shown in Table 3, traditional filiform needle acupuncture is the most commonly used intervention, followed by intradermal needle therapy and acupressure techniques. In contrast, electro-acupuncture (EA), transcutaneous electrical acupoint stimulation (TEAS), and auricular acupuncture have been reported in only a few studies. Core acupoints selected in clinical practice include Quchi (LI11), Zusanli (ST36), Xuehai (SP10), and Shaohai (HT3). Acupoint stimulation effectively improves local blood circulation, enhances the skin's self-repair capacity, and exerts bidirectional regulation on immune responses.[87]

In the case of atopic dermatitis, clinical studies have demonstrated that patients receiving acupuncture treatment exhibit significant improvements in both symptom severity and quality of life scores.[96] Additionally, some scholars propose that the mechanism of acupuncture in treating allergic skin diseases may be associated with regulating the release of cytokines by immune cells, such as IL-4, IL-2, and IL-10. Elevated IL-4 signaling is closely linked to the development of pruritus in atopic dermatitis.[97,98] Through cytokine regulation, EA directly reduces the generation of itch signals and inhibits inflammatory responses in the skin in cutaneous pruritus. Recent findings indicate that acupuncture decreases the levels of IL-4 and IgE while increasing interferon-γ (IFN-γ) in the blood of atopic dermatitis patients.[94] In humans, EA enhances serum levels of the anti-inflammatory cytokine IL-10 while inhibiting the pro-inflammatory cytokine TNF-α, thereby reducing skin inflammation.[99] Acupuncture is also thought to alleviate skin allergic reactions by inhibiting mast cell activation and the release of inflammatory mediators, providing a theoretical basis for its application in treating skin allergies.[100] Wang et al's research confirms that EA inhibits mast cell degranulation via cannabinoid CB2 receptors in a rat model of allergic contact dermatitis.[7] These examples demonstrate that acupuncture, as a non-invasive treatment method, can provide effective relief for patients with skin allergies.

Potential Mechanism of Acupuncture Regulating Mast Cells

Acupuncture, as a traditional therapy, regulates the secretion of cytokines, thereby further influencing the function of mast cells and demonstrating favorable therapeutic effects in the treatment of allergic diseases (as shown in Figure 2). After acupuncture, macrophages changed from M1 pro-inflammatory type to M2 anti-inflammatory type, and PPAR γ, the negative regulator of TLR4, was activated, thus inhibiting the activation of NLRP3 inflammatory bodies, reducing the recruitment of ASC and caspase-1, downregulating pro-inflammatory factors (such as TNF-α, IL-1, IL-1 β and IL-6), MCP-1, adhesion molecules ICAM-1 and VCAM-1) and INF-γ, and promoting the release of anti-inflammatory cytokines (such as IL-10). In some cases of autoimmune diseases, acupuncture can down regulate Th1 cells and inhibit their secretion of proinflammatory cytokines, such as INF-γ, IL-2 and TNF-α, while up cytokines, such as IL-4, IL-5, IL-10 and IL-13.

In addition, acupuncture also promotes the balance of the immune response by regulating the interactions between macrophages and other immune cells, thereby affecting the overall immune status.[101] Studies have shown that acupuncture can significantly reduce the levels of IgE in serum and the expression of various pro-inflammatory cytokines, such as tumor necrosis factor α (TNF-α) and interleukin-4 (IL-4), which play a crucial role in the activation and degranulation of mast cells.[7] In the Complete Freund's adjuvant (CFA) model, EA at ST36 can activate mast cells and promote mast cell degranulation by activating TRPV2 and inducing the release of histamine and adenosine, thus increasing the level of β-endorphin (β-END) in the cerebrospinal fluid and leading to analgesia.[102] Wang et al's study shows that EA at ST36 reduces the number of mast cells, down - regulates the release of TLR4, IL-1β and IL-8 by mast cells in the colon tissue, and improves the visceral hypersensitivity in the trinitrobenzene sulfonic acid (TNBS) - induced colitis model.[103] In addition, acupuncture also promotes the degranulation of mast cells and the structural remodeling of fibroblasts, inducing the release of substances such as adenosine triphosphate (ATP), substance P (SP), tryptase, histamine (HA), interleukins,

https://doi.org/10.2147/JGM.S579576

Table 3 Investigation of Acupuncture in the Treatment of Allergic Skin Diseases

Reference	Model	Interventions	Acupoints	Acupuncture Parameters	Biochemical Measurements	Conclusion
Park JY, 2013[88]	Mouse	MA	LI11	1/week	IgE↓, IL-4↓, IL-8↓, TNF-α↓, NF-κB↓, ERK1/2↓, JNK↓, p38↓	MA can effectively alleviate allergic contact dermatitis by reducing proinflammatory cytokines and proteins.
Wang Z, 2017[89]	Rats	EA	ST36	1/week	IgE↓, p38 MAPK↓, IL-10↑	EA therapy may improve ACD related inflammation by triggering local IL-10 production and inhibiting p38 MAPK activation.
Zhang XH, 2020[90]	Rats	EA	ST36, LI11, SP10	20 min x7/week	NF-α↓, IL-6↓, p-ERK↓, JNK↓, p-JNK↓, p-P38MAPK↓	EA can reduce skin allergic reaction in rats with urticaria
Wang YM, 2020[7]	Rats	MA	SP10, LI11	30min 7/week for 2weeks	IgE↓, Histamine↓, Serotonin↓, p-Lyn↓, p-Syk↓	MA at LI11 and SP10 is applicable in the treatment of urticaria.
Park JG, 2021[91]	Human	MA	LI11, ST36, PC6	15min x 2/week for 4 weeks	NR	MA treatment improved the symptoms of atopic dermatitis.
Zeng ZW, 2022[92]	Mouse	A-AHT	ST36, LI11	Once every other day for 28 days	IL-4↓, IgE↓, IFN-γ↑, T-bet↑	A-AHT has shown significant effectiveness in AD model mice by regulating Th1/Th2 immune responses.
Liu SJ, 2023[93]	Rats	EA	LI11, SP10	20 min x 7/week	IgE↓, Histamine↓, IL-33↓, ST2↓	EA pretreatment can prevent urticaria in rats, which may be related to its function of reducing IgE levels by inhibiting IL-33 and ST2.
Shi Y, 2023[94]	Human	MA	LI11, LI4, SP10, ST36, SP6, Zhongwan, Tianshu, Guanyuan, Yinlingquan,	Twisted 360°, 60 times/min, once every other day for 12 days.	IL-4↓, IgE↓, IFN-γ↑	MA can significantly alleviate the symptoms and negative emotions of patients, and improve their quality of life, sleep quality and balance of Th1/Th2 cytokines.
Li JQ, 2024[95]	Rats	EA	LI11, SP10	20 min x 1/day for 10 days	IgE↓, 5-HT↓, NLRP3↓, IL-1β↓, IL-18↓, Caspase-1↓	EA pretreatment can prevent and treat UR by inhibiting inflammatory response, which is related to the regulation of pyroptosis.
Du Y, 2024[6]	Rats	MA	GV20, CV12, LI11, SP10, GV14, BL 27	15 min x 7/week for 2 weeks	IgE↓, TPS↓, IL-4↓, IL-5↓, TNF-α↓	MA effectively suppress mast cell degranulation in the sensitized skin tissue on the back of urticaria rats.

Notes: ↑: Increased expression/level; ↓: Decreased expression/level.

Abbreviations: MA, Manual acupuncture; A-AHT, Acupoint autohemotherapy; AAT, Acupoint application therapy; NR, No report; LI11, Quchi; LI4, Hegu; ST36, Zusanli; SP6, Sanyinjiao; SP10, Xuehai; PC6, Neiguan; p-Lyn, phosphorylated tyrosine-protein kinase Lyn; p-Syk, phosphorylated tyrosine-protein kinase Syk.

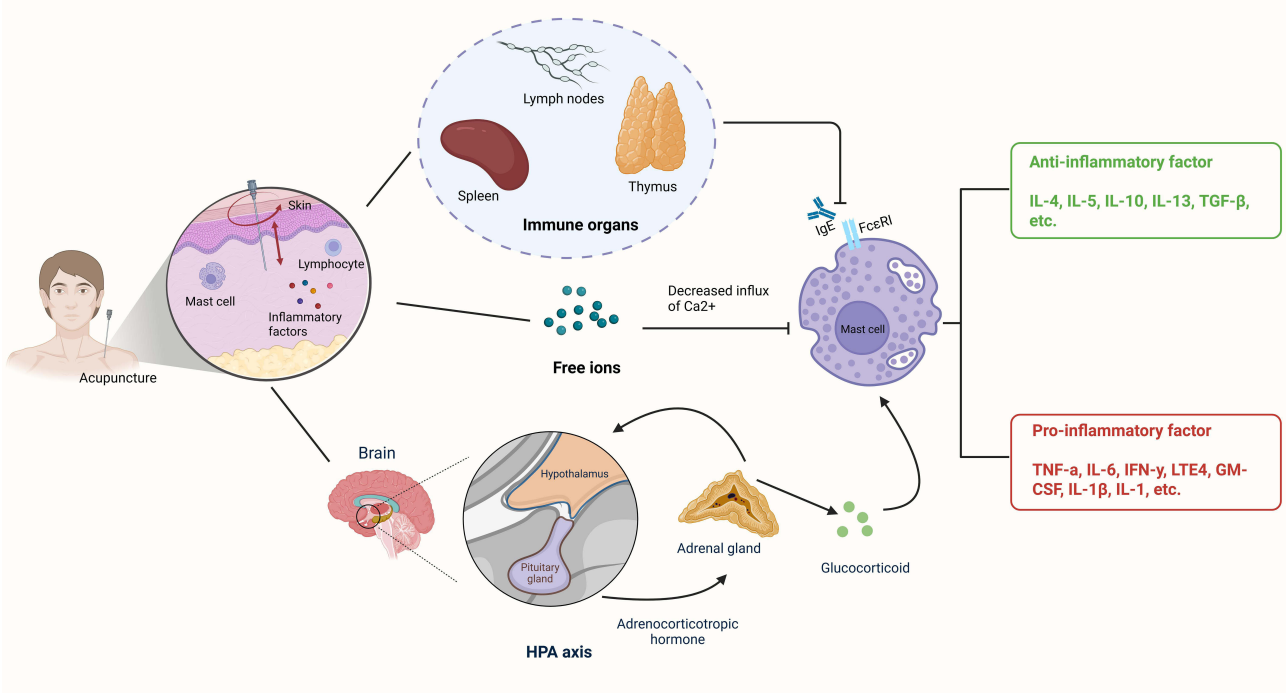

Figure 2 The mechanism of acupuncture regulating mast cells in the treatment of allergic diseases. Arrow represents the pathway of regulation and promotion; Flat arrow represents the inhibitory pathway; The red dots represent pro-inflammatory factors; The green dots represent anti-inflammatory factors; Green-upregulated by acupuncture; Red-downregulated by acupuncture.
Abbreviations: GM-CSF, Granulocyte-Macrophage Colony Stimulating Factor; LTE4, Leukotriene E4.

serotonin (5-HT), etc, which also mediate the effects of acupuncture.[104] These results indicate that acupuncture, by regulating the balance of cytokines, may play an important role in the immune response mediated by mast cells, thus providing new ideas for clinical treatment.

Acupuncture has increasingly gained attention for its role in regulating neuro-immune interactions. Recent studies indicate that the interaction between the hypothalamic-pituitary-adrenal (HPA) axis and the immune system plays a crucial role in maintaining tissue homeostasis and regulating immune responses.[105] The core components of the hypothalamic-pituitary-adrenal (HPA) axis include the paraventricular nucleus of the hypothalamus (PVN), adenohypophysis, and adrenal cortex, with PVN playing a key regulatory role in this neuroendocrine axis.[106] Cortisol, synthesized and released by this system, forms a complex with glucocorticoid receptors (GR), thereby exerting bidirectional regulation on the expression of genes related to pro-inflammatory and anti-inflammatory mediators: it inhibits the biosynthesis of multiple pro-inflammatory mediators on the one hand, and induces the production and release of anti-inflammatory mediators on the other.[107]

Acupuncture exerts anti-inflammatory effects by directly activating the endogenous HPA axis, thus avoiding side effects associated with excessive use of exogenous cortisol. In the pathological process of asthma, although persistent inflammation stimulates an increase in endogenous cortisol levels, activation of the negative feedback mechanism leads to reduced HPA axis reactivity.[108,109] Studies by Wei et al[60] have demonstrated that acupuncture effectively promotes the secretion of adrenocorticotropic hormone (ACTH) and cortisol, reversing the HPA axis from a hypo-reactive to a hyper-reactive state, thereby reducing the body's inflammatory burden. Specifically, this regulatory process decreases the infiltration of inflammatory cells in the airways (including leukocytes, neutrophils, lymphocytes, and eosinophils) and inhibits the biological activity of pro-inflammatory factors such as TNF-α, IL-1β, IL-5, and eosinophil chemokines.[108,110] Acupuncture stimulation can trigger the neuroimmune interaction pathway by activating the vagus nerve, thereby regulating the function of macrophages. Wang et al[111] proved that acupuncture activates the cholinergic anti-inflammatory pathway and induces macrophages to polarize into the anti-inflammatory phenotype (M2 type), which

https://doi.org/10.2147/IJGM.S579576

significantly inhibits the local and systemic inflammatory response mediated by macrophages, and achieves two-way regulation of the inflammatory microenvironment.

The above research provides a theoretical basis for the application of acupuncture in the treatment of allergic diseases and inflammatory diseases, but the potential mechanism of HPA axis regulation mediated by acupuncture needs further research.

Conclusion

In this article, we explored the potential of acupuncture in regulating mast cells and its prospects as an adjunctive therapy for allergic diseases. Mast cells play a central role in allergic reactions, with their activity influenced by multiple factors. By modulating interactions within the neuro-endocrine-immune system, acupuncture may exert positive effects on mast cell function and allergic responses. These findings offer a new perspective on acupuncture as an adjunctive approach for treating allergic conditions.

However, current research still harbors controversy regarding the specific mechanisms of acupuncture and the variability in its efficacy across different types of allergic diseases. While some studies demonstrate that acupuncture can effectively reduce allergic symptoms,[112,113] others fail to identify significant effects.[114] Such discrepancies may be attributed to differences in study design, acupuncture techniques employed, and individual patient variability. Therefore, designing more rigorous large-scale randomized controlled trials and standardizing acupuncture protocols and treatment courses will be essential steps in future research.

Future research should focus on the mechanisms by which acupuncture regulates mast cell function, with particular emphasis on its effects in different disease models. Through animal experiments and clinical trials, the impacts of acupuncture on mast cell activation, degranulation, and cytokine secretion should be evaluated to uncover therapeutic mechanisms. By integrating technologies such as gene editing and single-cell sequencing, studies can precisely analyze the effects of acupuncture on mast cells and their microenvironment, providing evidence for clinical applications in allergic diseases (eg, hay fever, asthma) and inflammatory disorders. Exploring the combined efficacy of acupuncture and conventional medications, while clarifying its specific mechanisms in various diseases, will offer comprehensive scientific support for clinical practice.

Overall, acupuncture holds significant research value and clinical prospects in regulating mast cells and their application in allergic diseases. Although current research findings remain inconsistent, further exploration and standardized studies may enable acupuncture to become an effective complementary approach in the treatment of allergic conditions.[115] To achieve this goal, it is essential to carefully balance the perspectives of different studies, promote the scientific development of acupuncture, and provide patients with more effective treatment options.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

The authors have no acknowledgments and funding to report.

Disclosure

The authors declare that this research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest. Figures 1, 2 and Supplementary Figure 2 in this article were created by Biorender.

References

1. Falcon RMG, Caoili SEC. Immunologic, genetic, and ecological interplay of factors involved in allergic diseases. *Front Allergy*. 2023;4:1215616.
2. Kim BJ, Lee SY, Kim HB, Lee E, Hong SJ. Environmental changes, microbiota, and allergic diseases. *Allergy Asthma Immunol Res*. 2014;6:389–400. doi:10.4168/aair.2014.6.5.389

3. Chang Y, Zhang Y, Bai Y, Lin R, Qi Y, Li M. The correlation between tic disorders and allergic conditions in children: a systematic review and meta-analysis of observational studies. *Front Pediatr*. 2023;11:1064001. doi:10.3389/fped.2023.1064001
4. Gonzalez-Diaz SN, Martin B, Villarreal-Gonzalez RV, et al. Psychological impact of the COVID-19 pandemic on patients with allergic diseases. *World Allergy Organ J*. 2021;14:100510. doi:10.1016/j.waojou.2021.100510
5. Porebski G, Dziadowiec A, Rybka H, Kitel R, Kwitniewski M. Mast cell degranulation and bradykinin-induced angioedema - searching for the missing link. *Front Immunol*. 2024;15:1399459. doi:10.3389/fimmu.2024.1399459
6. Du Y, Liang Y, Shi Y, et al. [Effect of acupuncture combined with bloodletting therapy on mast cell degranulation in urticaria rats]. *Zhongguo Zhen Jiu*. 2024;44:1273–1280. doi:10.13703/j.0255-2930.20240320-k0002 Dutch
7. Wang YM, Ma TM. [Effect of pre-acupuncture intervention on serum IgE and cutaneous phosphorylated tyrosine-protein kinase expression in rats with urticaria]. *Zhen Ci Yan Jiu*. 2020;45:111–116. doi:10.13702/j.1000-0607.1901886 Hausa
8. Zhuang Y, Xing JJ, Li J, Zeng BY, Liang FR. History of acupuncture research. *Int Rev Neurobiol*. 2013;111:1–23.
9. Kelly RB, Willis J. Acupuncture for Pain. *Am Fam Physician*. 2019;100:89–96.
10. Li N, Guo Y, Gong Y, et al. The anti-inflammatory actions and mechanisms of acupuncture from acupoint to target organs via neuro-immune regulation. *J Inflamm Res*. 2021;14:7191–7224.
11. Lv ZY, Yang YQ, Yin LM. Role of Purinergic Signaling in Acupuncture Therapeutics. *Am J Chin Med*. 2021;49:645–659. doi:10.1142/S0192415X21500294
12. Wei W, Wu Y, Zhang S, Li B, Cheng Z, Zhao W. Clinical efficacy and safety of acupuncture in the treatment for chronic spontaneous urticaria: a systematic review and meta-analysis. *Front Med*. 2025;12:1498795. doi:10.3389/fmed.2025.1498795
13. Chen YD, Jin XQ, Yu MH, Fang Y, Huang LQ. Acupuncture for moderate to severe allergic rhinitis: a non-randomized controlled trial. *Chin J Integr Med*. 2016;22:518–524. doi:10.1007/s11655-016-2453-x
14. Feng S, Han M, Fan Y, et al. Acupuncture for the treatment of allergic rhinitis: a systematic review and meta-analysis. *Am J Rhinol Allergy*. 2015;29:57–62. doi:10.2500/ajra.2015.29.4116
15. Miao XY, Lü YE, Ji MQ, et al. [Acupuncture inhibits epithelial mesenchymal transition in allergic asthma rats by activating the PI3K/AKT pathway through DEK activation]. *Zhen Ci Yan Jiu*. 2025;50:174–182. doi:10.13702/j.1000-0607.20230951 Hausa
16. Du Y, Xue Y, Liu X, et al. Efficacy evaluation of acupuncture combined with pricking blood therapy in the treatment of chronic spontaneous urticaria: a randomized controlled trial. *Am J Transl Res*. 2024;16:5268–5282. doi:10.62347/XDHG7875
17. Guo Y, Cai S, Deng J, et al. Trends and hotspots of acupuncture for allergic rhinitis: a bibliometric analysis from 2002 to 2022. *Complement Ther Med*. 2023;78:102984. doi:10.1016/j.ctim.2023.102984
18. Dou B, Li Y, Ma J, et al. Role of neuroimmune crosstalk in mediating the anti-inflammatory and analgesic effects of acupuncture on inflammatory pain. *Front Neurosci*. 2021;15:695670. doi:10.3389/fnins.2021.695670
19. Rottem M, Gershwin ME, Shoenfeld Y. Allergic disease and autoimmune effectors pathways. *Dev Immunol*. 2002;9:161–167. doi:10.1080/1044667031000137638
20. Vosughimotlagh A, Rasouli SE, Rafiemanesh H, et al. Clinical manifestation for immunoglobulin A deficiency: a systematic review and meta-analysis. *Allergy Asthma Clin Immunol*. 2023;19:75. doi:10.1186/s13223-023-00826-y
21. Borriello F, Iannone R, Marone G. Histamine release from mast cells and basophils. *Handb Exp Pharmacol*. 2017;241:121–139.
22. Vitte J, Vibhushan S, Bratti M, Montero-Hernandez JE, Blank U. Allergy, anaphylaxis, and nonallergic hypersensitivity: igE, mast cells, and beyond. *Med Princ Pract*. 2022;31:501–515. doi:10.1159/000527481
23. Han R, Zhu D, Sha J, Zhao B, Jin P, Meng C. Decoding the role of DNA methylation in allergic diseases: from pathogenesis to therapy. *Cell Biosci*. 2024;14:89. doi:10.1186/s13578-024-01270-0
24. Metcalfe DD, Baram D, Mekori YA. Mast cells. *Physiol Rev*. 1997;77:1033–1079. doi:10.1152/physrev.1997.77.4.1033
25. Jin JY, Zhong H, Liu Q, et al. [Comparison of stimulation-induced local changes of expression of local Meckel cell-related proteins and neuropeptides and number of mast cells among acupuncture and moxibustion alone or in combination in chronic atrophic gastritis rats]. *Zhen Ci Yan Jiu*. 2022;47:203–208. doi:10.13702/j.1000-0607.20210420 Hausa
26. Sun S, Gu Y, Wang J, Chen C, Han S, Che H. Effects of fatty acid oxidation and its regulation on dendritic cell-mediated immune responses in allergies: an immunometabolism perspective. *J Immunol Res*. 2021;2021:7483865. doi:10.1155/2021/7483865
27. Marsella R. Pruritic horse: approach to allergic skin diseases in horses. *Vet Clin North Am Equine Pract*. 2024;40:219–235. doi:10.1016/j.cveq.2024.05.002
28. Hu T, Dong Y, Yang C, Zhao M, He Q. Pathogenesis of children's allergic diseases: refocusing the role of the gut microbiota. *Front Physiol*. 2021;12:749544. doi:10.3389/fphys.2021.749544
29. Capucilli P, Hill DA. Allergic Comorbidity in Eosinophilic Esophagitis: mechanistic Relevance and Clinical Implications. *Clin Rev Allergy Immunol*. 2019;57:111–127. doi:10.1007/s12016-019-08733-0
30. Darabi A, Dehghanfard M, Jozan S, et al. Investigating the association between allergic diseases and COVID-19 in 400 Iranian patients. *Allergol Immunopathol*. 2021;49:9–15. doi:10.15586/aei.v49i5.105
31. Maychuk DY, Atlas SN, Loshkareva AO. [Ocular manifestations of coronavirus infection COVID-19 (clinical observation)]. *Vestn Oftalmol*. 2020;136:118–123. doi:10.17116/oftalma2020136041118 Norwegian
32. Mur T, Brook C, Platt M. Extranasal manifestations of allergy in the head and neck. *Curr Allergy Asthma Rep*. 2020;20:21. doi:10.1007/s11882-020-00914-8
33. Jackson CW, Pratt CM, Rupprecht CP, Pattanaik D, Krishnaswamy G. Mastocytosis and mast cell activation disorders: clearing the air. *Int J Mol Sci*. 2021;22:11270. doi:10.3390/ijms222011270
34. Ribatti D, d'Amati A. Hematopoiesis and mast cell development. *Int J Mol Sci*. 2023;24:10679. doi:10.3390/ijms241310679
35. Da silva EZ, Jamur MC, Oliver C. Mast cell function: a new vision of an old cell. *J Histochem Cytochem*. 2014;62:698–738. doi:10.1369/0022155414545334
36. Wagner A, Alam SB, Kulka M. The effects of age, origin, and biological sex on rodent mast cell (BMMC and MC/9) and basophil (RBL-2H3) phenotype and function. *Cell Immunol*. 2023;391-392:104751. doi:10.1016/j.cellimm.2023.104751
37. Castells M, Giannetti MP, Hamilton MJ, et al. Mast cell activation syndrome: current understanding and research needs. *J Allergy Clin Immunol*. 2024;154:255–263. doi:10.1016/j.jaci.2024.05.025

38. Elieh Ali Komi D, Wöhrl S, Bielory L. Mast cell biology at molecular level: a comprehensive review. *Clin Rev Allergy Immunol*. 2020;58:342–365.
39. Boyce JA. Mast cells and eicosanoid mediators: a system of reciprocal paracrine and autocrine regulation. *Immunol Rev*. 2007;217:168–185. doi:10.1111/j.1600-065X.2007.00512.x
40. Di Capite J, Parekh AB. CRAC channels and Ca2+ signaling in mast cells. *Immunol Rev*. 2009;231:45–58. doi:10.1111/j.1600-065X.2009.00808.x
41. Kumar M, Duraisamy K, Chow BK. Unlocking the Non-IgE-Mediated pseudo-allergic reaction puzzle with Mas-Related G-Protein Coupled Receptor Member X2 (MRGPRX2). *Cells*. 2021;10:1033.
42. Mousavizadeh R, Waugh CM, McCormack RG, Cairns BE, Scott A. MRGPRX2-mediated mast cell activation by substance P from overloaded human tenocytes induces inflammatory and degenerative responses in tendons. *Sci Rep*. 2024;14:13540. doi:10.1038/s41598-024-64222-1
43. Occhiuto CJ, Kammala AK, Yang C, et al. Store-operated calcium entry via STIM1 contributes to MRGPRX2 induced mast cell functions. *Front Immunol*. 2019;10:3143. doi:10.3389/fimmu.2019.03143
44. Che D, Hou Y, Zeng Y, et al. Dehydroandrographolide inhibits IgE-mediated anaphylactic reactions via calcium signaling pathway. *Toxicol Appl Pharmacol*. 2019;366:46–53. doi:10.1016/j.taap.2019.01.019
45. Lee HJ, Seo HS, Kim GJ, et al. Houttuynia cordata Thunb inhibits the production of pro-inflammatory cytokines through inhibition of the NFκB signaling pathway in HMC-1 human mast cells. *Mol Med Rep*. 2013;8:731–736. doi:10.3892/mmr.2013.1585
46. Dabbous OA, Soliman MM, Mohamed NH, et al. Evaluation of the improvement effect of laser acupuncture biostimulation in asthmatic children by exhaled inflammatory biomarker level of nitric oxide. *Lasers Med Sci*. 2017;32:53–59. doi:10.1007/s10103-016-2082-9
47. Cao QA, Zhang HF, Li LH, et al. [Clinical observation on the distribution characteristics and rules of pressing sensitive acupoints in bronchial asthma patients]. *Zhongguo Zhen Jiu*. 2020;40:169–172. doi:10.13703/j.0255-2930.20190320-k00034 Dutch
48. Tan C, Gao D, Zhang C, et al. [Research on correlation between lung and large intestine based on Meridian and acupoint palpation in patients with bronchial asthma]. *Zhongguo Zhen Jiu*. 2014;34:145–148. Dutch
49. Wang X, Zeng S, Li Z, Li Y, Jia H. A network meta-analysis of different acupuncture modalities in the treatment of bronchial asthma. *BMC Pulm Med*. 2023;23:357. doi:10.1186/s12890-023-02645-8
50. Pang J, Shergis JL, Zheng L, et al. Clinical evidence for acupuncture for adult asthma: systematic review and meta-analysis of randomised sham/placebo-controlled trials. *Complement Ther Med*. 2023;75:102956. doi:10.1016/j.ctim.2023.102956
51. Shang PP, Chen CT, Cheng M, et al. Analysis of acupoint selection and combinations in acupuncture treatment of asthma based on data mining. *Complement Med Res*. 2022;29:136–146. doi:10.1159/000521346
52. Li Y, Yu Y, Liu Y, Yao W. Mast cells and acupuncture analgesia. *Cells*. 2022;11:860.
53. Wang LN, Wang XZ, Li YJ, et al. Activation of subcutaneous mast cells in acupuncture points triggers analgesia. *Cells*. 2022;11:809. doi:10.3390/cells11050809
54. Chen B, Li MY, Guo Y, Zhao X, Lim HC. Mast cell-derived exosomes at the stimulated acupoints activating the neuro-immune regulation. *Chin J Integr Med*. 2017;23:878–880. doi:10.1007/s11655-016-2269-8
55. Li BR, Li YJ, Xu JW, et al. Mast cell-associated serotonin in acupoint contributes to acupuncture analgesia in arthritis rats by mediating ATP release. *Front Biosci*. 2023;28:1. doi:10.31083/j.fbl2801001
56. Yu WY, Ma LX, Tian Y, et al. Acupuncture alleviates menstrual pain in rat model via suppressing Eotaxin/CCR3 axis to weak EOS-MC activation. *Evid Based Complement Alternat Med*. 2022;2022:4571981. doi:10.1155/2022/4571981
57. Lambrecht BN, Hammad H. Lung dendritic cells in respiratory viral infection and asthma: from protection to immunopathology. *Annu Rev Immunol*. 2012;30:243–270. doi:10.1146/annurev-immunol-020711-075021
58. Carneiro ER, Xavier RA, De Castro MA, Do Nascimento CM, Silveira VL. Electroacupuncture promotes a decrease in inflammatory response associated with Th1/Th2 cytokines, nitric oxide and leukotriene B4 modulation in experimental asthma. *Cytokine*. 2010;50:335–340. doi:10.1016/j.cyto.2010.01.005
59. Wei Y, Dong M, Zhang H, et al. Acupuncture attenuated inflammation and inhibited Th17 and treg activity in experimental asthma. *Evid Based Complement Alternat Med*. 2015;2015:340126. doi:10.1155/2015/340126
60. Wei Y, Dong M, Zhong L, et al. Regulation of hypothalamic-pituitary-adrenal axis activity and immunologic function contributed to the anti-inflammatory effect of acupuncture in the OVA-induced murine asthma model. *Neurosci Lett*. 2017;636:177–183. doi:10.1016/j.neulet.2016.11.001
61. Dong M, Ma C, Wang WQ, Chen J, Wei Y. Regulation of the IL-33/ST2 pathway contributes to the anti-inflammatory effect of acupuncture in the ovalbumin-induced murine asthma model. *Acupunct Med*. 2018;36:319–326. doi:10.1136/acupmed-2017-011377
62. Nurwati I, Purwanto B, Mudigdo A, Saputra K, Prasetyo DH, Muthmainah M. Improvement in inflammation and airway remodelling after acupuncture at BL13 and ST36 in a mouse model of chronic asthma. *Acupunct Med*. 2019;37:228–236. doi:10.1177/0964528418818705
63. Liu YL, Zhang LD, Ma TM, et al. Feishu acupuncture inhibits acetylcholine synthesis and restores muscarinic acetylcholine receptor M2 expression in the lung when treating allergic asthma. *Inflammation*. 2018;41:741–750. doi:10.1007/s10753-017-0726-y
64. Dong M, Wang WQ, Chen J, et al. Acupuncture regulates the balance of CD4(+) T cell subtypes in experimental asthma mice. *Chin J Integr Med*. 2019;25:617–624. doi:10.1007/s11655-018-3055-6
65. Cui J, Dong M, Yi L, et al. Acupuncture inhibited airway inflammation and group 2 innate lymphoid cells in the lung in an ovalbumin-induced murine asthma model. *Acupunct Med*. 2021;39:217–225. doi:10.1177/0964528420924033
66. Zhao H, Dong F, Li Y, et al. Inhibiting ATG5 mediated autophagy to regulate endoplasmic reticulum stress and CD4(+) T lymphocyte differentiation: mechanisms of acupuncture's effects on asthma. *Biomed Pharmacother*. 2021;142:112045. doi:10.1016/j.biopha.2021.112045
67. Tang W, Qin J, Zhou Y, et al. Regulation of ferroptosis and ACSL4-15LO1 pathway contributed to the anti-asthma effect of acupuncture. *Int Immunopharmacol*. 2023;115:109670. doi:10.1016/j.intimp.2022.109670
68. Yu Y, Cui J, Sun N, Liu H, Wang H, Yang J. Serum from acupuncture-treated asthmatic rats regulates p38-MAPK activation in airway smooth muscle cells. *Am J Transl Res*. 2023;15:1063–1071.
69. Qiao Y, Liang Y, Zhuo S, et al. Effect and mechanism of acupuncture on airway smooth muscle relaxation during acute asthma attack in rats. *Zhongguo Zhen Jiu*. 2024;44:295–302. doi:10.13703/j.0255-2930.20230426-k0004

70. Dong B, Li B, Xie L, Li Y. Treatment of allergic rhinitis with acupuncture based on pathophysiological. *Int J Gen Med*. 2024;17:2741–2756. doi:10.2147/IJGM.S470949
71. Hong G. Research progress on the mechanism of acupuncture in the prevention and treatment of allergic rhinitis. *Altern Ther Health Med*. 2023;29:228–232.
72. Xiao L, Li B, Du YH, Xiong J, Gao X. [Systematic evaluation of the randomized controlled trials about acupuncture and moxibustion treatment of allergic rhinitis]. *Zhongguo Zhen Jiu*. 2009;29:512–516. Dutch
73. Chen Q, Zhang Q, Jiang L, et al. Effectiveness of strengthened stimulation during acupuncture for the treatment of allergic rhinitis: study protocol for a randomized controlled trial. *Trials*. 2014;15:301. doi:10.1186/1745-6215-15-301
74. McDonald JL, Smith PK, Smith CA, Changli Xue C, Golianu B, Cripps AW. Effect of acupuncture on house dust mite specific IgE, substance P, and symptoms in persistent allergic rhinitis. *Ann Allergy Asthma Immunol*. 2016;116:497–505.
75. Yang S, Wu J, Zhang Q, et al. Catgut implantation at acupoint reduces immune reaction in a rat model of allergic rhinitis. *Evid Based Complement Alternat Med*. 2018;2018:7629239. doi:10.1155/2018/7629239
76. Tu W, Chen X, Wu Q, et al. Acupoint application inhibits nerve growth factor and attenuates allergic inflammation in allergic rhinitis model rats. *J Inflamm*. 2020;17:4. doi:10.1186/s12950-020-0236-9
77. Gong Z, Yan ZF, Liu QP, et al. [Effect of intranasal acupuncture on neurogenic inflammation in allergic rhinitis rabbits]. *Zhen Ci Yan Jiu*. 2021;46:111–116. doi:10.13702/j.1000-0607.200250 Hausa
78. Gellrich D, Pfab F, Ortiz M, Binting S, Brinkhaus B, Gröger M. Acupuncture and its effect on cytokine and chemokine profiles in seasonal allergic rhinitis: a preliminary three-armed, randomized, controlled trial. *Eur Arch Otorhinolaryngol*. 2022;279:4985–4995. doi:10.1007/s00405-022-07335-5
79. Li Y, Wang R, Wu YL, Liu Z. [Effects of acupuncture on serum IL-4, IL-6 and IL-10 in patients with allergic rhinitis]. *Zhen Ci Yan Jiu*. 2022;47:715–718. doi:10.13702/j.1000-0607.20211229 Hausa
80. Wang Z, Wang Z, Jiang Y, Li J, Wu X, Wu J. Effect of acupuncture at Xinwu acupoint combined with loratadine and fluticasone propionate on symptom alleviation, nasal function, and serum histamine level in patients with allergic rhinitis. *Am J Transl Res*. 2023;15:1403–1411.
81. Liu LL, Gong Z, Tang L, Yan ZF. A novel and alternative therapy for persistent allergic rhinitis via intranasal acupuncture: a randomized controlled trial. *Eur Arch Otorhinolaryngol*. 2023;280:2773–2783. doi:10.1007/s00405-022-07793-x
82. Sun D, Jiang M, Lu M, Ma X, Shang G, Wang Y. The effect of warm acupuncture on EOS, IgE, inflammatory factors, and T lymphocyte subsets in patients with allergic rhinitis of lung Qi deficiency and cold-type. *Altern Ther Health Med*. 2023;29:271–277.
83. Tian MH, Zhang YN, Sun WF, Liu H, Tang Y. Acupuncture at "Die E acupoint" alleviates inflammatory reaction via inhibiting TLR4/MyD88/NF-κB signaling in rats with allergic rhinitis. *Zhen Ci Yan Jiu*. 2024;49:456–462. doi:10.13702/j.1000-0607.20230724
84. Dong BY, Li BQ, Li Y. [Clinical efficacy of intranasal acupuncture combined with Tiaoshen acupuncture in the treatment of moderate-to-severe persistent allergic rhinitis]. *Zhen Ci Yan Jiu*. 2024;49:964–971. doi:10.13702/j.1000-0607.20230959 Hausa
85. Choi B, Chang MS, Kim HY, Park JW, Ryu B, Kim J. Effects of low level laser therapy on ovalbumin-induced mouse model of allergic rhinitis. *Evid Based Complement Alternat Med*. 2013;2013:753829. doi:10.1155/2013/753829
86. Du SH, Guo W, Yang C, et al. Filiform needle acupuncture for allergic rhinitis: a systematic review and meta-analysis. *J Integr Med*. 2022;20:497–513. doi:10.1016/j.joim.2022.08.004
87. Podder I, Mondal H, Gayen RK. Global research trend on allergic skin disorders: a bibliometric analysis from 2001 to 2020. *Indian Dermatol Online J*. 2023;14:342–346. doi:10.4103/idoj.idoj_481_22
88. Park JY, Park HJ, Choi YY, Kim MH, Kim SN, Yang WM. Effects of acupuncture on 1-Chloro-2,4-dinitrochlorobenzene-induced atopic dermatitis. *Evid Based Complement Alternat Med*. 2013;2013:982095. doi:10.1155/2013/982095
89. Wang Z, Yi T, Long M, et al. Electro-Acupuncture at Zusanli Acupoint (ST36) suppresses inflammation in allergic contact dermatitis via triggering local IL-10 production and inhibiting p38 MAPK activation. *Inflammation*. 2017;40:1351–1364. doi:10.1007/s10753-017-0578-5
90. Zhang XH, Li FF, Qi Y, et al. [Electroacupuncture improves cutaneous allergic reaction by inhibiting degranulation of intrape-ritoneal mast cells, MAPK signaling and inflammatory factor levels in urticaria rats]. *Zhen Ci Yan Jiu*. 2020;45:299–304. doi:10.13702/j.1000-0607.190263 Hausa
91. Park JG, Lee H, Yeom M, Chae Y, Park HJ, Kim K. Effect of acupuncture treatment in patients with mild to moderate atopic dermatitis: a randomized, participant- and assessor-blind sham-controlled trial. *BMC Complement Med Ther*. 2021;21:132. doi:10.1186/s12906-021-03306-1
92. Zeng ZW, Huang JQ, Chen Y, Yu X, Zhu W, Zhang DS. Acupoint autohemotherapy attenuates atopic dermatitis lesions by regulating Th1/Th2 balance in DNCB-Induced BALB/c mice. *Chin J Integr Med*. 2022;28:612–619. doi:10.1007/s11655-022-3579-7
93. Liu SJ, Liu JT, Li JQ, et al. [Effect of acupuncture pretreatment of "Quchi"(LI11) and "Xuehai" (SP10) on mast cells and IL-33/ST2 in rats with urticaria]. *Zhen Ci Yan Jiu*. 2023;48:311–316. doi:10.13702/j.1000-0607.20211282 Hausa
94. Shi Y, Guo H, Du Y, Wang J, Shang Y, Wang Y. Acupuncture combined with pricking and cupping therapy is effective in patients with chronic spontaneous urticaria. *Am J Transl Res*. 2023;15:1195–1203.
95. Li JQ, Ma TM, Li SJ, et al. [Electroacupuncture preconditioning prevents urticaria by regulating inflammatory response in rats with urticaria]. *Zhen Ci Yan Jiu*. 2024;49:1047–1055. doi:10.13702/j.1000-0607.20240435 Hausa
96. Neumann Ł, Nowak R, Stępień J, et al. Thermography based skin allergic reaction recognition by convolutional neural networks. *Sci Rep*. 2022;12:2648. doi:10.1038/s41598-022-06460-9
97. Chan LS, Robinson N, Xu L. Expression of interleukin-4 in the epidermis of transgenic mice results in a pruritic inflammatory skin disease: an experimental animal model to study atopic dermatitis. *J Invest Dermatol*. 2001;117:977–983. doi:10.1046/j.0022-202x.2001.01484.x
98. Bogaczewicz J, Malinowska K, Sysa-Jedrzejowska A, Wozniacka A. Medium-dose ultraviolet A1 phototherapy improves SCORAD index and increases mRNA expression of interleukin-4 without direct effect on human β defensin-1, interleukin-10, and interleukin-31. *Int J Dermatol*. 2016;55:e380–385. doi:10.1111/ijd.13213
99. Zhang XF, Xiang SY, Lu J, et al. Electroacupuncture inhibits IL-17/IL-17R and post-receptor MAPK signaling pathways in a rat model of chronic obstructive pulmonary disease. *Acupunct Med*. 2021;39:663–672. doi:10.1177/0964528421996720
100. Komuro M, Mizugaki H, Nagane M, et al. Ganglioside GM3 deficiency enhances mast cell sensitivity. *FEBS J*. 2023;290:4268–4280. doi:10.1111/febs.16806
101. Hu C, Zhang Y, Liu J, You Y, Wu F, Zhou H. Functional property and regulatory mechanism of macrophages in complementary and alternative medicine: from bench to clinic. *Iran J Immunol*. 2024;21:103–120. doi:10.22034/iji.2024.99943.2668

102. Huang M, Wang X, Xing B, et al. Critical roles of TRPV2 channels, histamine H1 and adenosine A1 receptors in the initiation of acupoint signals for acupuncture analgesia. *Sci Rep*. 2018;8:6523. doi:10.1038/s41598-018-24654-y
103. Wang YL, Su YS, He W, Jing XH. Electroacupuncture relieved visceral and referred hindpaw hypersensitivity in colitis rats by inhibiting tyrosine hydroxylase expression in the sixth lumbar dorsal root ganglia. *Neuropeptides*. 2019;77:101957. doi:10.1016/j.npep.2019.101957
104. Gong Y, Li N, Lv Z, et al. The neuro-immune microenvironment of acupoints-initiation of acupuncture effectiveness. *J Leukoc Biol*. 2020;108:189–198.
105. Liu Y, Yu Z, Xia Y, Xu B, Xu T. Immune metabolic mechanisms of acupuncture in improving glycolipid metabolic disorders explored through pancreatic adipose tissue. *Zhongguo Zhen Jiu*. 2024;44:333–337. doi:10.13703/j.0255-2930.20230620-k0002
106. Liu Y, Ji B, Zhao G, et al. Protective effect of electro-acupuncture at maternal different points on perinatal nicotine exposure-induced pulmonary dysplasia in offspring based on HPA axis and signal transduction pathway. *Biochem Biophys Res Commun*. 2018;505:586–592. doi:10.1016/j.bbrc.2018.09.145
107. Zheng X, Cheng Y, Chen Y, et al. Ferulic acid improves depressive-like behavior in prenatally-stressed offspring rats via anti-inflammatory activity and HPA axis. *Int J Mol Sci*. 2019;20:493.
108. Jiale K, Zhongming DU, Wei G, Shuo DU, Guanxiong H, Sheng C. Effect of acupuncture on serum levels of hypothalamic-pituitary-adrenal axis related hormones and immune factors in rats with allergic rhinitis. *J Tradit Chin Med*. 2025;45:359–367. doi:10.19852/j.cnki.jtcm.2025.02.020
109. Zhang XN, He W, Wan HY, et al. Electroacupuncture and moxibustion-like stimulation activate the cutaneous and systemic hypothalamic-pituitary-adrenal axes in the rat. *Acupunct Med*. 2022;40:232–240. doi:10.1177/09645284211055745
110. McDonald JL, Cripps AW, Smith PK, Smith CA, Xue CC, Golianu B. The anti-inflammatory effects of acupuncture and their relevance to allergic rhinitis: a narrative review and proposed model. *Evid Based Complement Alternat Med*. 2013;2013:591796. doi:10.1155/2013/591796
111. Wang J, Liu JJ, Tang ZY, Liang QQ, Cui JW. Acupuncture promotes neurological recovery and regulates lymphatic function after acute inflammatory nerve root injury. *Heliyon*. 2024;10:e35702. doi:10.1016/j.heliyon.2024.e35702
112. Montalbano AM, Di Sano C, Chiappara G, et al. Cigarette smoke and non-neuronal cholinergic system in the airway epithelium of COPD patients. *J Cell Physiol*. 2018;233:5856–5868. doi:10.1002/jcp.26377
113. Zhang XF, Xiang SY, Geng WY, et al. Electro-acupuncture regulates the cholinergic anti-inflammatory pathway in a rat model of chronic obstructive pulmonary disease. *J Integr Med*. 2018;16:418–426. doi:10.1016/j.joim.2018.10.003
114. Choi JY, Jung HJ, Kim JI, et al. A randomized pilot study of acupuncture as an adjunct therapy in adult asthmatic patients. *J Asthma*. 2010;47:774–780. doi:10.3109/02770903.2010.485665
115. Chen H, He M, Cao J, et al. Acupuncture and moxibustion intervention in functional dyspepsia: gastric and duodenal regulation. *Heliyon*. 2024;10:e35696. doi:10.1016/j.heliyon.2024.e35696