

Research Progress on Acupuncture's Immune Regulation and Treatment Strategies for Autoimmune Diseases

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Abstract:

This paper systematically reviews the research progress of acupuncture in immune function regulation and its application strategies in treating autoimmune diseases. Studies have shown that acupuncture can function through regulating immune molecules, immune cells, and immune responses. At the molecular level, it regulates cytokines and immunoglobulins while at the cellular level, it affects the function of NK cells, T cells, and B cells. On the other hand, at the immune response level, it regulates phagocytic cell activity and the neuroendocrine system. Acupuncture has demonstrated significant therapeutic effects in treating autoimmune diseases such as rheumatoid arthritis, systemic lupus erythematosus, and chronic fatigue syndrome, and can work synergistically with other treatment methods to provide more comprehensive therapeutic solutions.

Keywords:

Acupuncture therapy
Immune regulation
Autoimmune diseases
Cytokines
Immune cells

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1. Introduction

Acupuncture, an essential component of Traditional Chinese Medicine, has a history spanning thousands of years. In recent years, with the advancement of modern medical research, the role of acupuncture in treating immune system diseases has gradually been revealed ^[1]. This paper aims to explore how acupuncture regulates the immune system and its application strategies in treating autoimmune diseases.

2. Research progress on acupuncture's immune regulation

2.1. Regulatory effects of acupuncture on immune molecules

Acupuncture's regulation of immune molecules is manifested in multiple aspects through stimulating specific acupoints, directly affecting the molecular level of the immune system. In inflammatory responses, tumor necrosis factor- α (TNF- α) and interleukin-1 β (IL-

1 β), as important pro-inflammatory cytokines, can lead to tissue damage and various disease developments when excessively expressed [2]. Research has shown that acupuncture can effectively reduce the levels of these pro-inflammatory cytokines, and decrease the release of inflammatory mediators, thereby achieving anti-inflammatory effects. This mechanism may be related to the activation of local nerve endings after acupuncture stimulation, which can trigger a series of biochemical reactions, ultimately inhibiting the activation of inflammation-related signaling pathways [3]. Moreover, acupuncture can promote the production of anti-inflammatory cytokines such as interleukin-10 (IL-10). IL-10 is an important anti-inflammatory cytokine that can inhibit pro-inflammatory cytokine synthesis, effectively regulate immune responses, and prevent excessive inflammatory responses from causing damage to the body. By increasing IL-10 levels, acupuncture not only helps balance the pro-inflammatory and anti-inflammatory states of the immune system but also protects organs from inflammatory damage to some extent, which is significant for maintaining body homeostasis. Besides affecting cytokines, acupuncture can also regulate immunoglobulin and complement system functions. Immunoglobulins are the main components of antibodies, crucial for recognizing and eliminating pathogens; while the complement system is part of innate immunity, helping to eliminate pathogens and clear damaged cells [4]. Acupuncture helps enhance the body's ability to resist external invasion while reducing tissue damage caused by autoimmune responses by regulating the levels or activity of these two components.

2.2. Regulatory effects of acupuncture on immune cells

Acupuncture's regulation of immune cells primarily manifests in its influence on the quantity and function of key immune cells such as natural killer (NK) cells, T cells, and B cells [5]. NK cells, as an important component of the body's non-specific immunity, can directly kill tumor cells and virus-infected cells. Research indicates that acupuncture can significantly enhance NK cell activity, suggesting that acupuncture can improve the body's anti-tumor capacity and ability to resist viral infections by enhancing NK cell function, which is important

for preventing and treating certain types of cancers and viral infectious diseases. Regarding the regulation of T cells and B cells, acupuncture demonstrates its potential in maintaining immune balance [6]. T cells are responsible for cellular immunity, participating in immune responses against intracellular pathogens such as viruses and tumors. B cells are responsible for producing antibodies and participating in humoral immune responses. Acupuncture can optimize cellular immune responses by adjusting the ratio of T cell subsets, such as balancing helper T cells (Th) and regulatory T cells (Treg). Meanwhile, acupuncture can promote B cell maturation and differentiation, increasing antibody production, and thereby strengthening humoral immunity. This regulation of T cell and B cell balance helps improve overall immune function, reduces the risk of autoimmune responses, and has positive implications for preventing and treating autoimmune diseases. Additionally, acupuncture can promote the release of neurotransmitters such as endorphins [7]. Endorphins are natural analgesic substances, and their release not only effectively relieves pain but can also regulate immune system function by affecting the hypothalamic-pituitary-adrenal (HPA) axis. Activation of the HPA axis can suppress inflammatory responses and reduce the production of inflammatory mediators, thereby alleviating inflammatory symptoms. Through this mechanism, acupuncture can not only relieve inflammation-induced pain but also further influence immune system activity, promoting the body's return to a healthy state.

2.3. Regulatory effects of acupuncture on immune responses

Acupuncture's regulation of immune responses is reflected in multiple aspects, including immune cell quantities, functions, and cytokine synthesis and secretion. Through stimulation of specific acupoints, acupuncture can significantly increase the number and function of phagocytic cells [8]. Phagocytic cells are the first line of defense in the immune system, responsible for clearing invading pathogens and dead cells, and maintaining the body's internal environment clean. Research shows that acupuncture can enhance the phagocytic ability and reactive oxygen species production capacity of macrophages and other phagocytic cells, improving

the body's efficiency in clearing bacterial, viral, and other pathogenic microorganisms, thereby effectively preventing infections. In terms of cytokine regulation, acupuncture also shows excellence. Cytokines are important messengers between immune cells, participating in the initiation, amplification, and termination processes of immune responses^[9]. Acupuncture can regulate cytokine synthesis and secretion, such as by reducing levels of pro-inflammatory cytokines (like TNF- α , IL-1 β) while increasing concentrations of anti-inflammatory cytokines (like IL-10), achieving effective control of inflammatory responses. Furthermore, acupuncture can promote the production of growth factors and chemokines, which are crucial for immune cell proliferation, differentiation, and migration, helping accelerate wound healing and tissue repair. More importantly, acupuncture can indirectly influence immune responses by regulating the neuroendocrine system^[10]. There exists a close connection between the nervous system and the immune system, where neurotransmitters and hormones can directly act on receptors on immune cells, affecting their activation state and migration ability. Through activating or inhibiting specific neural pathways, acupuncture can influence the hypothalamic-pituitary-adrenal (HPA) axis and sympathetic nervous system, thereby regulating the secretion of hormones such as cortisol. Cortisol has powerful anti-inflammatory effects, and appropriate cortisol levels can help control excessive immune responses, preventing the occurrence and development of autoimmune diseases. Meanwhile, acupuncture can promote the release of neurotransmitters such as endorphins, which not only relieve pain but can also indirectly support normal immune system function by improving emotional state^[11].

3. Acupuncture treatment strategies in autoimmune diseases

3.1. Acupuncture treatment for rheumatoid arthritis

The effectiveness of acupuncture in treating rheumatoid arthritis has been widely recognized. Rheumatoid arthritis is a chronic autoimmune disease primarily characterized by joint pain, swelling, and limited mobility, severely affecting patients' quality of life. Research shows that

acupuncture can effectively relieve these symptoms, providing a new treatment option for rheumatoid arthritis patients. Through stimulating specific acupoints, acupuncture can reduce levels of inflammatory cytokines in the serum of rheumatoid arthritis patients^[12]. Inflammatory cytokines, such as tumor necrosis factor- α (TNF- α) and interleukin-1 β (IL-1 β), play key roles in the pathogenesis of rheumatoid arthritis, and their excessive production leads to increased joint inflammation. Acupuncture treatment can significantly reduce the levels of these pro-inflammatory cytokines, thereby reducing inflammatory responses, decreasing joint pain and swelling, and improving patients' daily activity ability^[13]. Besides direct anti-inflammatory effects, acupuncture can also exert therapeutic effects by regulating immune system function. Acupuncture can promote the production of anti-inflammatory cytokines, such as interleukin-10 (IL-10), helping balance immune responses and reducing autoimmune attacks on joint tissues.

3.2. Acupuncture treatment for systemic lupus erythematosus

Systemic lupus erythematosus (SLE) is a complex autoimmune disease involving multiple system damage, with common symptoms including fatigue, joint pain, and skin damage^[14]. As a traditional therapy, acupuncture has shown significant effects in improving SLE patients' symptoms, providing a new treatment option for patients. Research indicates that acupuncture can reduce disease activity by regulating cellular immune function in SLE patients, thereby effectively alleviating patients' suffering. The pathogenesis of SLE is closely related to immune system abnormalities, especially T cell and B cell dysfunction, leading to the body producing large amounts of autoantibodies that attack normal tissues and organs. Acupuncture treatment, through stimulating specific acupoints, can regulate T cell and B cell balance, reduce autoantibody production, and decrease immune system hyperactivity. In terms of improving specific symptoms, acupuncture has obvious effects on relieving fatigue^[15]. Fatigue is one of the most common complaints among SLE patients, severely affecting daily life and workability. Acupuncture can promote blood circulation, improve microcirculation, and increase tissue oxygen and nutrient supply, thereby reducing fatigue. Meanwhile, acupuncture

can also promote the release of pain-relieving substances such as endorphins, effectively relieving joint pain, improving joint function, and increasing patients' mobility. Regarding skin damage, acupuncture also shows good therapeutic effects. SLE patients' skin damage manifests as butterfly rash, photosensitivity, etc., and acupuncture can reduce skin rash and itching symptoms by regulating the immune system and reducing inflammatory responses.

3.3. Acupuncture treatment for chronic fatigue syndrome

Chronic fatigue syndrome (CFS) is a complex disease primarily characterized by long-term fatigue, often accompanied by sleep disorders, cognitive dysfunction, and various other symptoms^[16]. As a traditional treatment method, acupuncture has shown significant effects in improving CFS patients' symptoms, bringing new hope to patients. Research shows that acupuncture can increase natural killer (NK) cell activity in CFS patients, enhancing body immune function. NK cells are an important component of the immune system, with the ability to directly kill virus-infected cells and tumor cells. CFS patients often have immune dysfunction and weakened NK cell activity, which may be one of the reasons for persistent fatigue and other symptoms^[17]. Through stimulating specific acupoints, acupuncture can activate the immune system, and increase NK cell activity, thereby enhancing the body's disease resistance and reducing fatigue. In terms of improving sleep disorders, acupuncture also shows excellence. CFS patients often suffer from insomnia or poor sleep quality, and acupuncture can help improve sleep quality by regulating neurotransmitter levels in the brain, such as increasing endorphin and serotonin secretion. Endorphins have sedative and sleep-promoting effects, while serotonin participates in regulating sleep cycles^[18]. Acupuncture can effectively relieve sleep disorders and improve patients' sleep quality by promoting the release of these neurotransmitters. For cognitive dysfunction, acupuncture can also provide help. CFS patients' cognitive dysfunction manifests as poor concentration, memory decline, and other symptoms. Acupuncture can help improve patients' cognitive abilities by regulating central nervous system function and improving brain blood flow and metabolism.

3.4. Combination of acupuncture with other treatment methods

As an adjunctive treatment method, acupuncture, when combined with drug therapy, nutritional support, psychological intervention, and other treatment methods, can significantly improve therapeutic effects, providing more comprehensive support for the management of various diseases. Through multi-faceted and multi-angle combined treatment approaches, it can better address the challenges of complex diseases and improve patients' overall health status. In combination with drug therapy, acupuncture can enhance drug effects while reducing side effects. For example, in treating chronic pain, acupuncture can be used in conjunction with non-steroidal anti-inflammatory drugs (NSAIDs), reducing drug dosage through acupuncture's analgesic effects, thereby decreasing gastrointestinal discomfort and other side effects. In treating depression, combining acupuncture with antidepressant medications can more quickly improve mood and quality of life^[19]. Acupuncture regulates the nervous system and promotes the release of natural analgesic substances like endorphins, complementing drug therapy to achieve better therapeutic effects. Combined with nutritional support, acupuncture can promote the body's absorption and utilization of nutrients, enhancing immunity. Malnutrition or absorption disorders are common problems faced by chronic disease patients, and acupuncture can help improve nutrition absorption efficiency by enhancing digestive system function, increasing appetite, and promoting gastrointestinal motility^[20]. Additionally, acupuncture can regulate the endocrine system, improve metabolic function, providing more comprehensive rehabilitation support for patients. In terms of psychological intervention, acupuncture can be combined with cognitive behavioral therapy, psychological counseling, and other methods to jointly improve patients' psychological state. Chronic disease patients often experience psychological issues such as anxiety and depression, and acupuncture can help alleviate negative emotions and improve psychological resilience by regulating neurotransmitter levels in the brain, such as increasing serotonin and dopamine secretion. Combined with psychological intervention, acupuncture can work on both physiological and psychological levels, providing more comprehensive

support for patients.

4. Conclusion

Acupuncture regulates the immune system through multi-level, multi-target mechanisms, demonstrating its unique advantages in immune regulation. At the molecular level, acupuncture can regulate the balance between pro-inflammatory and anti-inflammatory cytokines and influence immunoglobulin function. At the cellular level, it can optimize the quantity and functional status of

NK cells, T cells, and B cells. At the immune response level, it can achieve comprehensive immune function regulation through modulating the neuro-endocrine-immune network. These mechanisms enable acupuncture to play an important role in treating autoimmune diseases, particularly showing significant clinical effects in treating rheumatoid arthritis, systemic lupus erythematosus, and chronic fatigue syndrome. The combined application of acupuncture with other treatment methods further highlights its value in the comprehensive treatment of immune system diseases.

Disclosure statement

The authors declare no conflict of interest.

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