

Application and Mechanism of Acupuncture in Adverse Reactions to Breast Cancer Chemotherapy: Postprint

Authors: Ren Yuanyuan, Liu Sheng, Liu Sheng

Date: 2025-05-08T09:22:19+00:00

Abstract

Breast cancer patients typically develop a series of adverse reactions following chemotherapy, which severely impact patients' quality of life and pose challenges to clinical treatment. Acupuncture, as a safe and readily acceptable therapeutic modality for patients, demonstrates potential in ameliorating post-chemotherapy adverse reactions through its distinctive efficacy. Although research on acupuncture for managing chemotherapy-induced adverse reactions in breast cancer patients has achieved certain progress, current studies predominantly remain at the individual research level, lacking systematic integration and synthesis of relevant research. Moreover, mechanistic investigations are largely preliminary explorations, and a complete theoretical framework has yet to be established. Furthermore, no widely recognized standardized guidelines have been formulated for acupuncture treatment in this domain, which somewhat limits its standardized application in clinical practice. This study systematically integrates application research and mechanistic studies on acupuncture for chemotherapy-induced adverse reactions in breast cancer patients from SCI-indexed journals, concluding that a rich evidence chain has been established regarding the interventional value of acupuncture in managing chemotherapy adverse reactions in breast cancer. Acupuncture can significantly improve core symptoms such as post-chemotherapy gastrointestinal symptoms, peripheral neuropathy, myelosuppression, and cancer-related fatigue by modulating inflammatory factor levels, regulating the nervous system, and related signaling pathways, thereby exerting therapeutic effects. This article provides a reference for future clinical applications of acupuncture in treating chemotherapy-induced adverse reactions in breast cancer and for in-depth investigations into its mechanisms of action.

Full Text

Application and Mechanism of Acupuncture in Adverse Reactions to Chemotherapy for Breast Cancer

REN Yuanyuan¹, LIU Sheng^{2*}

¹Jiangxi University of Traditional Chinese Medicine, Nanchang 330004, China

²Longhua Hospital, Shanghai University of Traditional Chinese Medicine, Shanghai 200032, China

Corresponding author: LIU Sheng, Professor; E-mail: lshtcm@163.com

Abstract

Breast cancer patients undergoing chemotherapy typically experience a series of adverse reactions that severely impact their quality of life and pose significant challenges to clinical management. Acupuncture, as a safe and well-accepted therapeutic modality, demonstrates considerable potential in ameliorating chemotherapy-induced adverse effects through its unique therapeutic actions. While research on acupuncture for chemotherapy-related adverse reactions in breast cancer patients has achieved some progress, current studies remain largely fragmented, lacking systematic integration and synthesis. Moreover, mechanistic investigations are mostly preliminary and have not yet coalesced into a comprehensive theoretical framework. Additionally, the absence of widely recognized standardized guidelines for acupuncture treatment in this domain has limited its standardized application in clinical practice. This study systematically integrates applied research and mechanistic studies on acupuncture for chemotherapy-induced adverse reactions in breast cancer patients from SCI-indexed journals, concluding that a robust evidence chain has been established for the therapeutic value of acupuncture in managing breast cancer chemotherapy adverse reactions. Acupuncture can significantly improve core symptoms such as gastrointestinal dysfunction, peripheral neuropathy, myelosuppression, and cancer-related fatigue by modulating inflammatory cytokine levels, regulating the nervous system, and influencing relevant signaling pathways. This article provides a reference for future clinical applications of acupuncture in treating chemotherapy-induced adverse reactions in breast cancer and for in-depth mechanistic investigations.

Keywords: breast cancer; acupuncture; chemotherapy; adverse effects; clinical application

Breast cancer represents the most commonly diagnosed cancer globally, with particularly high incidence and mortality rates in low- and middle-income countries [1]. Research indicates that breast cancer has become the leading cause of cancer-related death among women aged 20–39 [2]. Chemotherapy constitutes

a standard treatment modality for breast cancer patients, demonstrating significant efficacy; however, it simultaneously produces a range of adverse reactions while eliminating tumor cells [3]. In this context, acupuncture, with its unique advantages of “multi-target action, minimal invasiveness, and holistic regulation,” has gradually emerged as a research hotspot in oncological supportive care. Acupuncture not only improves the quality of life for chemotherapy patients but also provides innovative pathways for the modern medical paradigm shift from “disease treatment” to “health maintenance.” Breast cancer patients frequently experience multi-system adverse reactions following chemotherapy, and acupuncture has demonstrated important clinical value in ameliorating these toxicities. Nevertheless, current research lacks standardization and systematic integration. Therefore, this article systematically reviews relevant clinical evidence and mechanistic research from SCI-indexed journals, presenting a classification framework based on both multi-system dimensional management and holistic symptom cluster approaches to establish a systematic structure that provides a new paradigm for subsequent research and further enhances the credibility and clinical applicability of acupuncture for chemotherapy-induced adverse reactions in breast cancer patients.

1. Literature Search Strategy

This review conducted systematic searches of PubMed, Web of Science, EM-Base, and the Cochrane Library using the following keywords: “breast cancer,” “breast neoplasms,” “chemotherapy,” “antineoplastic agents,” “acupuncture,” “electroacupuncture,” “adverse drug reaction,” “adverse effects,” “chemotherapy-induced toxicity,” and “mechanism.” Clinical study designs included randomized controlled trials, cohort studies, and clinical observations, while mechanistic studies encompassed experimental research and clinical trials. Non-English literature, case reports, and studies with incomplete data were excluded, yielding 79 articles for full-text review and categorical synthesis.

2. Systematic Review by Organ System

2.1 Digestive System Gastrointestinal symptoms such as nausea, vomiting, and appetite loss are common complications following chemotherapy in cancer patients [4]. Studies show that approximately 70–80% of chemotherapy patients experience nausea and vomiting, a condition termed chemotherapy-induced nausea and vomiting (CINV) [5]. In 1997, the U.S. National Institutes of Health recognized acupuncture as effective for CINV [6], and its application has since expanded. From a traditional Chinese medicine perspective, CINV falls under the category of “vomiting,” with treatment principles focusing on strengthening the spleen, harmonizing the stomach, and replenishing qi and blood.

The Society for Integrative Oncology (SIO) guidelines recommend acupuncture and acupressure for CINV management [7]. KONG et al. [8] demonstrated that acupuncture combined with antiemetic drugs significantly reduced the frequency of nausea and vomiting while decreasing antiemetic-related adverse effects and

improving quality of life. SHEN et al. [9] conducted a randomized trial dividing breast cancer chemotherapy patients into true electroacupuncture and sham electroacupuncture groups, both receiving standard triple antiemetic therapy. Results showed that the true electroacupuncture group achieved significantly higher complete protection rates (no vomiting, no rescue therapy, no significant nausea) compared to controls, increasing from 34.5% to 52.9%, with even higher rates during the delayed phase. These evidence-based findings suggest that integrating acupuncture into supportive care not only improves symptom control metrics but also enhances treatment tolerability and patient quality of life.

In summary, acupuncture can improve gastrointestinal symptoms such as nausea and vomiting through combined application with Western medicine or other traditional Chinese medicine modalities. Mechanistic studies indicate that these effects may involve acupuncture-induced release of pituitary β -endorphin and adrenocorticotrophic hormone, modulation of neurotransmitters (such as serotonin and dopamine), inhibition of the brain's chemoreceptor trigger zone and vomiting center, immune system regulation, reduction of gastrointestinal inflammation, and modulation of intestinal flora and gastric motility [10–13]. Acupuncture may also alleviate chemotherapy-induced nausea and vomiting indirectly through psychological interventions such as cognitive-behavioral therapy and guided imagery [14]. These findings demonstrate that acupuncture ameliorates post-chemotherapy nausea and vomiting through multiple mechanisms including neural regulation, anti-inflammatory effects, improved gastrointestinal function, and psychological modulation, exhibiting multidimensional, cross-system integrative regulatory characteristics. This systemic mechanism provides scientific rationale for establishing acupuncture treatment protocols based on the “brain-gut interaction” theory.

2.2 Peripheral Nervous System Chemotherapy-induced peripheral neuropathy (CIPN) represents a common adverse reaction in cancer patients, clinically manifested as sensory abnormalities, motor dysfunction, and pain [15]. CIPN often necessitates dose reduction or treatment discontinuation, ultimately compromising cancer control and worsening prognosis [16]. A study of 255 cancer patients found that 68–73% developed CIPN [17], with 25–50% of breast cancer patients experiencing CIPN after chemotherapy [18]. In traditional Chinese medicine, CIPN corresponds to “bi syndrome” or “wei syndrome,” with treatment principles of nourishing blood, harmonizing ying, and activating collaterals to relieve pain.

Acupuncture demonstrates significant efficacy in improving CIPN symptoms with minimal adverse effects. BAO et al. [19] conducted a single-arm clinical trial in 27 breast cancer patients, showing that acupuncture effectively reduced CIPN incidence and severity, suggesting both preventive and therapeutic roles. LU et al. [20] treated 20 breast cancer patients with acupuncture at Yintang, Taichong, and Zusanli points for eight weeks, resulting in improved neuropathic symptom scores and sensory assessments. HUANG et al. [21] administered

acupuncture to breast cancer patients receiving taxane-based chemotherapy, demonstrating significant pain reduction and improved tactile thresholds, confirming acupuncture's dual mechanisms of analgesia and nerve function repair.

ZHAO et al. [22] found that electroacupuncture attenuated chemotherapy-induced neuropathic pain by enhancing the Nrf2-ARE signaling pathway and reducing oxidative stress markers such as 8-hydroxy-2'-deoxyguanosine. Additionally, electroacupuncture restored superoxide dismutase levels and inhibited oxidative stress products, thereby reducing chemotherapy-induced mechanical and thermal hypersensitivity. Acupuncture alleviates numbness and pain in breast cancer chemotherapy patients by regulating neural function, improving nerve conduction, and reducing neuroinflammation [20–21]. Furthermore, acupuncture activates sensory nerve endings and nerve fibers to produce anti-neuroinflammatory effects while stabilizing intra- and extracellular ion concentrations to prevent protein denaturation and neurotoxicity [23–24]. Acupuncture also achieves analgesic effects through pituitary endorphin release and opioid receptor activation. Current evidence demonstrates that acupuncture improves CIPN symptoms through multiple mechanisms including redox regulation, ion channel homeostasis, and neuroplasticity induction, offering an evidence-based integrative solution to the challenge of limited targeted therapies for CIPN.

2.3 Hematologic System Chemotherapy-induced myelosuppression (CIM) refers to alterations in the bone marrow hematopoietic microenvironment caused by chemotherapeutic agents, affecting hematopoietic stem cell activity and function, manifested as decreased white blood cell, red blood cell, and platelet counts leading to anemia, infection, and bleeding [25]. Most chemotherapeutic agents cause dose-dependent myelosuppression [26]. Studies report an overall CIM incidence of 91.95%, with 25.09% of patients developing grade 3–4 CIM [27]. In traditional Chinese medicine, CIM corresponds to “blood deficiency,” with treatment principles of nourishing kidney and spleen, and supplementing qi and blood.

JI et al. [28] used moxibustion as adjunctive therapy for breast cancer patients with CIM, demonstrating reduced myelosuppression-related adverse events and improved white blood cell counts, thereby enhancing chemotherapy compliance and safety. SHIH et al. [29] found acupuncture significantly alleviated chemotherapy-induced leukopenia in breast cancer patients, markedly increasing white blood cell and neutrophil counts. CHEN et al. [30] employed acupuncture as adjunctive therapy for breast cancer CIM patients, showing improvements in white blood cell, platelet, and red blood cell counts, along with enhanced quality of life and reduced chemotherapy-related symptom severity. These studies demonstrate that acupuncture provides a feasible solution to the clinical dilemma of chemotherapy dose reduction or discontinuation caused by CIM, and its capacity to simultaneously improve multiple symptoms aligns perfectly with the evolving trend of oncological supportive care toward “preserving effi-

cacy while reducing toxicity.”

Acupuncture may enhance immune function by activating immune cells or modulating cytokine secretion, thereby alleviating chemotherapy-induced bone marrow suppression. Acupuncture also regulates the neuroendocrine system through the hypothalamic-pituitary-adrenal (HPA) axis, helping maintain internal homeostasis and reducing bone marrow suppression [31]. Inflammatory responses represent an important factor in post-chemotherapy myelosuppression, and acupuncture may improve bone marrow suppression by regulating relevant inflammatory signaling pathways and inhibiting inflammatory cytokine release. CHEN et al. [30] proposed that acupuncture may enhance bone marrow hematopoietic function by modulating key proteins in the Notch signaling pathway, such as Numb1 and Numb2, thereby inhibiting excessive Notch signal transduction. Additionally, acupuncture may promote DNA repair and upregulate DNA content in bone marrow cells, accelerating recovery of the damaged hematopoietic microenvironment. SHIH et al. [32] found that acupuncture increases granulocyte colony-stimulating factor (G-CSF) levels to promote blood cell production and enhances natural killer cell activity to improve chemotherapy tolerance. Acupuncture also accelerates bone marrow microvascular repair by increasing matrix metalloproteinase-2 (MMP-2) and MMP-9 expression in bone marrow tissue, promoting cytokine release from stromal cell membranes, facilitating bone marrow stromal cell transition from G1 to S and G2 phases, protecting and repairing bone marrow stromal cell DNA, and accelerating mitosis and proliferation, thereby effectively alleviating post-chemotherapy myelosuppression. This multi-layered intervention model, spanning from epigenetic regulation to systemic biological remodeling, not only overcomes the limitations of traditional colony-stimulating factor therapy but also provides an integrative strategy for oncological supportive care through microenvironmental remodeling.

2.4 Endocrine System Hot flashes represent one of the most common symptoms in cancer patients, particularly those with breast and prostate cancer [33], characterized by upper body skin flushing, heat sensation, sweating, palpitations, and anxiety [34]. Hot flashes are typically associated with hormonal level changes, and certain chemotherapeutic agents can affect patient hormone levels, triggering these symptoms [35]. In traditional Chinese medicine, this condition falls under “yin deficiency tidal fever,” with treatment principles of regulating Chong and Ren meridians and nourishing yin to clear heat.

HERVIK et al. [36] conducted long-term follow-up of breast cancer patients receiving acupuncture for hot flashes, demonstrating superior efficacy in the acupuncture group both at treatment completion and at three months post-treatment. MAO et al. [37] compared electroacupuncture with gabapentin in 120 breast cancer patients with hot flashes, showing significant and durable effects of electroacupuncture after eight weeks of treatment and 24 weeks of follow-up. LESI et al. [38] treated 85 breast cancer patients with hot flashes

using acupuncture, with acupuncture group showing superior hot flash scores at treatment completion and at three and six months post-treatment. These clinical studies demonstrate the sustained and cumulative therapeutic effects of acupuncture, elevating its recommendation level in international oncological supportive care guidelines.

Chemotherapy-induced hormonal changes can cause hot flashes that impair quality of life, and acupuncture shows significant and durable efficacy in managing this symptom. Research indicates that acupuncture alleviates hot flashes by regulating calcitonin gene-related peptide (CGRP) release, activating endogenous opioid peptide systems such as β -endorphin, and influencing vasodilation and thermoregulation [39–40]. Acupuncture also modulates hypothalamic-pituitary-ovarian axis function, affecting neurotransmitters and hormone levels [41]. Furthermore, acupuncture regulates the autonomic nervous system, particularly the balance between sympathetic and parasympathetic tone, inhibiting excessive sympathetic activation to facilitate thermoregulation and reduce hot flash occurrence [42]. These findings demonstrate that acupuncture improves hot flashes through mechanisms involving autonomic nervous system regulation, hormonal modulation, and neurotransmitter balance, providing a precise and safe therapeutic option that overcomes limitations of conventional hormone replacement therapy.

2.5 Whole-Body Systemic Effects Cancer-related fatigue (CRF) represents a subjective experience related to cancer and its treatment, unrelated to activity level, and unrelieved by rest or sleep, manifesting as multidimensional impairment across physical, psychological, and cognitive domains [43]. Up to 90% of cancer patients experience CRF, significantly impacting quality of life [44]. Research links CRF to immune system, central nervous system, endocrine system, and metabolic disturbances, classifying it as a systemic disease [45]. Clinical manifestations include fatigue, sleep disturbance, cognitive impairment, and mood abnormalities.

Given the complex symptomatology and mechanisms of CRF and the absence of specific pharmacological treatments, traditional Chinese medicine—particularly acupuncture—assumes particular importance. LV et al. [46] proposed that acupuncture may alleviate breast cancer-related fatigue by modulating the gut microbiota-gut-brain axis, potentially through improved intestinal barrier function, reduced inflammatory mediator release, and neurotransmitter modulation. HAN et al. [47] demonstrated that moxibustion improved CRF by regulating inflammatory cytokines including TNF- α , IL-6, and IL-2, HPA axis activity, and antioxidant capacity. Acupuncture's regulation of the HPA axis may occur through modulation of serotonin (5-HT) neurotransmitter and receptor expression, neuropeptide and hormone secretion, and microRNA expression [48]. XUE et al. [49] concluded that moxibustion's fatigue-alleviating mechanisms involve energy metabolism, neuroendocrine function, and immune-inflammatory responses. Moxibustion also improves sleep quality by regulating melatonin

and other sleep-related hormones [50]. LU et al. [51] found that moxibustion modulates neurotransmitters such as 5-HT and dopamine while reducing malondialdehyde (MDA) levels to decrease oxidative stress. LI et al. [52] proposed that acupuncture's antidepressant effects involve inhibition of neuroinflammatory responses, increased brain-derived neurotrophic factor (BDNF) expression to enhance neuroplasticity, and regulation of oxidative stress and mitophagy. BAE et al. [53] demonstrated that moxibustion modulates immune function by increasing G-CSF and IL-2 levels while decreasing TNF- α , improves microcirculation through thermal stimulation, and regulates energy metabolism via AMPK signaling pathway activation to alleviate CRF. These findings demonstrate that acupuncture ameliorates CRF through multi-target regulation of the gut microbiota-gut-brain axis, HPA axis, neuroplasticity, immune function, hormonal levels, energy metabolism, oxidative stress, and mitophagy—mechanisms that perfectly align with the heterogeneous pathological characteristics of CRF and provide a systematic medical paradigm for its treatment.

2.5.1 Fatigue Cancer patients frequently experience fatigue, shortness of breath, and lassitude after chemotherapy. Since these symptoms cannot be relieved by rest or sleep, they adversely affect quality of life and subsequent treatment. In traditional Chinese medicine, this corresponds to “consumptive disease” or “qi deficiency,” with treatment principles of supplementing qi, strengthening the spleen, and harmonizing organ function.

LI et al. [54] identified through serum sample sequencing that acupuncture alleviates chemotherapy-induced fatigue in breast cancer by regulating adenosine A1 receptor (ADORA1) expression, maintaining low fatigue levels. A meta-analysis demonstrated that acupuncture significantly improves cancer-related fatigue, particularly in breast cancer patients [55]. WU et al. [56] evaluated various non-pharmacological interventions for cancer-related fatigue, finding that acupuncture showed optimal efficacy based on quality-of-life assessments using the EORTC QLQ-C30 questionnaire, representing the optimal choice for advanced cancer patients with fatigue. In summary, acupuncture as a non-pharmacological therapy demonstrates significant advantages in managing chemotherapy-induced fatigue in breast cancer patients, particularly in the absence of specific medications, positioning it as a promising adjunctive therapeutic modality.

2.5.2 Sleep Disorders Sleep disturbance represents a critical factor affecting cancer patients' quality of life, assessable through sleep latency, nocturnal awakenings, total sleep time, and sleep medication usage. Research indicates that up to 80% of breast cancer patients develop sleep disorders during chemotherapy [57]. IRWIN et al. [58] demonstrated that sleep disturbances trigger inflammatory responses, increasing peripheral inflammation and cytokine levels that impair immune function and hinder recovery. In traditional Chinese medicine, this corresponds to “insomnia,” with treatment principles of harmonizing yin-yang and nourishing blood to calm the spirit.

Acupuncture effectively improves sleep disorders in cancer patients. GARLAND et al. [59] employed electroacupuncture for sleep disturbances in breast cancer patients, demonstrating significant improvements in sleep quality, particularly in sleep latency and efficiency. YOON et al. [60] administered six weeks of auricular acupressure to 20 breast cancer chemotherapy patients, using hematological tests and sleep activity monitors for objective assessment, and reported significant sleep quality improvement. ZHANG et al. [61] treated breast cancer patients with chemotherapy-associated insomnia using twice-weekly electroacupuncture plus auricular therapy for six weeks, showing significant improvements in insomnia severity index and Pittsburgh Sleep Quality Index parameters. These studies demonstrate that acupuncture substantially improves sleep disorders in breast cancer chemotherapy patients, providing an effective non-pharmacological alternative that overcomes tolerance limitations of conventional sedative medications and establishing a solid evidence base for acupuncture in oncological rehabilitation.

2.5.3 Cognitive Impairment Chemotherapy-related cognitive impairment (CRCI) manifests as decreased performance in learning, memory, attention, and executive function [62]. Research associates cognitive impairment with blood-brain barrier dysfunction, nerve damage, oxidative stress, and neuroinflammation [63]. Chemotherapy's impact on cognitive function can be analyzed through incidence rates of cognitive deficits, neuropsychological patterns, brain structural changes, and risk factors for neurotoxicity [64]. In traditional Chinese medicine, this corresponds to “forgetfulness,” with treatment principles of nourishing kidney essence, benefiting the brain, and filling marrow to enhance intelligence.

CRCI represents a prevalent side effect among chemotherapy-treated cancer patients. WHITTAKER et al. [65] reported that one in three breast cancer patients may develop significant cognitive impairment, with even higher prevalence based on patient-reported experiences compared to objective medical indicators. TONG et al. [66] treated 40 breast cancer patients with CRCI using acupuncture at Baihui, Sishencong, and Shenting points, demonstrating significant improvements in cognitive impairment and increased serum BDNF levels, with positive correlation suggesting BDNF-mediated mechanisms in alleviating “chemo-brain” symptoms. ZHANG et al. [67] evaluated electroacupuncture trigeminal nerve stimulation plus body acupuncture for attention and memory in breast cancer CRCI patients, showing significant efficacy at weeks 2 and 8 of treatment. These findings demonstrate that acupuncture provides a safe, well-tolerated, and personalized therapeutic option for breast cancer CRCI patients, highlighting its application value in oncological rehabilitation and its drug-interaction-free profile that advances the paradigm of tumor supportive care toward “cognitive preservation and functional protection.”

2.5.4 Mood Disorders Anxiety and depression are prevalent mood abnormalities among post-chemotherapy cancer patients, with conventional Western

treatments often causing adverse effects such as sedation, gastrointestinal discomfort, and hepatotoxicity [68], necessitating safer therapeutic alternatives. In traditional Chinese medicine, these correspond to “depression syndrome” or “visceral agitation,” with treatment principles of nourishing the heart, calming the spirit, and regulating qi to relieve depression.

MOLASSIOTIS et al. [69] conducted a six-week acupuncture intervention in 227 breast cancer patients, demonstrating significant improvements in anxiety and depression compared to usual care. GAO et al. [70] performed a systematic review of auricular acupuncture for depression in breast cancer patients, further confirming its clinical efficacy. WANG et al. [71] retrospectively studied 361 cancer patients with depression, reporting a 90% total effective rate after acupuncture and acupressure treatment, providing reliable evidence for this therapeutic approach. These studies demonstrate that acupuncture significantly improves mood disorders in breast cancer chemotherapy patients, highlighting its value in managing psychological distress and quality of life, and providing a dual approach of neuroprotection and psychological counseling that advances oncological supportive care toward the “mind-body integrated treatment” paradigm.

3. Symptom Cluster-Based Holistic Management

DODD et al. [72] first introduced the concept of symptom clusters in 2001, defined as multiple interconnected and relatively stable symptoms that co-occur during disease or treatment. Symptom cluster identification and management not only improve patient symptoms but also effectively enhance survival rates [73]. Furthermore, symptom cluster research facilitates identification of shared underlying mechanisms, enabling single interventions to manage multiple symptoms simultaneously [74]. FAN et al. [75] systematically reviewed symptom clusters in cancer patients, finding that breast cancer patients experience more symptom clusters during chemotherapy. LI et al. [76] evaluated symptom cluster changes during adjuvant therapy in breast cancer patients, identifying pain, fatigue, and mood abnormalities as common symptom clusters. The diversity and complexity of symptom clusters adversely affect disease prognosis, quality of life, and functional status, underscoring the importance of targeted treatment.

Western medicine often treats specific symptoms with specialized agents, presenting certain limitations. Acupuncture, rooted in traditional Chinese medicine’s holistic concept and syndrome differentiation, emphasizes overall regulation and personalized treatment, enabling comprehensive improvement of multiple symptoms without drug dependence. This confers unique advantages for symptom cluster management. JANG et al. [77] retrospectively demonstrated that acupuncture significantly improved treatment-related symptom clusters in breast cancer patients, including pain, fatigue, hot flashes, sleep disturbance, and anxiety, thereby substantially improving quality of life. D’ALESSANDRO et al. [78] found that acupuncture improved hot flashes while simultaneously benefiting sleep, mental, and emotional health. XIE et al. [79] used electroacupuncture to manage post-chemotherapy symptom

clusters including fatigue, insomnia, cognitive impairment, and anxiety, further confirming acupuncture's efficacy and feasibility for symptom cluster treatment. In summary, acupuncture demonstrates significant advantages in managing symptom clusters in breast cancer chemotherapy patients, warranting broader clinical application to achieve multiple therapeutic effects with a single intervention while minimizing side effects.

4. Perspectives and Future Directions

This study systematically reviewed clinical applications and mechanistic research on acupuncture for breast cancer chemotherapy adverse reactions from SCI-indexed journals, covering digestive, peripheral nervous, hematologic, endocrine, whole-body systems, and symptom cluster management. This integration partially standardizes the field and further confirms acupuncture's efficacy across multiple symptom systems, particularly its holistic approach to symptom clusters, warranting broader clinical application.

However, current research exhibits several limitations: (1) **Study Design:** Many studies suffer from small sample sizes, inappropriate control groups, inadequate randomization and blinding, and subjective outcome measures, limiting their persuasiveness. (2) **Technical Operation:** Variations in practitioner technique, including needling depth and precise point location, affect treatment consistency. (3) **Therapeutic Approaches:** Most studies employ combined therapies rather than single interventions, making it difficult to confirm the specific effects of acupuncture alone. (4) **Syndrome Differentiation:** Some studies address only the overall disease pattern without specific syndrome classification, potentially limiting applicability to certain patient subgroups. (5) **Mechanistic Research:** Current mechanistic studies rely primarily on animal experiments or serum biomarker detection, lacking exploration of deep mechanisms such as neural network remodeling and epigenetic regulation.

Future research should address these aspects through: (1) **Enhanced Clinical Research:** Conducting large-scale, well-designed randomized controlled trials with standardized intervention protocols including point combinations, stimulation parameters, and treatment duration. (2) **Strengthened Holistic Advantages:** Emphasizing symptom cluster management, particularly for common post-chemotherapy clusters such as “fatigue-sleep disturbance-pain” and “hot flashes-anxiety-cognitive impairment,” to expand clinical application. (3) **Scientific Rigor:** Strengthening basic research through multidisciplinary collaboration with immunology, neurobiology, and other fields to elucidate the modern scientific basis of acupuncture and provide stronger technical support. (4) **Traditional Chinese Medicine Principles:** Adhering to traditional Chinese medicine theories of organ, meridian, and eight-principle differentiation to develop comprehensive acupuncture systems, such as constructing “multi-stage differentiation” and “multi-meridian linkage” precision treatment frameworks based on the theory of “medical toxicity damaging collaterals, qi-blood consumption, and organ dysfunction.” (5) **Expanded Research:** Investigating

acupuncture's role in tumor suppression and enhancement of targeted therapy to fully realize its potential in oncology. (6) **Technological Innovation:** Developing novel acupuncture devices integrated with modern technology to improve precision and comfort, such as biodegradable magnetic nano-needles for targeted magnetic field release, quantitative devices for monitoring needling manipulation, and “electro-mechanical coupling” systems to simulate traditional tonifying and reducing techniques. (7) **AI Integration:** Implementing AI-assisted acupoint identification systems to automatically optimize electrical stimulation parameters and locate positive reaction points, enhancing diagnostic and therapeutic precision. (8) **Classical-Modern Integration:** Combining classical medical texts with modern clinical research to identify advantageous disease patterns for tumor acupuncture treatment and implement personalized approaches. (9) **Green Therapy Advocacy:** Promoting acupuncture's unique advantages as a green oncology therapy, emphasizing its high safety profile, minimal side effects, simple operation, broad adaptability, and cost-effectiveness.

In conclusion, the integrative advantages of acupuncture offer broad prospects for treating breast cancer patients with chemotherapy-induced adverse reactions. Future efforts should optimize study design, enhance scientific rigor, strengthen technological innovation, and establish an integrated “basic research-technological innovation-clinical translation” paradigm to develop an oncological acupuncture system combining traditional Chinese medicine characteristics with modern technology, thereby fully realizing its unique value in green oncology treatment and improving survival quality for cancer patients.

Funding: National Natural Science Foundation of China (82474508)

Citation: REN Yuanyuan, LIU Sheng. Application and mechanism of acupuncture in adverse reactions to chemotherapy for breast cancer [J]. Chinese General Practice, 2025. DOI: 10.12114/j.issn.1007-9572.2025.0031. [Epub ahead of print] [www.chinagp.net]

Conflict of Interest: The authors declare no conflicts of interest.

Received: 2025-02-06; **Revised:** 2025-03-14

Editor: LI Weixia

Note: Figure translations are in progress. See original paper for figures.

Source: ChinaXiv — Machine translation. Verify with original.