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Exploring the Synergistic Potential of Combined Acupuncture and Repetitive Transcranial Magnetic Stimulation for Postpartum Depression

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Abstract

Postpartum depression (PPD) remains a prevalent and serious mental health concern affecting mothers globally. While conventional pharmacological treatments such as selective serotonin reuptake inhibitors (SSRIs) are widely prescribed, their limitations including potential side effects and safety issues during breastfeeding have driven interest in alternative therapeutic strategies. Among these, the combination of acupuncture—an established component of Traditional Chinese Medicine—and repetitive transcranial magnetic stimulation (rTMS)—a non-invasive neuromodulation technique—has emerged as a promising integrative approach. This narrative review synthesizes current evidence regarding the efficacy, underlying mechanisms, and clinical implementation of combined acupuncture-rTMS therapy for PPD. Findings suggest that this dual-modality treatment may yield synergistic effects, resulting in greater reduction of depressive symptoms, improved neuroendocrine regulation, and enhanced overall quality of life compared to either intervention alone. Further investigation is warranted to refine treatment protocols, identify predictive biomarkers, and assess long-term outcomes.

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Introduction

Postpartum depression affects approximately 10–15% of women worldwide, with symptoms typically manifesting within the first month following childbirth, though onset may extend up to one year postpartum [1,2]. Clinical presentation extends beyond transient "baby blues" to include persistent sadness, anhedonia, profound fatigue, sleep disturbances, and in severe instances, suicidal ideation [3]. The etiology of PPD is multifactorial, encompassing hormonal fluctuations, genetic predisposition, psychosocial stressors, and neurobiological alterations [4-6]. Standard therapeutic approaches primarily involve antidepressants and psychotherapy [7]. However, concerns regarding medication safety during lactation, delayed therapeutic response, and adverse effects have spurred exploration of complementary and neuromodulatory interventions [8,9]. Repetitive transcranial magnetic stimulation (rTMS), a non-invasive brain stimulation modality [10,11], and acupuncture, a cornerstone of Traditional Chinese Medicine [12], have each demonstrated effectiveness in managing depressive disorders. Recent interest has focused on their combined application, which may enhance therapeutic outcomes for PPD through complementary mechanisms [13]. This narrative review aims to consolidate current knowledge regarding the integrated use of acupuncture and rTMS for PPD, examine proposed neurobiological synergies, and discuss clinical implications and future research priorities.

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Neurobiological Underpinnings of Postpartum Depression

A comprehensive understanding of PPD necessitates consideration of the profound neuroendocrine changes occurring during the postpartum period. Dramatic reductions in estrogen and progesterone following delivery significantly influence mood-regulating neurotransmitter systems, including serotonin, norepinephrine, and dopamine [14,15]. Estrogen, in particular, modulates serotonin synthesis and receptor function, potentially explaining increased susceptibility to depression during hormonal transitions [16]. Additionally, dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis and elevated levels of inflammatory cytokines such as IL-6 and TNF-α are frequently observed in PPD [17,18]. Neuroimaging studies further reveal functional and structural alterations in brain regions critical for emotional regulation, including the prefrontal cortex, amygdala, and components of the default mode network [19,20]. These interconnected neurobiological changes collectively contribute to the emotional and cognitive manifestations characteristic of PPD.

Acupuncture for PPD: Traditional Foundations and Contemporary Mechanisms

Traditional Chinese Medicine Perspective

Within Traditional Chinese Medicine (TCM) theory, PPD is principally associated with imbalances in the heart, liver, and kidney organ systems, often described using patterns such as "liver qi stagnation," "heart-spleen deficiency," or "kidney yin deficiency" [21]. Substantial blood loss during childbirth and subsequent depletion of vital energy (qi) are considered foundational causative factors [22]. Acupuncture treatment strategies typically aim to regulate qi flow, enrich blood, calm the spirit (shen), and restore balance among the organ networks [23]. Commonly employed acupoints include Baihui (DU20) to soothe the spirit and uplift yang energy, Shenting (DU24) to calm the heart and stabilize the mind, Yintang (EX-HN3) to alleviate anxiety, Shenmen (HT7) to nourish the heart and pacify the mind, and Taixi (KI3) to fortify kidney yin and enhance heart-kidney communication [24].

Modern Neurobiological Explanations

Contemporary research has elucidated several mechanisms through which acupuncture may ameliorate depressive symptoms:

- **Neurotransmitter Modulation:** Acupuncture elevates levels of serotonin, norepinephrine, and dopamine in key brain regions such as the prefrontal cortex, hippocampus, and amygdala [25].
- **HPA Axis Regulation:** It assists in normalizing cortisol levels and attenuating the physiological stress response [26].
- **Enhancement of Neuroplasticity:** Acupuncture promotes hippocampal neurogenesis and increases expression of brain-derived neurotrophic factor (BDNF), a protein essential for neuronal health and plasticity [27].
- **Anti-inflammatory Effects:** Treatment can reduce pro-inflammatory signaling molecules and modulate immune system activity [28].

rTMS in PPD: Principles and Clinical Application

rTMS involves the application of focused magnetic pulses to specific cortical areas, inducing electrical currents that modulate neuronal activity [29]. For depressive disorders, the primary stimulation target is the dorsolateral prefrontal cortex (DLPFC) [30]. The antidepressant mechanisms of rTMS are thought to include:

- **Modulation of Cortical Excitability:** High-frequency stimulation typically increases, while low-frequency stimulation decreases, cortical activity [31].
- **Restoration of Network Connectivity:** rTMS helps normalize functional communication between the DLPFC and emotion-processing limbic regions [32].
- **Neurotransmitter System Influence:** The technique affects multiple neurotransmitter pathways, including those involving serotonin, dopamine, and glutamate [33].
- **Neuroendocrine Effects:** rTMS can modulate HPA axis activity and the release of stress hormones [34]. For women with PPD, particularly those who are breastfeeding and wish to avoid pharmacotherapy, rTMS offers a valuable treatment alternative due to its localized action and favorable safety profile [35].

Clinical Evidence Supporting the Acupuncture-rTMS Combination for PPD

Growing clinical research indicates that combining acupuncture with rTMS may produce superior outcomes compared to monotherapy. A randomized controlled trial conducted by Zhang et al. (2023) compared four treatment arms: combined acupuncture-rTMS, rTMS alone, acupuncture alone, and a sham control group [36]. Results demonstrated that the combined treatment group achieved significantly greater reductions in depression scores (68.2% reduction vs. 54.3% for rTMS alone and 48.6% for acupuncture alone), along with higher response rates (85.7%) and remission rates (74.3%). Neurochemical analyses indicated more pronounced increases in serotonin, norepinephrine, and dopamine levels among participants receiving the combined therapy [36].

Assessments of quality of life using the GQOL-74 scale also revealed broad improvements across physical, psychological, social, and material life domains in the combination group [36].

Regarding safety, the combined approach appears well-tolerated, with adverse event rates comparable to those of each individual treatment and notably lower than rates associated with conventional antidepressant medications [37].

Proposed Synergistic Mechanisms of Combined Therapy

The enhanced therapeutic effect observed with combined acupuncture-rTMS may arise from complementary actions on shared neurobiological systems:

- **Neuroendocrine Regulation:** Both interventions independently influence the HPA axis. Their combination may produce more robust normalization of stress hormone levels, with acupuncture reducing cortisol and rTMS affecting glucocorticoid receptor sensitivity [38,39].
- **Neurotransmitter Modulation:** While rTMS primarily modulates cortical neurotransmitter activity, acupuncture exerts effects on deeper brain structures and autonomic pathways, potentially leading to more comprehensive neuromodulation across multiple systems [40].
- **Promotion of Neuroplasticity:** Both treatments enhance BDNF expression and support synaptic plasticity, possibly through distinct yet converging molecular pathways [41].
- **Integration of Brain Networks:** rTMS directly alters cortical network connectivity, whereas acupuncture influences broader network dynamics via somatosensory and autonomic inputs. Together, they may facilitate more harmonious neural reorganization [42].

Clinical Considerations and Future Directions

Treatment Timing and Sequencing

Optimal scheduling and sequencing of acupuncture and rTMS sessions require further investigation. Current evidence suggests that concurrent administration may be more effective than sequential treatment, potentially because the neurophysiological state induced by one modality enhances responsiveness to the other [43,44]. Initiating treatment early in the postpartum period (within three months) may also improve outcomes, possibly due to greater neuroplasticity during this timeframe [45].

Personalization and Predictive Biomarkers

Individual variability in treatment response underscores the need for personalized approaches. Potential biomarkers for predicting favorable outcomes include specific electroencephalogram (EEG) patterns, hormonal profiles, TCM diagnostic patterns, and genetic polymorphisms related to serotonin transport or BDNF function [46-48].

Integration with Comprehensive Care

While biologically focused, acupuncture-rTMS therapy should be integrated into a holistic treatment model that includes psychotherapy and psychosocial support [49]. The symptomatic improvement afforded by neuromodulation may enhance patients' engagement and benefit from psychological interventions [50].

Practical Implementation Challenges

Barriers to widespread adoption include the need for specialized equipment, trained practitioners, and the logistical demands of intensive treatment schedules (e.g., multiple rTMS sessions per week) [51,52]. Successful implementation will require interdisciplinary collaboration among psychiatry, neurology, and TCM specialties [53,54].

Future studies should focus on:

- Optimizing treatment parameters (e.g., rTMS frequency/intensity, acupuncture point selection, treatment duration) [55].
- Identifying reliable clinical and biological predictors of treatment response [56].
- Evaluating long-term efficacy and relapse prevention strategies [57].
- Conducting rigorous cost-effectiveness analyses [58].
- Exploring the integration of telehealth and digital health tools to improve accessibility.

Conclusion

The integration of acupuncture and rTMS represents a promising, synergistic approach for the treatment of postpartum depression. Current evidence supports its potential to significantly reduce depressive symptoms, modulate key neurobiological pathways, and improve quality of life, all within a framework of good tolerability and safety [36,37,59]. As the evidence base expands, this combined modality may offer an effective alternative for patients who are unable or prefer not to use pharmacotherapy, including breastfeeding mothers. Future rigorously designed studies are essential to refine treatment protocols, validate predictive biomarkers, and facilitate the incorporation of this integrative approach into standardized, evidence-based care pathways for postpartum depression [60,61].

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The authors contributed to the data analysis. Drafting, revising and approving the article, responsible for all aspects of this work.

Conflict of Interest

None

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