Postprint of a Network Meta-Analysis of Different Acupuncture Treatment Modalities for Upper Limb Lymphedema After Breast Cancer Surgery

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Abstract

Background Postoperative upper limb lymphedema is a common complication following breast cancer surgery that significantly impacts patients' quality of life and treatment confidence. Current Western medical treatments for this condition demonstrate limited efficacy, whereas acupuncture therapy shows promising therapeutic effects; however, research comparing different acupuncture modalities remains scarce.

Objective To compare the efficacy of various acupuncture modalities for postoperative upper limb lymphedema in breast cancer using network meta-analysis, thereby providing evidence-based guidance for clinical treatment selection.

Methods A systematic computerized search was conducted for randomized controlled trials (RCTs) investigating different acupuncture interventions for postoperative lymphedema in breast cancer across CNKI, Wanfang Data Knowledge Service Platform, VIP, Chinese Biomedical Literature Service System (SinoMed), PubMed, EMbase, Medline, and Cochrane Library databases from inception to October 31, 2023. Two researchers independently performed literature searches and conducted initial and secondary screenings strictly according to inclusion and exclusion criteria. Following classification of included studies, extraction of basic information and data, and assessment of bias risk, statistical analysis was performed using R 3.6.2, Stata 14.0, and other software.

Results Fourteen studies were ultimately included, comprising 915 patients with postoperative upper limb lymphedema following breast cancer (459 in treatment groups and 456 in control groups). Eleven intervention modalities were identified: conventional therapy, conventional acupuncture, warm acupuncture, filiform fire acupuncture, Western medication, acupuncture + moxa stick, conventional therapy + abdominal acupuncture, conventional therapy + warm

acupuncture, conventional therapy + acupuncture, conventional therapy + joint puncture, and conventional therapy + lidong acupuncture. SUCRA (surface under the cumulative ranking curve) rankings for circumference difference between affected and healthy limbs showed: conventional therapy + abdominal acupuncture (SUCRA=100.0%) > filiform fire acupuncture (SUCRA=66.4%) > conventional therapy + warm acupuncture (SUCRA=58.2%) > conventional acupuncture (SUCRA=19.0%) > conventional therapy (SUCRA=6.5%). SUCRA rankings for total effective rate showed: filiform fire acupuncture (SUCRA=90.1%) > conventional acupuncture (SUCRA=71.1%) > conventional therapy + lidong acupuncture (SUCRA=67.7%) > warm acupuncture (SUCRA=62.1%) > conventional therapy + warm acupuncture (SUCRA=57.9%) > acupuncture + moxa stick (SUCRA=50.7%) > conventional therapy + joint puncture (SUCRA=48.2%) > conventional therapy + acupuncture (SUCRA=47.7%) > conventional therapy + abdominal acupuncture (SUCRA=38.6%) > Western medication (SUCRA=9.6%) > conventional therapy (SUCRA=6.3%).

Conclusion Among the 11 intervention modalities, comprehensive ranking based on total effective rate and circumference difference between affected and healthy limbs indicates that filiform fire acupuncture represents the optimal treatment choice for postoperative upper limb lymphedema in breast cancer; however, additional high-quality RCTs are warranted for validation.

Full Text

Abstract

Background: Postoperative upper extremity lymphedema is a common complication in breast cancer patients that significantly impacts quality of life and treatment confidence. While Western medicine has limited efficacy in treating this condition, acupuncture demonstrates promising therapeutic effects. However, research comparing different acupuncture modalities remains scarce.

Objective: To compare the efficacy of various acupuncture approaches for postoperative upper extremity lymphedema following breast cancer surgery using network meta-analysis, providing an evidence-based foundation for clinical treatment selection.

Methods: We systematically searched China National Knowledge Infrastructure, Wanfang Data, VIP, SinoMed, PubMed, EMbase, Medline, and Cochrane Library databases for randomized controlled trials (RCTs) examining different acupuncture interventions for postoperative lymphedema after breast cancer, from database inception to October 31, 2023. Two researchers independently conducted literature searches, applying inclusion and exclusion criteria through initial and secondary screening. Included studies were categorized, with data extraction and bias risk assessment performed before analysis using R 3.6.2 and Stata 14.0 software.

Results: Fourteen studies comprising 915 patients with postoperative upper

extremity lymphedema were included (459 in treatment groups, 456 in control groups). Eleven interventions were evaluated: conventional treatment, ordinary acupuncture, warm acupuncture, millifire acupuncture, Western medicine, acupuncture plus moxa stick, conventional plus abdominal acupuncture, conventional plus warm acupuncture, conventional plus acupuncture, conventional plus guan needling, and conventional plus force-motion acupuncture. SUCRA rankings for affected-healthy side circumference difference showed: conventional + abdominal acupuncture (SUCRA=100.0%) > millifire acupuncture (SUCRA=66.4%) > conventional + warm acupuncture (SUCRA=58.2%) > ordinary acupuncture (SUCRA=19.0%) > conventional treatment (SUCRA=6.5%). SUCRA rankings for total effective rate showed: millifire acupuncture (SUCRA=90.1%) > ordinary acupuncture (SUCRA=71.1%) > conventional + force-motion acupuncture (SUCRA=67.7%) > warm acupuncture (SUCRA=62.1%) > conventional + warm acupuncture (SUCRA=57.9%) > acupuncture + moxa stick (SUCRA=50.7%) > conventional + guan needling (SUCRA=48.2%) > conventional + acupuncture (SUCRA=47.7%) > conventional + abdominal acupuncture (SUCRA=38.6%) > Western medicine (SUCRA=9.6%) > conventional treatment (SUCRA=6.3%).

Conclusion: Among the 11 interventions, millifire acupuncture represents the optimal choice for treating postoperative upper extremity lymphedema after breast cancer when considering both total effective rate and affected-healthy side circumference difference. However, additional high-quality RCTs are needed to confirm these findings.

Keywords: Breast cancer; Breast cancer lymphedema; Acupuncture; Network meta-analysis; Effective rate; Circumference difference

Introduction

Breast cancer is a malignant tumor with high incidence among Chinese women, with both morbidity and mortality showing continuous upward trends in China from 1990 to 2019. By 2020, its global incidence ranked first among all malignant tumors. Surgery represents the primary treatment for early-stage and some advanced breast cancer patients; however, extensive resection and lymph node dissection during surgery impair blood return and block lymphatic pathways, causing fluid accumulation in interstitial spaces and resulting in upper extremity lymphedema, persistent pain, and limited shoulder joint mobility. Statistics indicate that 30%-50% of postoperative patients develop upper extremity lymphedema, seriously compromising women's physical and mental health and quality of life. Risk factors include age, BMI, chemotherapy/radiotherapy, surgical type for breast and axilla, and other postoperative complications. While early assessment and prediction of risk are crucial, authoritative and widely applicable risk prediction models remain lacking.

Current clinical treatments primarily involve conservative approaches including exercise rehabilitation, compression bandaging, massage, and pneumatic com-

pression therapy. Acupuncture, as a safe and convenient traditional Chinese medicine therapy, stimulates acupoints to unblock meridians and regulate qi and blood circulation. A systematic review by JIN et al. demonstrated that acupuncture effectively treats postoperative upper extremity lymphedema after breast cancer, showing superior outcomes compared to Western medicine, physiotherapy, and functional training in reducing edema and improving Karnofsky Performance Scores. In China, acupuncture is also recommended as an effective traditional Chinese medicine prevention and treatment method in the "Chinese Expert Consensus on Integrated Traditional Chinese and Western Medicine Diagnosis and Treatment of Postoperative Lymphedema after Breast Cancer."

Clinical acupuncture encompasses numerous modalities with distinct characteristics. Although studies demonstrate that different needling techniques effectively reduce arm circumference and relieve pain in breast cancer-related upper extremity lymphedema, comparative research remains limited. Consequently, the optimal acupuncture approach for this condition remains unclear. This study employs Bayesian network meta-analysis to compare the efficacy of different needling methods for postoperative lymphedema, aiming to identify the best acupuncture therapy and provide evidence-based guidance for clinical decision-making.

Materials and Methods

This study strictly followed PRISMA reporting guidelines to ensure transparency and reproducibility and was registered with PROSPERO (registration number: CRD42022327529).

1.1 Literature Search Strategy

We systematically searched China National Knowledge Infrastructure, Wanfang Data, VIP, SinoMed, PubMed, EMbase, Medline, and Cochrane Library databases for RCTs examining different acupuncture interventions for postoperative lymphedema after breast cancer from inception to October 31, 2023. Supplementary searches were conducted by reviewing references of included studies. The search employed a combination of subject headings and free-text terms. Chinese search terms included: acupuncture (electroacupuncture, warm acupuncture, needling, filiform needle, three-edged needle, auricular acupressure, transcutaneous electrical acupoint stimulation), breast cancer postoperative lymphedema (breast cancer-related lymphedema, ipsilateral upper extremity lymphedema, postoperative upper extremity dysfunction, BCRL), and randomized controlled trial (randomization, clinical observation). English search terms included: acupuncture, breast cancer, lymphedema of the upper extremities, and randomized controlled trial.

1.2 Inclusion Criteria

(1) Study type: RCTs. (2) Participants: Patients histopathologically diagnosed with breast cancer and experiencing postoperative upper extremity lymphedema, with no restrictions on gender or age. (3) Interventions: Control groups received guideline-recommended standard rehabilitation for BCRL, including pneumatic compression and manual massage; treatment groups received different acupuncture therapies alone or combined with standard rehabilitation, including ordinary acupuncture, warm acupuncture, millifire acupuncture, abdominal acupuncture, guan needling, force-motion acupuncture, or acupuncture plus moxa stick.

1.3 Exclusion Criteria

(1) Duplicate publications or studies with potentially overlapping data (same author, consistent data source and intervention, overlapping timeline); (2) Abstracts only without full-text availability; (3) Non-Chinese or non-English publications; (4) Before-after comparisons of acupuncture parameters (e.g., needling depth, frequency, manipulation techniques).

1.4 Literature Screening and Data Extraction

Two researchers independently conducted literature screening and data extraction according to the established criteria, with cross-validation to ensure accuracy. Disagreements were resolved by a third researcher. Extracted data included: (1) Basic information (first author, publication year); (2) Control and treatment interventions; (3) Elements required for bias risk assessment; (4) Outcome indicator data; (5) Adverse event incidence and management.

1.5 Risk of Bias Assessment

The Cochrane risk-of-bias assessment tool was used to evaluate seven core domains: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other potential biases. Each domain was judged as "low risk," "high risk," or "unclear" to comprehensively evaluate the objectivity and accuracy of study results.

1.6 Statistical Analysis

RevMan 5.3 was used for bias risk analysis, while R 3.6.2 and Stata 14.0 conducted Bayesian network meta-analysis and generated funnel plots for publication bias. When closed loops existed in the network, node-splitting analysis tested for inconsistency. A consistency model was used if $P>0.05$; otherwise, an inconsistency model was applied. Heterogeneity was assessed using I-squared (I^2) statistics, with fixed-effects models for $I^2 \leq 50\%$ and random-effects models for $I^2 \geq 50\%$. Model simulation quality was evaluated using the Potential Scale

Reduction Factor (PSRF), where $1 \leq \text{PSRF} \leq 1.05$ indicated satisfactory convergence, with values closer to 1 indicating greater stability. Effective rate data (dichotomous) were expressed as log odds ratio (logOR) with 95% confidence intervals (CI). Interpretation: League table data represent logOR and 95%CI for column versus row treatments; statistical significance was indicated when the 95%CI did not contain 0. logOR>0 favored the column treatment, while logOR<0 favored the row treatment. Circumference difference data (continuous) were expressed as mean difference (MD) with 95%CI; statistical significance was indicated when the 95%CI did not contain 0. MD<0 favored the column treatment, while MD>0 favored the row treatment. SUCRA values from cumulative probability plots were used to rank treatment efficacy.

Results

2.1 Literature Search Results

The initial search retrieved 557 relevant studies. After removing duplicates and obviously irrelevant studies during initial screening, and further evaluating study type, participants, interventions, and outcome indicators during secondary screening, 14 studies were ultimately included. The screening process is illustrated in [Figure 1: see original paper].

2.2 Basic Characteristics of Included Studies

Fourteen two-arm RCTs were included, with a total sample of 915 patients (459 in treatment groups, 456 in control groups). Eleven interventions were evaluated: conventional treatment, ordinary acupuncture, warm acupuncture, millifire acupuncture, Western medicine, acupuncture + moxa stick, conventional + abdominal acupuncture, conventional + warm acupuncture, conventional + acupuncture, conventional + guan needling, and conventional + force-motion acupuncture. Basic characteristics are summarized in .

2.3 Risk of Bias Assessment

Using the Cochrane risk-of-bias tool, seven studies employed random number tables, two used computer-generated random numbers, and one used a random two-color ball method. Studies mentioning randomization without specific methods were judged as having unclear risk. No studies described blinding procedures. One study reported “double-blind assessment” of outcomes (low risk). Two studies had participant attrition but were judged as low risk due to minimal missing data. No study protocols were published, but all reported prespecified outcomes (low risk for reporting bias). No other potential biases were identified. Risk of bias graphs are shown in [Figure 2: see original paper] and [Figure 3: see original paper].

2.4 Circumference Difference Analysis

2.4.1 Network Evidence Diagram Five studies reported circumference difference outcomes, involving five interventions: conventional treatment, ordinary acupuncture, millifire acupuncture, conventional + abdominal acupuncture, and conventional + warm acupuncture. In the network diagram, connected points indicate direct comparisons, line thickness represents study quantity, and point size represents sample size [Figure 4: see original paper].

2.4.3 Network Meta-Analysis Results for Circumference Difference Among the five interventions, ten direct and indirect comparisons were generated. Statistically significant differences were found between conventional vs. millifire acupuncture, conventional vs. conventional + warm acupuncture, ordinary acupuncture vs. conventional + abdominal acupuncture, and millifire acupuncture vs. conventional + warm acupuncture ($P<0.05$) .

SUCRA probability ranking for circumference difference showed: conventional + abdominal acupuncture (SUCRA=100.0%) > millifire acupuncture (SUCRA=66.4%) > conventional + warm acupuncture (SUCRA=58.2%) > ordinary acupuncture (SUCRA=19.0%) > conventional treatment (SUCRA=6.5%).

2.4.4 Publication Bias The comparison-adjusted funnel plot for circumference difference [Figure 5: see original paper] showed most points distributed in the upper middle region, evenly dispersed on both sides of the red line, indicating minimal publication bias.

2.5 Effective Rate Analysis

2.5.1 Network Diagram Twelve studies reported total effective rate outcomes, involving 11 interventions: conventional treatment, ordinary acupuncture, warm acupuncture, millifire acupuncture, Western medicine, acupuncture + moxa stick, conventional + abdominal acupuncture, conventional + warm acupuncture, conventional + acupuncture, conventional + guan needling, and conventional + force-motion acupuncture [Figure 6: see original paper].

2.5.2 Inconsistency Test and Convergence Diagnostics The network diagram contained no closed loops, thus inconsistency testing was unnecessary and a consistency model was applied. Convergence diagnostics showed $1.00 \leq \text{PSRF} \leq 1.02$, indicating high reliability. MCMC chains stabilized with good overlap after 20,000 iterations, and bandwidth approached 0 and stabilized after 50,000 iterations, confirming good model convergence.

2.5.3 Network Meta-Analysis Results for Total Effective Rate Among the 11 interventions, 56 direct and indirect comparisons were generated. Statistically significant differences were found for multiple comparisons including con-

ventional vs. conventional + abdominal acupuncture, conventional vs. ordinary acupuncture, conventional vs. millifire acupuncture, conventional vs. acupuncture + moxa stick, and conventional + warm acupuncture vs. several other interventions (P<0.05) .

SUCRA probability ranking for total effective rate showed: millifire acupuncture (SUCRA=90.1%) > ordinary acupuncture (SUCRA=71.1%) > conventional + force-motion acupuncture (SUCRA=67.7%) > warm acupuncture (SUCRA=62.1%) > conventional + warm acupuncture (SUCRA=57.9%) > acupuncture + moxa stick (SUCRA=50.7%) > conventional + guan needling (SUCRA=48.2%) > conventional + acupuncture (SUCRA=47.7%) > conventional + abdominal acupuncture (SUCRA=38.6%) > Western medicine (SUCRA=9.6%) > conventional treatment (SUCRA=6.3%).

2.5.4 Publication Bias The comparison-adjusted funnel plot for total effective rate [Figure 7: see original paper] showed most points distributed in the middle region, evenly dispersed on both sides of the red line, indicating minimal publication bias.

2.6 Safety Evaluation

Among the 12 included studies, four reported adverse events, primarily mild hematoma and bruising related to compromised vascular elasticity after breast cancer surgery. Hematomas resolved with several minutes of compression, and bruising self-resolved without affecting subsequent treatment. One study reported a mild fainting episode 5 minutes post-treatment that resolved after rest. Another study reported one case of mild scalding due to position changes, managed with topical application of oil; one case of skin infection; and two cases of mild pain. No serious adverse events were reported.

Discussion

Traditional Chinese medicine classifies postoperative lymphedema after breast cancer as “edema” or “vessel bi” syndrome, with etiology rooted in “deficiency,” “stasis,” and “dampness.” Breast cancer patients often present with liver qi stagnation and impaired dispersing function; when liver qi transversely invades the spleen, splenic dysfunction leads to fluid distribution disorders, causing dampness accumulation and stasis that obstructs vessels. Surgical procedures and axillary radiotherapy further damage vessels, impairing fluid distribution in upper extremity meridians and causing blood stasis and dampness retention that eventually obstruct vessels and produce edema.

Currently, few specialized clinical practice guidelines address prevention and treatment of breast cancer-related lymphedema, and existing guidelines lack specificity regarding preventive behaviors such as exercise modalities, intensity, and duration. Treatment options primarily include conservative therapy (manual lymphatic drainage, multi-layer low-stretch bandaging, compression

garments, intermittent pneumatic compression, laser therapy, exercise) and surgical procedures (lymphatic reconstruction and excisional surgery). However, these approaches have limited efficacy and poor durability. Traditional Chinese medicine emphasizes "early intervention, long-term maintenance, and individualized treatment," demonstrating advantages in reducing edema, preserving limb function, stabilizing therapeutic effects, and slowing or reversing disease progression.

This study evaluated 11 interventions: conventional treatment, ordinary acupuncture, warm acupuncture, millifire acupuncture, Western medicine, acupuncture + moxa stick, conventional + abdominal acupuncture, conventional + warm acupuncture, conventional + acupuncture, conventional + guan needling, and conventional + force-motion acupuncture. Analysis revealed the top six interventions for total effective rate were millifire acupuncture, ordinary acupuncture, conventional + force-motion acupuncture, warm acupuncture, conventional + warm acupuncture, and acupuncture + moxa stick. The top three for improving circumference difference were conventional + abdominal acupuncture, millifire acupuncture, and conventional + warm acupuncture. Although SUCRA rankings differed between the two outcome measures, both "millifire acupuncture" and "conventional + warm acupuncture" ranked highly. These therapies combine needling stimulation with thermal effects, effectively promoting local blood and lymphatic circulation to warm meridians, unblock collaterals, move qi, activate blood, and reduce swelling, embodying the Chinese medicine principle of "warming and unblocking." By leveraging the warming power of "fire," these methods stimulate and dredge meridian qi, assisting qi and blood circulation, warming yang to transform fluids, and unblocking vessels to relieve pain.

Based on these rankings, we can reasonably infer that incorporating "millifire acupuncture" and "warm acupuncture"—thermal needling modalities—may yield better therapeutic outcomes in future clinical practice. However, this study has limitations. First, the limited number of included studies and lack of high-quality research, with most failing to clearly describe allocation concealment methods, may introduce bias and affect accuracy and credibility. Second, inadequate follow-up prevented assessment of treatment durability. Third, acupoint selection was largely based on personal experience rather than standardized protocols. Future research should explore optimal acupuncture prescriptions for this condition to establish standardized treatment protocols. Additionally, basic research should integrate modern biological technologies to investigate acupuncture mechanisms in treating tumors and complications, laying foundations for clinical application.

Author Contributions

HE Yun conceptualized the research, designed the study, and drafted the manuscript. FAN Huanfang provided guidance and revised the manuscript. MA Pan performed statistical analysis and interpreted results. XU Shaoqing

conducted statistical analysis and created figures. YANG Liu and JIN Mingzhe performed literature search and screening. ZHANG Mingrui and CHEN Jiaqi collected and verified data.

Conflict of Interest

The authors declare no conflict of interest.

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