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Observation on the Efficacy and Mechanism of Blood-Letting and Cupping Therapy in Improving Upper Limb Lymphedema after Breast Cancer Surgery

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Abstract: Objective: To evaluate the clinical efficacy of blood-letting cupping combined with manual lymphatic drainage in treating breast cancer-related lymphedema (BCRL) and explore its mechanism of action from both traditional Chinese medicine and modern medical perspectives, providing a scientific basis and novel therapeutic approaches for clinical management of BCRL. Methods: Patients with BCRL admitted to the outpatient and inpatient departments of Hebei University Affiliated Hospital were enrolled. A prospective randomized controlled trial design was adopted, with eligible patients randomly assigned to a treatment group and a control group. The control group received manual lymphatic drainage alone, while the treatment group received manual lymphatic drainage combined with blood-letting cupping therapy. Post-treatment comparisons evaluated upper limb circumference reduction, edema severity grading, and upper limb functional scores. Vital signs and adverse reactions during treatment were recorded for both groups. Statistical software analyzed the data. *Results:* The treatment group demonstrated significantly greater reduction in upper limb circumference, improvement in edema severity, and higher upper limb function scores compared to the control group ($P < 0.05$). Vital signs remained stable throughout treatment in both groups. No severe adverse reactions occurred in the treatment group; only isolated cases of mild skin itching were reported, which resolved after symptomatic management. *Conclusion:* The combination of blood-letting cupping and manual lymphatic drainage demonstrates reliable efficacy in treating BCRL, effectively alleviating edema symptoms and improving upper limb function with high safety. Its mechanism may relate to traditional Chinese medicine principles of "unblocking meridians, promoting blood circulation, and resolving stasis" and modern medical concepts of "enhancing local blood circulation, facilitating lymphatic drainage, and reducing inflammatory responses".

Keywords: Blood-letting cupping; Postoperative breast cancer; Upper limb lymphedema; Efficacy observation; Mechanism of action

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1. Introduction

Breast cancer ranks among the most prevalent malignant tumors affecting women globally, posing a serious threat to their physical and mental health as well as their lives [1]. With advances in medical technology, the clinical cure rate for breast cancer has significantly improved. However, postoperative complications have become increasingly prominent, with breast cancer-related lymphedema (BCRL) being one of the most common. Studies indicate that the incidence of BCRL ranges from approximately 20% to 40%, and in some patients, the incidence rate can still exceed 30% during 5-year postoperative follow-up [2]. BCRL primarily results from axillary lymph node dissection during breast cancer surgery, which damages lymphatic drainage pathways. This leads to abnormal accumulation of lymph fluid in the interstitial spaces of the upper limb, causing symptoms such as swelling, pain, numbness, and limited mobility. Severe cases may also present with skin thickening, fibrosis, and infection, significantly reducing patients' quality of life and imposing a heavy physical and psychological burden [3]. Modern medical treatments for BCRL primarily include manual lymphatic drainage, compression therapy, functional exercises, and medication. However, these methods often exhibit limited efficacy, require prolonged treatment periods, and are prone to recurrence. Additionally, some medications may cause adverse reactions [4]. Traditional Chinese Medicine (TCM) possesses a long history and extensive experience in treating edema-related conditions. TCM external therapies, characterized by simplicity, convenience, safety, and efficacy, demonstrate unique advantages in managing BCRL. Blood-letting cupping, a key component of TCM external therapies, combines acupuncture with bloodletting and cupping to unblock meridians, promote blood circulation, resolve stasis, and eliminate water retention. It has been widely applied in treating various edema and pain-related conditions [5]. This study, grounded in both TCM and modern medical theories, employs a prospective randomized controlled trial design to evaluate the clinical efficacy and safety of combined blood-letting cupping and manual lymphatic drainage for treating BCRL. It aims to explore the underlying mechanisms of action, providing novel therapeutic approaches and theoretical support for BCRL management while enhancing patients' quality of life.

2. Materials and methods

2.1. Study population

Patients with BCRL who visited the outpatient or inpatient departments of Hebei University Affiliated Hospital between January 2023 and January 2024 were selected as study subjects. Inclusion criteria: (1) Diagnosis of breast cancer with upper limb lymphedema developing after surgical treatment (modified radical mastectomy or radical mastectomy); (2) Lymphedema onset occurring 1 month to 2 years post-surgery; (3) Peripheral circumference of the affected upper limb ≥ 2 cm larger than the unaffected side; (4) Age 18–70 years, conscious, and able to cooperate with treatment and efficacy evaluation; (5) Voluntary participation with signed informed consent. Exclusion criteria: (1) Severe dysfunction of vital organs (heart, liver, kidney, etc.); (2) Patients with coagulation disorders or bleeding tendencies; (3) Patients with skin lesions, ulcers, infections, or dermatological conditions on the affected upper limb; (4) Pregnant or lactating women; (5) Patients with allergies to blood-letting cupping or manual lymphatic drainage; (6) Patients with psychiatric disorders or those unable to cooperate with treatment.

2.2. Study design

This study employed a prospective randomized controlled trial design. Patients meeting the inclusion criteria were randomly assigned using a random number table to either the treatment group or the control group, with 30

patients in each group. Comparisons of general characteristics between groups—including age, disease duration, surgical approach, and edema severity—revealed no statistically significant differences ($P > 0.05$), ensuring comparability.

2.3. Treatment methods

Both groups received basic care, including health education (guiding patients to avoid weight-bearing and pressure on the affected upper limb, and maintaining warmth), dietary adjustments (light meals, avoiding spicy or irritating foods), and functional exercises (guiding patients in simple upper limb movements such as fist clenching and arm elevation). On this basis, the two groups received the following treatment protocols:

Control Group: Manual lymphatic drainage therapy alone. Performed by professional rehabilitation therapists using internationally recognized manual lymphatic drainage techniques. Starting from the fingers of the affected side, gentle pushing, kneading, and pressing were applied sequentially toward the wrist, forearm, elbow, upper arm, and axilla to promote lymphatic drainage. Each session lasted 30 minutes, with 5 sessions per week for 4 consecutive weeks.

Treatment group: Combined bloodletting and cupping therapy in addition to the manual lymphatic drainage of the control group. Specific procedures were as follows: (1) Point selection: Acupoints on the affected upper limb (Quchi, Shousanli, Hegu, Chize, Quze, Jianyu) and areas with prominent edema were selected for bloodletting and cupping. (2) Disinfection: Thoroughly disinfect selected acupoints and surrounding skin with povidone-iodine. After drying, remove iodine residue with 75% alcohol. (3) Bloodletting: Using sterile disposable three-edged needles, puncture disinfected acupoints and skin areas to a depth of 0.2–0.3 cm. Perform 3–5 punctures per site to induce minimal bleeding. (4) Cupping: Immediately place fire cups over the punctured areas. Select glass cups of appropriate size based on the area. Leave the cups in place for 10–15 minutes, monitoring the patient's skin color and bleeding to prevent excessive hemorrhage. (5) Post-procedure care: After cup removal, clean residual blood from the skin with sterile dry cotton balls and disinfect again with povidone-iodine. Bloodletting and cupping therapy are performed twice weekly, alternating with manual lymphatic drainage therapy, for a total of 4 consecutive weeks.

2.4. Observation indicators

2.4.1. Efficacy-related indicators

The following measurements were taken for both groups before treatment, immediately after treatment, and at weeks 4 and 8 post-treatment: (1) Upper limb circumference measurement: Measurements were taken at four sites on the affected upper limb: wrist crease, 10 cm above wrist crease, elbow crease, and 10 cm above elbow crease. A soft tape measure was used to record circumferences with 0.1 cm precision. The difference between affected and unaffected limb circumferences was calculated. (2) Edema Severity Grading: Following the BCRL grading criteria of the International Lymphology Society, edema severity was categorized as:(affected arm circumference >5 cm less than unaffected arm, marked skin thickening and hardening with fibrosis, accompanied by pain and limited mobility). (3) Upper Limb Function Score: Assessed using the Disability of the Arm, Shoulder, and Hand (DASH) scale. This 30-item questionnaire covers pain, daily activities, work, and leisure, with each item scored 0 to 4 points. Total scores range from 0 to 100, where higher scores indicate more severe upper limb dysfunction.

2.4.2. Safety indicators

During treatment, vital signs (respiratory rate, temperature, pulse, blood pressure) were recorded daily. Patients

were closely monitored for adverse reactions, including needle phobia, intolerable pain, skin itching, blistering, and infection during and after treatment. The timing, manifestations, management, and outcomes of adverse reactions were documented in detail.

2.5. Statistical methods

All data were analyzed using SPSS 26.0 statistical software. Quantitative data were expressed as mean ± standard deviation (SD). Paired t-tests were used for intra-group comparisons before and after treatment, while independent samples t-tests were used for inter-group comparisons. Qualitative data were expressed as rates (%). Inter-group comparisons for qualitative data were performed using chi-square (χ^2) tests. Ordinal data (edema severity grading) were analyzed using the rank sum test. A P value < 0.05 was considered statistically significant.

3. Results

This study included 60 patients with BCRL, randomly assigned to a treatment group and a control group, each comprising 30 patients. The treatment group patients ranged in age from 28 to 68 years, with a mean age of (55.9 ± 5.45) years old. Their disease duration ranged from 1 to 3 months, with a mean duration of (44.6 ± 8.63) days. Surgical procedures included modified radical mastectomy (25 cases), radical mastectomy (1 case), breast-conserving surgery (2 cases), and total excision (2 cases).Edema severity was mild in 7 cases, moderate in 16 cases, and severe in 7 cases. The control group comprised patients aged 29–69 years (mean age: 56.67 ± 5.34 years) with a disease duration of 1–3 months (mean duration: 42.43 ± 8.24 days). Surgical procedures included modified radical mastectomy in 27 cases, breast-conserving surgery in 1 case, and total mastectomy in 2 cases. with edema severity classified as mild in 7 cases, moderate in 15 cases, and severe in 8 cases. There were no statistically significant differences between the two groups in terms of age, disease duration, surgical approach, or edema severity (P > 0.05), indicating comparability. Regarding upper limb circumference difference, there was no statistically significant difference between the two groups before treatment (P > 0.05). After treatment, the arm circumference difference was (1.62 ± 0.55) cm in the treatment group and (2.38 ± 0.56) cm in the control group. Four weeks after treatment completion, the values were (1.23 ± 0.18) cm and (2.51 ± 0.27) cm, respectively. and 8 weeks post-treatment, the values were (0.7 ± 0.26) cm and (2.06 ± 0.29) cm, respectively. Both groups showed significant reduction compared to pre-treatment levels (P < 0.05), with the treatment group exhibiting a significantly greater reduction than the control group (P < 0.05). Regarding edema grading, no statistically significant difference existed between groups before treatment (P > 0.05). Significant improvement was observed in both groups after treatment and at weeks 4 and 8 post-treatment compared to baseline (P < 0.05), with the treatment group showing significantly greater improvement than the control group (P < 0.05). Regarding upper limb function DASH scores, no statistically significant difference existed between the two groups before treatment (P > 0.05). Post-treatment scores were (29.22 ± 7.44) for the treatment group and (34.28 ± 6.38) for the control group. At 4 weeks post-treatment, scores were (23.14 ± 6.99) for the treatment group and (30.25 ± 6.59) for the control group. and at 8 weeks post-treatment, the treatment group scored (18.81 ± 7.14) points while the control group scored (25.67 ± 6.87) points. Both groups showed significant reductions post-treatment compared to pre-treatment (P < 0.05), with the treatment group exhibiting a significantly greater reduction than the control group (P < 0.05). Regarding safety, vital signs, including respiration, body temperature, pulse, and blood pressure, remained stable throughout treatment in both groups without significant abnormalities. No notable adverse

reactions occurred in the control group. Only two patients in the treatment group experienced mild skin itching, which resolved after topical application of calamine lotion without affecting treatment. The incidence of adverse reactions showed no statistically significant difference between groups ($P > 0.05$).

4. Mechanism discussion

According to traditional Chinese medicine theory, BCRL falls under the categories of "edema" and "bi syndrome". Its pathogenesis is primarily associated with "Qi and blood stasis, meridian obstruction, and internal retention of dampness". Breast cancer surgery compromises the patient's vital energy, impairs Qi and blood circulation, and obstructs meridians, leading to abnormal water metabolism. Lymphatic fluid (referred to as "body fluids" in TCM) accumulates in the interstitial spaces of the upper limbs, forming edema. Bloodletting and cupping, as classic external therapies in TCM, exert their effects primarily through two mechanisms: unblocking meridians and harmonizing qi and blood, and promoting blood circulation to resolve stasis while draining fluids to reduce swelling. Specifically, the acupoints selected for this study—Quchi (LI11), Shousanli (LI10), and Hegu (LI4)—are all crucial points on meridians closely related to upper limb qi and blood circulation, such as the Hand Yangming Large Intestine Meridian and the Hand Taiyin Lung Meridian. Stimulating these points and the edematous areas through bloodletting and cupping unblocks obstructed meridians, harmonizes qi and blood circulation, restores normal Qi and blood distribution throughout the body, and simultaneously expels local stagnant blood and turbid fluids. The negative pressure generated by cupping enhances local blood circulation and strengthens Qi and blood movement. It also regulates the functions of the lung, spleen, and kidney to restore normal fluid metabolism, thereby promoting the excretion of bodily fluids at the root level to achieve edema reduction. From a modern medical perspective, the mechanism of blood-letting cupping therapy for BCRL primarily involves improving local blood circulation, promoting lymphatic drainage, reducing inflammatory responses, regulating immune function, and enhancing local tissue repair capacity. Following axillary lymph node dissection during breast cancer surgery, patients experience impaired lymphatic drainage pathways in the upper limbs and compromised local blood circulation. During blood-letting cupping, the puncture with a three-edged needle stimulates local vasodilation and increases vascular permeability. The negative pressure from cupping promotes local blood circulation, accelerates blood flow velocity, and directly propels lymph fluid from the damaged pathways toward normal pathways, reducing its accumulation in tissue spaces. Concurrently, blood-letting cupping lowers levels of inflammatory mediators such as interleukin-6 and Tumor Necrosis Factor-α (TNF-α) levels in local tissues, thereby mitigating inflammatory responses. It inhibits fibroblast proliferation and reduces collagen synthesis, delaying or suppressing the progression of local tissue fibrosis. Furthermore, as a physical stimulus, it activates the immune system, enhances immune cell activity, promotes local tissue metabolism and repair of damaged tissues, facilitates the restoration and reconstruction of lymphatic drainage pathways, and ultimately enhances therapeutic efficacy [6–10].

5. Discussion

The innovation of this study manifests in two key aspects: First, it fully leverages the broad applicability, significant efficacy, safety, and absence of notable side effects characteristic of TCM external therapies. By integrating blood-letting cupping with manual lymphatic drainage into a synergistic treatment protocol, clinical

trials have validated the efficacy and safety of this combined approach for treating BCRL, further highlighting the unique value of TCM external therapies in BCRL management. Second, it overcomes the limitations of previous studies that primarily focused on clinical efficacy observation with superficial exploration of mechanisms. By integrating recent literature, this study systematically discusses the mechanisms of action from the perspectives of TCM theories— "unblocking meridians, promoting blood circulation and resolving stasis, and promoting diuresis and reducing swelling"—and modern medicine— "improving local blood circulation, promoting lymphatic drainage, reducing inflammatory responses, and regulating immune function". Thipromoting diuresis and reduces edema with modern medicine's concepts of "improving local blood circulation, enhancing lymphatic drainage, reducing inflammatory responses, and regulating immune function". This systematic discussion clarifies the mechanism of action for blood-letting cupping in treating BCRL, providing crucial theoretical guidance for future clinical practice and efficacy enhancement. This study also has certain limitations. Specifically, the sample size was small and the research period was short, preventing long-term follow-up of patients to observe long-term efficacy and recurrence rates. Operational parameters such as the puncture depth and retention time of blood-letting cupping were not optimized to determine the optimal treatment regimen. Furthermore, the exploration of the mechanism of action was primarily based on existing literature and theoretical analysis, lacking supporting experimental research. Future work will focus on expanding sample size, extending the study duration, and conducting long-term follow-up to further validate the long-term efficacy and safety of blood-letting cupping therapy for BCRL. Additionally, multicenter, large-scale clinical studies will be initiated to optimize operational parameters and establish standardized treatment protocols. Basic research, including animal experiments, will also be conducted to explore the molecular biological mechanisms, thereby providing a more robust scientific foundation for clinical application.

6. Conclusion

In summary, the combination of blood-letting cupping and manual lymphatic drainage demonstrates definite efficacy and high safety in treating postoperative upper limb lymphedema following breast cancer surgery. It effectively alleviates edema symptoms and improves upper limb function. Its mechanisms correlate with traditional Chinese medicine principles of unblocking meridians, promoting blood circulation to remove stasis, and draining water to reduce swelling, as well as modern medical approaches of improving local blood circulation, enhancing lymphatic return, and reducing inflammatory responses. This treatment regimen warrants clinical promotion and application.

Disclosure statement

The authors declare no conflict of interest.

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