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Clinical Observation of Traditional Chinese Medicine Foot Bath Combined with Analgesic Pump on Post-Cesarean Section Pain and Recovery of Lower Limb Circulation

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Abstract: *Objective*: To explore the clinical effect of traditional Chinese medicine (TCM) foot bath combined with postoperative analgesic pump on post-cesarean section pain and recovery of lower limb circulation. *Methods*: A total of 500 puerperas who underwent cesarean section in our hospital from January 2023 to December 2023 were selected and randomly divided into an experimental group (234 cases) and a control group (266 cases). The control group received conventional postoperative electronic analgesic pump (sufentanil + ondansetron + dezocine) for continuous analgesia, while the experimental group received additional TCM foot bath treatment based on the control group's regimen. The postoperative pain level (NRS score), analgesic pump drug usage, time of first ambulation, and lower limb swelling rate were observed in both groups. *Results*: The NRS scores at 24h and 48h postoperatively in the experimental group (2.03 ± 0.54, 0.91 ± 0.27) were significantly lower than those in the control group (3.45 ± 0.71, 1.85 ± 0.49) ($P < 0.001$). The total drug usage of the analgesic pump in the experimental group was reduced by 28.6%, and the time of first ambulation was advanced to (12.2 ± 1.9) h, which was better than that of the control group (15.7 ± 2.3) h ($P < 0.001$). The incidence of lower limb swelling in the experimental group (6.8%) was significantly lower than that in the control group (18.4%) ($P < 0.001$). *Conclusion*: TCM foot bath combined with an analgesic pump can synergistically relieve post-cesarean section pain, reduce the demand for analgesic drugs, promote lower limb blood circulation and early ambulation, with significant clinical effects.

Keywords: Traditional Chinese Medicine foot bath; Analgesic pump; Post-cesarean section pain; Recovery of lower limb circulation

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1. Introduction

Post-cesarean section pain and lower limb circulation disorders are important factors affecting the recovery of puerperas. Postoperative bed rest, residual anesthetic drugs, and a hypercoagulable state can easily lead to lower

limb swelling and even deep venous thrombosis (DVT) [1]. According to statistics, about 15%-30% of puerperas experience lower limb swelling due to pain and limited mobility after cesarean section, and 3%-5% of them may develop deep venous thrombosis, which severely threatens their lives [2]. Currently, the analgesic pump is the main method for postoperative analgesia. Continuous infusion of opioid drugs (such as sufentanil) combined with anesthetics (such as dezocine) can effectively relieve pain, but its sole application has limited improvement on lower limb circulation and may affect puerperas' willingness to ambulate early due to drug side effects (such as nausea and dizziness) [3]. Traditional Chinese medicine external therapies are gradually emerging in postoperative rehabilitation. Among them, the TCM foot bath combines drug penetration and thermal effects. By stimulating foot acupoints (such as Yongquan and Sanyinjiao), it can promote blood circulation, remove blood stasis, warm meridians, and improve microcirculation while relieving pain [4]. Studies have shown that the active ingredients in the TCM foot bath have anti-inflammatory, analgesic, and circulation-improving effects, which can effectively reduce blood viscosity and prevent postoperative thrombosis [5]. However, there are currently few clinical studies on the combination of TCM foot baths and modern analgesic techniques, and their synergistic effects and safety still need further verification. This study aims to explore the interventional effects of TCM foot baths combined with analgesic pumps on post-cesarean section pain and lower limb circulation. By comparing and analyzing pain scores, drug usage, and lower limb swelling rates, it provides a scientific basis for optimizing postoperative multimodal analgesia regimens.

2. Materials and methods

2.1. General information

This study was approved by the Ethics Committee of Shaanxi Provincial People's Hospital (Ethics Approval Number: 2023K-S055). All participants signed informed consent forms. The study included 500 cases of parturients who underwent cesarean section at our hospital from January 2023 to December 2023, aged between 20–40 years old, with ASA grades I–II, and all were singleton pregnancies. There were 234 cases in the experimental group, with an average age of (28.2 ± 3.6) years old; and 266 cases in the control group, with an average age of (28.7 ± 4.1) years old. Exclusion criteria were: (1) damaged or infected skin on the feet; (2) allergy to traditional Chinese medicine ingredients (such as mugwort, windproof powder, etc.); (3) severe varicose veins of lower extremities or history of deep vein thrombosis; (4) abnormal coagulation function (PT > 14 s or APTT > 40 s); (5) combined with severe cardiopulmonary disease or mental disorder. There was no statistically significant difference between the two groups in age, gestational age, delivery method (all elective cesarean section), and baseline pain score (NRS ≥ 6) ($P > 0.05$).

2.2. Research methods

2.2.1. Control group

Routine use of electronic pain relief pumps (Jiangsu Aipeng Medical Technology Co., Ltd., model: ZZB-I-100) after surgery. The drug formula was a mixture of sufentanil 0.5 μg/mL, ondansetron 0.08 mg/mL, and dezocine 0.4 mg/mL. The background infusion rate was set at 2 mL/h, with a single additional dose of 0.5 mL and a lockout time of 15 minutes. Nurses assessed the analgesic effect daily and recorded adverse reactions (such as nausea and skin itching).

2.2.2. Experimental group

Based on the control group, a traditional Chinese medicine foot bath intervention was added, and the specific plan was as follows:

(1) Traditional Chinese medicine formula: optimized according to the recommended prescription in "Obstetrics and Gynecology of Traditional Chinese Medicine," using 30 g of mugwort, 30 g of windproof powder, 30 g of mulberry powder, 30 g of cassia twig powder, and 30 g of eucommia powder. The above medicinal materials were uniformly purchased by the hospital's Chinese medicine dispensary and identified to meet the standards of the Chinese Pharmacopoeia.

(2) Timing: Intervention starts 12-24 hours after surgery (after stable vital signs), once a day (15:00 pm).

(3) Temperature control: The temperature of the medicinal liquid was strictly controlled at 40-45℃, monitored in real-time using a digital thermometer to avoid burns.

(4) Operation method: The parturient was in a semi-recumbent position, with both feet soaked in the medicinal liquid, and the water depth was 10cm above the ankle joint. The soaking time was 20 minutes. After soaking, use a sterile towel to dry both feet and wear cotton socks to keep warm.

(5) Precautions: Observe whether the parturient has dizziness, palpitations, or other discomforts during the foot bath, and adjust the temperature of the medicinal liquid or terminate the intervention in a timely manner.

2.3. Observation indicators

(1) Degree of pain: The Numeric Rating Scale (NRS) was used to evaluate the pain intensity at 12h, 24h, and 48h after surgery. The score ranged from 0 (painless) to 10 (unbearable pain).

(2) Dosage of analgesic drugs: Record the total amount of sufentanil (μg) used in the pain relief pump within 48 hours after surgery, and convert it into an equivalent dose for comparison.

(3) Postoperative recovery indicators: Time of first getting out of bed: the time from the end of the operation to the first time the parturient walks independently (hours). Lower extremity swelling rate: Measure the circumference of both lower extremities (15 cm above the patella) 24 hours after surgery. An increase in circumference of ≥ 2 cm is defined as positive.

(4) Adverse reactions: Record the incidence of nausea, vomiting, skin itching, and hypotension.

2.4. Statistical methods

Data analysis was performed using SPSS 27.0 software. Measurement data were expressed as mean ± standard deviation (SD), and independent sample *t*-tests were used for comparisons between groups. Count data were expressed as frequency (percentage), and comparisons between groups were performed using the χ^2 test or Fisher's exact test. $P < 0.05$ was considered statistically significant.

3. Results

3.1. Comparison of postoperative pain scores

The NRS scores of the experimental group at each time point after surgery were significantly lower than those of the control group (**Table 1**). At 12 hours after surgery, the score of the experimental group was 3.09 ± 0.61, which was 29.6% lower than that of the control group (4.31 ± 0.76); at 48 hours after surgery, the score of the experimental group further dropped to 0.91 ± 0.27, which was close to a painless state.

Table 1. Comparison of postoperative NRS scores between the two groups (mean ± SD, points)

Group	Number of Cases	12h post-operation	24h post-operation	48h post-operation
Control group	266	4.31 ± 0.76	3.45 ± 0.71	1.85 ± 0.49
Experimental group	234	3.09 ± 0.61	2.03 ± 0.54	0.91 ± 0.27
t-value		20.114	25.635	24.892
P-value		< 0.001	< 0.001	< 0.001

3.2. Dosage of analgesic drugs and postoperative recovery

The total consumption of sufentanil within 48 hours postoperatively in the experimental group was (38.2 ± 6.2) μg, which was reduced by 28.7% compared to the control group (53.6 ± 8.2) μg ($P < 0.001$). Additionally, the time of first ambulation in the experimental group was significantly advanced to (12.2 ± 1.8) hours, shortened by 34.6% compared to the control group (15.7 ± 2.4) hours ($P < 0.001$).

3.3. Recovery of lower limb circulation

The incidence of lower limb swelling at 24 hours postoperatively in the experimental group was 6.8% (16/234), significantly lower than that in the control group, which was 18.4% (49/266) ($\chi^2 = 14.726$, $P < 0.001$). Ultrasonography showed that the venous blood flow velocity in the lower limbs of the experimental group was increased by 22.3% compared to the control group ($P = 0.003$).

3.4. Safety analysis

No serious adverse reactions occurred in either group. Three cases (1.3%) in the experimental group experienced mild dizziness, while eight cases (3.0%) in the control group reported nausea, with no statistically significant difference ($P = 0.172$).

4. Discussion

4.1. Synergistic analgesic mechanism of Traditional Chinese Medicine (TCM) foot bath

Post-cesarean section pain originates from inflammatory reactions and nerve sensitization triggered by surgical trauma. The analgesic pump inhibits pain signal transmission via central opioid receptors but has limited regulation on local inflammatory mediators [6]. In this study, the addition of a TCM foot bath significantly enhanced the analgesic effect, and its mechanism may include the following three aspects:

(1) Direct effects of medicinal components

Eucalyptol in mugwort leaf has anti-inflammatory and analgesic activities, inhibiting COX-2 expression and reducing PGE2 production [7], with warming and analgesic effects. Windproof powder relieves muscle tension or spasmodic pain caused by postoperative weakness and exposure to wind, reduces inflammatory factor release (such as IL-6, TNF-α) by inhibiting the NF-κB pathway, and enhances immune function to prevent pain caused by infection. Mulberry twig powder promotes the resolution of lower limb edema, relieves tension pain caused by swelling, contains flavonoids that dilate peripheral blood vessels and improve microcirculation, inhibits COX-2, and reduces inflammation around nerve roots. Cassia twig powder promotes pelvic and lower limb blood circulation, relieves cold coagulation and blood stagnation pain, regulates pain transmission by activating the

TPRV1 receptor, enhances the effect of the analgesic pump, and has a synergistic analgesic and diaphoretic effect, especially for patients with postoperative chills and lumbosacral cold pain. Eucommia bark powder nourishes the liver and kidneys, strengthens muscles and bones, accelerates the repair of surrounding tissues at the incision site, regulates adrenergic receptors, and alleviates the amplification effect of postoperative stress on pain perception.

(2) Physiological regulation of warming effects

The 40–45 ℃ medicinal liquid can dilate foot blood vessels, promote blood circulation, accelerate the elimination of metabolic waste (such as lactic acid and histamine), and relieve muscular spasmodic pain [8].

(3) Neural regulation of acupoint stimulation

The Yongquan acupoint on the foot belongs to the kidney meridian. Stimulation can activate the release of β-endorphin in the spinal dorsal horn, producing a synergistic analgesic effect with opioids [9].

4.2. Clinical significance of improved lower limb circulation

Postoperative lower limb swelling is closely related to venous blood stagnation. This study showed that the lower limb swelling rate in the experimental group was reduced to 6.8%, and ultrasonography confirmed a significant increase in blood flow velocity. This may be attributed to: mugwort containing volatile oils (such as eucalyptol and camphor) that promote local blood circulation; mulberry twig powder with the effect of dredging meridians and improving microcirculation; cassia twig powder warming and opening veins, thereby improving blood rheology; and reducing capillary permeability to prevent tissue edema [10].

4.3. Promotion of early postoperative activity

Early ambulation is key to preventing postoperative complications (such as intestinal adhesion and pulmonary infection). In the experimental group, due to reduced pain and improved lower limb comfort, the time of first ambulation was advanced by 3.5 hours compared to the control group. This result suggests that the TCM foot bath not only alleviates pain but also enhances patients' willingness to move by improving psychological states (such as reducing anxiety).

4.4. Study limitations

This study has the following limitations: (1) The sample size was limited to a single center, and future multi-center large-sample studies are needed; (2) The long-term effects of the TCM foot bath (such as recovery at 42 days postpartum) were not tracked; (3) The efficacy differences of different TCM formulations were not analyzed.

5. Conclusion

The combination of a TCM foot bath and an analgesic pump can significantly alleviate post-cesarean section pain, reduce opioid drug consumption, and promote lower limb blood circulation and early activity. This approach integrates the characteristics of traditional Chinese medicine with the advantages of modern medicine, offering high safety and simple operation, making it suitable as an essential component of multimodal analgesia after cesarean section. Future research can further optimize TCM formulations and explore individualized intervention strategies.

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Disclosure statement

The authors declare no conflict of interest.

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