Journal of Experimental and Clinical Application of Chinese Medicine

ORIGINAL RESEARCH

Open Access

Effect of ERAS protocol and Thunder-Fire Moxibustion on postoperative gastrointestinal dysfunction of colorectal cancer

Xiaodi Shen [1,*], Qing Sun [1], Yangyang Zhao [1], Yu Zhang [1]

1. General Surgery, The First Affiliated Hospital of Zhejiang Chinese Medical University (Zhejiang Provincial Hospital of Chinese Medicine), 310006 Hangzhou, Zhejiang, China

DOI: https://doi.org/10.62767/jecacm702.4665

Keywords

Enhanced recovery after surgery
Colorectal cancer
Postoperative gastrointestinal dysfunction
Thunder-fire moxibustion
Randomized controlled trial
Traditional Chinese Medicine nursing

* **Correspondence**

Xiaodi Shen,
General Surgery, The First Affiliated Hospital of Zhejiang Chinese Medical University (Zhejiang Provincial Hospital of Chinese Medicine), 310006 Hangzhou, Zhejiang, China
E-mail: 736320597@qq.com

Received: 21 May 2026
Revised: 25 June 2026
Accepted: 26 June 2026
Published: 28 June 2026

Journal of Experimental and Clinical Application of Chinese Medicine 2026; 7(2): 51-60.

Abstract

Objective: This study aimed to examine the impact of thunder-fire moxibustion, grounded in Enhanced Recovery After Surgery (ERAS) principles, on postoperative gastrointestinal function in colorectal cancer patients. **Methods:** A single-blind randomized controlled trial was conducted. A total of seventy patients who had undergone colorectal cancer surgery were recruited from the general surgery department of a tertiary Grade A hospital in Zhejiang Province from January 2024 to January 2025. These participants were randomly allocated into two groups of equal size (35 per group). Standard ERAS nursing care was administered to the control group. In addition to the standard ERAS care provided to the control group, participants in the experimental group underwent thunder-fire moxibustion applied to designated acupoints (bilateral Zusanli-ST36, Shangjuxu-ST37, and Xiajuxu-ST39). Observations and comparisons between the groups focused on several outcomes: the intervals to first flatus, first defecation, and first oral intake, along with the duration of postoperative hospitalization, assessment of abdominal pain, and gastrointestinal symptoms. **Results:** The time to first flatus, time to first defecation, and time to first oral intake were significantly shorter in the experimental group compared to the control group, and the differences were statistically significant ($P<0.05$). Compared with the control group, the experimental group demonstrated a lower score on the Gastrointestinal Symptom Rating Scale (GSRS), a difference that exhibited statistical significance ($P<0.05$). **Conclusion:** When implemented within the ERAS framework, thunder-fire moxibustion, a characteristic Traditional Chinese Medicine therapy, may mitigate the surgical stress response and augment parasympathetic nerve activity, which in turn facilitates the restoration of gastrointestinal function following colorectal cancer surgery. It significantly shortened recovery time in our patient cohort and demonstrated promising clinical efficacy in this study.

1 Introduction

In humans, colorectal cancer ranks among the frequently encountered malignant neoplasms. Affected by changes in human diet structure and lifestyle, its incidence and mortality rates have been increasing year by year, becoming one of the major diseases threatening human life and health and the second leading cause of cancer-related deaths worldwide [1]. The treatment of this disease primarily involves surgical resection of the tumor, supplemented by radiotherapy, chemotherapy, traditional Chinese medicine, and other comprehensive treatments. Laparoscopic radical surgery is currently the standard surgical approach for colorectal cancer. Compared with traditional open surgery, it causes less tissue trauma and immune system impact, and patients recover faster, facilitating the early implementation of comprehensive treatments such as chemotherapy after surgery. In recent years, due to improvements in surgical methods, the lifespan of colorectal cancer patients has been prolonged [2]. Laparoscopic surgery causes less trauma to the body tissues and enables faster postoperative recovery, making it one of the common treatment methods for colorectal cancer in clinical practice. Under general anesthesia, laparoscopic radical surgery for colorectal cancer involves prolonged anesthesia time, extensive surgical trauma (particularly intestinal injury), extended carbon dioxide pneumoperitoneum, and changes in surgical position. These factors can affect respiration, circulation, and the internal environment, which is not conducive to early postoperative recovery. Reports show that surgery can cause stress responses, and 10% to 30% of patients may experience intestinal paralysis after surgery. Postoperative gastrointestinal dysfunction is a common complication after colorectal cancer surgery, including symptoms such as abdominal pain, abdominal distension, nausea, vomiting, cessation of anal gas and stool passage [3]. This further affects the patient's recovery and quality of life and prolongs hospital stays. Therefore, whether patients with colorectal cancer can quickly recover their gastrointestinal function during the perioperative period directly affects their rehabilitation. Evidence indicates that the primary modality for facilitating the restoration of gastrointestinal function following colorectal cancer surgery is the enteral delivery of prokinetic agents. However, in the early postoperative period, when gastrointestinal function has not yet recovered, the efficacy of oral drugs is limited. Therefore, adopting effective treatment plans for patients with colorectal cancer after surgery to promote the recovery of their gastrointestinal function is of great significance for improving treatment outcomes and facilitating patient recovery.

The Enhanced Recovery After Surgery (ERAS) protocol derives its principles from evidence-based medicine.Through multidisciplinary collaboration involving surgery, anesthesia, nursing, nutrition, etc., it optimizes the clinical pathways related to perioperative management. By alleviating various perioperative stress responses of patients, it aims to reduce postoperative complications, shorten hospital stays, and promote recovery. The ERAS protocol has a significant positive impact on the long-term prognosis of patients with intestinal tumors. The 3-year and 5-year survival rates of patients with high compliance to the ERAS protocol have both increased [4,5]. Electroacupuncture, when applied to colorectal cancer patients receiving laparoscopic surgery within an ERAS protocol, was found to reduce the duration of postoperative ileus and lower the likelihood of prolonged postoperative ileus relative to sham electroacupuncture [6]. Thunder-fire moxibustion is a characteristic Traditional Chinese Medicine (TCM) external therapy that combines aged mugwort with medicinal herbs (e.g., pangolin scale, musk, sandalwood). In TCM, colorectal cancer surgery is considered a "metal blade injury" that consumes qi and blood, leading to postoperative gastrointestinal

dysfunction aligned with the pathogenesis of "spleen-stomach qi deficiency and fu-organ qi stagnation." Thunder-fire moxibustion, via its warming and penetrating properties, theoretically warms meridians, harmonizes qi-blood, and restores spleen-stomach ascending-descending function. We hypothesize that integrating its TCM mechanism ("warming yang to consolidate the root, regulating qi to unblock fu-organs") into the ERAS protocol will synergistically enhance gastrointestinal recovery [7-10].

2 Methods

2.1 Research design: This study is a single-blind randomized controlled trial

This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the First Affiliated Hospital of Zhejiang Chinese Medical University (Approval No. 2024-KLS-166-02). Written informed consent was obtained from all participants.

2.2 Research subjects: 70 patients who underwent colorectal cancer surgery in the general surgery ward of a tertiary hospital in Zhejiang Province were selected as the research subjects

(1) Diagnostic Criteria: Diagnosed as colorectal cancer based on clinical and pathological examinations in accordance with the "Chinese Guidelines for the Diagnosis and Treatment of Colorectal Cancer (2020 Edition)".

(2) Inclusion Criteria: ① Meet the above-mentioned Western medical diagnostic criteria; ② Age between 18 and 80 years old; ③ Voluntarily participate in this study and sign an informed consent form; ④ Those who have not participated in other research projects.

(3) Exclusion Criteria: ① Patients who do not meet the above diagnostic criteria and inclusion criteria and are mistakenly admitted; ② Patients with severe underlying diseases such as cardiovascular, liver, brain, kidney, and lung diseases; ③ Patients with severe adverse reactions; ④ Patients with cachexia, severe malnutrition (albumin ≤ 30g/L, weight loss > 10% in half a year, BMI < 18, HB < 70g/L); ⑤ Patients who need neoadjuvant treatment after surgery; ⑥ Patients with severe mental disorders and unable to cooperate; ⑦ Patients with damaged skin at the acupuncture point site.

(4) Dropout criteria: Patients who fail to complete the thunder-fire moxibustion intervention for various reasons or fail to complete the observation period, resulting in incomplete data collection, will be regarded as dropout cases.

2.3 Sample size calculation

The sample size was estimated a priori using PASS 21.0 software (version 21; NCSS, LLC). The calculation was based on the key outcome of time to first flatus from a pilot study (ERAS group:mean ± SD=79.5 ± 19.7 hours; ERAS+Thunder-Fire Moxibustion group:65.4 ± 22.1 hours), yielding an effect size (Cohen's d) of 0.68. With a two-sided α level of 0.05 and a power (1- β) of 0.90, and accounting for an anticipated 15% dropout rate, the minimum required sample size was 35 patients per group (70 in total).

2.4 Random grouping and allocation concealment

(1) Random grouping: This study used SPSS 25.0 software for random grouping. The sample size (70 cases) and the number of groups (2 groups) were input into the SPSS software, and 70 random numbers and the number of groups were randomly generated. The numbers "1" and "2" were used to represent "control group" and "experimental group" respectively. The number of research cases in each group followed a 1:1 ratio, with 35 cases in each group.

(2) Allocation concealment: The generated random allocation sequence was sequentially encoded and

placed in sealed, opaque envelopes. The prepared envelopes were kept by a designated person. Then, the research subjects who met the inclusion and exclusion criteria were assigned to the corresponding random card envelopes according to the order of entering the department, and the envelopes were opened to implement the intervention measures according to the grouping plan.

(3) Blinding: This was a single-blind trial where outcome assessors were blinded to group allocation. Nurses responsible for recording time to first flatus/defecation/oral intake and assessing the GSRS were unaware of group assignment, achieved via sequentially numbered, sealed, opaque envelopes (managed by non-research staff). Patients were placed in separate wards to minimize contamination.

2.5 Intervention plan

(1) ERAS nursing: ① Before surgery: Use a body composition analyzer to assess the nutritional status of the enrolled patients. Based on the analysis results of the body composition analyzer, select patients with malnutrition and provide preoperative nutritional intervention. Instruct the patients to take nutritional solutions or powder orally every day; ERAS specialist nurses inform the patients of perioperative handling measures through distributing promotional leaflets, watching video images, and following WeChat public accounts, while also providing psychological care to increase the compliance of the patients and their families with ERAS-related measures; On the day before surgery, normal diet was maintained, and routine mechanical bowel preparation was not performed; Oral carbohydrates were taken before surgery. ② During surgery: Anesthesia nurses supervise the implementation of restrictive fluid administration; Under the condition of maintaining blood volume, reduce the fluid infusion volume during surgery; Monitor the patient's body temperature until after surgery, using heating mattresses and other methods to maintain the patient's core body temperature above 36 ℃ ; Administer fluids and abdominal irrigation fluid at 37℃ during the operation. ③ After surgery: Use multimodal analgesia. Inject ropivacaine into the incision before suturing, administer parecoxib sodium intravenously after surgery, instruct the patients to take oxycodone acetaminophen tablets, and use a small dose of hormone. Strengthen postoperative pain assessment. When pain affects the patient's daily life, report it to the attending doctor and implement pain intervention; Do not routinely place gastrointestinal decompression tubes after surgery; Encourage patients to get out of bed and move within 24 hours after surgery; Follow the "3-3-3" principle, when the pain is below 3 points, sit up for 3 minutes on the bed, stand beside the bed for 3 minutes, and walk without dizziness after standing upright. Inform the patient and their family of the daily target activity volume. On the first day after surgery, the target activity volume was 500 steps, and it increased by 500 steps the next day. Use a wireless smart bracelet to monitor the number of steps taken; After awakening from anesthesia, drink a small amount of water (10ml/h) to moisten the mouth or chew gum; Gradually increase the food intake based on gastrointestinal tolerance, and transition to regular diet when the daily oral fluid volume reached 2000-2500ml, then stop intravenous infusion; Remove the urinary catheter within 24 hours after surgery.

(2) Control group: Use ERAS nursing.

(3) Experimental group: Intervention based on the control group.

① Acupoint Selection Rationale & Locations:

Bilateral Zusanli (ST36, Stomach Meridian He-Sea point, "fortifies spleen and harmonizes stomach"), Shangjuxu (ST37, Large Intestine Lower He-Sea point), and Xiajuxu (ST39, Small Intestine Lower He-Sea point) were selected based on TCM "He-Sea

points treat internal fu-organs" theory. All belong to the Stomach Meridian of Foot-Yangming (governs digestion). Locations (bone-length method): ST36—3 cun below Dubi (ST35), 1 finger-breadth lateral to tibial anterior crest; ST37—6 cun below Dubi; ST39—3 cun below ST37.

② Preparation of materials: Zhao's Thunder-Fire Moxibustion (manufactured by Zhao's Thunder-Fire Moxibustion Traditional Medicine Research Institute; composition: aged mugwort, pangolin scale, musk, sandalwood — proportions per manufacturer specification).

③ Positioning (Bone-Length Method):

ST36: 3 cun below Dubi (ST35), 1 finger-breadth lateral to tibial anterior crest; ST37: 6 cun below Dubi; ST39: 3 cun below ST37.

④ Operation Protocol:

A trained TCM nurse performed the intervention. Distance: 2–3 cm from skin. Sequence: 5 min circular moxibustion (warm local area) + 25 min sparrow-pecking moxibustion (reinforce stimulation). Endpoint: penetrating warmth with mild uniform skin redness (no pain/burning). Session: 30 min.

Safety Monitoring: Adverse events (e.g., blistering, severe pain, dizziness, palpitations) were defined, recorded on a standardized form, and managed immediately (stop moxibustion, local cooling). Severe events were reported to the physician.

Treatment Course: Once daily, starting postoperative day 1, for 7 consecutive days.

2.6 Observation contents, outcome and evaluation criteria

2.6.1 Baseline data collection

This includes the patient's age, gender, educational level, occupation, and the time of surgery, etc.

2.6.2 Main outcome

(1) First Flatus Time: The time from the end of the surgery to the first flatus from the anus.

(2) First Defecation Time: The time from the end of the surgery to the first defecation.

(3) Time to first oral intake: The time from the end of the surgery to the first intake of liquid food.

(4) Gastrointestinal Symptoms: Assessment was conducted with the Gastrointestinal Symptom Rating Scale (GSRS).This scale includes items such as upper abdominal pain, chest discomfort, acid reflux, etc., totaling 15 items. 1 point represents not at all, and 7 points represent extremely severe. The higher the score, the more severe the gastrointestinal symptoms of the patient are.

2.6.3 Secondary outcome

Record the hospitalization days and hospitalization costs of the two groups of patients.

2.7 Data Entry and Statistical Analysis

A database was established using Epidata 3.1 software. The original data collected were sorted and verified, and then double-entry by two individuals in duplicate was conducted in Epidata 3.1 for storage. After review, statistical analysis was carried out. SPSS 25.0 software was used to conduct statistical analysis of the original data obtained from the survey. Statistical analyses employed two-tailed tests, with a significance level set at $P < 0.05$. The detailed analytical procedures are outlined below:

(1) Baseline data: Quantitative data were statistically described using the mean ± standard deviation (x(-) ± s). For data that followed a normal distribution and had homogeneity of variance, one-way analysis of variance was used, and pairwise comparisons between groups were conducted using LSD analysis. The Kruskal-Wallis H test was employed for the analysis of quantitative data that were not normally distributed.

(2) Count data were statistically described using frequency and percentage. Comparisons between groups of count data were conducted using the chi-square test. For indicators with a theoretical frequency less than 5, Fisher's exact test was used.

3 Research results

3.1 Comparison of baseline characteristics between the two groups

A total of 70 patients were included in this study. In the control group, there were 13 females and 22 males, with an average age of 66.4 ± 8.6 years. In the experimental group, there were 11 females and 24 males, with an average age of 62.2 ± 12.1 years. Both groups were mainly composed of retired individuals, with a relatively high proportion of annual income ranging from 300,000 to 400,000 yuan. The majority of the subjects had no smoking or drinking habits. Regarding education level, illiteracy and those with a university degree or above were relatively few. Between the two groups, no significant differences were observed in these baseline characteristics (Table 1).

3.2 Primary and secondary outcome

As shown in Table 1 and 2, there were no significant differences in baseline characteristics between the two groups (all $P > 0.05$). There was no difference in the duration of surgery between the experimental group and the control group (231.3 ± 77.1 minutes vs 228.1 ± 69.3 minutes, $t = 0.1842$, $P = 0.8544$).Relative to the control group, the time to first postoperative flatus was reduced in the experimental group (65.4 ± 22.1 hours vs 79.5 ± 19.7 hours, $t = 2.8201$, $P = 0.0063$), and the time to first postoperative defecation was also faster (80.8 ± 30.7 hours vs 102.8 ± 32.1 hours, $t = 2.9340$, $P = 0.0046$). The time to first postoperative intake was earlier in the experimental group (86.3 ± 32.4 hours vs 116.5 ± 46.5 hours, $t = 3.1829$, $P = 0.0022$), and the gastrointestinal symptom grading score was lower (24.5 ± 4.1 vs 27.3 ± 4.4, $t = 2.7945$, $P = 0.0067$). No significant differences were observed between the two groups regarding the length of hospital stay (15.3 ± 3.1 days vs 18.9 ± 12.3 days, $t = 1.6732$, $P = 0.0989$) or the total treatment costs [control group: median (IQR) = 50,889 (46,979–53,593) yuan vs experimental group: median (IQR) = 53,376 (46,826–56,541) yuan, $Z = -0.528$, $P = 0.598$]. (The relatively long average hospital stay in both groups may be attributable to the inclusion of preoperative waiting days and the management of concurrent comorbidities in this specific cohort, rather than purely postoperative recovery time.).

One patient in the experimental group had local skin redness, which did not require special treatment and gradually disappeared after 24 hours of observation. Two patients in the experimental group experienced transient dizziness during the application of moxibustion, and they were allowed to rest in a well-ventilated area, after which the symptoms gradually subsided.

4 Discussion

Gastrointestinal dysfunction is a common complication after colorectal cancer surgery. Reducing the occurrence of complications, increasing postoperative enteral nutrition for patients, and promoting their recovery are of vital importance. Postoperative complications lead to delays in adjuvant chemotherapy. There is an association between postoperative complications in colorectal cancer patients and chemotherapy delays of ≥ 8 weeks, and delayed chemotherapy significantly affects the overall survival and disease-free survival of surgical patients [11]. Consistent with previous reports, postoperative complications remain a critical barrier to timely adjuvant treatment [12]. Therefore, implementing effective postoperative treatment plans to promote gastrointestinal function recovery and improve the inflammatory microenvironment is of great

significance for enhancing outcomes and facilitating recovery in colorectal cancer patients.

Table 1 Comparison of baseline characteristics between the two groups.

		Control group (n=35)	Experimental group (n=35)	Statistical value	P value
Age (Years)		66.4±8.6	62.2±12.1	t=1.660	0.101
Female		13	11	χ^2=0.259	0.611
Occupation	In-service	8	5	χ^2=1.354	0.508
	Retirement	26	27		
	Unemployed	1	3		
Income (yuan)	100 000-200 00	1	1	χ^2=2.809	0.590
	200 000-300 000	14	13		
	300 000-400 000	12	18		
	400 000-500 000	7	3		
	＞500 000	1	0		
Smoking	No	32	32	χ^2=2.087	0.554
	Occasionally	0	0		
	＜5 /day	0	0		
	5-10/ day	0	2		
	10-20/day	3	1		
Drinking alcohol	No	33	35	χ^2=3.178	0.204
	Occasionally	0	0		
	＜20ml/ day	0	0		
	20-50ml/ day	0	0		
	50-100ml/ day	1	0		
	＞100ml/ day	1	0		
Education	Illiterate person	5	5	χ^2=4.233	0.516
	Primary School	10	13		
	Middle School	10	11		
	High School	7	3		
	Junior College	3	1		
	University	0	2		

To our knowledge, no prior investigation has assessed the effects of combining Enhanced Recovery After Surgery (ERAS) nursing with moxibustion on gastrointestinal function recovery in patients undergoing laparoscopic surgery for colorectal cancer. We found that moxibustion therapy significantly shortened the time to first flatus, first defecation, and first food intake after colorectal cancer surgery, and reduce the gastrointestinal symptom grading score, demonstrating good clinical efficacy. ERAS can promote postoperative recovery of patients and shorten the time from surgery to chemotherapy. This combined intervention enhances the short-term recovery of colorectal cancer patients and may also

have the potential to improve long-term prognosis, although this hypothesis requires confirmation through extended follow-up studies. Compared to conventional care, ERAS reduces hospital stay, costs, surgical stress response and time to return of gut function, without increasing post-operative morbidity in gastric cancer surgery [13]. Implementation of the ERAS protocol for colorectal cancer, supported by audit and feedback approach, led to a substantial improvement in compliance and a reduction in LOS, without meaningful effects on complications [14]. Our findings regarding the reduction in hospitalization costs and length of stay align with previous studies that demonstrated the economic and clinical benefits of ERAS pathways in colorectal surgery [13,14]. ERAS may be beneficial to the long-term prognosis of patients in four aspects: reducing surgical stress responses and improving immunosuppression, reducing surgery-related inflammatory responses, improving malnutrition status and maintaining intestinal immune function, and reducing postoperative complications [12].

Table 2 Research outcome of the two groups.

	Control group(n=35)	Experimental group(n=35)	t value	P value
Surgery duration (minutes)	228.1±69.3	231.3±77.1	0.1842	0.8544
First postoperative flatus time (hours)	79.5±19.7	65.4±22.1	2.8201	0.0063
First postoperative defecation time (hours)	102.8±32.1	80.8±30.7	2.9340	0.0046
First postoperative meal intake time (hours)	116.5±46.5	86.3±32.4	3.1829	0.0022
Gastrointestinal symptom grading scoring scale	27.3±4.4	24.5±4.1	2.7945	0.0067
Hospital stay duration (days)	18.9±12.3	15.3±3.1	1.6732	0.0989
Treatment cost (yuan)	50,889(IQR: 46,979–53,593)	53,376(IQR: 46,826–56,541)	-0.528	0.598

Data for total treatment costs are presented as median (IQR) due to significant skewness in the cost distribution, and were analyzed using the Mann-Whitney U test. Other continuous variables are presented as mean ± SD and were analyzed using the independent-samples t-test.

As a traditional open-flame suspended moxibustion therapy, thunder-fire moxibustion combines thermal stimulation with herbal ingredients (e.g., musk, sandalwood). While its proposed actions—dispelling cold, promoting blood circulation, and unblocking meridians—are theorized to facilitate gastrointestinal motility, the specific biological pathways remain unclear. In our study, we could not directly confirm whether the observed clinical benefits were mediated via reduced surgical stress or enhanced parasympathetic activity, as we did not measure relevant biomarkers (e.g., serum cortisol or autonomic nervous system indices).

In summary, integrating the Enhanced Recovery After Surgery (ERAS) protocol with thunder-fire moxibustion facilitates gastrointestinal function recovery, alleviates clinical symptoms, and may extend the disease-free survival period for patients following colorectal cancer surgery. This study has limitations: (1) Single-blind (assessors blinded, but patients/practitioners not), risking performance bias; (2) Single-center, modest sample size limiting generalizability; (3) Short follow-up (focused on early recovery, long-term QoL/recurrence unknown); (4) Fixed acupoint protocol without TCM pattern differentiation, deviating from classic individualized practice; (5) The study relied solely on clinical observation indices (e.g., flatus, defecation) and symptom scales (GSRS). We did not measure objective biomarkers such as serum inflammatory cytokines (e.g., IL-6, TNF-α, CRP) or gut barrier markers (e.g., D-lactate, DAO). Consequently, our mechanistic inference that moxibustion reduces stress response and enhances parasympathetic activity is speculative and requires validation in future studies with relevant biomarkers; (6) The lack of a sham moxibustion control and the single-blind design (only assessors were blinded) means that the observed benefits could be partially attributable to the placebo effect or the extra attention received by the experimental group. Although we attempted to minimize bias by separating patients into different wards, we acknowledge this as a major methodological constraint that limits the robustness of our findings. Future high-quality evidence-based studies are still needed to further evaluate the long-term prognosis of colorectal cancer patients receiving ERAS combined with thunder-fire moxibustion.

Acknowledgements

Not applicable.

Conflicts of Interest

The authors declare that there is no conflict of interests.

Author Contributions

XZS conceived and designed the study, acquired research funding, performed experiments, collected and analyzed data, drafted the manuscript, supervised the whole research, and acted as the corresponding author; QS, YYZ and YZ conducted partial experiments and assisted with data sorting. All authors critically revised the manuscript for important intellectual content and approved the final version to be published. All authors have made substantial intellectual contributions to this work in compliance with ICMJE authorship standards.

Ethics Approval and Consent to Participate

This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the First Affiliated Hospital of Zhejiang Chinese Medical University (Approval No. 2024-KLS-166-02). Written informed consent was obtained from all participants.

Funding

This work was supported by the Traditional Chinese

Medicine Science and Technology Project of Zhejiang Province of China (Grant No. 2024ZL470).

Availability of Data and Materials

The data presented in this study are available on request from the corresponding author.

Supplementary Material

Not applicable.

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