

Combination of acupoint herbal plaster and ear acupuncture for effective pain relief in patients after laparoscopic appendectomy

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Abstract: Laparoscopic appendectomy effectively treats appendicitis and other related conditions. However, postoperative pain remains a major concern. This study elucidates the effect of traditional Chinese medicine (TCM) therapies on postoperative recovery of patients who had undergone laparoscopic appendectomy. The study encompassed 262 patients, including 41 controls and 221 TCM-treated patients. Quality control was monitored by two senior TCM physicians and one researcher. Postoperative outcomes included the length of hospitalization, antibiotic use, pain, analgesia and plasma drainage. No significant differences were observed between the groups concerning sex, age, acute appendicitis, postoperative complications and plasma drainage, except for pain and analgesia (both $P < 0.001$). Moxibustion or partitioned moxibustion alone had no effect, compared with the control; however, ear acupuncture alone, acupoint herbal plaster + ear acupuncture, acupoint herbal plaster + moxibustion/partitioned moxibustion and acupoint herbal plaster + ear acupuncture + moxibustion/partitioned moxibustion exerted a significant effect. Pain index and analgesia duration were significantly lower for ear acupuncture alone than in the control group but remained higher than in the three acupoints herbal plaster-treated groups. The combination of acupoint herb plaster and ear acupuncture provided greater pain relief than ear acupuncture alone.

Keywords: Laparoscopic appendectomy, moxibustion/partitioned moxibustion, ear acupuncture, acute appendicitis, analgesia

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INTRODUCTION

Appendicitis-a common condition-is characterized by acute abdominal pain, with a higher prevalence in men than women (1.4:1) (Humes and Simpson 2006). Appendectomy is the mainstay treatment for appendicitis, but it may cause complications, including the risk of negative appendectomy. Laparoscopic appendectomy-a minimally invasive surgery-offers the advantages of reduced pain, a simpler operation, minimal trauma and fewer complications, compared with traditional open appendectomy (Gu and Hua 2023; Athanasiou *et al.* 2017). However, postoperative recovery remains an important concern, affecting both the quality of recovery and surgical success.

Traditional postoperative recovery methods lack systematic rehabilitation interventions, resulting in delayed recovery and a high incidence of complications, particularly postoperative pain. Most patients experience varying degrees of postsurgical pain (Hines *et al.* 1992). Analgesics are widely used for pain relief (Chitnis *et al.* 2020); however, they can cause adverse effects, such as nausea, vomiting and depressive symptoms. In severe cases, these adverse events can cause complications and even death (Doleman *et al.* 2023). Therefore, improving

postoperative pain management is central to alleviating pain and improving patient outcomes.

Acupuncture-point stimulation is a widely used TCM modality that improves pain management (Chae *et al.* 2013; Liu *et al.* 2015). Several acupoint stimulation methods, including acupoint massage, acupuncture and moxibustion and electric laser, are applied. The complex methods include acupoint herbal plaster and partitioned moxibustion. Ear acupuncture involves stimulating the ear points using short filiform needle acupuncture or other methods. It reduces pain scores in several conditions, including pregnancy and cancer (Faria *et al.* 2024; Jan *et al.* 2017; Vas *et al.* 2019). Because of its wide treatment range and application convenience, ear acupuncture has become a systematic solution for auxiliary nursing care in China. Unlike ear acupuncture, acupoint herbal plasters are applied externally and have a longer duration of action. Herbal plasters contain several Chinese herbal formulations and offer analgesic benefits (Liu *et al.* 2024; Yang *et al.* 2022; Yu *et al.* 2018). However, regional differences in the unique herbal ingredients across China alter their efficacy, warranting further clinical confirmation. Partitioned moxibustion-a modified moxibustion therapy-encompasses heat stimulation, herbal stimulation and acupoint stimulation. It has been used to treat conditions, including Crohn's disease, primary dysmenorrhea and diarrhea-predominant irritable bowel

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syndrome (Ma *et al.* 2020; Wang *et al.* 2020a; Wang *et al.* 2020b). However, the therapeutic effect of partitioned moxibustion in assisting appendectomy surgery or postoperative rehabilitation remains elusive.

Certain TCM techniques, such as ear acupuncture and acupoint herbal plaster, are effective for specific diseases. Nonetheless, their combination may yield substantial therapeutic effects. For example, Li *et al.* (2017) reported that auricular point sticking combined with acupoint application therapy safely and effectively decreased postoperative constipation. Wang *et al.* (2024) combined acupoint application and ear plaster therapy to improve sleep disorders in patients with chronic obstructive pulmonary disease. In this study, the Affiliated Traditional Chinese Medicine Hospital's expertise in acupoint herbal plaster therapy, combined with ear acupuncture and partitioned moxibustion, was utilized to determine their efficacy in auxiliary rehabilitation after laparoscopic appendectomy.

MATERIALS AND METHODS

Participants

Patients who underwent laparoscopic appendectomy at the Affiliated Traditional Chinese Medicine Hospital of Southwest Medical University from May 2018 to May 2024 were included. The inclusion criteria were as follows: (i) patients who signed the informed consent form; (ii) diagnosed with appendicitis based on clinical and pathological examination and were indicated for laparoscopic appendectomy; (iii) could actively cooperate with surgery and nursing care and (iv) had no recurrence or readmission within 6 months after discharge. The exclusion criteria were as follows: (i) patients with a history of abdominal enlargement surgery; (ii) with severe liver, liver, or kidney dysfunction; (iii) with contraindications for laparoscopic surgery; and (iv) refused or could not cooperate with postoperative treatment. A total of 262 participants, including 41 controls and 221 patients, were enrolled (Supplemental table S1). The study was conducted per the tenets of the Declaration of Helsinki and approved by the ethics committee of the same hospital (No. BY2025062). All participants provided written informed consent.

Postoperative treatments

Routine nursing methods were used before and during surgery. After an appendectomy, participants in the control group continued to receive routine care, whereas participants in the treatment group received TCM interventions.

Postoperative treatment methods were divided into the following five types: 1) ear acupuncture alone (19 patients); 2) moxibustion/partitioned moxibustion alone (33 patients); 3) acupoint herbal plaster + ear acupuncture (64 patients); 4) acupoint herbal plaster +

moxibustion/partitioned moxibustion (66 patients) and 5) acupoint herbal plaster + ear acupuncture + moxibustion/partitioned moxibustion (39 patients). Among the 138 patients who received moxibustion/partitioned moxibustion, 41 (29.7%) received moxibustion, whereas 97 (70.3%) received partitioned moxibustion. TCM treatments were commenced on the first day after surgery and continued until the patients showed substantial improvements, leading to treatment termination or discharge, as evaluated by the physician. Treatment durations and the use of TCM therapies for each patient were strictly evaluated and determined by TCM physicians. The treatment methods and related details of ear acupuncture, herbal plasters and moxibustion/partitioned moxibustion are listed in Supplementary Method 1.

Quality control

The quality control team consisted of two senior TCM physicians and one researcher. For each patient, a doctor was responsible for acupoint selection training and medication preparation. Additionally, one or two nurses administered or guided treatment application. A dedicated record form was maintained for each patient receiving TCM treatments to facilitate tracking of their recovery, document completed treatments and prepare for the subsequent step. Nurses checked the buried needles and acupoint plasters daily to ensure no displacement or detachment. The quality control team monitored and checked nursing steps and treatments, held discussion meetings every 3 days and resolved any problems or deviations that arose.

Observation index

The first mobilization time after surgery the length of hospitalization, pain condition, antibiotic use and plasma drainage were assessed. Pain severity was determined by physicians based on patients' condition and classified using the verbal descriptor scale method into no, mild, moderate, or severe pain (Woo *et al.* 2015). Dizocin injection, sufentanil citrate injection and tramadol were the key analgesics.

STATISTICAL ANALYSIS

Statistical analysis was conducted using IBM SPSS version 22.0 (IBM, Armonk, NY, USA). Quantitative data were analyzed using *t*-test and are expressed as mean \pm standard deviation. Differences in frequencies of clinical factors and subtypes were analyzed using the Chi-square test. A *P*-value < 0.05 was considered statistically significant.

RESULTS

Characteristics of the six groups

A total of 6 groups, including one control group and five TCM-treated groups, were analyzed.

Table 1: Characteristics of 262 patients who underwent laparoscopic appendectomy

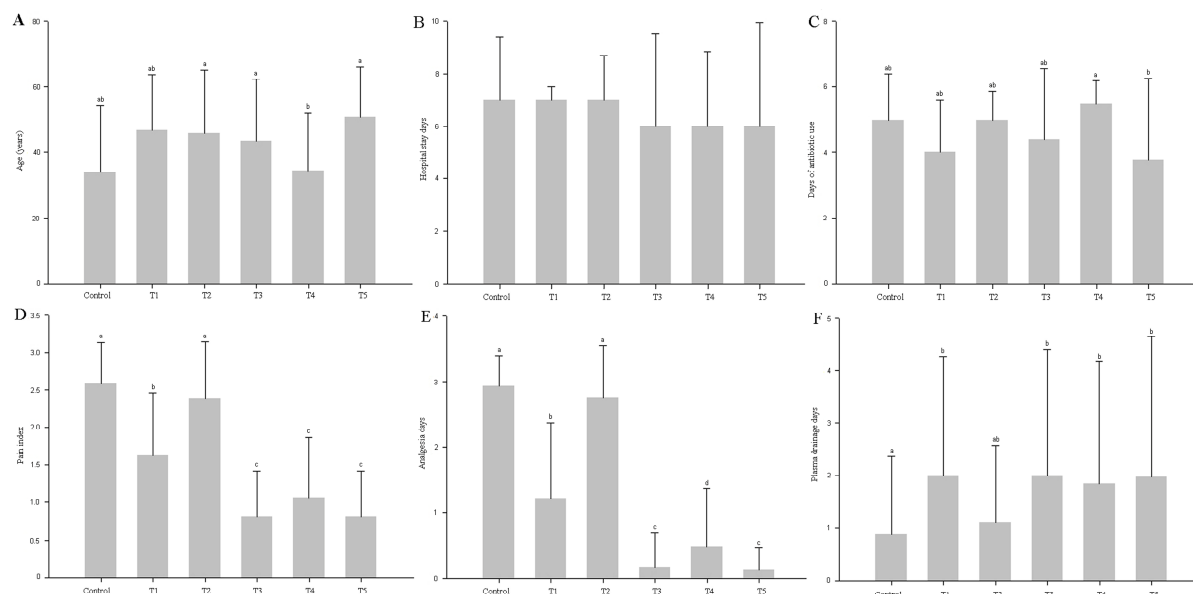
Characteristic	Control	Ear acupuncture	Moxibustion/partitioned moxibustion	Acupoint plaster + ear acupuncture	Acupoint moxibustion/partitioned moxibustion	Acupoint plaster + moxibustion / partitioned moxibustion	P-value
Total patients, n (%)	41 (15.6)	19 (7.3)	33 (12.6)	64 (24.4)	66 (25.2)	39 (14.9)	
Sex, n (%)							
Female	19 (46.3)	11 (57.9)	20 (60.6)	33 (51.6)	28 (42.4)	22 (56.4)	0.502
Male	22 (53.7)	8 (42.1)	13 (39.4)	31 (48.4)	38 (57.6)	17 (43.6)	
Age, n (%)							
<50	29 (70.7)	12 (63.2)	19 (57.6)	37 (57.8)	49 (74.2)	19 (48.7)	0.101
≥50	12 (29.3)	7 (36.8)	14 (42.4)	27 (42.2)	17 (25.8)	20 (51.3)	
Acute appendicitis, n (%)							
No	4 (9.8)	2 (10.5)	2 (6.1)	4 (6.3)	6 (9.1)	2 (5.1)	0.933
Yes	37 (90.2)	17 (89.5)	31 (93.9)	60 (93.7)	60 (90.9)	37 (94.9)	
Having complication, n (%)							
No	38 (92.7)	19 (100.0)	30 (90.9)	62 (96.9)	62 (93.9)	37 (94.9)	0.700
Yes	3 (7.3)	0 (0.0)	3 (9.1)	2 (3.1)	4 (6.1)	2 (5.1)	<0.001**
Yes Pain, n (%)							
No	0 (0.0)	0 (0.0)	1 (3.0)	18 (28.1)	14 (21.2)	10 (25.6)	<0.001**
Yes	41 (100.0)	19 (100.0)	32 (97.0)	46 (71.9)	52 (78.8)	29 (74.4)	
Postoperative analgesia, n (%)							
No	1 (2.4)	10 (52.6)	2 (6.1)	56 (87.5)	47 (71.2)	34 (87.2)	<0.001**
Yes	40 (97.6)	9 (47.4)	31 (93.9)	8 (12.5)	19 (28.8)	5 (12.8)	
Plasma drainage, n (%)							
No	29 (70.7)	10 (52.6)	20 (60.6)	35 (54.7)	39 (59.1)	23 (59.0)	0.438
Yes	12 (29.3)	9 (47.4)	13 (39.4)	29 (45.3)	27 (40.9)	16 (41.0)	

Note: Categorical variables were analyzed using the χ^2 test. Significance is defined as $p < 0.05$ level. * $p < 0.05$ level, and ** $p < 0.01$ level.

Table 2: Correlation analysis of clinical factors

	Sex	Age	Acute appendicitis	Postoperative treatments	Complications	Postoperative pain	Plasma drainage
Sex							
Age	-0.170 (0.006**)		0.024 (0.695)	-0.038 (0.539)	0.004 (0.953)	-0.100 (0.108)	-0.065 (0.293)
Acute appendicitis				0.069 (0.265)	0.134 (0.030*)	-0.066 (0.289)	0.060 (0.329)
Postoperative treatments			0.131 (0.034*)		0.004 (0.944)	0.028 (0.654)	0.149 (0.016*)
Complications				0.034 (0.579)		-0.191 (0.002**)	0.098 (0.113)
Postoperative pain					-0.038 (0.542)		0.046 (0.457)
Plasma drainage						0.014 (0.826)	0.008 (0.893)

Note: The data in the column: correlation coefficient (P-value). Significance is defined as $p < 0.05$ level. * $p < 0.05$ level, and ** $p < 0.01$ level.



(A-C) No significant difference in age (A), the length of hospitalization (B) and antibiotic use (C) between the control and TCM treatment groups. (D-F) All TCM treatment groups, except for the moxibustion/partitioned moxibustion group, demonstrate a lower pain index (D) and analgesia days, (E) but longer plasma drainage days (F), compared with the control group.

Fig. 1: Effect analysis of traditional Chinese medicine (TCM) therapies on clinical factors among patients who received laparoscopic appendectomy

TCM treatment outcomes were analyzed among the groups. Sex, age, acute appendicitis, postoperative complications and plasma drainage did not differ among the groups (table 1). However, postoperative pain and analgesia in patients differed significantly among the groups.

Correlation analysis of clinical factors

Correlation analysis of factors indicated that older age was significantly correlated with female sex, acute appendicitis and complications (table 2). A higher frequency of acute appendicitis was associated with increased plasma drainage. Postoperative treatments were not correlated with any factor; however, they were negatively correlated with postoperative pain.

Combination analysis of postoperative treatments

The patients were assigned to one of the five TCM treatment groups, namely, ear acupuncture alone, moxibustion/partitioned moxibustion alone, acupoint herbal plaster + ear acupuncture, acupoint herbal plaster + moxibustion/partitioned moxibustion and acupoint herbal plaster + ear acupuncture + moxibustion/partitioned moxibustion group. The average age in the control group was 36.9 ± 17.3 (range: 6-69) years, which was insignificantly different from that in the TCM treatment groups (fig. 1A). No the length of hospitalization and antibiotic use did not significantly differ between the control and treatment groups (fig. 1B and C). However, the pain index and analgesia days were significantly higher for the control and moxibustion/partitioned moxibustion alone

group than those for the remaining four treatment groups (fig. 1D and E). Nevertheless, the pain index and analgesia days for ear acupuncture alone were significantly higher than those in the three acupoints herbal plaster-treated groups. Plasma drainage days were significantly lower for the control group than for the four TCM treatment groups, except for the moxibustion/partitioned moxibustion group (fig. 1F).

DISCUSSION

Laparoscopic appendectomy is a key surgical technique to treat acute and chronic appendicitis; nonetheless, some patients still experience pain and complications that affect surgical outcomes. The combination of conventional surgery with TCM is an excellent approach to reducing pain severity among patients and promoting their physical and mental recovery (Faria *et al.* 2024; Liu *et al.* 2015). Current findings confirmed that patients receiving TCM treatments exhibited reduced pain and analgesia days, compared with patients in the control group.

Acupuncture techniques, including ear acupuncture, effectively provide pain relief and facilitate postoperative rehabilitation (Faria *et al.* 2024; Jan *et al.* 2017; Liu *et al.* 2015). Therefore, ear acupuncture is used as a routine adjuvant therapy after surgery across several TCM hospitals in China. In this study, patients treated with ear acupuncture exhibited a significantly low pain index, consistent with previous reports. In contrast to ear acupuncture, acupoint herbal plaster therapy

simultaneously stimulates relevant acupoints and achieves therapeutic or auxiliary recovery effects through drug action, suggesting a complex mechanism of action (Liu *et al.* 2015; Liu *et al.* 2024; Ren *et al.* 2019; Yang *et al.* 2022). The Affiliated Traditional Chinese Medicine Hospital specializes in the research and application of acupoint plasters and has summarized various plasters and therapies effective in clinical practice. In this study, the effect of combining acupoint herbal plasters with ear acupuncture and/or moxibustion/partitioned moxibustion for effective analgesia was explored in patients after laparoscopic appendectomy. This combination exerted excellent analgesic effects, consistent with the clinical efficacy of electro acupuncture combined with moxibustion in patients with post-stroke urinary incontinence (Yi *et al.* 2024) and acupoint massage combined with acupoint application in patients undergoing laparoscopic cholecystectomy (Ren *et al.* 2019).

Despite no comprehensive explanation of the mechanism by which herbal plasters relieve pain, some studies have pointed in favorable directions. Shi *et al.* (2020) used fluorescein-labeled dextran, histological research and reverse transcription-polymerase chain reaction. The therapeutic effect of their herbal plaster was not achieved by inhibiting tumor growth but rather by alleviating damage to the intestinal and mucosal basement layers and enhancing cytokine expression in the toll-like receptor 4 pathway, as well as interleukin-1 β expression, thereby activating the host immune response. Therefore, herbal plasters may activate the immune system and self-repair ability in patients, resulting in rapid analgesia. In this study, patients who received a herbal plaster demonstrated a lower pain index and required fewer days of analgesia but longer days of plasma drainage, compared with the controls, confirming this speculation.

Partitioned moxibustion is a type of moxibustion. However, unlike traditional moxibustion a herb cushion is placed between the moxibustion stick and the skin. Partitioned moxibustion effectively treats various conditions, particularly chronic diseases and can also alleviate pain (Ma *et al.* 2020; Wang *et al.* 2020a; Wang *et al.* 2020b). However, there are few reports on its effect in relieving post-appendectomy pain. In this study, the effect of moxibustion/partitioned moxibustion was analyzed in patients who had undergone laparoscopic appendectomy. Patients treated with moxibustion/partitioned moxibustion alone experienced pain and analgesia levels similar to the controls. This may be attributed to the insufficient intensity or frequency of conventional moxibustion/partitioned moxibustion treatment for post-appendectomy patients. Notably, the intensity and frequency of moxibustion/partitioned moxibustion vary for pain relief in different diseases, such as dysmenorrhea (Yang *et al.* 2017) and cancer (Li *et al.* 2023). Therefore, future clinical trials are necessary to determine the effectiveness of moxibustion/partitioned moxibustion by enhancing its intensity or

prolonging the treatment duration in patients who have undergone laparoscopic appendectomy. Additionally, further testing is warranted to identify the most effective partitioned herb for partitioned moxibustion in post-appendectomy patients.

The combination of acupoint herb plaster and acupoint stimulation effectively manages numerous diseases, indicating their complementary effects (Li *et al.* 2017; Shi *et al.* 2020; Shou *et al.* 2020; Wang *et al.* 2024). Similarly, partitioned moxibustion combined with electro acupuncture is beneficial for patients exhibiting symptoms of kidney deficiency and phlegm dampness (Zhao *et al.* 2021). In this study, moxibustion/partitioned moxibustion exerted no analgesic effect in patients who underwent laparoscopic appendectomy, whereas ear acupuncture and herb plaster significantly reduced pain. Therefore, differences may exist in the complementarity of therapeutic effects while using various TCM therapies. The combination of acupoint herb plaster with ear acupuncture exerted the highest analgesic effect, compared with other therapies. Nonetheless, the combination of three therapies was not superior to that of acupoint herb plaster and ear acupuncture possibly because of the insufficient efficacy of moxibustion/partitioned moxibustion used in this study. Therefore, the actual effectiveness of the combination of the three therapies warrants further investigation.

CONCLUSION

TCM enabled pain management in post-appendectomy patients. Both acupoint herb plaster and ear acupuncture exerted analgesic effects in patients who underwent laparoscopic appendectomy. The combination of acupoint herb plaster and ear acupuncture yielded analgesia-related outcomes better than that achieved using ear acupuncture alone.

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Contributors' statement

Sample preparation and analysis: Heng Huang, Fei liu and Min Su; Design of the study: Heng Huang and Wenbo Long; Interpretation of the data: Heng Huang and Wenbo Long; Drafting the manuscript: Wenbo Long.

Conflict of interest

There is no conflict of interest.

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