

The effect of acupuncture on recovery after colorectal cancer resection

A systematic review meta-analysis of randomized controlled trials

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Abstract

Background: To evaluate the efficacy and safety of acupuncture by systematically reviewing the literature on colorectal cancer resection.

Methods: Seven electronic databases were searched from inception to February 28, 2023. Randomized controlled trials on acupuncture in patients after CRC resection were included. Two reviewers independently selected relevant trials, extracted data, and assessed the risk of bias. A random-effects meta-analysis model was used to obtain summary effect estimates. The data were pooled and analyzed using RevMan 5.3. The heterogeneity of selected studies was evaluated by evaluating the I-squared (I^2) statistics.

Results: Twenty-two studies with 1878 patients were included. Results of the meta-analysis showed there was a low level evidence that acupuncture may improve early postoperative symptoms, such as time to first flatus ($n = 876$, MD -0.77 h, 95% CI -1.22 to -0.33 h, $I^2 = 89\%$), time to first bowel movement ($n = 671$, MD -1.41 h, 95% CI -2.20 to -0.63 h, $I^2 = 95\%$), time to first defecation ($n = 556$, MD -1.03 h, 95% CI -1.88 to -0.18 h, $I^2 = 95\%$), and nausea/vomiting ($n = 1488$, RR 0.72, 95% CI 0.59–0.89, $I^2 = 49\%$) compared with usual care and sham acupuncture. However, there were no statistically significant differences in postoperative pain ($n = 1188$, MD -0.21 , 95% CI -0.59 to 0.17 , $I^2 = 74\%$). And there was no sufficient evidence of improving long-term functional outcomes. There was substantial heterogeneity across trials. The adverse events associated with acupuncture stimulation were minor in include studies.

Conclusion subsections: There is currently low-level evidence supporting the use of acupuncture on postoperative symptoms for patients after colorectal cancer resection. More investigations should be established based on the STRICTA statement strictly.

Abbreviations: CI = confidence intervals, CRC = colorectal cancer, MD = mean difference, PONV = postoperative nausea and vomiting, QoL = quality of life, RCTs = randomized controlled trials, RR = risk ratios, STRICTA = Revised Standards for Reporting Interventions in Clinical Trials of Acupuncture, TCM = Traditional Chinese Medicine, VAS = Visual Analog Scale, VRNS = Numerical Rating Scale.

Keywords: abdominal surgery, acupuncture, colorectal cancer, meta-analysis

1. Introduction

Colorectal cancer (CRC) was the third most common cancer in men and the second in women, and there were more than 93,000 deaths due to CRC worldwide in 2020.^[1] Despite developments in early diagnosis, 5-year relative survival is still under 65%.^[2] Cancer brings about a substantial economic

and epidemiology burden worldwide, which is set to further increase over future decades because of demographic transitions.

Surgical resection is currently one of the major approaches for CRC. However, patients can experience various problems immediately following surgery such as nausea and vomiting,

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All data generated or analyzed during this study are included in this published article [and its supplementary information files].

All analyses were based on previous published studies, thus no ethical approval and patient consent are required.

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postoperative pain, and bowel dysfunction, which are closely related to increased complication rates and prolonged length of stay (LOS).^[3] It not only decreases patients' quality of life (QoL) but also imposes a heavy burden on treatment-related costs. Enhanced recovery after surgery (ERAS) has been investigated to speed up early recovery, however, success has been limited due to multiple complications caused by analgesic and antiemetic armamentarium.^[4–6]

Acupuncture can be manipulated manually, electrically, or by heat.^[7] As a common part of complementary medicine, it is effective in treating various symptoms after major abdominal surgery such as postoperative pain, postoperative nausea/vomiting and enhancing the quality of life for patients.^[8] In the theory of Traditional Chinese Medicine (TCM), acupoints are specifically chosen sites for acupuncture manipulation, located on the meridians along which the body's vital energy (Qi) flows. Stimulation of specific acupoints may restore the continuous flow of "Qi" and maintain health by acting on the critical pathological factors, such as qi stagnation and blood stasis, during the recovery of CRC resection.^[9]

Some systematic reviews reported the benefit of acupuncture in improving postoperative symptoms,^[10–14] but the conclusions may not apply to patients with CRC, because there were specific syndromes and mechanisms among different diseases. The latest systematic review^[15] of 7 trials published in 2016 suggested that acupuncture was of modest efficacy for certain results reflecting gastrointestinal function recovery in low-level evidence. However, there were still some limitations of this 2016 review in the following points: Different methods were used to measure the same outcomes such as postoperative pain. Some critical items of intervention such as the timing of acupuncture were not reported appropriately. Results of long-term functional recovery and QoL were not reported in this 2016 review. Thus, there remains a lack of sufficient evidence to conclude that acupuncture is beneficial for the multi-dimensional aspects of recovery following colorectal cancer resection.

The clinical impressions of this study are that acupuncture may have a positive effect on the recovery of patients after colorectal cancer resection, including reducing pain and nausea, improving bowel function, and enhancing overall physical and emotional well-being. However, there remain unanswered questions regarding the optimal timing and duration of acupuncture treatment, as well as the specific mechanisms underlying its therapeutic effects. To some extent, we have sought to avoid the above limitations, and provide relatively complete evidence. Thus, we carried out a systematic review to assess the efficacy and safety of acupuncture for the multi-dimensional aspects of recovery following colorectal cancer resection, including short-term benefits and long-term functional outcomes.

2. Materials and methods

This study follows the Preferred Reporting Items for Systematic Reviews and Meta-Analysis report specification,^[16] and its protocol is available in the PROSPERO registration (No. CRD42022337613).

2.1. Search strategy

Three English-language databases (PubMed, Embase, and Cochrane) and 4 Chinese-language databases (China National Knowledge Infrastructure, Wan Fang, Chinese Biomedical Literature Database, VIP Database for Chinese Technical Periodicals) are searched by 2 independent investigators (L.Q. and S.H.S) for high-quality randomized controlled trials (RCTs) from inception to February 28, 2023.

The search terms included terms related to acupuncture (e.g., "acupuncture" OR "acupuncture therapy" OR "electroacupuncture" OR "EA" OR "warm needle" OR "warm needling

acupuncture" OR "warm-needling"), and terms related to colorectal cancer ("colorectal Neoplasms" OR "colorectal tumor" OR "colorectal cancer" OR "colorectal carcinoma"), and terms related to randomized controlled trial ("randomized controlled trial" OR "controlled clinical trial"). Details of the search strategies were listed in Table S1, Supplemental Digital Content, <http://links.lww.com/MD/J474> (see Table S1, Supplemental Digital Content, which listed details of the search strategies).

We search ClinicalTrials.gov and the Chinese Clinical Trial Register for unpublished RCTs. The reference lists were checked for studies, including international guidelines.^[16] Revised Standards for Reporting Interventions in Clinical Trials of Acupuncture (STRICTA)^[17] set out reporting guidelines for the details of needling, the treatment regimen, the practitioner background, the control interventions and other details, applicable to a broad range of clinical evaluation designs. Existing systematic reviews were examined to identify additional trials.

2.2. Inclusion and exclusion criteria

Participants, interventions, comparisons, outcomes, and study design approach was applied to establish the inclusion criteria.

- (1) *Types of studies* The studies were RCTs (blinded or non-blinded).
- (2) *Types of participants* Patients aged > 18 years and undergoing abdominal surgery including open and laparoscopic surgery. No restrictions are placed on sex or ethnicity. A clear diagnosis of colorectal cancer in pathology.
- (3) *Types of interventions* The intervention measures in the treatment group were manual acupuncture, electroacupuncture, or warm-needling. The intervention measures in the control group were sham acupuncture or preoperative routine nursing. In addition, the comparison could be between manual acupuncture/warm-needling and sham acupuncture (SA) and no acupuncture (NA). The SA group should not use penetrating needles.
- (4) *Types of outcomes*

Primary outcomes were early postoperative symptoms (time to first flatus and/or defecation and/or bowel sound recovery), nausea and vomiting (either postoperative nausea or vomiting or both, as some studies, only reported a composite outcome), and postoperative pain scores (0–100 mm Visual Analog Scale and 11-point Numerical Rating Scale).

Secondary outcomes included length of hospital stay and any measure of the quality of life.

Adverse events include the proportion of participants who experience any unfavorable outcome during the intervention but not necessarily caused by intervention; death or significant disability due to adverse events; dropping out due to adverse events.

Trials with the following characteristics were excluded: Patients with a history of other malignant tumors. The application of other TCM treatments in the intervention or control groups. The method of stimulating acupoints without needle insertion such as transcutaneous electrical stimulation and acupuncture including specific "microsystems" like ear acupuncture. Outcomes were biochemical indicators solely instead of patient-centered such as postoperative nausea and vomiting (PONV) or pain intensity.

2.3. Study selection

Two review authors (S.H.S and Q.L.) imported records retrieved from the selections according to the search strategy into EndNote and removed duplicates (Endnote 2016). We identified and reviewed articles that were deemed relevant by screening the list of titles and abstracts, and those obviously did not meet the eligibility criteria was excluded. We did not

exclude studies solely on the basis of reporting outcome data. The full text was reviewed for articles with a remote potential for study inclusion after we checked whether inclusion and exclusion criteria were met independently. Any disagreement between the 2 reviewers was resolved by involving a third review author (H.L.J.). We recorded reasons for exclusion of full text articles (Table S2, Supplemental Digital Content, <http://links.lww.com/MD/J475>, which illustrates the reasons for exclusion).

2.4. Data extraction

Two review authors (S.H.S and L.Q.) independently conducted data extraction using predesigned forms, and a third review author checked the input data carefully comparing with the presentation of data in the system review.

Characteristics include publication information: author, year, country; study designs: methods of randomization and blinding, sample size; baseline characteristics (age, sex, type of surgery, surgery duration, and primary disease cancer site); details of intervention and comparators (acupuncture procedures should be described according to the standards for reporting interventions in clinical trials of acupuncture, STRICTA); primary and secondary outcomes (dichotomous data), such as incidence of PONV, were extracted as the number of patients and that of events; continuous data, such as pain scores, were extracted as the number of patients, means and S.D.; and funding support. We contacted the authors of the studies with missing data to ensure the overall quality of research. If data were presented as median and established approximation method was used to estimate the mean difference.^[18] Calculations were carried out in Microsoft Excel 2019 by Q.L.

2.5. Assessment of risk of bias in included studies

Study quality was evaluated by 2 authors independently using Cochrane's "Risk of bias" tool as follows: sequence generation, allocation concealment, blinding of participants and outcome assessment, incomplete outcome data, selective outcome reporting, and other potential threats. We graded each potential source of bias as high, low, or unclear. We described each item according to what happened in those studies, and a judgment was made in the risk of bias table relating to that item. Disagreements were resolved by a discussion where necessary involving a third review author (T.H.).

2.6. Statistical analyses

We used RevMan version 5.3 (The Cochrane Collaboration, The Nordic Cochrane Centre, Copenhagen, Denmark) to synthesize data from included studies. Subgroups that we planned to conduct including the type of treatment (manual acupuncture, electroacupuncture, or combination) and the comparator (sham acupuncture and usual care).

The treatment efficacy of postoperative pain depends largely on subjective reports of patients, measured by various scales including the 0 to 100mm Visual Analog Scale (VAS) and 11-point Numerical Rating Scale (VRNS). VAS was converted into VRNS with the corresponding grade because the 2 scales were closely related. For example, a result of 50mm on the 100-mm version of VAS was recorded as 5 points in VRNS for data synthesis.

The severity of PONV was measured by various scales, and VAS and VRNS were used in this study. Some authors reported the occurrence of PONV concerning the WHO criteria,^[19] and Grade III and IV were defined as PONV. If any study reported several occurrences of outcome indicators, the longest cumulative follow-up data was adopted at the end of surgery.

Moreover, various decisions may be made for included studies on how to combine data. For dichotomous data, results were

presented as risk ratios (RRs) with 95% confidence intervals (CIs). The method of merging subgroups is to add the sample size of each subgroup and the number of cases with target events. For continuous data, we presented the results as mean difference (MD) with 95% CI if the same scales were used in all studies, otherwise, standardized mean difference was used.

The heterogeneity of selected studies was evaluated by evaluating the I-squared (I^2) statistics when values of 50% or higher were substantial heterogeneity. If heterogeneity was indicative, a Mantel-Haenszel random effect model was applied to analyze data.

We planned to perform subgroup analyses, where appropriate, to explore the impact of grouping factors on results and potential sources of heterogeneity among the studies as follows: the postoperative day and the severity of the disease.

Sensitivity analyses were conducted using the method of leave-one-out to enhance the robustness of the results. Funnel plot and Egger's test were not applied to explore publication bias because no sufficient studies were available.

2.7. Certainty assessment

Grading of Recommendations Assessment, Development, and Evaluation (GRADE) was used by 2 review authors to assess the certainty of evidence.^[20] The evidence was downgraded if there were limitations including a high risk of bias, substantial heterogeneity, detected publication bias, imprecision, and indirectness.

3. Results

3.1. Literature search and study selection

A total of 1341 trials were identified 1066 duplicates were removed, and 238 articles were excluded after reviewing abstracts and titles. An additional 9 non-RCTs were excluded from the study pool, and 6 articles were also excluded due to low study quality and insufficient data for the analysis. Figure 1 is a flow chart of the trial selecting process.^[21] Finally, 22 trials are included in this review, involving a total of 1878 participants.^[22–43] Twenty-one of the studies (95.5%) included were conducted in China, and one (4.5%) was in the United States. All potentially relevant papers were reviewed by 2 independent investigators.

3.2. Description of studies

Characteristics of included RCTs were summarized in Table 1. A total of 1878 patients were included, with 988 (52.6%) in the experimental group, 890 (47.4%) in the control group, and the average sample size of the RCTs was 85 participants (ranging from 39–165). The age of participants ranged from 18 to 80 years.

There were differences among these trials. Most RCTs were two-arm trials, except 3 which have 3 arms, one 4-arm, and one 5-arm trial. Twenty-two comparisons were therefore included in this review. Surgery type included laparoscopic surgery (13.6%, 3/22), open surgery (31.8%, 7/22), both laparoscopic and open surgery (22.7%, 5/22), and undefined (31.8%, 7/22). Three different forms of acupuncture were evaluated: manual acupuncture (36.4%, 8/22), electroacupuncture (50.0%, 11/22), and warm-needling (13.6%, 3/22). Control treatments involved standard postoperative care (80.95%, 17/22) or sham EA (19.05%, 4/21). The most selected acupoints were Zusanli (ST36) (86.4%, 19/22), Neiguan (PC6) (40.9%, 9/22), Sanyinjiao (SP6) (31.8%, 7/22), Shangjuxu (ST37) (27.3%, 6/22), Hegu (LI4) (27.3%, 6/22), Zhigou (SJ6) (18.2%, 4/22), Yinlingquan (SP9) (18.2%, 4/22), Tianshu (ST25) (18.2%, 4/22). The majority of studies (77.3%, 17/22) used acupuncture postoperatively, 3 studies used MA and EA within the 24 hours before the surgery, and the

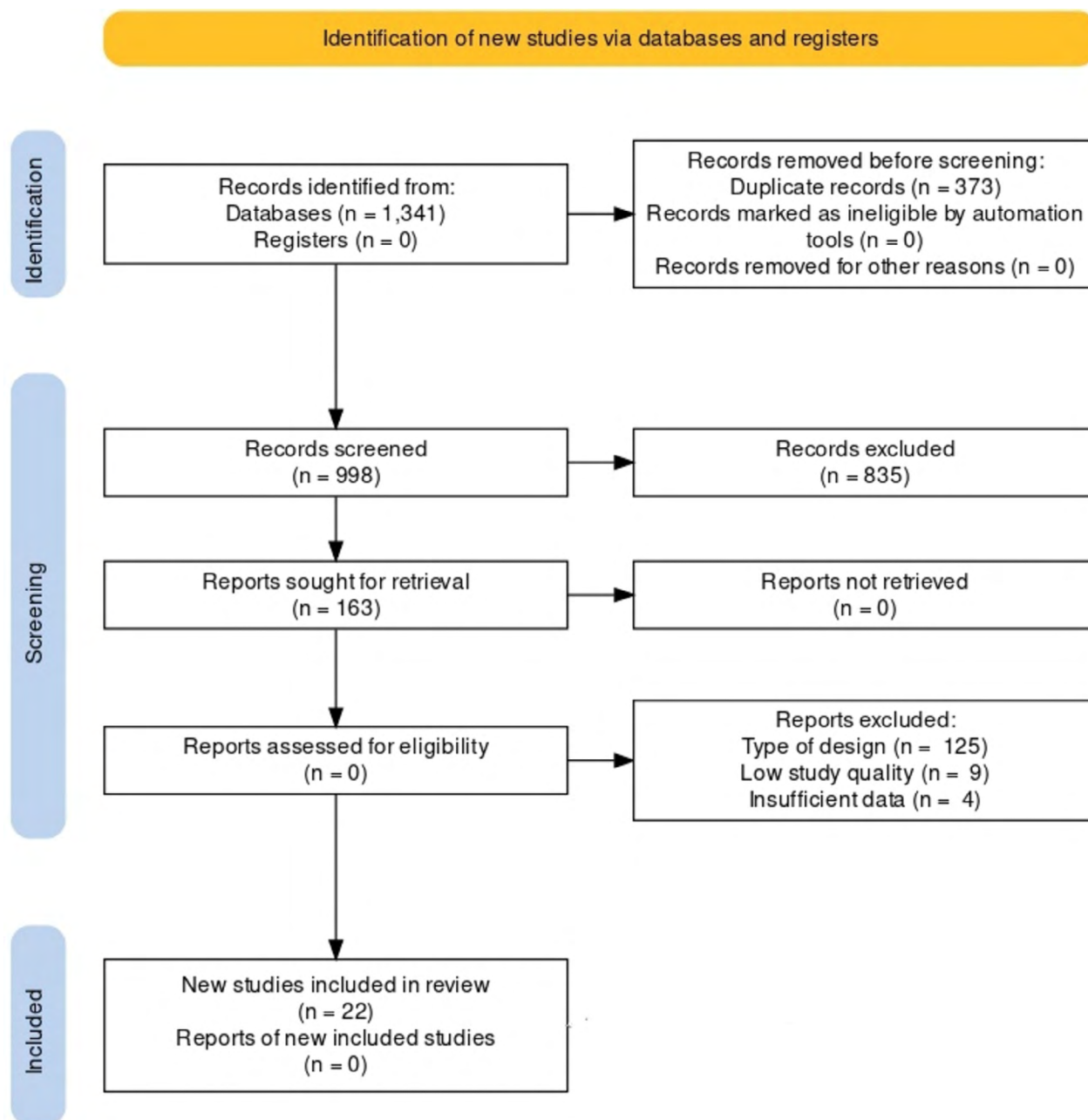


Figure 1. Study flow diagram.

other 2 did not report it. The duration of treatment ranged from 3 days to 2 weeks and the longest follow-up time for outcome assessment was 2 weeks. We reported acupuncture procedures in Table 1 according to STRICTA. The other details are shown in Table 2.

3.3. Risk of bias in included studies

18 studies that used a random number table or a computer random number generator were assessed as having a low risk of bias. Three studies were evaluated as having a high risk of bias because they used the patient registration number.^[35,36,41] One study did not refer to methods of random sequence generation were rated as unclear risk of bias.^[32]

Five RCTs^[22,31,33,38,43] that used a center-controlled method or opaque envelope were assessed as a low risk of bias, while the other 17 RCTs were appraised as unclear risk of bias

because they did not report whether allocation concealment was used.

Five studies^[22,25,31,38,43] (22.7%) mentioned blinding the statistical analyses, while 8 trials (36.4%)^[26–28,33,35–37,42] did not mention whether participants and study personnel were used. Six studies (27.2%)^[24,25,32,38,42,43] were at low risk of attrition bias, and 8 (36.4%)^[23,25,28,32,33,35] were at low risk of selective outcome. The results were reported in Figures 2 and 3 and Table S3, Supplemental Digital Content, <http://links.lww.com/MD/J476> (see Table S3, Supplemental Digital Content, which listed the risk of bias).

3.4. Primary outcomes

3.4.1. Physiological recovery. Eleven trials analyzed time to first flatus. Meta-analysis results indicated that the time to first flatus in the acupuncture groups was shorter than that in the

Table 1

Details of interventions.

Author (year)	Type of intervention	Number of needle insertions	Names of points (uni/bilateral)	Depth	Response sought	Needle stimulation	Needle retention time	Needle type (diameter, length and manufacturer or material)	Frequency	Treatment period
Deng (2013)	EA	14	bilateral (ST36, PC6, LU4, SP6, SP9, ST25, HT7)	–	De qi	Continuous waves at 2 Hz	30 min	Single-use, sterilized, disposable, filiform acupuncture needles (stainless steel, 32 G in width, and ranged from 1/200 to 300 long)	Twice daily	3 d
Ng (2012)	EA	8	bilateral (ST36, SP6, LU4, TE6)	20 mm	De qi	Continuous waves at 100 Hz	20 min	Sterile acupuncture needles (length 25 mm, diameter 0.22 mm; Hwato, Suzhou Medical Appliance Factory, China)	Once daily	4 d
Zhang (2014)	EA	2	bilateral (ST36, SP6, LU4, TE7)	–	De qi	Continuous waves at 100 Hz	30 min	Sterile acupuncture needles (length 50 mm, diameter 0.20 mm; Hwato, Suzhou Medical Appliance Factory, China)	Once daily	5 d
Meng (2010)	EA	8	bilateral (ST36, GB34, SJ6, ST37)	–	De qi	Continuous waves at 2 Hz	20 min	Sterile acupuncture needles (length 1.5 cun, diameter 0.32 mm; Hwato, Suzhou Medical Appliance Factory, China)	Once daily	6 d
Yao (2012)	EA	8	bilateral (PC6, LU4, SJ6, LU11)	–	De qi	Dilatational waves at 3Hz/20Hz, peak current 15–30 ma	30 min	Sterile acupuncture needles (length 25 mm, diameter 0.35mm; Hwato, Suzhou Medical Appliance Factory, China)	–	–
Pei(2016)	EA	4	bilateral (ST36, SP6)	30–40 mm	De qi	Dilatational waves at 2Hz/50Hz ,peak current < 2 ma	30 min	–	–	–
Long (2021)	EA	4	bilateral (LU9, LU7)	LU9 (7.5–12.5 mm), LU7(12.5–20 mm)	De qi	Continuous waves at 2 Hz 1–2ma	30 min	Sterile acupuncture needles (length 50 mm, diameter 0.30 mm; Hwato, Suzhou Medical Appliance Factory, China)	–	5 d
Mai(2017)	EA	8	bilateral (ST36, ST37, ST39) + ST25, RN12	25–45 mm	De qi	Continuous waves at 2 Hz 2–3ma	30 min	Sterile acupuncture needles (length 25 mm, diameter 0.25 mm; Hwato, Suzhou Medical Appliance Factory, China)	–	–
Wang (2019)	EA	8	bilateral (LU9, ST39); bilateral (RN12, ST25); bilateral (LU9, ST39, RN12, ST25)	–	De qi + Muscle twitch response	–	20 min	Sterile acupuncture needles (length 40 mm, diameter 0.30 mm; Hwato, Suzhou Medical Appliance Factory, China)	Once daily	10 d

(Continued)

Table 1
(Continued)

Author (year)	Type of intervention	Number of needle insertions	Names of points (uni/bilateral)	Depth	Response sought	Needle stimulation	Needle retention time	Needle type (diameter, length and manufacturer or material)	Frequency	Treatment period
Xiao (2016)	EA	12	bilateral (LU7, LU5, LU4, SJ6, ST36, SP6)	LU7 (0.5–0.8 cun); LU5 (0.8–1.2 cun); LU4 (0.5–1 cun); SJ6 (0.5–1 cun); ST36 (1–2 cun); SP6 (1–1.5 cun); 25 mm	Muscle twitch response	continuous waves at 2–15 Hz	30 min	Sterile acupuncture needles (length 50 mm, diameter 0.31 mm; Hwato, Suzhou Medical Appliance Factory, China)	Twice daily, 30 min	14 d
Sun (2021)	Warm-needling	10	bilateral (ST36, SP6, SP9, ST37, KI6)	25 mm	De qi	After punching the center of the paper (4 cm × 4 cm × 1 mm), place it on the needle body to insulate and protect the skin. Put a 15 mm long moxa stick section on the needle handle, moxibustion 2 sections at each point	20s + 45 min	Sterile acupuncture needles (length 50 mm, diameter 0.30 mm; Tianxie, Suzhou Medical Appliance Factory, China)	Once daily	15 d
Sun (2019)	MA + Tro-pisetron + FOLFOX4	4	bilateral (ST36, PC6)	–	De qi	Manual	4 min	Sterile acupuncture needles (length 1.5 mm, diameter 0.22 mm; Weigao, Sichuan Medical Appliance Factory, China)	–	–
Zhao (2019)	MA + Tro-pisetron + FOLFOX4	4	bilateral (ST36, PC6)	–	De qi	Manual	3–5 min	Sterile acupuncture needles (length 1.5 mm, diameter 0.22 mm; Weigao, Sichuan Medical Appliance Factory, China)	–	14 d
Zhang (2020)	MA + Tro-pisetron + FOLFOX6	4	bilateral (ST36, PC6)	–	–	Manual	3–5 min	Sterile acupuncture needles (length 1.5 mm, diameter 0.22 mm; Weigao, Sichuan Medical Appliance Factory, China)	–	28 d
Zhang (2011)	Warm-needling	10	bilateral (ST36, ST37, ST39, SP6, SP9)	–	–	After punching the center of the paper (4 cm × 4 cm × 1 mm), place it on the needle body to insulate and protect the skin. Put a 15 mm long moxa stick section on the needle handle, moxibustion 2 sections at each point	45 min	Sterile acupuncture needles (length 40 mm, diameter 0.30 mm; Tianxie, Suzhou Medical Appliance Factory, China)	–	10 d
Gu (2020)	Warm-needling + Ondansetron + HIPEC	6	bilateral (ST36, SP6, SP9, PC6)	25 mm	De qi	After punching the center of the paper (4 cm × 4 cm × 1 mm), place it on the needle body to insulate and protect the skin. Put a 15 mm long moxa stick section on the needle handle, moxibustion 3 sections at each point	20s + 30 min	Sterile acupuncture needles (length 50 mm, diameter 0.32 mm; Tianxie, Suzhou Medical Appliance Factory, China)	Once daily	3 d
Tong (2014)	MA	8	bilateral (ST36, ST37, PC6, SP4)	ST36 (1–2 cun); ST37 (1–2 cun); PC6 (0.8 cun); SP4 (0.8 cun)	De qi	Manual	30 min	Sterile acupuncture needles (length 50 mm, diameter 0.32 mm; Tianxie, Suzhou Medical Appliance Factory, China)	Once daily	–

(Continued)

Table 1
(Continued)

Author (year)	Type of intervention	Number of needle insertions	Names of points (uni/bilateral)	Depth	Response sought	Needle stimulation	Needle retention time	Needle type (diameter, length and manufacturer or material)	Frequency	Treatment period
Liu (2021)	MA + ERAS	8	bilateral (ST36, ST37, PC6, LI4)	ST36 (1–2 cun); ST37 (1–2 cun); PC6 (0.8 cun); LI4 (0.5–1 cun)	De qi	Manual	30 min	Sterile acupuncture needles (length 40 mm, diameter 0.30 mm; Tianxie, Suzhou Medical Appliance Factory, China)	Once daily	4 d
Liu (2017)	MA + Tro-pisetron + FOLFOX4	6	bilateral (ST36, PC6, RN6, CV4)	1–1.2 cun	De qi	Manual	30 min	Sterile acupuncture needles (length 40 mm, diameter 0.25 mm; Hwato, Suzhou Medical Appliance Factory, China)	Once daily	5 d
Du (2021)	MA + FOLFOX, FOLFIRI or XELOX	6	bilateral (ST36, CV6, CV4)	–	De qi	Manual	30 min	–	Once daily	8 d
Li (2018)	MA + FOLFOX	8	bilateral (DU20, LI4, SJ5, ST36)	TE 5 (0.2–0.3 cun); LI4 (0.2–0.3 cun); ST36 (1–2 mm)	Needling sensation such as soreness and tenderness; obvious local acid swelling, numbness, heaviness or swelling pain.	Manual	30 min	Sterile acupuncture needles (length 40 mm, diameter 0.35 mm; Hwato, Suzhou Medical Appliance Factory, China)	Once daily	14 d
Yang (2022)	EA	2	bilateral (ST36/ST25)	–	De qi	Dilatational waves at 2 Hz/100 Hz	30 min	Sterile acupuncture needles (length 40 mm, diameter 0.30 mm; Hwato, Suzhou Medical Appliance Factory, China)	Once daily	

Zusanli (ST36), Neiguan (PC6), Sanyinjiao (SP6), Shangjuxu (ST37), Hegu (LI4), Zhigou (SJ6), Yinqingquan (SP9), Tianshu (ST25), Zhongwan (RN12), Xiajuxu (ST39), Waiguan (SJ5), Taiyuan (LU9), Shenmen (HT7), Shanglian (LI9), Quchi (LI11), Qihai (RN6), Gongsun (SP4), Chize (LU5), Chengliang (RN24), Baihui (DU20). 1 cun (a cun is the width between the 2 medial ends of the creases of the interphalangeal joints in the middle finger on the palmar aspect). The acupuncture needles used (Huatuo, Suzhou, China) conformed to the requirements of the ISO 9002, EN46002 and CE certification, United States FDA International Good Manufacturing Practices, and the World Health Organization's standards for quality and safety. Deqi (a sensation of aching, soreness, swelling, heaviness, or numbness).

Table 2
Characteristics of included RCTs.

Author (year)	Country	Language	Sample Size (T/C) a	Age (yr)(T/C)	No. of Male (T/C) a	Operative time (minutes) (T/C)	Type of surgery
Deng (2013)	New York, American	English	81 (39/42)	56 (50, 69)/59 (51, 70)	26/26	227 (172, 295)/234 (180, 273)	Both laparoscopic and open surgery
Ng (2012)	Hong Kong, China	English	165 (55/55/55)	67.4 ± 9.7/67.4 ± 10.7/68.5 ± 10.6	35/33/31	157.3 ± 39.2/158.6 ± 46.5/164.1 ± 52.5	Open
Zhang (2014)	Heilongjiang, China	English	39 (19/20)	63 ± 9/60 ± 10	11/11	175 ± 48/182 ± 43	—
Meng (2010)	Shanghai, China	English	85 (44/41)	53.7(29,73)	47	—	Open
Yao (2012)	Guangxi, China	Chinese	120(23/25/22/25/25)	49 ± 9/46 ± 8/44 ± 10/47 ± 8/48 ± 9	12/12/11/12/11	—	Open
Pei (2016)	Jiangxi, China	Chinese	50 (25/24)	56 ± 11/56 ± 11	14/13	250 ± 53/239 ± 48	Laparoscopic
Long (2021)	Guangdong, China	Chinese	60 (30/30)	63.53 ± 14.39/61.83 ± 11.90	17/15	235.34 ± 52.72/236.57 ± 47.40	Both laparoscopic and open surgery
Mai (2017)	Yinchuan, China	Chinese	60 (20/20/20)	51 ± 1/50 ± 5/52 ± 5	11/13/12	3.12 ± 0.64/3.36 ± 0.70/3.22 ± 0/72	Open
Wang (2019)	Jiangsu, China	Chinese	80 (20/20/20/20)	63.90 ± 6.85/65.25 ± 5.84/62.00 ± 7.78/62.45 ± 6.87/	9/11/10/11	—	Open
Xiao (2016)	Tianjin, China	Chinese	60 (30/30)	67.43 ± 16.35/68.52 ± 17.16	17/16	—	Both laparoscopic and open surgery
Sun (2021)	Nanjing, China	Chinese	84 (42/42)	59.3 ± 1.6/59.1 ± 1.4	23/24	—	—
Sun (2019)	Shanxi, China	Chinese	100 (50/50)	51.40 ± 14.20/49.60 ± 13.71	34/29	—	—
Zhao (2019)	Fujian, China	Chinese	120 (60/60)	49.5 ± 13.6/51.3 ± 14.1	67/34	—	Laparoscopic
Zhang (2020)	China	Chinese	120(60/60)	61.32/60.38	48/43	—	Open
Zhang (2011)	Xinjiagn, China	Chinese	105 (35/35/35)	57.1 ± 11.7/60.1 ± 13.6/59.1 ± 8.5	26/27/26	271.8 ± 91.4/272.2 ± 86.4/267.8 ± 87.4	—
Gu (2020)	Guangzhou, China	Chinese	120 (60/60)	61.1 ± 12.1/58.5 ± 11.3	26/35	—	Both laparoscopic and open surgery
Tong (2014)	Xinjiang, China	Chinese	84 (42/42)	58.6 ± 15.1/59.2 ± 14.7	24/26	2.7 ± 0.3/2.8 ± 0.2	Open
Liu (2021)	Beijing, China	Chinese	68 (33/35)	60.06 ± 11.50/58.40 ± 10.18	15/20	3.36 ± 1.03/2.92 ± 1.05	Both laparoscopic and open surgery
Liu (2017)	Shanghai, China	Chinese	63 (31/32)	63.63 ± 7.96/63.17 ± 9.30	16/17	—	—
Du (2021)	Guangzhou, China	English	50 (26/24)	55.62 ± 12.04/61.83 ± 10.55	18/15	—	—
Li (2018)	Chongqing, China	English	60 (30/30)	62.29 ± 7.50/61.25 ± 8.48	13/16	—	—
Yang (2022)	Beijing, China	English	105(35/35/35)	61.8 ± 11.0/60.7 ± 12.7/60.7 ± 10.5	18/25/23	177.3 ± 61.5/187.7 ± 59.4/174.3 ± 54.0	Laparoscopic

A T/C, data of treatment group/data of control group (C).

B Data presented as mean (SD) or median (range).

D Data presented as the range of age: number.

C Not reported separately for different groups.

E Risk of bias tool domains: random sequence generation; allocation concealment; blinding of participants and outcome assessors; incomplete outcome data addressed; selective outcome reporting; other potential threats respectively.

F (1) Time to first flatus, (2) Time to first defecation, (3) Time to first bowel sound, (4) Nausea and Vomiting (either postoperative nausea or vomiting, or both), (5) Postoperative pain scores (VAS/VNRS), (6) Measure of quality of life (QoL, PFS, and PS score), (7) Length of hospital stay, (8) Postoperative complications, (9) Incidence of adverse effects, (10) Number of adverse reaction events.

EA = electroacupuncture, MA = manual acupuncture, NA = no acupuncture, SA = shame acupuncture.

Primary site (Colon/Rectum) (T/C)	Interventions			Control measures			Target outcomes	Adverse events	Follow-up periods
	Type of intervention	Frequency/dose	Treatment period	Type of control	Frequency/dose	Treatment period			
Colon (28/30); Rectum (11/8); Ileostomy and jejunostomy (13/16)	EA	Twice daily	3 d	SA	Twice daily	3 d	1, 2, 3, 4, 5	—	—
Right colon (15/12/17); Left colon (12/12/10); Sigmoid (7/7/8); Rectum (21/24/20)	EA	Once daily	4 d	SA/NA	Once daily	4 d	1, 3, 5, 7,	—	—
Colon	EA	Once daily	5 d	SA	Once daily	5 d	1, 2, 3, 4, 7	—	—
Colon	EA	Once daily	6 d	NA	Once daily	6 d	1, 3, 4, 5, 6	9	6 d after surgery/leave hospital
Rectum	EA	—	—	NA/Granisetron	—	24 hours after surgery	5	—	24 h after surgery
Rectum	EA	—	—	SA	—	24 hours after surgery	—	—	24 h after surgery
Right colon (9/9); transverse colon (1/1); left colon (10/8); Sigmoid colon (10/12)	EA	—	5 d	NA	—	5 d	1, 2, 3, 7	10	5 d
Rectum	EA	—	—	NA	—	—	1, 2, 3	—	3 d after surgery
Rectum	EA	Once daily	10 d	NA	Once daily	10 d	1, 2, 3	—	24 h after surgery/First defecation after operation
Sigmoid colon (8/11); Right colon (4/3); Left colon (3/4); Transverse colon (1/2); Rectum (6/4)	EA	Twice daily, 30 min	14 d	NA	Once daily	—	1, 2, 3	—	14 d
Colon and rectum	Warm-needling	Once daily	15 d	NA	Once daily	15 d	8	9	—
Colon and rectum	MA + Tropisetron + FOLFOX4	—	—	NA + Tropisetron + FOLFOX4	Twice daily, 5 mg each time	—	4	10	—
Colon and rectum	MA + Tropisetron + FOLFOX4	—	14 d	NA + Tropisetron + FOLFOX5	Twice daily, 5 mg each time	14 d	4	10	—
Colon and rectum	MA + Tropisetron + FOLFOX6	—	28 d	FOLFOX6+	Twice daily, 5 mg each time	28 d	4, 8	—	—
Colon	Warm-needling/Warm-needling	—	10 d	NA	—	10 d	1, 2, 3	—	10 d after surgery
Right colon (34/31); Left colon (26/29)	Warm-needling + Ondansetron + HIPEC	Once daily	3 d	NA + Ondansetron + HIPEC	Once daily	3 d	4, 7, 8	9	7 d
Rectum	MA	Once daily	—	NA	Once daily	—	4	—	5 d after surgery
Colon and rectum	MA + ERAS	Once daily	4 d	ERAS	Once daily	4 d	1, 2, 3, 4, 7	10	—
Colon and rectum	MA + Tropisetron + FOLFOX4	Once daily	5 d	NA + Tropisetron + FOLFOX4	Once daily, 5 mg each time	5 d	4	—	—
Colon	MA + FOLFOX, FOLFIRI or XELOX	Once daily	8 d	NA + FOLFOX, FOLFIRI or XELOX	Once daily	12 d	6	10	21 d
Colon and rectum	MA + FOLFOX	Once daily	14 d	NA + VitaminB6 + FOLFOX	Once a day, 300 mg per day	14 d	6	—	—
Colectomy, proctectomy and coloproctectomy	EA	Once daily	4 d	NA	—	4 d	1, 2, 4, 5, 7, 8	—	4 d/leave hospital

Study	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Deng 2013	+	+	+	+	+	+	+
Du 2021	+	+	+	+	+	+	+
Gu 2020	+	+	+	+	+	+	+
Li 2018	+	+	+	+	+	+	+
Liu 2017	+	+	+	+	+	+	+
Liu 2021	+	+	+	+	+	+	+
Long 2021	+	+	+	+	+	+	+
Mai 2017	+	+	+	+	+	+	+
Meng 2010	+	+	+	+	+	+	+
Ng 2012	+	+	+	+	+	+	+
Pei 2016	+	+	+	+	+	+	+
Sun 2019	+	+	+	+	+	+	+
Sun 2021	+	+	+	+	+	+	+
Tong 2014	+	+	+	+	+	+	+
Wang 2019	+	+	+	+	+	+	+
Xiao 2016	+	+	+	+	+	+	+
Yang 2022	+	+	+	+	+	+	+
Yao 2012	+	+	+	+	+	+	+
Zhang 2011	+	+	+	+	+	+	+
Zhang 2014	+	+	+	+	+	+	+
Zhang 2020	+	+	+	+	+	+	+
Zhao 2019	+	+	+	+	+	+	+

Figure 2. Risk of bias summary.

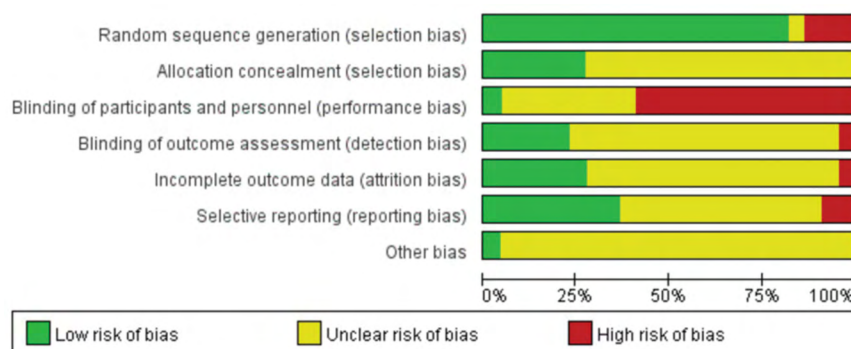


Figure 3. Risk of bias graph.

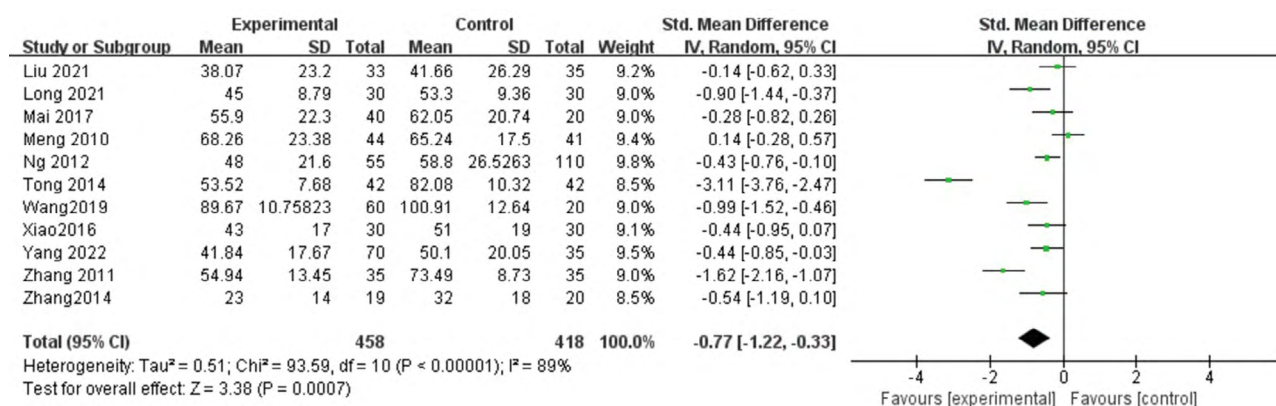


Figure 4. The effect of acupuncture on hours to first flatus.

sham or usual groups (MD -0.77h, 95% CI -1.22 to -0.33h, $I^2 = 89\%$, REM, $P = .0007$) (Fig. 4)

Nine trials analyzed the time to first bowel movement. Compared with control groups, there was a significant/modest benefit of acupuncture (MD -1.41h, 95% CI -2.20 to -0.63h, $I^2 = 95\%$, REM, $P < .00001$) (Fig. 5).

Nine trials reported time to first defecation, with meta-analysis results revealing that acupuncture was superior to time to sham or usual groups in terms of times to first defecation (MD -1.03h, 95% CI -1.88 to -0.18h, $I^2 = 95\%$, REM, $P < .00001$) (Fig. 6).

However, the I^2 value of over 90% suggested indicative heterogeneity probably influenced by the outlying study, while the study by Tong 2014, Wang 2019, Long 2021, and Zhang 2011 had a larger treatment effect than the other studies. Excluding

the report by Tong, Wang, Long and Zhang reduced the heterogeneity ($I^2 = 16\%/27\%/32\%$), with statistical difference in time to first flatus/ bowel movement/defecation (MD -0.30, 95% CI -0.48 to -0.12, $I^2 = 8\%$, $P = .001$)/(MD -0.41, 95% CI -0.65 to -0.17, $I^2 = 27\%$, $P = .0008$)/(MD -0.25, 95% CI -0.51 to 0.02, $I^2 = 40\%$, $P = .007$) in (Figures S1–S3, Supplemental Digital Content, <http://links.lww.com/MD/J477>, which illustrated the forest plot after excluding 4 reports). The GRADE quality was judged to be low, downgraded by the risk of bias and inconsistency.

3.4.2. Postoperative pain. About postoperative pain measured by VAS and VRNS from 5 RCTs, Figure 7 showed the results of the pooled studies on a postoperative day (POD) 1 to 5. The analysis indicated that pain was relieved with a pain score

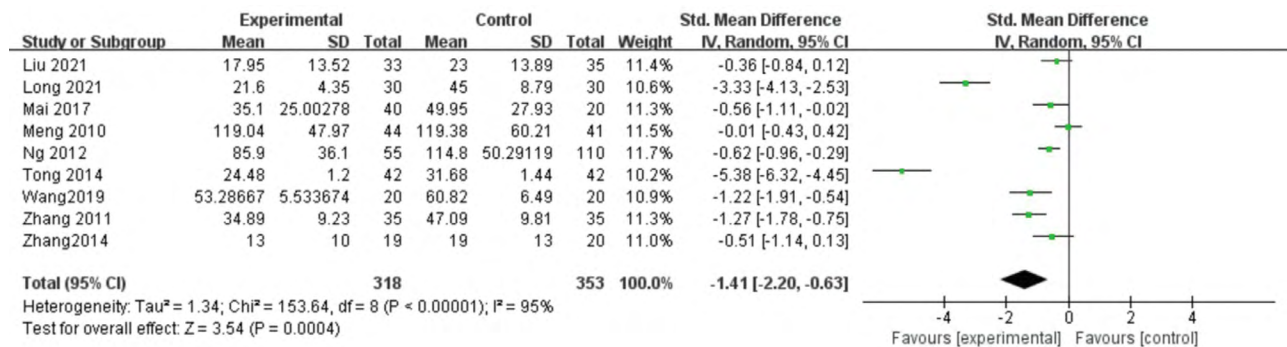


Figure 5. The effect of acupuncture on first bowel movement.

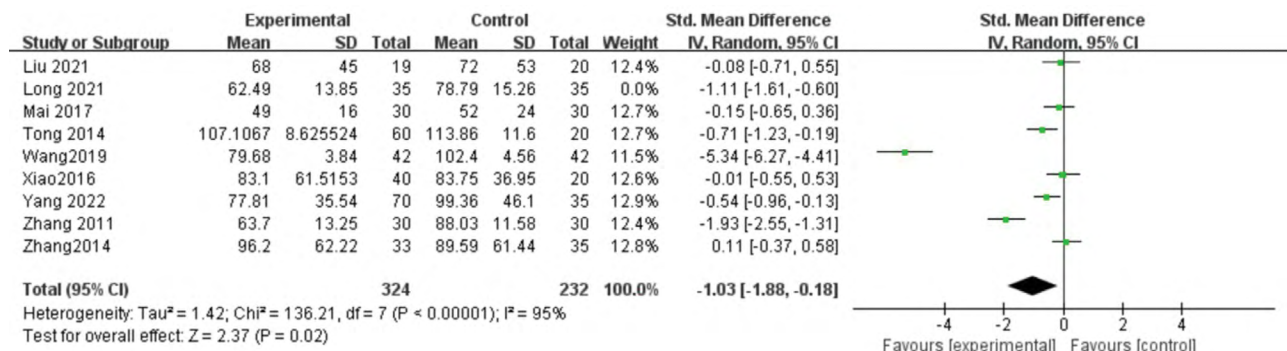


Figure 6. The effect of acupuncture on first defecation.

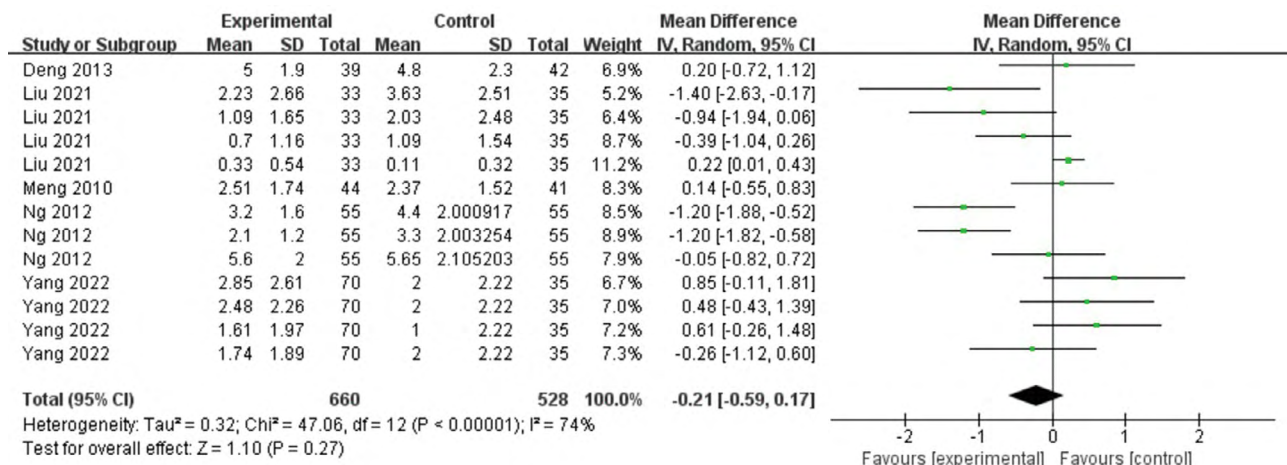


Figure 7. The effect of acupuncture on postoperative pain.

of -0.21 points, 95% CI -0.59 to 0.17 , $I^2 = 74\%$, $P = .27$. This result was inadequate to conclude this outcome due to wide CI and the significant heterogeneity, while the reduction in postoperative pain did not reach clinical significance. Furthermore, the symmetry funnel plot of this endpoint was observed in Figure 8.

3.4.3. Postoperative nausea or vomiting. Ten studies reported nausea or vomiting but varied widely concerning their measurement.

For the dichotomous outcomes, 5 studies reported the rates of either postoperative nausea or vomiting ($n = 3$) or both ($n = 2$). The statistical heterogeneity was substantial, so the

random-effects model was applied for meta-analysis. Then we performed a subgroup analysis based on the severity of the disease and divided the 5 studies into 2 groups. The risk of nausea in the acupuncture group was lower than that in the control groups (RR 0.71, 95% CI 0.52–0.97, $I^2 = 60\%$, $P = .03$) (Fig. 9). However, there was no obvious difference between the acupuncture and control group in vomiting (RR 0.74, 95% CI 0.53–1.03, $I^2 = 48\%$, $P = .08$) (Fig. 9). The results showed that the effect size of the nausea subgroup was lower than those of the vomiting subgroup (RR 0.72, 95% CI 0.59–0.89, $I^2 = 49\%$, $P = .002$) This suggested that acupuncture may have a better effect on postoperative nausea than vomiting. However, due to the small sample size, it still needs

to be explored to what extent acupuncture is most effective for nausea and vomiting.

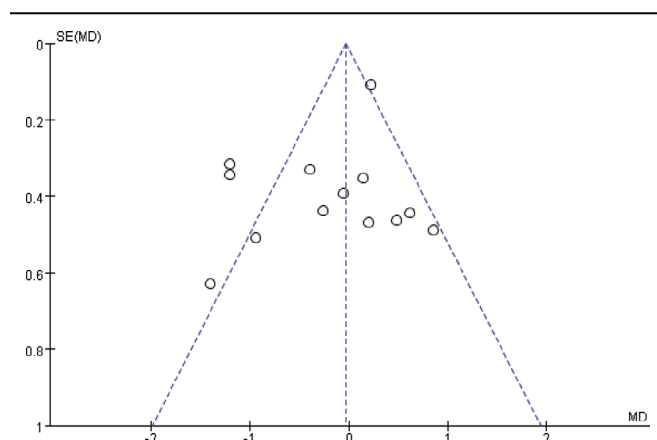


Figure 8. Funnel plot.

For the continuous outcomes, 4 studies reported PONV scores on VAS and VRNS. However, pooled results on the PONV scores showed there was no benefit of acupuncture (MD 0.10, 95% CI -1.52 to 1.71 h, $I^2 = 91\%$, REM, $P = .90$) (Fig. 10).

3.5. Secondary outcomes

Due to the small number of trials, the length of hospital stay could not be meta-analyzed. For perceived general health, we considered if it was feasible to combine results of different assessment tools using standardized mean differences. But different assessment tools were designed to measure different behaviors, which are clinically heterogeneous and we decided not to combine the different scales.

3.6. Adverse events

Among 22 RCTs, 15 RCTs did not mention the occurrence of an adverse event. Of 7 RCTs, 3 trials reported no adverse events, 3 studies reported mild adverse events, and one trial reported only the number of occurrences and the severity were

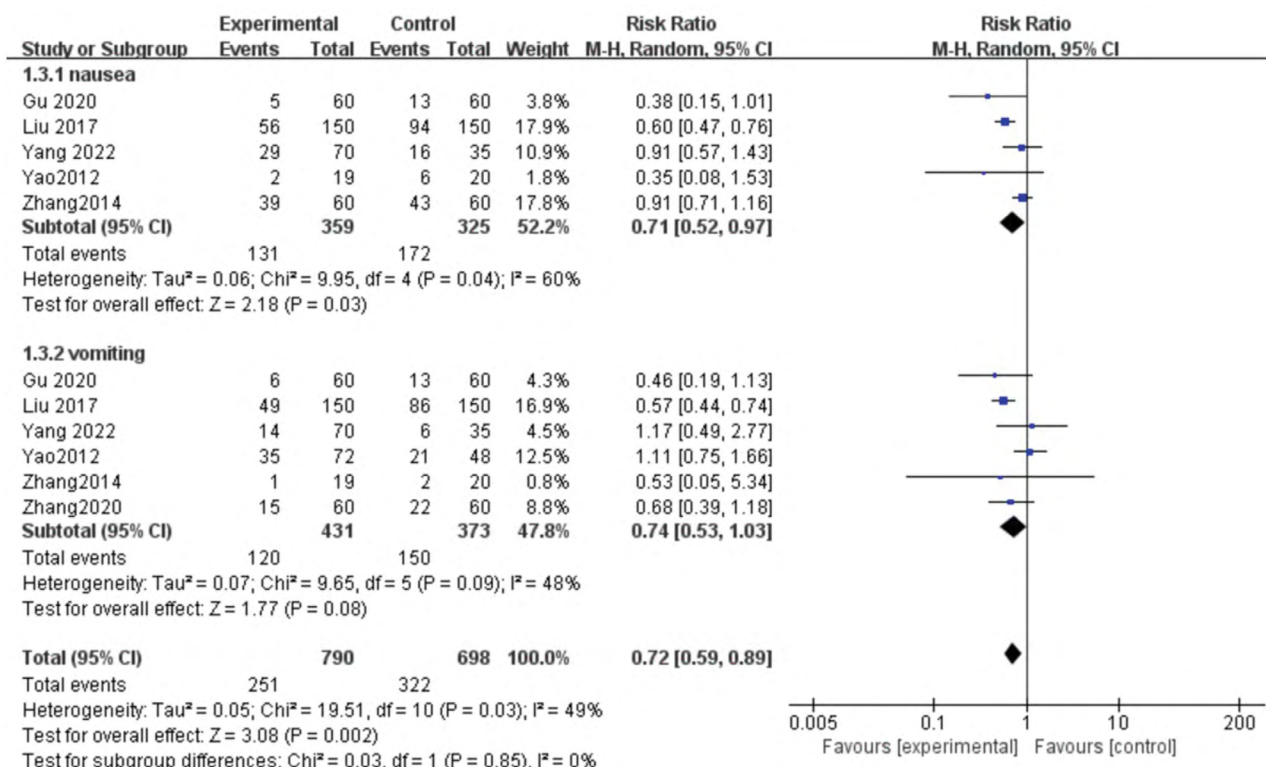


Figure 9. The effect of acupuncture on the occurrence of PONV. PONV = postoperative nausea and vomiting.

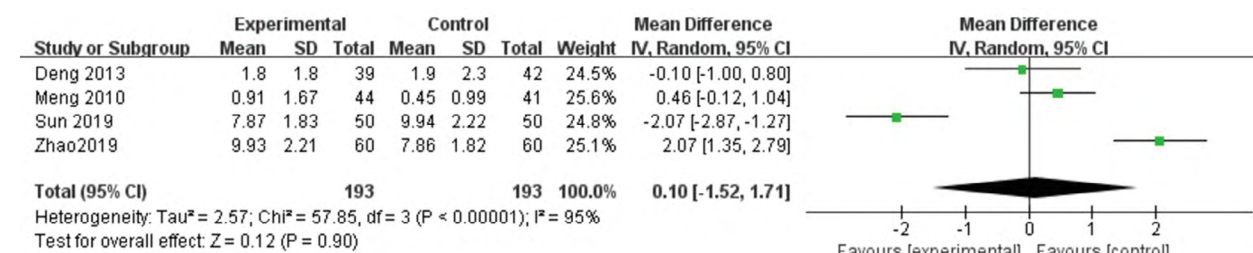


Figure 10. The effect of acupuncture on the severity PONV. PONV = postoperative nausea and vomiting.

not mentioned. There were no dropouts related to adverse reactions associated with acupuncture treatment in included studies.

4. Discussions

4.1. Summary of main results

In the 22 randomized controlled trials involving 1878 participants, a set of acupuncture points were used, 8 with manual acupuncture, 11 with electro-acupuncture, and 3 with warm-needling. The available evidence showed acupuncture has a positive impact on the earlier return of GI function when compared with those receiving a control treatment. Certain studies have supported that EA at ST36, ST37, ST39, or CV4 protected SMC to improve gastrointestinal transit by reducing local inflammation in the intestinal musculature^[44]; acupuncture can promote the secretion of motilin, change the activity the intestinal nervous system,^[45,46] and effectively relieved systemic inflammation by restraining local intestinal inflammatory response.^[47]

The results also showed that acupuncture was beneficial for postoperative nausea and vomiting, and it had a better effect on the less severe symptoms. The potential mechanisms are listed as follows: Endogenous beta-endorphin release in the cerebrospinal fluid,^[48] a change in serotonin transmission by activation of serotonergic and noradrenergic fibers.^[49] Research suggested TEAS on PC6 and ST36 decreased the plasma concentration of 5-HT and the incidence of PONV decreased.^[50] PC6 has been confirmed to affect PONV prevention.^[51]

However, there is no statistically significant difference between acupoint stimulation and sham acupuncture on postoperative pain, and the heterogeneity is significant, it may have a lot to do with the insufficient sample size. Its underlying mechanism might associate with opioid peptides, adenosine, dopamine, cytokines, norepinephrine, and serotonin.^[52–54]

We were unable to objectively assess the efficacy of certain functional recovery standards because there were insufficient data to provide robust estimates of how LOS and health quality of life evolve. Adverse events of acupuncture were mild though inconsistently described.

4.2. Comparison with other studies or reviews

Compared with the previous reports, the innovative potential of our meta-analysis is listed as follows: This report is the most up-to-date analysis of the effects of acupuncture on recovery after CRC resection and is conducted under the guidance of a comprehensive search strategy. We included 13 newly published studies^[17,23,24,26,28,32–35,40,41] that were not identified in the most recently published meta-analysis and 4 studies^[26,30,39,40] that were not included from the previous meta-analyses. For the outcome of pain and POVN, we combined all data presented on either VAS 0 to 100mm or VNRS 0 to 10 and transformed all into VNRS 0 to 10 compared with the previous meta-analysis. The detailed characteristics of acupuncture such as the timing of acupuncture were extracted appropriately based on the STRICTA statement, and results for certain long-term functional recovery were qualitative described, extending the findings of the previous review to some extent.

4.3. Limitations of included trials

The limitations of included trials are given in the following points:

- (1) How to speed up recovery after CRC surgery is a global issue, however, most of the studies we included are from China, and only one report was available from the United States, which may not be representative.

- (2) About interventions, most of the studies do not take the training level of acupuncturists into account, such as the length of acupuncture practice, which may affect findings and results. Besides, what defines usual care in control groups is still not imprecise, and this can be quite complex and varied between studies, including fluid management and perioperative care environment. Analyzing data from some of the included trials using potential “nonoptimal” regimens may affect the adequacy of our results.
- (3) About outcomes, the analysis focused on the short-term benefits of treatment as the results of most studies are evaluated immediately after the intervention period. The follow-up time was not sufficiently long to fully observe the durability of acupuncture treatment. Thus, there was no sufficient evidence of improving long-term functional outcomes.

What is more, patient expectations and treatment-related satisfaction may affect treatment outcomes deeply due to the subjective nature of certain outcomes such as nausea and pain. However, none of the included studies assessed the expectations of patients. Moreover, some studies reported only the rates of events, such as the rates of PONV, but the duration of vomiting, the dose of antiemetic drugs, and the side effects caused by the use of antiemetic drugs were not unknown.

- (4) The suboptimal methodology of included trials is further drawbacks. The underlying quality of the RCTs was generally poor. Most of the trials included in our meta-analysis are considered to be of significant bias. One of the key issues was the absence of technical details in the blinding procedures of some selected articles, however, those articles all claimed to be double-blinded. Besides, some trials did not adequately describe selection methods and lack of necessary follow-up, which may reduce the reliability of the findings. Fortunately, there are still 4 high-quality RCTs ongoing, and we will track the results.^[55–57]

4.4. Limitations of the review

Our study has several notable limitations.

The first one is that heterogeneity among the studies was high for most outcomes. Therefore, even if we used random-effects models to take heterogeneity into account, some of the estimates should be interpreted with caution. We consider if there were other possible sources as follows: the qualification and experience levels of acupuncturists; Various acupoints used in individual studies; the different forms of acupuncture (mammal acupuncture, EA, and warm-needling); the diversity in the duration of treatment; and diversity of routine nursing in the control group. However, it was not handled with subgroup analyses not only insufficient data but also the vague description in the original studies.

Second, diversification of research interventions leads to fewer studies when comparing each intervention, accordingly, the sample size for each comparison is also reduced, causing the power of summary results to be lower.

In addition, our analysis used pooled data, which restricted us from performing a more detailed analysis.

4.5. Implications for practical application

Though ERAS has been applied to speed up early recovery after abdominal surgery, a considerable number of patients cannot tolerate the adverse effects of analgesics and antiemetics, or have contraindications. Our results show that acupuncture can be used as an alternative treatment. The differences between acupuncture treatment and comparator support might have preventive effects on the recovery of GI function and reduction of PONV for populations undergoing CRC resection. The frequency provided by trials cannot

be meta-analyzed, the adequate frequency of acupuncture remains unclear.

Besides, the determination of what constitutes minimal clinically (MCID) on postoperative syndromes such as pain intensity is controversial because of the subjectivity. A clear definition of MCID for therapeutic interventions on specific diseases should be established to better guide its clinical application.

Based on our results, clinical acupuncturists should pay careful attention to the specific components of acupuncture, including acupuncture points and acupuncture sensations, and the nonspecific effects of acupuncture.

4.6. Future research and ongoing trials

Our findings supported acupuncture as a promising treatment for improving GI function and reducing the incidence of PONV after CRC resection. High-quality studies should be performed with conscientiousness to keep the fairness of the results, including patient allocation, random sequence generation, and allocation concealment. Besides, more investigations should be established based on the STRICTA statement strictly. For example, the effect of acupuncture compared with SA should be evaluated, and try to explore an ideal SA based on the influential factors of acupuncture to minimize the specific effects of SA. Further investigations of the optimum frequency of acupuncture are needed to provide that these observed protective effects are warranted. Trials with longer follow-up periods are needed to further explore long-term functional improvements and estimate the durability of acupuncture treatment. For physiological outcomes, the measurement method should be standardized, and the original data is recommended to be provided in compound outcomes, with a total effective rate applied to avoid exaggerating efficacy. The adverse reaction should be reported. For the exploration of heterogeneity, a clear recording of interventions will allow a better explanation of heterogeneity. Acupuncture can be recommended as a treatment when updating the guidelines for ERAS. We will be monitoring high-quality and large-scale trials to update this systematic review.

5. Conclusions

In conclusion, this meta-analysis of available evidence showed the application of acupuncture has a limited impact on postoperative recovery following CRC resection, as demonstrated by the earlier return of gastrointestinal function recovery and a lower incidence of postoperative nausea when compared with control groups. So far there were few adverse events in reported studies that were not systematically assessed. However, the high risk of bias and incomplete reporting of the included trials weakens the level of evidence and its clinical implications. As current evidence is insufficient, more full-scale randomized and larger sample size random controlled trials are needed to evaluate the further impact on other relevant clinical outcomes for patients with colorectal cancer after surgery.

Author contributions

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References

- [1] Erratum: Global cancer statistics 2018: GLOBOCAN estimates incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin.* 2020;70:313.

- [2] Patel SG, Karlitz JJ, Yen T, et al. The rising tide of early-onset colorectal cancer: a comprehensive review of epidemiology, clinical features, biology, risk factors, prevention, and early detection. *Lancet Gastroenterol Hepatol.* 2022;7:262–74.
- [3] Liska D, Novello M, Cengiz BT, et al. Enhanced recovery pathway benefits patients undergoing nonelective colorectal surgery. *Ann Surg.* 2021;273:772–7.
- [4] Lee Y, Yu J, Doumouras AG, et al. Enhanced recovery after surgery (ERAS) versus standard recovery for elective gastric cancer surgery: a meta-analysis of randomized controlled trials. *Surg Oncol.* 2020;32:75–87.
- [5] Ni X, Jia D, Chen Y, et al. Is the Enhanced Recovery After Surgery (ERAS) program effective and safe in laparoscopic colorectal cancer surgery? a meta-analysis of randomized controlled trials. *J Gastrointest Surg.* 2019;23:1502–12.
- [6] Ni X, Jia D, Guo Y, et al. The efficacy and safety of enhanced recovery after surgery (ERAS) program in laparoscopic digestive system surgery: a meta-analysis of randomized controlled trials. *Int J Surg.* 2019;69:108–15.
- [7] Chen J, Tu Q, Miao S, et al. Transcutaneous electrical acupoint stimulation for preventing postoperative nausea and vomiting after general anesthesia: a meta-analysis of randomized controlled trials. *Int J Surg.* 2020;73:57–64.
- [8] Zhang W, Zhang H, Wang SM, et al. Perioperative acupuncture optimizes surgical outcomes: theory, clinical practice and future perspectives. *Am J Chin Med.* 2022;50:961–78.
- [9] Yuan W, Wang Q. Perioperative acupuncture medicine: a novel concept instead of acupuncture anesthesia. *Chin Med J (Engl).* 2019;132:707–15.
- [10] Wang D, Shi H, Yang Z, et al. Efficacy and safety of transcutaneous electrical acupoint stimulation for postoperative pain: a meta-analysis of randomized controlled trials. *Pain Res Manag.* 2022;2022:7570533.
- [11] Li HY, Chen Y, Hu ZY, et al. Meta-analysis of acupuncture and moxibustion for the therapeutic effect on postoperative gastrointestinal dysfunction of gastric cancer [in Chinese]. *Zhongguo Zhen Jiu.* 2022;42:595–602.
- [12] Ye Z, Wei X, Feng S, et al. Effectiveness and safety of acupuncture for postoperative ileus following gastrointestinal surgery: a systematic review and meta-analysis. *PLoS One.* 2022;17:e0271580.
- [13] Chen KB, Huang Y, Jin XL, et al. Electroacupuncture or transcutaneous electroacupuncture for postoperative ileus after abdominal surgery: a systematic review and meta-analysis. *Int J Surg.* 2019;70:93–101.
- [14] Liu Y, May BH, Zhang AL, et al. Acupuncture and related therapies for treatment of postoperative ileus in colorectal cancer: a systematic review and meta-analysis of randomized controlled trials. *Evid Based Complement Alternat Med.* 2018;2018:3178472.
- [15] Kim KH, Kim DH, Kim HY, et al. Acupuncture for recovery after surgery in patients undergoing colorectal cancer resection: a systematic review and meta-analysis. *Acupunct Med.* 2016;34:248–56.
- [16] Moher D, Shamseer L, Clarke M, et al.; PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Syst Rev.* 2015;4:1.
- [17] MacPherson H, Altman DG, Hammerschlag R, et al.; STRICTA Revision Group. Revised Standards for Reporting Interventions in Clinical Trials of Acupuncture (STRICTA): extending the CONSORT statement. *PLoS Med.* 2010;7:e1000261.
- [18] Luo D, Wan X, Liu J, et al. Optimally estimating the sample mean from the sample size, median, mid-range, and/or mid-quartile range. *Stat Methods Med Res.* 2018;27:1785–805.
- [19] Grading standard for acute and subacute toxicity of anticancer drugs (WHO standard). *Cancer.* 1992;254.
- [20] Balshem H, Helfand M, Schunemann HJ, et al. GRADE guidelines: 3. rating the quality of evidence. *J Clin Epidemiol.* 2011;64:401–6.
- [21] Haddaway NR, Page MJ, Pritchard CC, et al. PRISMA2020: an R package and Shiny app for producing PRISMA 2020-compliant flow diagrams, with interactivity for optimised digital transparency and Open Synthesis. *Campbell Syst Rev.* 2022;18:e1230.
- [22] Deng G, Wong WD, Guillem J, et al. A phase II, randomized, controlled trial of acupuncture for reduction of postcolectomy ileus. *Ann Surg Oncol.* 2013;20:1164–9.
- [23] Du XT, Tian WP, Liu B, et al. Prevention and treatment of acupuncture for cancer-related fatigue caused by chemotherapy of intestinal cancer: a randomized controlled trial. *World J Acupunct Moxibustion.* 2021;31:83–8.
- [24] Fangfei L, Chen H, Guosen L. Chemotherapy-induced hand-foot syndrome in rectal cancer treated with acupuncture. *World J Acupunct Moxibustion* 2018;28:151–155 + 229.

- [25] Ng SS, Leung WW, Hon SS, et al. Electroacupuncture for ileus after laparoscopic colorectal surgery: a randomised sham-controlled study. *Hong Kong Med J*. 2013;19(Suppl 9):33–5.
- [26] Sicong M, Jinhai M, Wenjuan W, et al. Influence of electroacupuncture pretreatment on intestinal function in the patients of colorectal cancer surgery. *Zhongguo Zhen Jiu* 2017;37:483–7.
- [27] Sun H, Zhang B, Qian HH, et al. Effect of warm-needle moxibustion intervention on immune function and intestinal flora in patients after colorectal cancer radical operation. *Zhen Ci Yan Jiu*. 2021;46:592–7.
- [28] Xiangdong P, Zhidong Z, Guohai X. Effect of electroacupuncture on immune function of patients undergoing laparoscopic radical resection of rectal cancer. *China Acupunct Moxibustion*. 2016;36:613–6.
- [29] Xuying G, Zhiqing G, Zijong Z, et al. The effect of warm acupuncture and moxibustion on gastrointestinal response of patients undergoing intraperitoneal hyperthermic perfusion chemotherapy after colon cancer surgery. *Acupunct Res*. 2020;45:315–9.
- [30] Zhang SY, Du YQ. Effects of warming needle moxibustion on the improvement of gastrointestinal and immune function in patients with postoperation of colorectal cancer. *Zhongguo Zhen Jiu*. 2011;31:513–7.
- [31] Zhang Z, Wang C, Li Q, et al. ST36 Electroacupuncture at ST36 accelerates the recovery of gastrointestinal motility after colorectal surgery: a randomized controlled trial. *Acupunct Med*. 2014;32:223–6.
- [32] Liu M, Weidong S, Shaodan C. The efficacy of acupuncture treatment on gastrointestinal toxicity in patients with colorectal cancer undergoing chemotherapy. *J Shanghai Univ Tradit Chin Med*. 2017;31:38–42.
- [33] Xueyan L, Jian H, Hao Y, et al. Study on the effect of acupuncture on the recovery of intestinal function in patients with colorectal cancer after surgery. *Chin Online Mag. Colorectal Dis*. 2021;10:605–12.
- [34] Ying L, Zijong Z, Zhanming H, et al. Clinical observation on the treatment of intestinal obstruction after colorectal cancer surgery by electroacupuncture at the original collateral points of the lung channel. *J Guangzhou Univ Chin Med*. 2021;38:518–23.
- [35] Yun S, Yanxia D, Xiaolong B, et al. Observation on the effect of pressing needle embedding to alleviate nausea and vomiting in postoperative chemotherapy patients with colorectal cancer. *Integrated Tradit Chin West Med Nurs* 2019;5:41–3.
- [36] Wanyun T, Le X; Ayiguli. The effect of acupoint acupuncture on gastrointestinal peristalsis function after rectal cancer surgery. *Introduction Tradit Chin Med*. 2014;20:39–41.
- [37] Yi W, Tonghu L. Research on promoting gastrointestinal function recovery after rectal cancer surgery by electroacupuncture at distant and near points. *Clin J Acupunct Moxibustion Moxibustion*. 2019;35:26–8.
- [38] Ling X, Bing Z, Junzhong Z, et al. Clinical study on the improvement of intestinal function in elderly patients with colorectal cancer after radical surgery using acupuncture for regulating the lungs and benefiting the intestines. *Shandong J Tradit Chin Med*. 2016;35:701–4.
- [39] Yao X, Yang H, Tian X, et al. Effect of acupuncture at different times on postoperative nausea and vomiting in patients with rectal cancer after radical resection: determination of plasma gastrin concentration. *Chin J Anesthesiol*. 2012;32:820–3.
- [40] Zhang S. 60 cases of chemotherapy-related nausea and vomiting in patients with rectal cancer treated by embedding Neiguan and Zusanli with pressing needles. *Zhejiang J Tradit Chin Med*. 2020;55:215–6.
- [41] Lan Z, Juan L, Jing L. Observation on the effect of pressing needle embedding therapy on improving nausea and vomiting symptoms in patients with colorectal cancer after chemotherapy. *Gen Nurs*. 2019;17:206–8.
- [42] Li L, Xiaodong T. Acupuncture prevention of early inflammatory Bowel obstruction after abdominal surgery. *China Acupunct Moxibustion* 2006;26:65.
- [43] Yang JW, Shao JK, Wang Y, et al. Effect of acupuncture on postoperative ileus after laparoscopic elective colorectal surgery: a prospective, randomised, controlled trial. *EClinicalMedicine*. 2022;49:101472.
- [44] Yang NN, Ye Y, Tian ZX, et al. Effects of electroacupuncture on the intestinal motility and local inflammation are modulated by acupoint selection and stimulation frequency in postoperative ileus mice. *Neurogastroenterol Motil*. 2020;32:e13808.
- [45] Yu B, Sun M, Wang Z, et al. Effects of stimulating local and distal acupoints on diabetic gastroparesis: a new insight in revealing acupuncture therapeutics. *Am J Chin Med*. 2021;49:1151–64.
- [46] Wang X, Lu L, Zi L, et al. Electroacupuncture at acupoint st36 (zusanli) improves intestinal motility dysfunction via increasing the proportion of cholinergic neurons in rat ileal myenteric ganglia after severe acute pancreatitis. *Evid Based Complement Alternat Med*. 2022;2022:7837711.
- [47] Oh JE, Kim SN. Anti-inflammatory effects of acupuncture at st36 point: a literature review in animal studies. *Front Immunol*. 2022;12:813748.
- [48] Stein DJ, Birnbach DJ, Danzer BI, et al. Acupressure versus intravenous metoclopramide to prevent nausea and vomiting during spinal anesthesia for cesarean section. *Anesth Analg*. 1997;84:342–5.
- [49] Cao X, White PF, Ma H. An update on the management of postoperative nausea and vomiting. *J Anesth*. 2017;31:617–26.
- [50] Frey UH, Scharmann P, Lohlein C, et al. P6 acustimulation effectively decreases postoperative nausea and vomiting in high-risk patients. *Br J Anaesth*. 2009;102:620–5.
- [51] Lin JG, Chen WL. Acupuncture analgesia: a review of its mechanisms of actions. *Am J Chin Med*. 2008;36:635–45.
- [52] Zhang R, Lao L, Ren K, et al. Mechanisms of acupuncture-electroacupuncture on persistent pain. *Anesthesiology*. 2014;120:482–503.
- [53] Zhao ZQ. Neural mechanism underlying acupuncture analgesia. *Prog Neurobiol*. 2008;85:355–75.
- [54] Chan K, Lui L, Yu K, et al. The efficacy and safety of electro-acupuncture for alleviating chemotherapy-induced peripheral neuropathy in patients with colorectal cancer: study protocol for a single-blinded, randomized sham-controlled trial. *Trials*. 2020;21:58.
- [55] Chen T-L. Efficacy of acupuncture in prevention of chemotherapy induced peripheral neuropathy – a pilot study. Available at: <https://clinicaltrials.gov/study/NCT02744274>.
- [56] ChiCTR. Electroacupuncture for postoperative ileus after colorectal cancer surgery: a randomized controlled clinical study. 2019. Available at: <https://www.chictr.org.cn/showproj.html?proj=45780>.
- [57] ChiCTR. Study on the effect of acupuncture on the gastrointestinal function of patients with colorectal cancer after operation: a randomized controlled trial. 2020. Available at: <https://www.chictr.org.cn/showproj.html?proj=45184>.