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Clinical efficacy of acupuncture in patients with adhesive intestinal obstruction
A meta-analysis

Yujia Xie, Bachelor of Medicine[a], Chengwen Zheng, Bachelor of Medicine[a], Xiyue Tan, Bachelor of Medicine[a], Zongyu Li, Bachelor of Medicine[b], Yiyi Zhang, Bachelor of Medicine[a], Yuan Liu, Bachelor of Medicine[a],* ID

Abstract

Background: Adhesive intestinal obstruction (AIO) is a common surgical emergency. Surgical exploration has a considerable risk of intestinal injury, and surgical treatment may greatly reduce the quality of life after surgery and cause AIO after re-operation. The nonsurgical treatment is effective for approximately 70% to 90% of patients with adhesive small bowel obstruction (ASBO). However, the high recurrence (30%) and mortality (2%) rates of ASBO are concerning. Moreover, the ideal management method of ASBO remains debatable. Studies have shown that acupuncture can also promote postoperative gastrointestinal function recovery and prevent postoperative complications such as nausea, vomiting, and visceral pain.

Aim: We aimed to evaluate the effectiveness of acupuncture in the treatment of AIO.

Methods: Randomized controlled trials investigating the effectiveness of acupuncture for adhesive bowel obstruction published until November 2021 were identified by searching 8 comprehensive databases. Data analysis was performed using RevMan v. 5.4 and Stata software v. 16.0. The random-effects model and the fixed-effects model were used to perform the meta-analysis on the experimental group and control group.

Results: Twelve studies with a total of 892 participants were included. The results showed that the experimental group had a significantly higher effective rate (relative risk: 1.20; 95% confidence interval (CI): 1.11–1.28; $P < .00001$) and a markedly shorter time of the first defecation (mean difference: –11.49, 95% CI: –19.31 to –3.66; $P = .004$) than the control group. The experimental group also showed a reduction in the duration of abdominal pain, and the reduced length of hospital stay. However, no statistical differences were observed between the 2 groups in terms of the surgery conversion rate.

Conclusion: Acupuncture is effective in the treatment of AIO. It can remarkably alleviate some clinical symptoms in patients with AIO.

Abbreviations: AIO = adhesive intestinal obstruction, ASBO = adhesive small bowel obstruction, CI = confidence interval, EA = electric acupuncture, ER = effective rate, MD = mean difference, RCT = randomized controlled trial, RR = relative risk.

Keywords: acupuncture, acupuncture therapy, adhesive intestinal obstruction, adhesive small bowel obstruction, intestinal obstruction, meta-analysis

1. Introduction

Adhesive intestinal obstruction (AIO) is a common surgical emergency in which intestinal substances cannot pass and function smoothly. Adhesion formation happens generally 2 types: congenital and acquired. Among these types, the incidence of the latter is high, which often occurs because of factors such as intra-abdominal surgery, inflammation, trauma, bleeding, and foreign bodies.[1] AIO generally manifests

clinically as abdominal pain, bloating, nausea, and vomiting, and the reduction in or disappearance of gas and bowel movements. Liquid and gas planes can be seen in plain abdominal radiographs, and the obstruction can be found in abdominal computed tomography scans. Adhesive small bowel obstruction (ASBO) after surgery accounts for the majority of clinical cases, and the risk of ASBO is the highest especially after colorectal surgery, gynecological tumor surgery, or pediatric surgery.[2–5] In the United States, more than 350,000 small bowel

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obstruction operations are performed each year, resulting in more than 960,000 hospital days and medical expenses of US$ 2.3 billion.[6]

Physicians recommend the use of nonsurgical treatment first for ASBO unless the signs of peritonitis, strangulation, or intestinal ischemia are observed.[2] Surgical exploration has a considerable risk of intestinal injury, and surgical treatment may greatly reduce the quality of life after surgery and cause AIO after re-operation.[7–9] Conservative treatments generally include fasting and water deprivation, gastrointestinal decompression, parenteral nutrition support, and maintenance of electrolyte, and acid–base balance in the body.[10] The nonsurgical treatment is effective for approximately 70% to 90% of patients with ASBO.[11,12] However, the high recurrence (30%) and mortality (2%) rates of ASBO are concerning.[13,14] Moreover, the ideal management method of ASBO remains debatable.[15] Therefore, exploring a new feasible treatment method that can increase the possibility of successful nonsurgical treatment and reduce the recurrence rate of ASBO is important.

Acupuncture has been practiced in China for over 3000 years and is an increasingly popular natural healing method, as well as a recognized practice among the public and healthcare professionals worldwide.[16] It is recommended in various clinical guidelines for the treatment of various diseases such as osteoarthritis, low back pain, dysmenorrhea, and stroke.[17–20] Studies at home and abroad have shown that acupuncture can also promote postoperative gastrointestinal function recovery and prevent postoperative complications such as nausea, vomiting, and visceral pain.[21,22] Several clinical studies have shown that basic acupuncture treatment can shorten treatment cycle and indwelling time of gastric tube, reduce the pain of treatment, reduce transfer operation rate, improve the quality of life after treatment, reduce medical costs and increase the satisfaction of both doctors and patients receiving treatment for intestinal obstruction.[23] However, the guidelines of the World Society of Emergency Surgery do not include acupuncture in the treatment protocol.[2] Therefore, we performed a meta-analysis and merged the data from our meta-analysis to provide clinical decision-making recommendations.

2. Materials and Methods

The systematic review protocol was developed using guidance from the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) statement, and the study was registered in PROSPERO (CRD42021290754).

2.1. Search strategy

Randomized controlled trials (RCTs) were retrieved by searching the following databases from their date of inception to November 2021: PubMed, Cochrane Library, EMBASE, EBSCO, Web of Science, China National Knowledge Infrastructure, Wanfang Database, and China Science and Technology Journal Database. Trials published in English or Chinese language were included. According to the characteristics of each database, the search terms were as follows: ("acupuncture" OR "electro-acupuncture" OR "acupuncture points" OR "moxibustion") AND ("intestinal obstruction" OR "bowel obstruction").[24] Table 1 displays a PubMed search strategy as an example.

2.2. Inclusion and exclusion criteria

2.2.1. Participants. Participants were the patients with clinically confirmed AIO, regardless of the type, ethnicity, sex, age, country, and pathogenesis.

Table 1	
PubMed search strategy.	
Number	**Search terms**
#1	"Acupuncture" [Mesh]
#2	Pharmacopuncture [Title/Abstract]
#3	Acupuncture Therapy [Title/Abstract]
#4	Acupressure [Title/Abstract]
#5	Electroacupunctur* [Title/Abstract]
#6	electro-acupunctur* [Title/Abstract]
#7	acupoint* [Title/Abstract]
#8	meridian* [Title/Abstract]
#9	non-meridian* [Title/Abstract]
#10	trigger* [Title/Abstract]
#11	moxibustion [Title/Abstract]
#12	moxa* [Title/Abstract]
#13	acupuncture points [Title/Abstract]
#14	auriculotherapy [Title/Abstract]
#15	zhenjiu [Title/Abstract] OR zhen jiu [Title/Abstract] OR zhen ci [Title/Abstract] OR dian zhen [Title/Abstract] OR zhen ya [Title/Abstract] OR er zhen [Title/Abstract] OR ti zhen [Title/Abstract] OR she zhen [Title/Abstract] OR tou pi zhen [Title/Abstract] OR xue wei [Title/Abstract]
#16	(((ching [Title/Abstract]) AND (lo [Title/Abstract])) OR (jing [Title/Abstract] AND luo [Title/Abstract])) OR (jinglo [Title/Abstract])
#17	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16
#18	Intestinal Obstruction [Mesh]
#19	Bowel* [Title/Abstract] OR Intestin* [Title/Abstract] OR gastrointestin* [Title/Abstract] OR gastro-intestin* [Title/Abstract] OR colon* [Title/Abstract] OR colorect* [Title/Abstract] OR retrosigmoid* [Title/Abstract]
#20	Obstruct* [Title/Abstract] OR block* [Title/Abstract]
#21	#19 and #20
#22	#18 OR #21
#23	#17 AND #22

This search strategy was modified, as per the requirement, for other electronic databases.

2.3. Intervention

The experimental group received several types of acupuncture treatments including manual, electric, auricular and scalp acupuncture, warm needle, and fire needle, regardless of the acupoint selection and treatment frequency. Moxibustion, laser acupuncture, and acupuncture point injection were excluded.[24] The control group received conventional treatments such as gastrointestinal decompression, electrolyte disturbance correction, and nutritional support. To eliminate the effect of Chinese medicine on efficacy, studies involving interventions such as oral Chinese medicine and Chinese medicine enemas for either the experimental group or the control group were excluded.

2.4. Outcomes

The main outcome indicator was the effective rate. The secondary outcomes were the surgery conversion rate, the time of the first defecation, the symptom alleviation time of abdominal pain, and hospital stay.

2.5. Study types

Only RCTs were included, regardless of the blinding method used. The studies published in English or Chinese language were included.

2.6. Outcome measurements

The results are mainly expressed as the effective rate, which was calculated as follows: the number of cases (cured + markedly

effective + improved)/total number of cases × 100%. The secondary outcomes were the surgery conversion rate, the symptom alleviation time (abdominal pain, and first defecation), and the length of hospital stay.

2.7. Study selection

All articles were imported into Endnote X9.3.3 for management. Two authors (Yujia Xie and Chengwen Zheng) read the titles and abstracts and then independently screened the literature and managed the articles with duplicate titles and abstracts by placing them in the "duplicate articles" folder. After excluding the duplicates, the articles that did not meet the criteria of study type, participants, interventions, comparisons, and outcomes were removed. After reviewing the full text, the studies meeting the aforementioned inclusion criteria were included. Any problem encountered during the process of study selection was resolved by discussion with the third author (Xiyue Tan). The study selection process is illustrated using the PRISMA flowchart (Fig. 1).

2.8. Data extraction

The data were independently extracted by 2 authors (Yujia Xie and Zongyu Li), who compared and checked the extracted data. Any difference encountered was resolved through meetings or consultation with the third author (Yiyi Zhang). The available information was recorded in Microsoft Excel 2010 by using a standard-design table. The extracted content included the first author, publication year, country, sample size, male to female ratio, participants' age, random method used in the study, intervention measures used in the treatment group and the control group, evaluation times of the outcome indicators, all outcome indicators, and each acupuncture point selected by the research institution.

2.9. Data analysis

The relative risk (RR) with a 95% confidence interval (CI) was selected as the statistic for dichotomous data. Because the unit of the outcome indicator was consistent, the mean difference (MD) with 95% CI was used to describe continuous variables. During the heterogeneity test, the Chi-squared test was performed first, and based on its findings, the estimates of heterogeneity (I^2) were applied. $I^2 > 50\%$ indicated significant heterogenicity. When $I^2 > 50\%$, the random-effects model was selected to summarize the outcomes; when $I^2 < 50\%$, the fixed-effects model was applied. Publication bias was explored using a funnel plot analysis. Statistical analysis was performed using RevMan v. 5.4.

3. Results

3.1. Study selection

According to the search strategy, 3644 studies were retrieved from the date of inception of databases to October 27, 2021. After eliminating the duplicate studies, 3120 related studies were screened out. A total of 3104 studies were eliminated after reading the titles and abstracts, and 16 relevant studies were identified. After reading the full texts of these 16 studies,
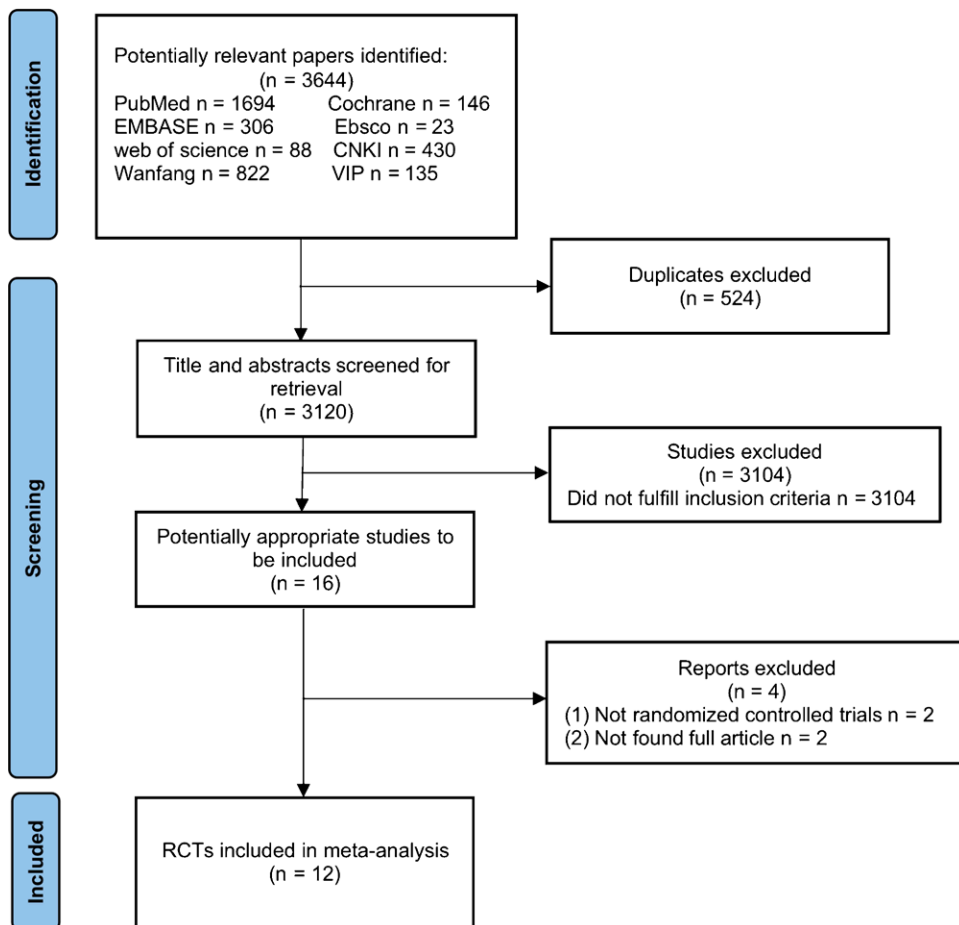

Figure 1. PRISMA flow diagram. PRISMA = Preferred Reporting Items for Systematic Review and Meta-Analyses, RCTs = randomized controlled trials.

4 studies were excluded from the analysis for the following reasons: 2 studies[25,26] were not RCTs and 2 studies[27,28] did not contain the full text. Eventually, 12 studies were included in this meta-analysis (Fig. 1).

3.2. Study characteristics

Of the 12 RCTs included in this meta-analysis,[10,29–39] 11 RCTs were published in Chinese language, and 1 RCT was published in English language. All 12 studies were 2-arm trials. Out of 892 patients with AIO, 456 patients constituted the experimental group and 436 constituted the control group. All the participants were from China. The intervention for the experimental group comprised electric acupuncture or manual acupuncture. The control group that comprised patients from 11 studies received conventional symptomatic treatments, namely fasting and water deprivation, gastrointestinal decompression, and parenteral nutrition support, whereas patients from one study[38] underwent laparoscopic surgery. A total of 9 studies reported the effective rate[10,29–33,35,37,39]; 3 studies reported the surgery conversion rate[10,29,36]; 5 studies reported the time of the first defecation[10,29,33,34,36]; 3 studies reported the symptom alleviation time of abdominal pain[10,34,36]; and 5 studies recorded

the length of hospital stay[29–31,35,38]. Tables 2 and 3 present the characteristics of the included studies.

3.3. Risk of bias in included studies

Two authors (Yujia Xie and Xiyue Tan) independently assessed the quality of each study. The risk of bias of the included studies was assessed using the Cochrane Collaboration's risk-of-bias tool and software RevMan v. 5.4. Each study was considered to have low-risk bias, unclear bias, or high-risk bias according to the following 7 parameters: random sequence generation, allocation concealment, blinding of participants and personnel, blind method for evaluating results, incomplete result data, selective reporting, and other biases. Any difference encountered was resolved by the third author (Chengwen Zheng).

All studies mentioned randomization. Among these studies, 5 studies[29,32,34,35,39] did not report specific randomization methods, and 2 studies[31,37] used random methods with a high risk of bias, such as single and double numbers of hospital cards and hospitalization numbers. Five studies[10,30,33,36,38] applied the random number table method or computer random number method to generate random sequences. None of the studies reported information about application allocation hiding. Regarding the

Table 2

Characteristics of included studies.

Study	Country	Experimental design	Experimental group					Stimulus parameter		
			Sample size	Age (yr)	Sex (male/female)	Intervening measure	Acupoint	Stimulus	Time (min)	Frequency (n/d)
Lihua Zhang, 2019	China	RCT, 2 arms	49	54.78 ± 10.11	23/26	Acupuncture + moxibustion	RN12, ST25, ST36–37, SJ6, BL25 and BL27	Acupuncture manipulation	30	1
Zhipeng Liu, 2019	China	RCT, 2 arms	30	64 ± 11.1	17/13	EA + Acupuncture + conventional therapy	ST25, ST36–37, ST39, PC6, RN4, RN6, and RN12	Pulse frequency of 20 Hz, continuous wave + patient tolerance	30	1
Peng Liu, 2019	China	RCT, 2 arms	39	56.98 ± 4.31	21/18	Acupuncture + conventional therapy	ST25, ST28, ST36–37, RN12	Acupuncture manipulation	30	/
Mengting Dong, 2016	China	RCT, 2 arms	64	56.87 ± 5.26	40/24	Acupuncture + conventional therapy	ST25, ST28, ST36–37 and RN12	Patient tolerance	30	1
Qingyun Chen, 2014	China	RCT, 2 arms	28	24–48*	16/12	EA + conventional therapy	ST25, ST36–37, ST39, RN4, RN6 and PC6	Dilatational wave + patient tolerance	30	1
Cheng Li, 2013	China	RCT, 2 arms	47	41.8 ± 4.3	26/21	EA + Acupuncture + conventional therapy	RN4, RN12, ST25 and ST36	Pulse frequency of 3–5 Hz, continuous wave + patient tolerance	30	1
Linhua Li, 2012	China	RCT, 2 arms	45	17–76*	25/20	Acupuncture + conventional therapy	ST36–37, PC6 and SP6	acupuncture manipulation	30	2
Zhimin Cui, 2012	China	RCT, 2 arms	21	48.7 ± 5.6	13/8	EA + conventional therapy	RN12, ST25, ST36–37 and PC6	Pulse frequency of 2 Hz, dilatational wave + patient tolerance	30	2
Wei Wang, 2010	China	RCT, 2 arms	32	53.45 ± 15.15	16/16	Acupuncture + conventional therapy	RN4, RN6, RN10, RN12, and ST25	Acupuncture manipulation	20	/
Junwu Wang, 2009	China	RCT, 2 arms	54	13–68*	31/23	EA + acupuncture + conventional therapy	RN4, RN6, RN12, ST25, ST36–37 and SJ6	low frequency pulse	30	1
Shengde Liao, 2006	China	RCT, 2 arms	29	24.38 ± 5.57	/	EA + laparoscope surgery	ST36–37	Dilatational wave	30	1
Haiqiang Li, 2001	China	RCT, 2 arms	16	/	/	EA	RN5, RN10, ST25 and ST36	Continuous wave + patient tolerance	30	1

EA = electric acupuncture, RCT = randomized controlled trial.
*Range.

blinding method, none of the other studies involved blinding of patients or evaluators, except for one study[36] that used single blinding (the detailed operation description was absent). In terms of incomplete data and selective reporting, all included RCTs had a low risk of bias. The risk-of-bias assessment result is summarized in Figures 2 and 3.

3.4. Meta-analysis results

3.4.1. Effective rate. The effective rate was the primary outcome of this study. Nine trials involving 681 patients reported the effective rate as an endpoint. No obvious heterogeneity was found among the 9 trials ($P = .73$, $I^2 = 0\%$). Therefore, the fixed-effects model was used to perform a meta-analysis of the acupuncture and control groups. The results showed that the effective rate between the acupuncture group and the control group had significant differences (RR: 1.20; 95% CI: 1.11–1.28; $P < .00001$). The meta-analysis results on the effective rate are presented in Figure 4.

3.4.2. Surgery conversion rate. Three studies involving 219 patients reported the surgery conversion rate. The heterogeneity among the studies was low ($P = .45$, $I^2 = 0\%$), and thus, the fixed-effects model was adopted. No statistical differences were observed in the surgery conversion rate between the experimental group and the control group (RR: 0.58; 95% CI: 0.29–1.16; $P = .12$). The results of the meta-analysis of the surgery conversion rate are presented in Figure 5.

3.5. Time of the first defecation

Five studies involving 402 patients reported the time of the first defecation. Statistical analyses revealed considerable heterogeneity among the 5 RCTs ($P < .00001$, $I^2 = 90\%$). The random-effects model indicated significant differences in the time of the first defecation between the acupuncture group and the control group (MD: –11.49, 95% CI: –19.31 to – 3.66; $P = .004$). The results of the meta-analysis are shown in Figure 6.

3.6. Symptom alleviation time of abdominal pain

Three studies involving 249 patients reported the symptom alleviation time of abdominal pain. Statistical analyses showed considerable heterogeneity among the 3 RCTs ($P < .00001$, $I^2 = 99\%$). The random-effects model showed statistical differences in the symptom alleviation time of abdominal pain between the acupuncture group and the control group (MD: –17.59, 95% CI: –37.81 to 2.63; $P = .09$). The results of the meta-analysis of the symptom alleviation time of abdominal pain are presented in Figure 7.

3.7. Length of hospital stay

Five studies involving 364 patients reported the length of hospital stay. Statistical analyses showed considerable heterogeneity among the 2 RCTs ($P < .00001$, $I^2 = 98\%$). The random-effects model showed statistical differences in the length of hospital stay between the acupuncture group and the control group

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Table 3

Characteristics of included studies continued.

| Study | Control group | | | | | |
	Sample size	Age (yr)	Sex (male/female)	Intervening measure	Outcome	Measurement time point (d)
Lihua Zhang, 2019	50	51.98 ± 8.46	20/30	Conventional therapy	①②③	5
Zhipeng Liu, 2019	30	64.63 ± 11.6	19/11	Conventional therapy	①②③⑤	/
Peng Liu, 2019	39	56.74 ± 4.26	22/17	Conventional therapy	①⑤	/
Mengting Dong, 2016	64	56.17 ± 5.86	42/22	Conventional therapy	①⑤	/
Qingyun Chen, 2014	24	25–56*	14/10	Conventional therapy	①	/
Cheng Li, 2013	46	45.4 ± 5.1	20/26	Conventional therapy	①③	6
Linhua Li, 2012	45	18–78*	28/17	Conventional therapy	③④	/
Zhimin Cui, 2012	21	50.4 ± 6.4	10/11	Conventional therapy	①⑤	/
Wei Wang, 2010	28	52.66 ± 12.87	14/14	Conventional therapy	②③④	/
Junwu Wang, 2009	43	10–67*	25/18	Conventional therapy	①	/
Shengde Liao, 2006	27	23.92 ± 4.95	/	Laparoscope surgery	⑤	/
Haiqiang Li, 2001	16	/	/	Conventional therapy	①	/

① Effective rate; ② Surgery conversion rate; ③ Time of the first defecation; ④ Symptom alleviation time of abdominal pain; and ⑤ Hospital stay.
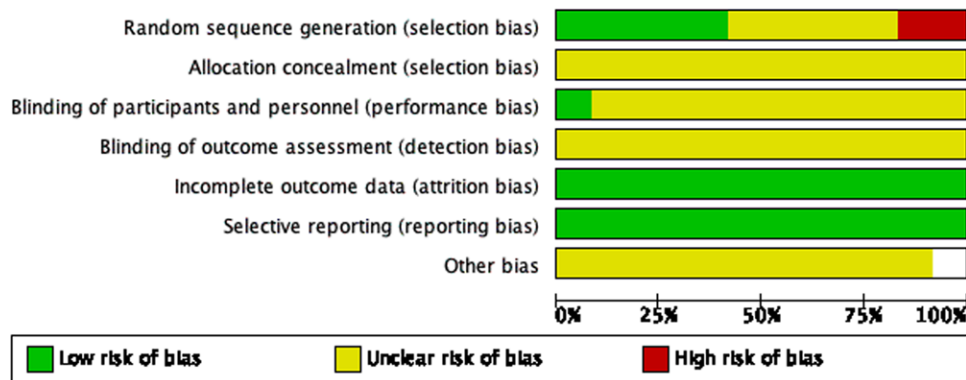*Range.

Figure 2. Details of the risk of bias of the included studies.

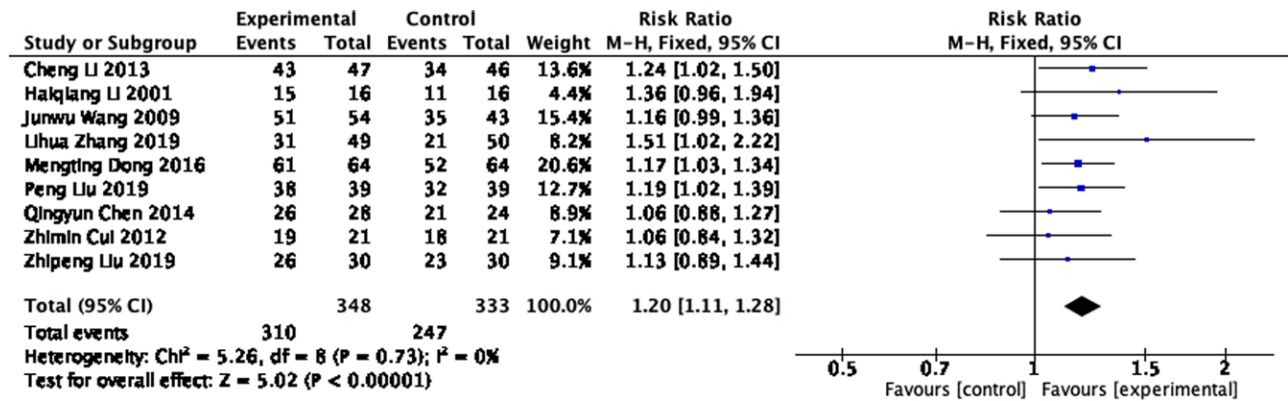**Figure 3.** A summary of the risk of bias of included studies.

Figure 4. Meta-analysis results of the effective rate. CI = confidence interval.
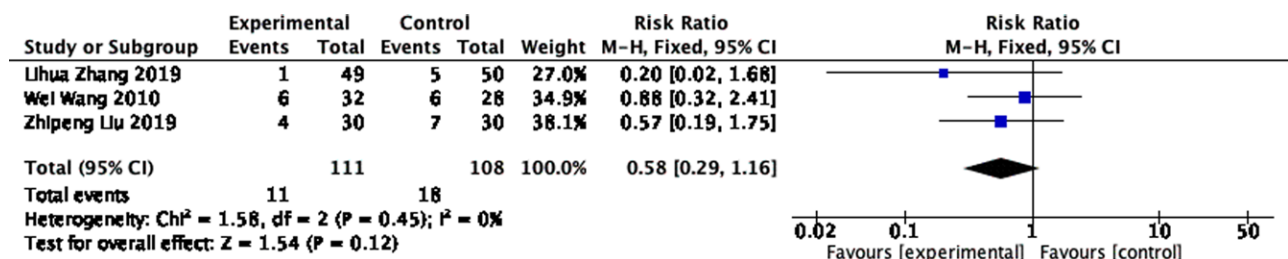

Figure 5. Meta-analysis results of the surgery conversion rate. CI = confidence interval.
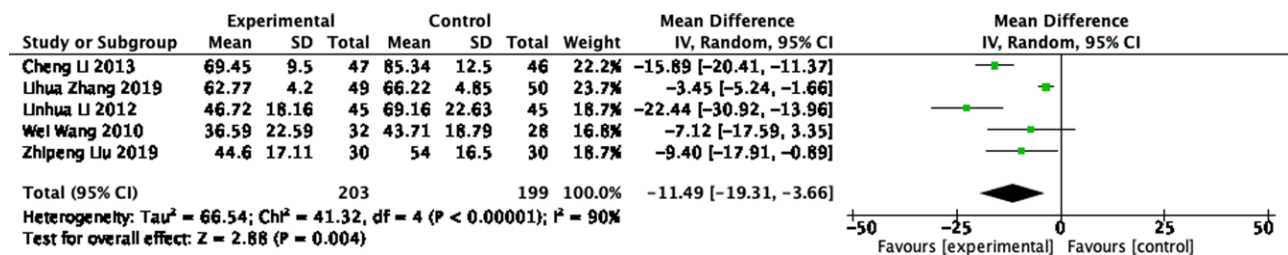

Figure 6. Meta-analysis results of the time of the first defecation. CI = confidence interval, SD = standard deviation.
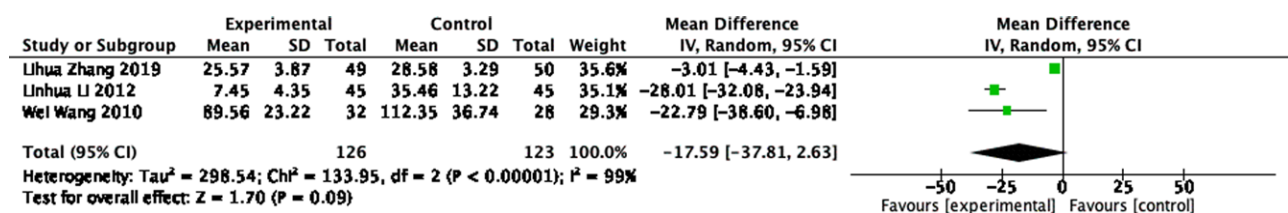

Figure 7. Meta-analysis results of the symptom alleviation time of abdominal pain. CI = confidence interval, SD = standard deviation.

(MD: −5.12, 95% CI: −8.63 to −1.61; P = .004). The results of the meta-analysis of the length of hospital stay are presented in Figure 8.

3.8. Publication bias

We performed a funnel plot analysis of the 12 RCTs to analyze the publication bias, which indicated no significant asymmetry for the effective rate (Fig. 9). A trim-and-fill analysis showed that the results were mostly with a P value of > .1. The Egger's test showed that the P value of the effective rate was .3542

(P > .05), which indicated that no publication bias was present in the meta-analysis of the effective rate. However, because most of the included studies were in Chinese language, the risk of language bias may be present.

4. Discussion

4.1. Principal findings

Studies published after the establishment of databases until October 2021 and fulfilling the inclusion criteria were included
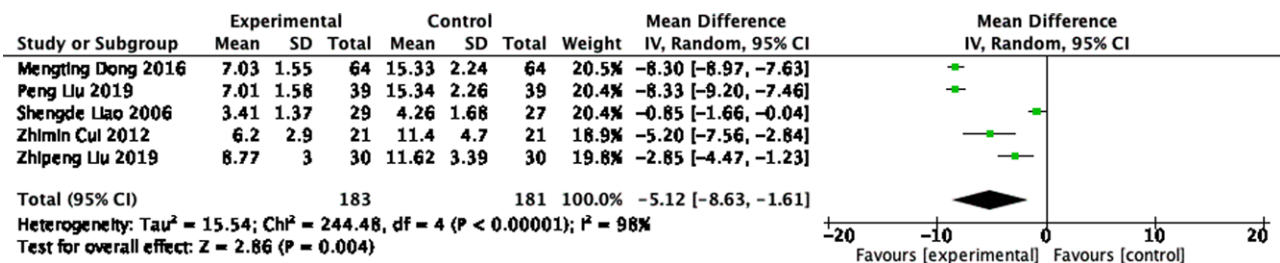
Figure 8. Meta-analysis results of the length of hospital stay. CI = confidence interval, SD = standard deviation.
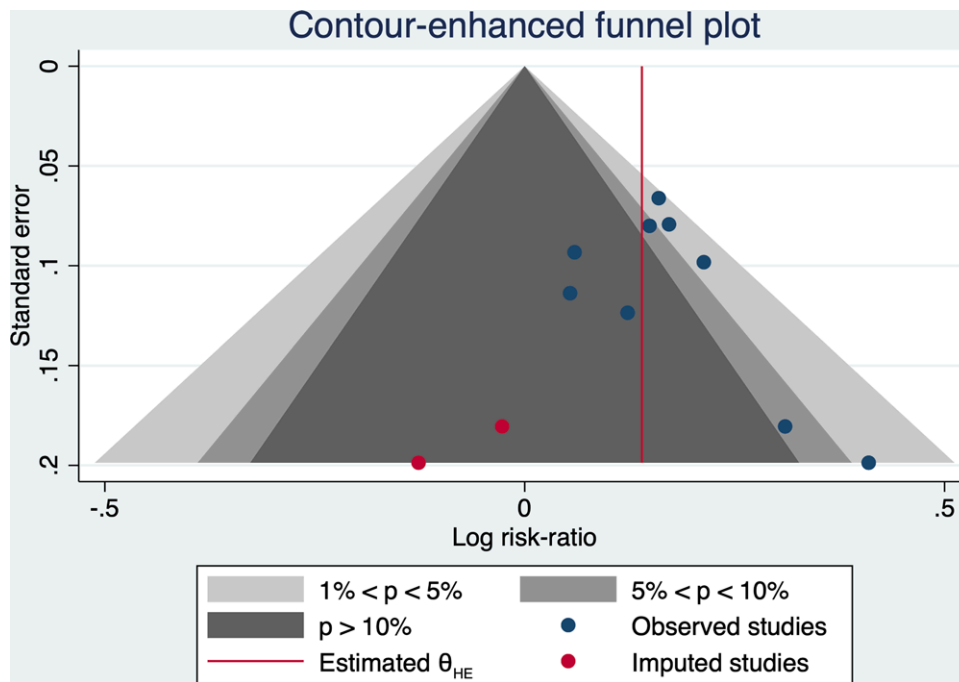

Figure 9. Publication bias of the effective rate.

in the present meta-analysis to analyze the efficacy of acupuncture treatment of AIO. The 12 studies comprised a total of 892 patients (456 patients in the experimental group and 436 patients in the control group). This study showed that the acupuncture treatment group exhibited the improved total effective rate, reduction in the duration of abdominal pain, and first defecation compared with the control group. Moreover, the length of hospital stay in the acupuncture group was significantly reduced. The results showed that acupuncture had obvious advantages over the conventional treatment in alleviating AIO. The advantages included the improved symptoms, greater functional recovery, and reduced length of hospital stay. However, no significant difference was observed between the 2 groups in terms of the surgery conversion rate. For AIO, patients' and physicians' most urgent request is to avoid surgery through conservative treatment. Although the results indicated no significant difference in the surgery conversion rate between the 2 groups, this may be attributable to subjective and objective factors. By analyzing its causes, it is hoped that future research will be able to reflect the effect of acupuncture on intestinal obstruction more objectively and accurately. First, only three[10,23,36] of the included studies reported the surgery conversion rate. Two[10,36] of these studies demonstrated a lower surgery conversion rate in the acupuncture group compared to the control group (the difference was statistically significant). Nonetheless, because the sample size was insufficient, no positive results were obtained.

Second, most studies used cure or efficacy as the criterion for evaluating the treatment's efficacy but did not consider the conversion rate to surgery. (Note: Cure refers to the complete elimination of intestinal obstruction, the complete disappearance of symptoms like abdominal pain and distension, the recovery of defecation, and the absence of liquid gas level or a small amount of flatulence on abdominal upright X-ray examination. Efficacy refers to the improvement of intestinal obstruction, the relief of abdominal pain and distension, and other symptoms, and abdominal X-ray examination reveals only mild expansion of the intestinal tube or a small amount of liquid.) If the patient is cured, the intestinal obstruction has been eliminated through conservative treatment without surgery. If the treatment is effective, the patient's condition can be temporarily monitored before receiving additional care. Both cases suggest that the acupuncture group can avoid or postpone surgery more effectively compared to the control group. However, because the researchers did not record the data clearly, we could not include them in our statistical analysis.

4.2. Mechanism of acupuncture

In clinical practices, most cases of AIO occur as a result of previous surgeries because the bowel often forms bands of scar (called adhesions) after being handled during surgery. In severe

cases, the blood supply might be compromised, and the bowel tissues might undergo necrosis.[40] Acupuncture has a good regulatory effect on the gastrointestinal function and can adjust the physiological function of the entire body to a certain extent. Many studies have reported that acupuncture has multiple regulatory effects on the gastrointestinal system. Acupuncture can regulate the function of the vagus nerve, which in turn regulates the function of various internal organs.[41] Murakami et al,[42] Hu et al,[43] and other researchers found that stimulating the vagus nerve and parasympathetic nerve pathways with acupuncture can promote intestinal peristalsis, prevent ileal mucosal damage through an autonomous mechanism, and accelerate postoperative recovery. The interstitial cells of Cajal are self-rhythmic pacing and excitatory conduction cells of gastrointestinal motility that can improve gastrointestinal motility.[41] Acupuncture may improve the gastrointestinal activity by repairing the ultrastructure of interstitial cells of Cajal and restoring their function.[44] Various studies have reported that acupuncture has an anti-inflammatory effect in the early stages of intra-abdominal adhesion formation. Acupuncture may reduce the formation of adhesions and promote the recovery of intestinal function by reducing the level of gastrointestinal immune activity, reducing gastrointestinal inflammatory reactions, improving intestinal blood circulation, and reducing angiogenesis.[45,46]

In traditional Chinese medicine, AIO belongs to the category of "intestinal knot" and "Guange." There are 2 subtypes of patients; one subtype of patients are weak due to body deficiency, weak spleen and stomach, insufficient Qi and blood transformation, and inability to promote the excretion of metabolic waste from the intestine, whereas the other subtype of patients are weak mainly because of heat, cold coagulation, dampness, blood stasis, and other pathologies that block the flow of Qi and blood. The aforementioned factors eventually lead to intestinal dysfunction, resulting in the accumulation of metabolic waste in the body and development of diseases.[23] According to the traditional Chinese medicine theory, acupuncture can promote Qi and blood circulation. Therefore, acupuncture can promote the excretion of cold dampness, blood stasis, and other waste products from the human body and promote the recovery of intestinal function. However, the effectiveness of acupuncture depends on various factors such as the selection of acupuncture points and the angle and depth of needle insertion.

4.3. Implications for clinical practice and further research

The present study reported that acupuncture is a convenient treatment method having a positive effect on AIO. The commonly used acu-points reported in various studies include Tianshu (ST25), Shuidao (ST28), Zusanli (ST36), Shangjuxu (ST37), and Zhongwan (RN12). Further research for the selection of fixed and effective acu-points should be performed to create a reliable and accurate acupuncture treatment plan to benefit a large number of patients with AIO.[24] High-quality, large-scale, and multi-center clinical randomized controlled studies are required to obtain accurate analysis results. Further research should use strict randomization methods, allocation concealment and blinding, and clear inclusion and exclusion criteria. Moreover, the treatment criteria should be standardized and unified.

4.4. Advantage

The current systematic review of AIO mainly focused on the combination of acupuncture and medicine. The present study included only the trials based on acupuncture and moxibustion, and those involving the use of Chinese medicine-related therapies (such as external application of Chinese medicine, internal Chinese medicine, and Chinese medicine enema) were excluded. Because the effect of different interventions on the results was

minimized, the present meta-analysis accurately assessed the efficacy of acupuncture in the treatment of AIO. Additionally, the present study did not limit the cause of AIO which comprehensively evaluates the effectiveness and universality of acupuncture in the treatment of AIO.

4.5. Limitations

The study has some limitations. First, 11 of the 12 included studies were in Chinese language, which could have led to publication bias. Second, due to the lack of high-quality, multi-center clinical randomized controlled studies, the data in this study were limited. Third, most of the included studies had a small sample size. Fourth, the methodological quality of the included studies was poor, and the curative effect evaluation methods, such as the measurement standard with many subjective factors, were flawed. Fifth, due to the particularity of acupuncture and moxibustion therapy, this study only focused on acupuncture and moxibustion stimulation methods and did not analyze differences in the acupuncture point selection and acupuncture depth, which is not conducive for the further analysis of data. Sixth, none of the studies reported adverse events, and all included studies provided insufficient safety reports.

5. Conclusion

Acupuncture is effective in the treatment of AIO. The present study reported that acupuncture can significantly alleviate the symptoms of abdominal pain and distension in patients with AIO, promote the recovery of bowel movements, reduce the time of the first defecation, and reduce the length of hospital stay. However, acupuncture had no obvious effect on reducing the surgery conversion rate. In summary, acupuncture can be an important complementary therapy as one of non-surgical options for AIO. Limitation of the currently available evidence warrants further high-quality, large-sample, and multi-center clinical RCTs to strengthen the conclusions of our study.

Acknowledgments

Author contributions

Conceptualization: Yujia Xie, Yuan Liu.
Data curation: Yujia Xie, Chengwen Zheng, Zongyu Li, Xiyue Tan, Yiyi Zhang.
Formal analysis: Yujia Xie, Xiyue Tan, Chengwen Zheng.
Writing-original draft: Yujia Xie.
Writing-review & editing: Chengwen Zheng, Yuan Liu.

References

[1] ten Broek RPG, Issa Y, van Santbrink EJP, et al. Burden of adhesions in abdominal and pelvic surgery: systematic review and met-analysis. BMJ. 2013;347:f5588.

[2] Ten Broek RPG, Krielen P, Di Saverio S, et al. Bologna guidelines for diagnosis and management of adhesive small bowel obstruction (ASBO): 2017 update of the evidence-based guidelines from the world society of emergency surgery ASBO working group. World J Emerg Surg. 2018;13:24.

[3] Montz FJ, Holschneider CH, Solh S, et al. Small bowel obstruction following radical hysterectomy: risk factors, incidence, and operative findings. Gynecol Oncol. 1994;53:114–20.

[4] Ellis H, Moran BJ, Thompson JN, et al. Adhesion-related hospital readmissions after abdominal and pelvic surgery: a retrospective cohort study. Lancet. 1999;353:1476–80.

[5] Lower AM, Hawthorn RJS, Clark D, et al. Adhesion-related readmissions following gynaecological laparoscopy or laparotomy in Scotland: an epidemiological study of 24 046 patients. Hum Reprod. 2004;19:1877–85.

[6] Behman R, Nathens AB, Mason S, et al. Association of surgical intervention for adhesive small-bowel obstruction with the risk of recurrence. JAMA Surg. 2019;154:413–20.

[7] Fevang B-TS, Fevang J, Lie SA, et al. Long-term prognosis after operation for adhesive small bowel obstruction. Ann Surg. 2004;240:193–201.

[8] ten Broek RP, Strik C, Issa Y, et al. Adhesiolysis-related morbidity in abdominal surgery. Ann Surg. 2013;258:98–106.

[9] Jeppesen M, Tolstrup M-B, Gögenur I. Chronic pain, quality of life, and functional impairment after surgery due to small bowel obstruction. World J Surg. 2016;40:2091–7.

[10] Zhang LH, Zhang S, Yan PJ, et al. Acupuncture and moxibustion for incomplete adhesive intestinal obstruction: a randomized controlled trial (vol 29, pg 174, 2019). World J Acupunct-Moxibustion. 2021;31:2499.

[11] Fazel MZ, Jamieson RW, Watson CJE. Long-term follow-up of the use of the Jones' intestinal tube in adhesive small bowel obstruction. Ann R Coll Surg Engl. 2009;91:50–4.

[12] Schraufnagel D, Rajaee S, Millham FH. How many sunsets? Timing of surgery in adhesive small bowel obstruction: a study of the Nationwide Inpatient Sample. J Trauma Acute Care Surg. 2013;74:181–7; discussion 187–9.

[13] Miller G, Boman J, Shrier I, et al. Natural history of patients with adhesive small bowel obstruction. Br J Surg. 2000;87:1240–7.

[14] Dayton MT, Dempsey DT, Larson GM, et al. New paradigms in the treatment of small bowel obstruction. Curr Probl Surg. 2012;49:642–717.

[15] Hajibandeh S, Hajibandeh S, Panda N, et al. Operative versus non-operative management of adhesive small bowel obstruction: a systematic review and meta-analysis. Int J Surg. 2017;45:58–66.

[16] Zhuang Y, Xing J-j, Li J, et al. History of acupuncture research. Int Rev Neurobiol. 2013;111:1–23.

[17] Kolasinski SL, Neogi T, Hochberg MC, et al. 2019 American College of rheumatology/arthritis foundation guideline for the management of osteoarthritis of the hand, hip, and knee. Arthritis Care Res (Hoboken). 2020;72:149–62.

[18] Qaseem A, Wilt TJ, McLean RM, et al. Noninvasive treatments for acute, subacute, and chronic low back pain: a clinical practice guideline from the American College of Physicians. Ann Intern Med. 2017;166:514–30.

[19] Zhang J-J, Wang J, Bai P, et al. Evidence-based Clinical Practice Guideline of Acupuncture and Moxibustion for Primary Dysmenorrhea: development and characteristics. Zhongguo Zhen Jiu. 2019;39:1343–6.

[20] Yang N-N, Ye Y, Tian Z-X, 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.

[21] Takahashi T. Acupuncture for functional gastrointestinal disorders. J Gastroenterol. 2006;41:408–17.

[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] 韩正阳. 中医"针药结合"治疗肠梗阻系统评价/Meta分析 [硕士]. 山东中医药大学. 2019.

[24] Zheng C, Li Z, Lu H, et al. Effectiveness of acupuncture on urinary retention: a meta-analysis. Evid Based Complement Alternat Med. 2021;2021:2500282.

[25] 蔡燕治. 针灸治疗粘连性肠梗阻85例. 中国针灸. 1995;12.

[26] Tseng CC, Tseng A. Effect of acupuncture on postoperative adhesive intestinal obstruction. Acupunct Med. 2015;33:338–9.

[27] 吴耀华, 张博焱, 梁佩韶, et al. 基层医院腹腔镜微创技术配合腹针治疗粘连性肠梗阻的应用研究. . 中国基层医药 2016;23:1649–52.

[28] 刘卫华, 邢萧. 针灸治疗粘连性肠梗阻36例. 中华实用中西医杂志. 2010;23:38;40.

[29] 刘志鹏. 普通针刺联合电针治疗粘连性不完全性肠梗阻临床观察 [硕士]. 辽宁中医药大学 2019.

[30] 刘鹏, 董娟, 白意晓, 李建平. 针灸辅助在粘连性肠梗阻治疗中的疗效观察. 世界最新医学信息文摘（连续型电子期刊）. 2019;19:200–1.

[31] 董梦婷, 李广梅, 张彩霞. 中西医结合治疗粘连性肠梗阻疗效观察. 沈阳医学院学报. 2016;18:151–3.

[32] 陈清云 付谦. 针刺治疗粘连性肠梗阻疗效观察. 上海针灸杂志. 2014;33:59.

[33] 李成 赵辉. 电针治疗粘连性肠梗阻临床观察. 辽宁中医药大学学报. 2013;15:193–4.

[34] 李琳华. 针刺辅助治疗急性粘连性肠梗阻疗效观察. 中国中医急症. 2012;21:1818–9.

[35] 崔志敏 董永红. 针灸辅助治疗粘连性肠梗阻的临床疗效观察. 中医临床研究. 2012;4:61–2.

[36] 王伟, 郑燕生, 何军明, 谭志健. 薄氏腹针治疗粘连性肠梗阻疗效观察. 新中医. 2010;42:93–4.

[37] 王军武, 陈理国, 冉崇福, et al. 腹部针刺治疗粘连性肠梗阻54例疗效观察. 西南国防医药. 2009;19:701–2.

[38] 廖圣德 王建隆. 腹腔镜联合电针治疗粘连性肠梗阻. 广东医学. 2006;27:351–2.

[39] 李海强. 电针治疗粘连性肠梗阻32例. 四川中医. 2001;19:73–4.

[40] Baiu I, Hawn MT. Small bowel obstruction. JAMA. 2018;319:2146.

[41] Wang WY, Liang FX, Chen R. [Research advances in the mechanism of acupuncture and moxibustion in regulating gastrointestinal motility and related thinking]. Zhen Ci Yan Jiu. 2020;45:771–5.

[42] Murakami H, Li S, Foreman R, et al. Intraoperative vagus nerve stimulation accelerates postoperative recovery in rats. J Gastrointest Surg. 2019;23:320–30.

[43] Hu X, Yuan M, Yin Y, et al. Electroacupuncture at LI11 promotes jejunal motility via the parasympathetic pathway. BMC Complement Altern Med. 2017;17:329.

[44] 张程程, 林亚平, 彭艳, et al. 电针对糖尿病胃轻瘫大鼠胃窦Cajal间质细胞超微结构及干细胞因子-kit信号途径的影响. 针刺研究. 2017;42:482–8.

[45] Du MH, Luo HM, Tian YJ, et al. Electroacupuncture ST36 prevents postoperative intra-abdominal adhesions formation. J Surg Res. 2015;195:89–98.

[46] 刘丽, 吴雪芬, 郑雪娜, et al. 点灸、电针对糖尿病胃轻瘫大鼠胃窦内皮细胞型一氧化氮合酶及血管紧张素IImRNA表达的影响. 针刺研究. 2017;42:240–5.