SYSTEMATIC REVIEW

Effectiveness of acupuncture in postoperative ileus: a systematic review and Meta-analysis

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Abstract

OBJECTIVE: To conduct a systematic review and Meta-analysis of the effectiveness of acupuncture and common acupoint selection for postoperative ileus (POI).

METHODS: Randomized controlled trials (RCTs) comparing acupuncture and non-acupuncture treatment were identified from the databases PubMed, Cochrane, EBSCO (Academic Source Premier and MEDLINE), Ovid (including Evidence-Based Medicine Reviews), China National Knowledge Infrastructure, and Wanfang Data. The data from eligible studies were extracted and a Meta-analysis performed using a fixed-effects model. Results were expressed as relative risk (RR) for dichotomous data, and 95% CI (confidence intervals) were calculated. Each trial was evaluated using the CONSORT (Consolidated Standards of Reporting Trials) and STRICTA (STandards for Reporting Interventions in Controlled Trials of Acupuncture) guidelines. The quality of the study was assessed using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) approach.

RESULTS: Of the 69 studies screened, eight RCTs were included for review. Among these, four RCTs (with a total of 123 patients in the intervention groups and 124 patients in the control groups) met the criteria for Meta-analysis. The Meta-analysis results indicated that acupuncture combined with usual care showed a significantly higher total effective rate than the control condition (usual care) (RR 1.09, 95% CI 1.01, 1.18; P = 0.02). Zusanli (ST 36) and Shangjuxu (ST 37) were the most common acupoints selected. However, the quality of the studies was generally low, as they did not emphasize the use of blinding.

CONCLUSION: The results suggested that acupuncture might be effective in improving POI; however, a definite conclusion could not be drawn because of the low quality of trials. Further large-scale, high-quality randomized clinical trials are needed to validate these findings and to develop a standardized method of treatment. We hope that the present results will lead to improved research, resulting in better patient care worldwide.

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Key words: Gastrointestinal diseases; Postoperative complications; Ileus; Acupuncture; Point ST 36 (Zusanli); Point ST 37 (Shangjuxu); Review; Meta-analysis

INTRODUCTION

Postoperative ileus (POI), also known as postoperative
functional gastrointestinal disorder or enteroplegia, is a frequent condition after surgery. Ileus is the absence of intestinal peristalsis without mechanical obstruction. POI refers to the time post-surgery before coordinated electromotor bowel function resumes. It is generally defined as transient inhibition of normal gastrointestinal motility and typically lasts 3-5 days post-surgery. POI can selectively affect the stomach, small intestine, or colon; each type is characterized by different mechanisms and clinical presentations and is managed differently. The small bowel normally resumes activity several hours post-surgery, the stomach 24-48 h post-surgery, and the colon 3-5 days post-surgery. After abdominal surgery, multiple reasons may cause functional gastrointestinal disorders, which disturb the recovery of the patients and it usually takes 2-4 days to heal. POI that persists longer than this can be considered pathologic and is sometimes called paralytic ileus.

The clinical consequences of POI include worsened postoperative pain, nausea, vomiting, delay in resuming enteral nutrition, and prolonged hospitalization. Other postoperative complications include deconditioning, malnutrition, increased risk of nosocomial infections, and pulmonary complications. Prolonged hospital stays increase the risk of hospital-acquired infections, deep vein thrombosis, and other conditions. The mean length of hospital stay for patients with POI is 9.3 days; for patients without POI is 5.3 days. The economic burden of the disorder is considerable.

Neural and chemical factors may cause POI. Important risk factors are a sympathetic-parasympathetic imbalance, chemical mediators (e.g., nitric oxide), vasoactive intestinal peptide, substance P, calcitonin gene-related peptide, endogenous opioids, inflammation, and narcotic analgesics. Opiates delay colonic transit in postoperative patients. Nonsteroidal anti-inflammatory drugs such as ketorolac (Toradol) possess anti-inflammatory and opiate-sparing properties, but can cause bleeding, renal insufficiency, and gastritis.

Strategies for POI prevention and management include surgical techniques, supportive care, patient-initiated activities, and pharmacologic interventions. Epidural anesthesia shortens ileus and reduces the need for narcotics. Thoracic epidural analgesia effectively blocks sympathetic pathways, hastens the return of bowel function by 1-2 days, and reduces the need for opiates compared with systemic opioids alone.

Laparoscopic surgery is less traumatic than open surgery and results in a less vigorous systemic inflammatory response, as measured by interleukin-1, -6, and C-reactive protein circulating levels. The length of stay and the duration of POI are also shorter. Prokinetic agents have been evaluated with mainly disappointing results. Metoclopramide failed to improve postoperative bowel motility in several randomized trials. Cisapride showed promise in some prospective trials but was withdrawn from the US market because of cardiovascular side effects. Erythromycin was ineffective inShortening POI in two prospective trials. Domperidone has not been evaluated in a postoperative setting and is not currently available in the United States of America. Laxatives are a potential agent in the management of POI but larger, randomized trials need to be performed before their routine use in postoperative care.

A recent small study showed that cyclooxygenase (COX)-2-selective inhibitors are effective in reducing ileus and may decrease the risk of bleeding associated with nonselective COX inhibitors. However, a standardized treatment with minimal side effects still awaits further trials.

Acupuncture is widely accepted in China as well as throughout the world as an effective treatment option for the management of postoperative nausea and vomiting, and various functional gastrointestinal disorders. However, its role in treating POI is less clear and data from the Chinese and Western literature are scarce. Acupuncture injection, auricular acupuncture, abdominal acupuncture, electroacupuncture, and catgut embedment have been used to treat gastrointestinal disorders. Common acupoints selected include single acupoints of Zusanli (ST 36) and Tianzhong (ST 25); the lower confluent acupoints of bilateral Zusanli (ST 36), Shangjuxu (ST 37), Xiajuxu (ST 39), and Yanglingquan (GB 34); the distant acupoints of bilateral Hegu (LI 4), Zusanli (ST 36), Shangjuxu (ST 37), Xiajuxu (ST 39); and combinations of near and distant acupoints, such as Zhongwan (CV 12), Tianzhong (ST 25), Guanyuan (CV 4), Qihai (CV 6), Zhiqiu (TE 6), Zusanli (ST 36), and Shangjuxu (ST 37) and such as Zhongwan (CV 12), Tianzhong (ST 25), Zusanli (ST 36), Yinlingquan (SP 9) and Pishu (BL 20). Other methodologies used for these problems are warm needle therapy, acupuncture combined with oral Chinese herbs, and acupuncture combined with topical Chinese medicine.

In view of the potential value of acupuncture treatment for POI, this study was carried out to evaluate its efficacy and to examine common acupoint(s) selection, manipulation techniques, side effects, and its effects on the use of rescue anti-emetics.

MATERIALS AND METHODS

The study registration number was PROSPERO CRD42013005485.

Database search strategy

The following search terms for Chinese and English articles were used:
1# To locate articles on POI: “postoperative” OR “ileus” OR “functional gastrointestinal disorder” OR “gastrointestinal dysfunction” OR “gastrointestinal disorder” OR “gastrointestinal motility” OR “gastrointestinal function” OR “enteroplegia” OR “enteroparalysis” OR “intestinal paralysis” OR “paralytic ileus”
The exclusion criteria were as follows: non-randomized trials; non-clinical trials; studies involving patients with other coexisting acute or chronic illness; studies involving patients who had taken medication before surgery; articles not in English or Chinese; duplicate articles; and articles with incomplete data or analysis.

Data collection and analysis

Articles were evaluated independently by two authors. Relevant, complete articles were sorted and cross-examined. Any discrepancies were discussed or further evaluated by the third author. Data were collected using MS Excel 2010 (Microsoft Corporation, Washington, USA), and included journal title, author(s), publication year, type of randomization, type and duration of anesthesia and surgery, type of intervention, sample size, age and gender of participants, timing and technique of intervention, needle retention, depth of insertion, duration of intervention, follow-up, any side effects, use of rescue anti-emetics, results, and conclusions. Trials satisfying the inclusion criteria were included for initial analysis. Trials whose protocols significantly varied from others were excluded (Figure 1). Data were divided into subgroup according to type of intervention. The control groups of the studies selected were treated with the usual care and/or medication.

A Meta-analysis was performed using a fixed-effects model with RevMan (version 5.2, The Cochrane Collaboration). Analysis was presented as RR (relative risk) for dichotomous data and 95% CI (confidence intervals) with \( P < 0.05 \) as the significance level. Heterogeneity of the data was assessed using \( I^2 \) values. \( I^2 \) values of 25%, 50%, and 75% represent low, moderate, and high heterogeneity, respectively. A funnel plot was produced to check for bias (outcome level). If the heterogeneity test yielded values of \( P < 0.1 \) or \( I^2 > 50 \), a sensitivity analysis was carried out; any outliers were examined as potential causes of heterogeneity.

All trials were evaluated according to the CONSORT (Consolidated Standards of Reporting Trials)\(^3\) and STRICTA (STandards for Reporting Interventions in Controlled Trials of Acupuncture) guidelines. The quality of each study was assessed using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) approach\(^8\) with the GRADE profiler (version 3.6, GRADE Working Group) according to: (a) the risk of bias/study limitations (study level), inconsistency, indirectness, imprecision, and publication bias (evidence for downgrading the quality of evidence); (b) magnitude of the effect, influence of residual plausible confounding, and dose-response gradient (evidence for upgrading the quality of evidence).

The quality of each study was graded as high, moderate, low, or very low.\(^9\)

RESULTS

Of the 69 studies screened, eight randomized controlled trials (RCTs)\(^15-18\) were included for review and...
among these, four studies (247 participants)\textsuperscript{11-14} met the criteria for Meta-analysis (Table 1).

**Risk of bias**
Assessment was based on descriptions of sequence generation for randomization, allocation concealment, blinding, incomplete outcome data, and other bias. One study\textsuperscript{11} reported the generation of random sequences and allocation concealment (low risk of bias). No studies reported blinding of participants, personnel, or outcome assessors. All studies\textsuperscript{11-14} were assessed as having a low risk of bias associated with incomplete outcome data. One study reported drop-out.\textsuperscript{11} No studies used intention-to-treat analysis. All trials reported baseline comparisons of age and gender.\textsuperscript{11-16} One study\textsuperscript{12} compared pre- and post-treatment electrogastroenterogram frequency and amplitude and one study\textsuperscript{13} compared pre- and post-treatment motilin and vasoactive intestinal peptide levels; these two studies were assigned as low risk for other bias (Figure 2A, 2B).

**Response rate to acupuncture**
All trials classified the acupuncture effect according to four levels of improvement: three trials\textsuperscript{11,12,14} classified the effect as "recovered," "markedly effective," "improved," and "ineffective"; one trial\textsuperscript{13} classified the effect as "recovered," "markedly effective," "effective," and "ineffective." Treatment outcomes were based on clinical symptoms,\textsuperscript{11-14} color Doppler ultrasound,\textsuperscript{11-13} and leucocyte count\textsuperscript{14} according to the 2000\textsuperscript{12} and 2002\textsuperscript{14} internationally recognized Rome II criteria. For overall analysis, we transformed these outcomes into dichotomous data by grouping together "recovered," "markedly effective," "improved," and "effective" into the category "total effective."

**Acupuncture + usual care versus control (usual care)**
The proportion of "total effective" outcomes for the four pooled trials was 95.93\% (118/123) for (acupuncture + usual care) and 87.90\% (109/124) for the control. The pooled RR was 1.09 (95\% CI 1.01, 1.18), \( P = 0.02 \). Acupuncture combined with usual care showed a significantly higher total effective rate than the control condition (Figure 3). The results showed low to moderate heterogeneity, \( P > 0.1 \) and \( I^2 < 50 \) and the funnel plot indicated no bias (Figure 4).

**Type of intervention**
All four studies\textsuperscript{11-14} involved the use of manual acupuncture. One of the studies applied a fast-track treatment programme.\textsuperscript{13}

**Acupoint(s) selection**
Zusanli (ST 36) and Shangjuxu (ST 37) were the most common acupoints selected.\textsuperscript{11-14} In addition, some studies used Xiajuxu (ST 39),\textsuperscript{11,13} Yanglingquan (GB 34),\textsuperscript{11} Neiguan (PC 6),\textsuperscript{14} and Gongsun (SP 4).\textsuperscript{14}
<table>
<thead>
<tr>
<th>Author, year &amp; country</th>
<th>Study population (average)</th>
<th>Type, duration of surgery (average)</th>
<th>Type, duration of anaesthesia (average)</th>
<th>Experimental events (n)</th>
<th>Control events (n)</th>
<th>Rescue anti-emetics</th>
<th>Side effects</th>
<th>Cure or effective rate</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kou XR et al 2010</td>
<td>Adult: M/F 5/13, 35-77 (58±21) yo</td>
<td>Cholelithotomy: I: (86.05 ± 29.30) min, C: (86.47 ± 30.57) min</td>
<td>Combined intravenous inhalational anaesthesia: I: (108.61±98.84) min, C: (108.82 ± 99.72) min</td>
<td>Usual care + manual acupuncture at bilateral Zusanli (ST 36), Shangjuxu (ST 37), Xiajuxu (ST 39), Yanglingquan (GB 34), needle retention for 20-30 min, manipulate once at 5-10 min interval, once daily, total 2 treatment (n=20)</td>
<td>Usual care (n=20)</td>
<td>N/A</td>
<td>Nil</td>
<td>Care rate</td>
<td>ÀÀOO LOW</td>
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<tr>
<td>Tianjin, China</td>
<td>I: M/F 4/15, 27-74 (58±11) yo</td>
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<td>I: 5/18 (27.8%)</td>
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<tr>
<td>Zhang Y et al 2011</td>
<td>Adult: M/F 32/28, 17-72 (44) yo</td>
<td>Abdominal appendectomy</td>
<td>N/A</td>
<td>Usual care + manual acupuncture at bilateral Zusanli (ST 36), Shangjuxu (ST 37), Xiajuxu (ST 39) for 30 s within 8 h postoperatively, needle retention for 20 min, during needle retention manipulate once at 10 min interval, total 1 treatment (n=60)</td>
<td>Usual care (n=60)</td>
<td>N/A</td>
<td>Nil</td>
<td>Care rate</td>
<td>ÀÀOO LOW</td>
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<tr>
<td>Tianjin, China</td>
<td>I: M/F 29/31, 21-73 (49) yo</td>
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<td>I: 7/60 (11.7%)</td>
</tr>
<tr>
<td>Zhao XF et al 2010</td>
<td>Adult: M/F 16/14, 17-72 (44) yo</td>
<td>Elective abdominal appendectomy</td>
<td>N/A</td>
<td>Usual care + manual acupuncture at bilateral Zusanli (ST 36), Shangjuxu (ST 37), Xiajuxu (ST 39) for 30 s within 8 h postoperatively, needle retention for 20 min, during needle retention manipulate once at 10 min interval, total 1 treatment (n=30)</td>
<td>Usual care (n=30)</td>
<td>N/A</td>
<td>Nil</td>
<td>Care rate</td>
<td>ÀÀOO LOW</td>
</tr>
<tr>
<td>Tianjin, China</td>
<td>I: M/F 14/16, 21-73 (49) yo</td>
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<td>I: 2/30 (6.7%)</td>
</tr>
<tr>
<td>Wang HM 2011</td>
<td>Adult: M/F 1/4, 39-80, (60±11.01) yo</td>
<td>Radical left hemicolectomy, radical right hemicolectomy, Dixon operation, radical sigmoidectomy</td>
<td>General anaesthesia + continuous epidural anaesthesia</td>
<td>Usual care (fast track surgery programme) + manual acupuncture at Neiguan (PC 6), Gongsun (SP 4), Shangjuxu (ST 37), Zusanli (ST 36), needle retention 30 min, once daily, total 5 day (n=15)</td>
<td>Usual care (fast track surgery programme) (n=15)</td>
<td>N/A</td>
<td>N/A</td>
<td>Care rate</td>
<td>ÀÀOO LOW</td>
</tr>
<tr>
<td>Nanjing, China</td>
<td>I: M/F 9/6, 41-78, (58±10.24) yo</td>
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<td>I: 10/15 (66.7%)</td>
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Notes: M: male; F: female; n: number of events; I: intervention; C: control; *statistically significant compared to control group. Same acupuncture were applied for all patients in a study.
Manipulation technique

A study of cholelithotomy performed single finger insertion bilaterally with reinforcing-reducing for 20 s using 0.30 mm $\times$ 40 mm filiform needles. The needle was left in for 20-30 min and manipulated once at 5-10 min intervals; treatment was done once daily, totally 2 treatment.\(^1\) Two studies on appendectomy performed rapid insertion with lift-thrust and twirl rotation techniques, reinforcing-reducing bilaterally for 30 s, followed by needle retention for 20 min; the needle was manipulated once at 10 min intervals with 0.30 mm $\times$ 40 mm filiform needles within 8 h post-surgery.\(^{11,12}\)

Another study on colorectal carcinoma resection performed acupuncture at 24 h after surgery. Lift-thrust, twirl rotation techniques were used, with rapid insertion followed by slow penetration to a depth of 0.8 inch at Neiguan (PC 6) and Gongsun (SP 4) using 32\# x 1 inch filiform needles and to a depth of 1-1.5 inch at Shangjuxu (ST 37) and Zusanli (ST 36) using 32\# x 1.5 inch filiform needles. Needles were left in for 30 min, and treatment was performed once daily for 5 days.\(^{13}\)

Side effects and use of rescue anti-emetics

Three studies\(^{11-13}\) reported no side effects. One study\(^{14}\) did not mention whether there were any side effects. None reported the use of anti-emetics.
Quality evaluation
In relation to the CONSORT criteria, three studies (75%) reported baseline data, one study (25%) reported sequence generation for randomization, and one study (25%) reported allocation concealment. No studies reported details of blinding (Figure 5A).

In relation to the STRICTA criteria, two studies (50%) reported the style of acupuncture used, three studies (75%) reported acupoint locations (as unilateral or bilateral), one study (25%) reported depth of needle insertion, four studies (100%) reported the response sought, four studies (100%) reported needle stimulation, four studies (100%) reported duration of needle retention, and four studies (100%) reported the needle type (Figure 5B).

In relation to the GRADE criteria, all four studies showed low quality of evidence (Table 1). Blinding was not applied and precision was not reported in the outcomes.

DISCUSSION
Risk of bias
Blinding is a challenge for acupuncture practice. Many patients have some experience with acupuncture or realize that “deqi” is necessary. However, blinding of assessors and statisticians is feasible and should be adopted in future studies.

Response rate to acupuncture
There is a lack of standardization in the measurement of acupuncture outcomes. A standard scale is strongly recommended. The use of total scores would better reflect symptom severities.

Type of intervention
The total effective rate for manual acupuncture combined with usual care was significantly higher than for usual care alone. One study applied acupuncture with usual care in a fast-track surgery programme. The results were more effective than usual care alone. One study applied acupuncture with usual care alone. One study applied acupuncture with usual care alone. One study applied acupuncture with usual care alone.

The use of drugs to stimulate gastrointestinal motility not only fails to treat the root of the disease, but increases the burden of the gastrointestinal tract. Acupuncture balances the disharmony of blood, Qi, and the functions of the internal organs without additional burden. It can effectively promote the recovery of gastrointestinal function. In a study conducted by Wu (2008),19 acupuncture was given simultaneously with enteral nutrition support. The results showed that acupuncture could effectively relieve abdominal pain, bloating, nausea, vomiting, diarrhea, and other gastrointestinal disorder symptoms, and could facilitate the administration of enteral nutrition, speed up post-surgery early energy intake, and promote patients’ recovery. Chinese medicine practitioners believe that Yin and Yang deficiency are the main causes of poor Qi, Qi stagnation, blood stasis, internal organ Qi transportation disorders, and disharmony of Qi within the Stomach and Spleen in abdominal surgery. Acupuncture regulates the smooth transport of Qi within the Stomach and the Small and Large intestines.

Acupoint(s) selection
Acupoints frequently used were Zusanli (ST 36) and Shangjuxu (ST 37), which are located along the Stomach meridian of Foot-Yangming. Zusanli (ST 36) is the lower He-Sea point of the Stomach. It plays a two-way role in regulating gastrointestinal movement. Acupuncture during gastric relaxation strengthens its contraction; acupuncture during gastric contraction increases relaxation and relieves pyloric spasm. Acu-
puncture at Zusanli (ST 36) also regulates gastric secretion; increases low gastric acid levels, pepsin, and lipase activity; promotes increase of opsonin levels and the phagocytic index; and enhances body immunity.13 Shangjuxu (ST 37) is the lower He-Sea point of the Large Intestine and point of the Sea of Blood. Acupuncture at this acupuncture improves bowel activity, abdominal pain, diarrhea, constipation, appendicitis, and other gastrointestinal disorders.14 Acupuncture at both Zusanli (ST 36) and Shangjuxu (ST 37) regulates gastrointestinal Qi, harmonizes the Stomach, alleviates pain, smooths the qi of the intestinal organs, and eliminates bloating.14

In a study of acupuncture following cholelithotomy,15 Xiajuxu (ST 39) and Yanglingquan (GB 34) were used in addition to Zusanli (ST 36) and Shangjuxu (ST 37). Xiajuxu (ST 39) is the lower He-Sea point of the Small Intestine and point of the Sea of Blood and is located along the Stomach meridian of Foot-Yangming. Acupuncture at Shangjuxu (ST 37) and Xiajuxu (ST 39) regulates the Qi of the Large and Small intestines, respectively.53 Yanglingquan (GB 34) is the lower He-Sea point of the Gall Bladder and is located along the Gall Bladder meridian of Foot-Shaoyang. Acupuncture at Yanglingquan (GB 34) disperses stagnant Liver qi, promotes bile flow, smooths the flow of Gallbladder Qi, and prevents regurgitation.11,19 Integrated application of the above points activates the flow of qi and blood, regulates gastrointestinal functions, induces catharsis in the Liver and Gallbladder, promotes intestinal peristalsis, and improves abdominal bloating.53 Acupuncture at the lower He-Sea points shortens the healing process and recovery period11 of post-cholelithotomy gastrointestinal function.

Two studies on appendectomy performed manual acupuncture on bilateral Zusanli (ST 36), Shangjuxu (ST 37), and Xiajuxu (ST 39).11,13 A study of colorectal carcinoma resection selected Neiguan (PC 6) and Gongsun (SP 4) in addition to Zusanli (ST 36) and Shangjuxu (ST 37).14 Neiguan (PC 6) is located along the Pericardium meridian of Hand-Jueyin; it is frequently used to treat vomiting and has a good pain relief function.14 Acupuncture at Neiguan (PC 6) adjusts gastrointestinal function, inhibits gastric acid secretion, and regulates intestinal motility.14 Gongsun (SP 4) is located along the Spleen meridian of Foot-Taiyin. It regulates, and has a special relationship with, the Stomach and Intestine and lowers inverse Qi.14 Neiguan (PC 6) and Gongsun (SP 4) are two of the eight confluent acupoints connecting the eight extra channels. Gongsun (SP 4), the master point of the Chong Mai vessel, tonifies the Spleen and promotes Yang. Coupled with Neiguan (PC 6), it helps to regulate the Qi of the middle Jiao. Modern research indicates that the coupling of these two acupoints can have synergistic effects.15 They can transmit information through the nervous system to adjust the Stomach and other viscera.13 Neiguan (PC 6) coupled with Zusanli (ST 36) tonifies the Spleen, harmonizes the Stomach, regulates Qi, and alleviates pain.14 Different acupoints may be chosen based on the type of surgery.

**Manipulation technique**

Techniques used included lift thrust,12-14 twirl rotation,12-14 or reinforcing-reducing12-13 for 20 s14 or 30 s12-13 rapid insertion12-13 or rapid insertion followed by slow penetration to the depth of 0.8-1.5 inch;14 and needle retention for 20 min11-13 or 30 min.11,14 Three studies reported the use of bilateral acupoints.11-13 Shi Xuemin has devised some new acupuncture definitions and quantitative manipulation techniques. One of these is the direction of applied force as an important factor that determines reinforcing-reducing. He has also suggested that the reinforcing-reducing effect of twirling rotating is directly related to the applied force; that the best duration of reinforcing-reducing manipulation of a twirling rotating needle is 1-3 min for each point; and that the best interval between two acupuncture sessions is 3-6 h, making acupuncture therapy more standardized, reproducible, and controllable.22 It is still unclear whether bilateral acupuncture produces a better effect than unilateral acupuncture. The number of treatments needed might be related to the type of acupuncture and intervention combination. Larger-scale trials are needed to draw firmer conclusions.

**Side effects and use of rescue anti-emetics**

Overall, there were no major adverse events. The studies we examined did not report the use of anti-emetics. Thus, the effect of acupuncture on these medications could not be evaluated.

**Quality evaluation**

Although high-quality evidence does not necessarily imply strong recommendations, and strong recommendations can arise from low quality evidence,10 future studies should follow the standard guidelines to improve the quality of evidence.

**Limitations**

Because of the lack of studies using the same type of intervention(s), it was difficult to form subgroups for Meta-analysis. Therefore, we could not evaluate the efficacy of interventions other than manual acupuncture, the efficacy of different types of combination interventions, and the efficacy of acupuncture or combination intervention versus anti-emetics. Another limitation was that practitioners may vary on their judgments of the extent of recovery. The resulting bias could be reduced with larger sample sizes. Although the database search included articles worldwide, the articles that met the inclusion criteria were mainly from mainland China. The small sample size was also a potential limitation of this study.

**Studies not included in the meta-analysis**

The four studies15-18 that were excluded involved colon
cancer surgery, intestinal surgery, and abdominal surgery. The techniques used included manual acupuncture, manual and electroacupuncture, electroacupuncture with usual care, and acupuncture, electroacupuncture combined with oral Chinese medicine (Table 2). As techniques used among the studies were not uniform, an attempt to categorize them into the same subgroup would have increased heterogeneity and affected the validity of the results. Not all of these trials generated random sequences. One trial reported allocation concealment (low risk of bias). None reported blinding of participants, personnel, or outcome assessors. All studies were assessed as low risk of bias associated with incomplete outcome data. One study reported drop-out. No studies used intention-to-treat analysis. Three trials reported baseline comparisons of age and gender. Three studies reported comparison of total clinical symptom scores for pre- and post-treatment and were assessed as low risk (Figure 6A and 6B).

One trial classified acupuncture effects according to four levels of improvement: "recovered," "markedly effective," "effective," and "ineffective." Three studies classified the outcome according to the effect index: [(total scores pre-treatment total scores post-treatment)/total scores pre-treatment] \times 100\% . One study defined the treatment outcome as "markedly effective" (effect index \times 76\% ), "effective" (51%-75\% ), "improved" (26%-50\% ), and "ineffective" (<25\% ). Two studies defined the treatment outcome as "recovered" (effect index \geq 95\% ), "markedly effective" (70\% \leq n < 95\% ), "effective" (30\% \leq n < 70\% ), and "ineffective" (n < 30\% ); where n = effect index. Evaluations were based on clinical symptoms. In these studies, the total effective rate was higher in the intervention group than in the control group. Frequently used acupoints were Zusanli (ST 36), Shangjuxu (ST 37), and Xiajuxu (ST 39). Two studies reported the use of bilateral acupoints. Side effects were not reported for all studies. No trials reported the use of anti-emetics. Acupoint(s) selection might vary according to different combination of interventions. The use of combined interventions might improve efficacy and reduce the need for anti-emetics (thus reducing their side effects). However, more RCTs are needed to verify this.

In relation to the CONSORT criteria, two studies (50\%) reported baseline data, no studies reported sequence generation for randomization, one study (25\%) reported allocation concealment, and no studies reported details of blinding (Figure 7A). In relation to the STRICTA criteria, one study (25\%) reported the style of acupuncture used, two studies (50\%) reported acupoint locations, two studies (50\%) reported the depth of needle insertion, four studies (100\%) reported the response sought, four studies (100\%) reported needle stimulation, four studies (100\%) reported the duration of needle retention, and three studies (75\%) reported needle type (Figure 7B). In relation to the GRADE criteria, all studies showed low quality of evidence (Table 2). Blinding was not applied and precision was not reported for all outcomes.

Other types of interventions
Interventions such as acupoint injection, auricular acupuncture, and catgut embedding might be useful therapies. However, there were no RCTs using these interventions that fulfilled the inclusion criteria for review and Meta-analysis.

Conclusion
Acupuncture treatment might be beneficial for POI. We could not draw any firm conclusions regarding its efficacy because of the low quality of trials. Further large-scale, high-quality RCTs are needed to validate the indications reported here and to develop a standardized method of treatment. Zusanli (ST 36) and Shangjuxu (ST 37) were the most common acupoints used. The techniques used included lift thrust, swirl rotation, reinforcing-reducing, rapid insertion, and rapid insertion followed by slow penetration; needle retention was between 20 min and 30 min. Generally, no major adverse events occurred. Rescue anti-emetics did not seem to be an important part of management in these studies. More rigorous trials are needed to evaluate the efficacy of different types of acupuncture and combination interventions. Although these trials were mainly carried out in mainland China, acupuncture intervention for POI is worth further investigation, as it is a potentially effective therapy that could be used worldwide. We hope that the results of this systematic review and Meta-analysis will prompt further research that leads to better patient care for POI patients both in China and worldwide.

REFERENCES

<table>
<thead>
<tr>
<th>Author, Year &amp; Country</th>
<th>Study population (average)</th>
<th>Type, duration of surgery (average)</th>
<th>Type, duration of anesthesia (average)</th>
<th>Experimental events (n)</th>
<th>Control events (n)</th>
<th>Rescue anti-emetics</th>
<th>Side effects</th>
<th>Cure or effective rate</th>
<th>Grade</th>
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<tbody>
<tr>
<td>Dai ZY et al 2011</td>
<td>Adult M/F 28/32 37-75 (56) yo</td>
<td>Colon cancer surgery</td>
<td>N/A</td>
<td>Manual acupuncture at Zusanli (ST 36), Sanyinjiao (SP 6), Jueguf (GB 39), Xuehai (SP 10), Juzen (ST 41), Neiting (ST 13) for 30 min, twice daily, for 3 d (n=30)</td>
<td>Oral Domperidone (two times daily) (n=30)</td>
<td>N/A</td>
<td>N/A</td>
<td>Total effective rate</td>
<td></td>
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<tr>
<td>Guangzhou, China</td>
<td>2011</td>
<td>Abdominal surgery</td>
<td>General anesthesia</td>
<td>Usual care + electro-acupuncture at bilateral Zusanli (ST 36), Sanyinjiao (ST 39), Xuejiao (ST 39), needle retention for 30 min, twice daily, for 3 d (n=30)</td>
<td>Sodium chloride solution 600 mL per anal (n=45)</td>
<td>N/A</td>
<td>N/A</td>
<td>Total effective rate</td>
<td></td>
</tr>
<tr>
<td>Shih JE, Guangzhou, China 2012</td>
<td>Adult M/F 15/15 53.17±13.49 yo (65.83±25.4 cm, 64.95±7.21 kg)</td>
<td>Abdominal surgery</td>
<td>General anesthesia</td>
<td>Usual care + electro-acupuncture at bilateral Zusanli (ST 36), Sanyinjiao (ST 39), Xuejiao (ST 39), needle retention for 30 min, twice daily, for 3 d (n=30)</td>
<td>Oral Domperidone (two times daily) (n=30)</td>
<td>N/A</td>
<td>N/A</td>
<td>Total effective rate</td>
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<tr>
<td>Shaera G, Xinjiang, China 2012</td>
<td>Adult M/F 21/10 51.39±14.26 yo (68.95±13.11 kg, 49.88±16.94 cm, 68.74±12.52 kg)</td>
<td>Abdominal surgery (appendix, stomach, colon, liver, gallbladder, small intestine)</td>
<td>General anesthesia</td>
<td>Acupuncture at Zhongwan (CV 12), Xiawan (CV 10), Qihai (CV 6), Tianshu (ST 25), Zusanli (ST 36), Sanyinjiao (ST 39), Quchi (LI 11), Qiuxu (GB 39), Neiting (ST 13), Liangqi (ST 34) + electro-acupuncture at Zusanli (ST 36) and Quchi (LI 11) in the morning 2nd day after surgery using G91-D 1.5 V, 2 Hz rarefraction/dense wave, 30 min, once daily, for 7 d (n=31)</td>
<td>&quot;Damp-heat pattern&quot; oral Chinese medicine for post abdominal surgery gastrointestinal dysfunction, twice daily, for 7 day (n=34)</td>
<td>N/A</td>
<td>N/A</td>
<td>Total effective rate</td>
<td></td>
</tr>
</tbody>
</table>
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