

# Acupuncture therapy on postoperative nausea and vomiting in abdominal operation

## A Bayesian network meta analysis

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### Abstract

**Background:** Postoperative nausea and vomiting (PONV) is a common complication after surgery. However, drugs cannot prevent it completely, and acupuncture therapy shows the potential in preventing PONV, yet the best choice hasn't been demonstrated.

**Objective:** This network meta analysis aimed to evaluate the effectiveness of different acupuncture therapies used for preventing PONV in abdominal operation.

**Methods:** Authors searched articles from PubMed/Medline, Cochrane library, Web of Science, Ebsco and Ovid/Embase, and established database from setup time to June 2019. Quality evaluation of included studies was performed with Cochrane risk-of-bias tool (ROB 2.0). Pairwise and network meta analysis were conducted by RevMan and Addis respectively.

**Results:** Twenty studies with 2862 patients were included in this research. Pairwise meta analysis shows that compared with placebo, transcutaneous electric nerve stimulation had lower risk of postoperative nausea (PON) (odds ratio (OR) = 0.42, 95% confidence interval (CI): 0.30–0.60), postoperative vomiting (POV) (OR = 0.53, 95%CI: 0.36–0.78), PONVs (OR = 0.46, 95%CI: 0.31–0.68), and postoperative rescue (POR) (OR = 0.61, 95%CI: 0.41–0.90), Capsicum had lower risk of PON (OR = 0.16, 95%CI: 0.09–0.28), PONVs (OR = 0.23, 95%CI: 0.12–0.45), Acupressure had lower risk of POV (OR = 0.42, 95%CI: 0.25–0.70), POR (OR = 0.42, 95%CI: 0.27–0.64). In network meta analysis, compared with usual care, the probability rank suggested that Acupoint Injection showed lowest risk of PON (OR = 0.02, 95%CI: 0.00–0.11), POV (OR = 0.06, 95%CI: 0.01–0.49), Usual care for PONVs (OR = 0.31, 95%CI: 0.13–0.75), and Capsicum for POR (OR = 0.39, 95%CI: 0.07–2.33). Further study should be carried out to verify this result.

**Conclusion:** Both pairwise and network meta analysis showed acupuncture therapy was superior to placebo and usual care. Different acupuncture therapy regimens may have advantages in different aspects. And compared with POV, PON seems easier to control. Research results may provide guidance for the prevention of PONV.

Systematic review registration: PROSPERO CRD42019147556.

**Abbreviations:** 5HTRA = 5-hydroxytryptamine receptor antagonists, AI = Acupoint Injection, CI = confidence interval, OR = odds ratio, PON = postoperative nausea, PONV = postoperative nausea and vomiting, POR = postoperative rescue, POV = postoperative vomiting, PSRF = Potential Scale Reduction Factor, RCTs = randomized controlled trials, TEN = transcutaneous electric nerve stimulation, UC = usual care.

**Keywords:** accelerate rehabilitation, acupuncture therapy, network meta analysis, postoperative nausea and vomiting

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## 1. Introduction

Since anesthesia has been carried out in 1840s, a great amount of surgical patients received anesthesia each year, but until 1 century later, doctors realized that postoperative nausea and vomiting (PONV) is an operative complication rather than inadvertent ones.<sup>[1,2]</sup> According to the simplified Apfel score, the main risk factors of PONV are female gender, non-smoking, history of PONV and motion sickness, postoperative opioids.<sup>[3]</sup> About 30% surgical patients had this unpleasant experience and the ratio can increase to 80% in high-risk patients.<sup>[1,2,4]</sup> Therefore, patients have to pay an extra 30% cost to avoid PONV.<sup>[5]</sup> PONV is not fatal, but when dehydration, electrolyte imbalance and esophageal rupture come across, the situation will nosedive and even cause death.<sup>[6]</sup> To reduce PONV, a series of antiemetic drugs were produced including histamine type 1receptor antagonists, 5-hydroxytryptaminereceptor antagonists (5HTRA), dopamine receptor antagonists, corticosteroids and neurokinin-1 receptor antagonists.<sup>[7]</sup> It has been established that each single drug can reduce 20% to 25% PONV risk and combination antiemetic therapy may reduce 60% PONV risk at most<sup>[8]</sup>; however, high returns are accompanied by high risks, patients may suffer from the adverse effects of those drugs. Drowsiness and headache are common adverse effects when taking histamine type 1receptor antagonists. Patients using histamine type 1receptor antagonists may suffer from long-QT interval and malignant ventricular arrhythmias. Besides, corticosteroids easily caused glucose variability endocrine dyscrasia.<sup>[2]</sup> In addition, short half-life time and economic aspects limit the use of 5HTRA and corticosteroids and neurokinin-1 receptor antagonists respectively.<sup>[2]</sup> Moreover, only 28% of patients will benefit from prophylactic use of antiemetics,<sup>[9]</sup> while PONV within 24 hours still occurs in 25% to 30% of patients.<sup>[10]</sup> Thus, concerning about the side effect and massive cost of drugs, researchers are becoming interested in using complementary and alternative therapies such as musicotherapy, ginger, and aromatherapy.<sup>[11-14]</sup> And among all complementary and alternative therapies, acupuncture is one of the most common and acceptable physical therapies. It is reported that Neiguan (PC6), a wide-used acupoint, shows confident potential in alleviating PONV according to practical acupuncture prescriptions.<sup>[1,15-18]</sup> In addition, acupuncture therapy can reduce the incidence of pain and PONV-related outcomes of certain operations both in adults and adolescents.<sup>[19-21]</sup> However, few meta analysis about acupuncture therapy in preventing PONV after abdominal surgery has been reported. Moreover, which therapy is more effective remains disputable. In this review, we assessed the effectiveness of different acupuncture therapies in preventing PONV by utilizing network meta analysis and hoped this work could inspire relevant study.

## 2. Method

The review has been registered on PROSPERO (<https://www.crd.york.ac.uk/prospero>) NO. CRD42019147556. We used the Preferred Reporting Items for Systematic review and Meta-Analysis statement for network meta analysis to conduct the meta-analysis.<sup>[22]</sup> Because this was systematic literature research, ethical approval can be skipped.

### 2.1. Literature search strategies

Authors searched PubMed/Medline, Cochrane library, Web of Science, Ebsco, and Ovid/Embase from setup time to June 2019 and language was restricted to English and Chinese. The search

strategy contained both PONV and acupuncture therapies including “acupuncture,” “electroacupuncture,” “acupuncture therapy,” “PONV,” “postoperative nausea and vomiting,” “PON,” “POV,” and similar terms. The complete search strategy is shown in Appendix 1, <http://links.lww.com/MD/E271>.

## 2.2. Eligibility criteria

### 2.2.1. Inclusion criteria.

- (1) randomized controlled trials (RCTs),
- (2) patients completed abdominal surgery with general anesthesia,
- (3) report at least 1 outcome of PON, POV, PONVs and POR in 24 hours after operation,
- (4) experimental group received acupuncture therapy and specifically, acupressure and transcutaneous electric nerve stimulation (TEN) with acupoint are regarded as acupuncture therapies,
- (5) control group consisted of UC, sham, medication, or counseling,
- (6) only the latter of any duplicate publications was selected,
- (7) patients underwent surgery regardless of age, gender, ethnic.

### 2.2.2. Exclusion criteria.

- (1) case report, review, protocol, animal study, supplementary issue, and conference paper
- (2) study without acupuncture therapies or specific acupoints,
- (3) non-RCTs or retrospective study or novelty or letter,
- (4) non-prophylactic use of acupuncture therapies or patients had been diagnosed as PONV before intervention.

## 2.3. Data extraction

After identification of the target RCTs, 1 reviewer extracted the following data into a database created by Excel 2019 and checked by a second reviewer:

- (1) title, first author, year, country, sex, and sample size,
- (2) diseases, American Society of Anesthesiologists Class, types of intervention, types of outcomes, and acupoints. The third reviewer was the referee in case of doubts or disagreements.

## 2.4. Quality of evidence assessment and risk of bias assessment

Cochrane risk-of-bias tool (ROB 2.0) was used to evaluate the quality.<sup>[23]</sup> ROB 2.0 has 5 domains including: bias arising from the randomization process, bias due to deviations from intended interventions, bias due to missing outcome data, bias in measurement of the outcome and bias in selection of the reported result. Two reviewers used ROB 2.0 to assess all matched literatures and the third reviewer requested adjudications if necessary.

## 2.5. Statistical analysis

Cytoscape 3.7.0 is a visualization tool which is commonly used in biomedicine field. For this literature, network plots were drawn by using Cytoscape, the node size and the line thickness represent the size of treatment and study respectively.

RevMan 5.3 is used to solve pairwise meta analysis, and odds ratio (OR) and 95% confidence interval (CI) were adopted.

Heterogeneity is quantified with the  $I^2$  statistic. When the  $I^2 > 50\%$ , a random effect model was adopted; if not, a fixed effect model.

ADDIS 1.16.6 is a software based on Bayesian framework which uses the Markov Chain Monte Carlo theory to perform the multi-treatment meta analysis.<sup>[24]</sup> Convergence is calculated by using the Brooks-Gelman-Rubin method. It compares within-chain and between-chain variance in order to calculate the Potential Scale Reduction Factor (PSRF). The more PSRF approximate 1, the better convergence can be obtained, and  $PSRF \leq 1.05$  is acceptable.<sup>[25-27]</sup> As the incidence rate is dichotomous data, OR and 95%CI were adopted. A random effect model is used as it is a more appropriate method.<sup>[28]</sup> Node split analysis is an alternative method to assess inconsistency by assessing whether direct and indirect evidence are in agreement and  $P > .05$  indicates no significant inconsistency is found.<sup>[29]</sup> Rank probability plots suggested potential efficacy when 2 treatments had no statistical significance (in this review, a lower rank is worse), but it should be treated with caution.<sup>[30]</sup>

### 3. Results

As showed in Figure 1, authors retrieved 19,116 articles from 5 databases, 8115 duplicate articles were removed. A total of 10,692 articles were eliminated by reading titles and abstracts and 204 articles by reading the full text. Finally, 20 RCTs published from 1998 to 2015 with 2862 patients matched the final criteria through web search and selection.

#### 3.1. Study characteristics

The sample size of RCTs ranged from 27 to 410 and consisted mainly of female. Participants were from Asia, Europe and America between 1998 and 2015. Among all included studies, PC6 and Zusanli (ST36) are the most commonly used acupoints. TEN may be the most common acupuncture therapy appeared in 7 studies with 490 patients. 7 studies were 3-arm trails and other were 2-arm trails. 13 studies employed placebo as control group and 7 studies employed Usual Care (UC). Main characteristics of included RCTs were shown in Table 1 and network plots of included RCTs were shown in Figure 2.

#### 3.2. Methodological evaluation

The risk of bias assessment for the 20 RCTs is summarized in Table 2. About two thirds studies were assessed having low to moderate risk of bias. Twelve studies were considered as low risk in randomization for describing appropriate random sequence generation and concealment. In regard to deviations from intended interventions, 13 studies had low risk for patients were blinded. All studies may have low risk of missing outcome data for the observation time was short and missing data was few. As PONV was reported by patients themselves, 13 studies used placebo so that patients could not recognize which group did they participate. Fifteen studies had low risk in reporting bias for they had got approval from Ethic Committee. When taking all bias into consideration, 10 studies had low risk Appendix 2, <http://links.lww.com/MD/E272>.

#### 3.3. Pairwise meta analysis of outcomes

The pairwise meta analysis result concluded by RevMan is displayed in Table 3 and Appendix 5, <http://links.lww.com/MD/E275>.

**3.3.1. PON.** It showed that some acupuncture therapies, compares with placebo, have lower risk of PON (TEN OR = 0.42, 95%CI: 0.30–0.60), (Capsicum OR = 0.16, 95%CI: 0.09–0.28).

**3.3.2. POV.** Patients use Acupressure, TEN, Capsicum, rather than placebo, have lower risk of POV (Acupressure OR = 0.42, 95%CI: 0.25–0.70), (TEN OR = 0.53, 95%CI: 0.36–0.78), (Capsicum OR = 0.23, 95%CI: 0.12–0.45).

**3.3.3. PONVs.** Compared with placebo, TEN can lower the risk of PONVs in postoperative 24 hours (OR = 0.46, 95%CI: 0.31–0.68).

**3.3.4. POR.** Compared with placebo, both Acupressure and TEN can solve with the requirement of POR (Acupressure OR = 0.42, 95%CI: 0.27–0.64), (TEN OR = 0.61, 95%CI: 0.41–0.90).

#### 3.4. Network meta analysis of outcomes

According to the extracted data, parameters of ADDIS were set as initial and the network meta analysis for PON, POV, PONVs, and POR were analyzed. The value of RSPF approximates to 1 which indicates complete convergence (Appendix 3, <http://links.lww.com/MD/E273>). According to node split analysis (Appendix 4, <http://links.lww.com/MD/E274>) all  $P$  values exceeded .05 and consistency model was adopted (Tables 4–7). OR at the left lower part means the odds ratio of vertical to horizontal, a smaller OR value represents a better efficacy. The rank probability plots are displayed in Figure 3.

**3.4.1. PON.** Compared with placebo and UC, Acupressure, Capsicum, Acupoint Injection (AI), and TEN show significance difference, and especially, combined with rank probability plots, AI has the highest probability to rank first for PON in 24 hours and Capsicum is the secondary best. In addition, the circle of TEN, 5HTRA, and TEN+5HTRA reveals that the combination has lower risk of PON.

**3.4.2. POV.** Compared with placebo and UC, Capsicum, and AI show significance difference. TEN has lower risk of POV than UC. AI still has the highest probability to rank first for POV in 24 hours. The second and third most effective interventions are Capsicum and TEN respectively. In addition, the circle of TEN, 5HTRA, and TEN+5HTRA reveals that the combination has lower risk of POV.

**3.4.3. PONVs.** With the help of Figure 3, it suggests that EA + propofol is the best therapy in preventing PONVs while UC is ranked as the worst on the aspect of PONVs. Moreover, TEN is more effective than UC but has no significance difference comparing with placebo.

**3.4.4. POR.** Acupressure and Capsicum can reduce the use of POR rather than placebo (Acupressure OR = 0.41, 95%CI: 0.23–0.77; Capsicum OR = 0.21, 95%CI: 0.05–0.92). And placebo is worse than UC (OR = 1.89, 95%CI: 0.71–5.48).

### 4. Discussion

It is still controversial that whether surgery type is a risk factor of PONV,<sup>[31,32]</sup> but in order to reduce heterogeneity as much as possible, we only chose abdominal surgery into this review. This review aimed to assessed the effect of different acupuncture therapies by using Bayesian meta analysis. The RCTs were

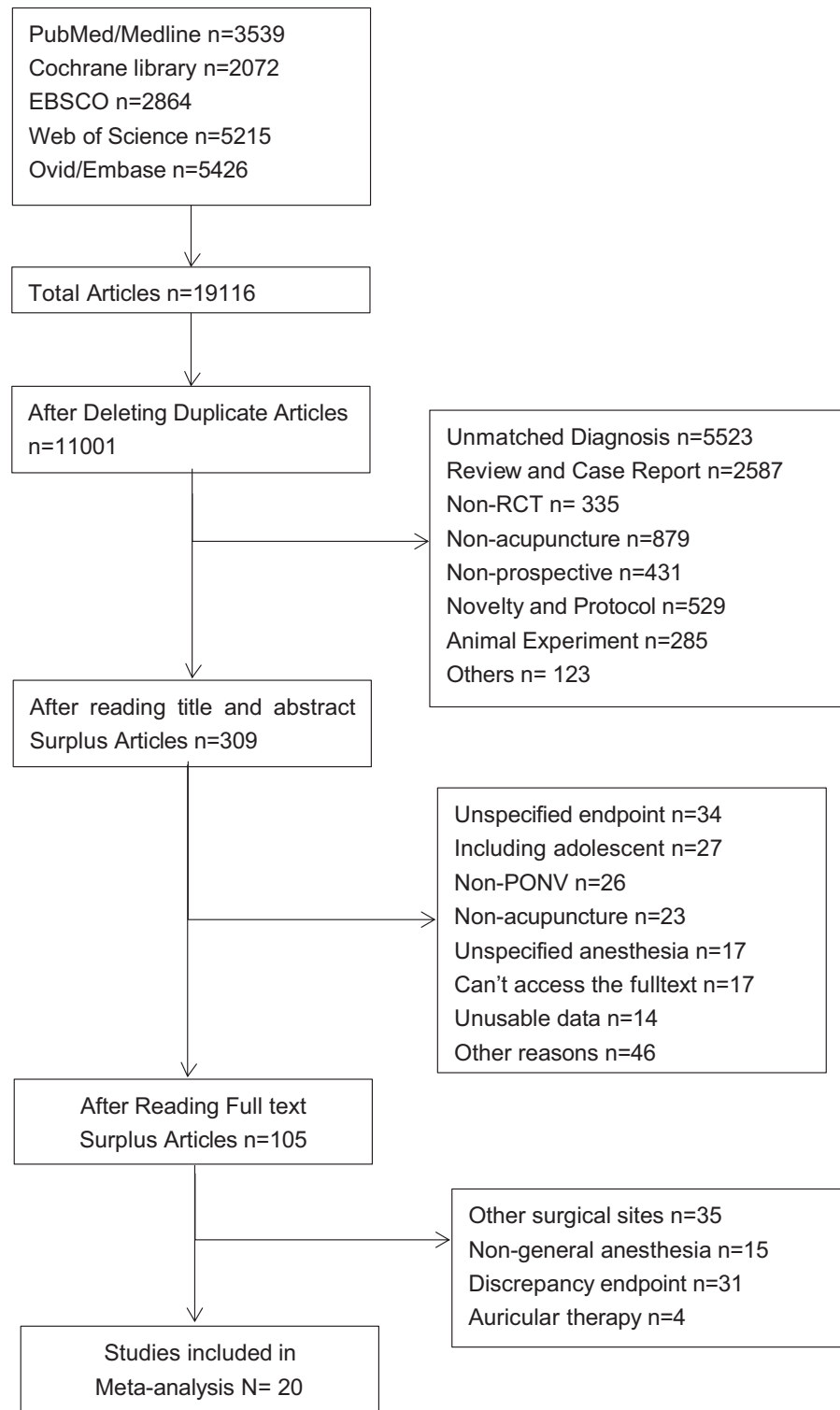


Figure 1. PRISMA flow diagram of the study selection process.

acceptable in quality, which is helpful to lift the quality of evidence. The results indicated that acupuncture therapy can reduce the risk of PONV by the combination of direct and indirect evidence. It is in accordance with previous research.<sup>[33]</sup> Moreover, authors concluded some key findings as follows.

First, all acupuncture therapies taken into this meta analysis, show certain potential to lower the risk of PONV. And in this review, AI is thought as the best choice to prevent PONV, which can treat diseases by synergetic effects of acupuncture and medication.<sup>[34]</sup> Besides, Tan et al<sup>[7]</sup> regarded that the efficacy

**Table 1****Characteristics of enrolled studies.**

Author	Yr	Country	Treatment	Sample	Sex	ASA	Acupoint	Outcomes
Chen	1998	China	TEN	25	F	1,2	ST36	(1)(2)(4)
			Placebo	75				
Harmon	1999	Ireland	Acupressure	52	F	1,2	PC6	(1)(2)(4)
			Placebo	52				
Alkaissi	1999	Sweden	Acupressure	20	F	Unclear	PC6	(1)
			Placebo	20				
			UC	20				
Agarwal	2000	India	Acupressure	100	F/M	1,2	PC6	(1)(2)(4)
			Placebo	100				
Sim	2002	Singapore	EA	60	F	1,2	PC6, ST36	(3)
			Placebo	30				
Kim	2002	Korea	Capsicum	50	F	1,2	PC6	(1)(2)
			Placebo	60				
Coloma	2002	America	TEN	30	F/M	1,2,3	PC6	(1)(2)
			TEN+5HTRA	30				
			5HTRA	30				
Alkaissi	2002	Sweden	Acupressure	135	F	Unclear	PC6	(1)(2)(3)(4)
			Placebo	139				
			UC	136				
Lin	2002	China	EA	50	F	1,2	ST36	(1)(2)
			Acupuncture	25				
			UC	25				
Turgut	2007	Turkey	Acupressure	50	F	1,2	PC6	(1)(2)(4)
			Placebo	50				
Arnberger	2008	Switzerland	TEN	110	F	1,2,3	PC6	(1)(2)(3)(4)
			Placebo	110				
Zhu	2010	China	AI	40	F	1,2	PC6	(1)(2)
			Droperidol	40				
			UC	40				
Kim	2011	Korea	TEN	210	F	1,2	PC6	(1)(2)(3)(4)
			Placebo	54				
White	2012	America	Placebo	50	F/M	1,2	PC6	(1)(2)(4)
			Acupressure	50				
Tang	2013	China	EA	90	F	1,2	PC6	(3)
			UC	30				
Yin	2013	China	TEN	30	F	Unclear	ST36, ST34	(1)(2)
			UC	30				
Yang	2014	China	EA	30	F	1,2	LR8, LR11	(3)
			EA+ Propofol	32				
			Propofol	31				
Yang	2015	China	TEN	50	F	1,2	PC6	(1)(2)(3)(4)
			5HTRA	53				
			UC	50				
Kim	2015	Korea	Placebo	60	F/M	1,2	PC6	(1)(2)(4)
			Capsicum	60				
Yao	2015	China	TEN	35	F	1,2	PC6, LI4, ST36, SP6	(1)(2)
			Placebo	36				

(1) PON, (2) POV, (3) PONVs, (4) POR.

5HTRA = 5-hydroxytryptamine receptor antagonists, ASA = American Society of Anesthesiologists, EA = electroacupuncture, F = female, M = male, PON = postoperative nausea, PONV = postoperative nausea and vomiting, POR = postoperative rescue, POV = postoperative vomiting, TEN = transcutaneous electric nerve stimulation, UC = usual care.

between acupoint stimulation and drugs were comparable, however, considering about the circle of TEN, 5HTRA, and TEN+5HTRA, acupuncture therapy may be more effective in the rank, and the combination may be the best choice, though the results did not reach statistical significance. Thus, more prospective study is needed to strengthen this evidence. Moreover, capsaicin is a pungent substance from chili pepper, and both internal and external use take effect in preventing PON and POV, which gave patients another choice.<sup>[35]</sup>

Second, based on the evaluation of OR value, acupuncture therapy can provide more protection in PON than POV. Nausea

is confused with vomiting in most cases, even recognized as foreboding symptom of vomiting.<sup>[36]</sup> Actually, nausea is controlled by cerebral cortex and adjacent tissue while the key neural circuits for producing vomiting are located in the medulla. They are 2 reflections with a part of same neuronal pathway. Thus, the variance of effect might be found due to different physiological reaction mechanisms.<sup>[37,38]</sup>

Third, it is obvious that PC6 and ST36 are the popular choice in this review. According to traditional Chinese medicine theory, PC6 can treat all thoracic and abdominal diseases. Researchers found that PC6 can relieve the intensity of nausea while other

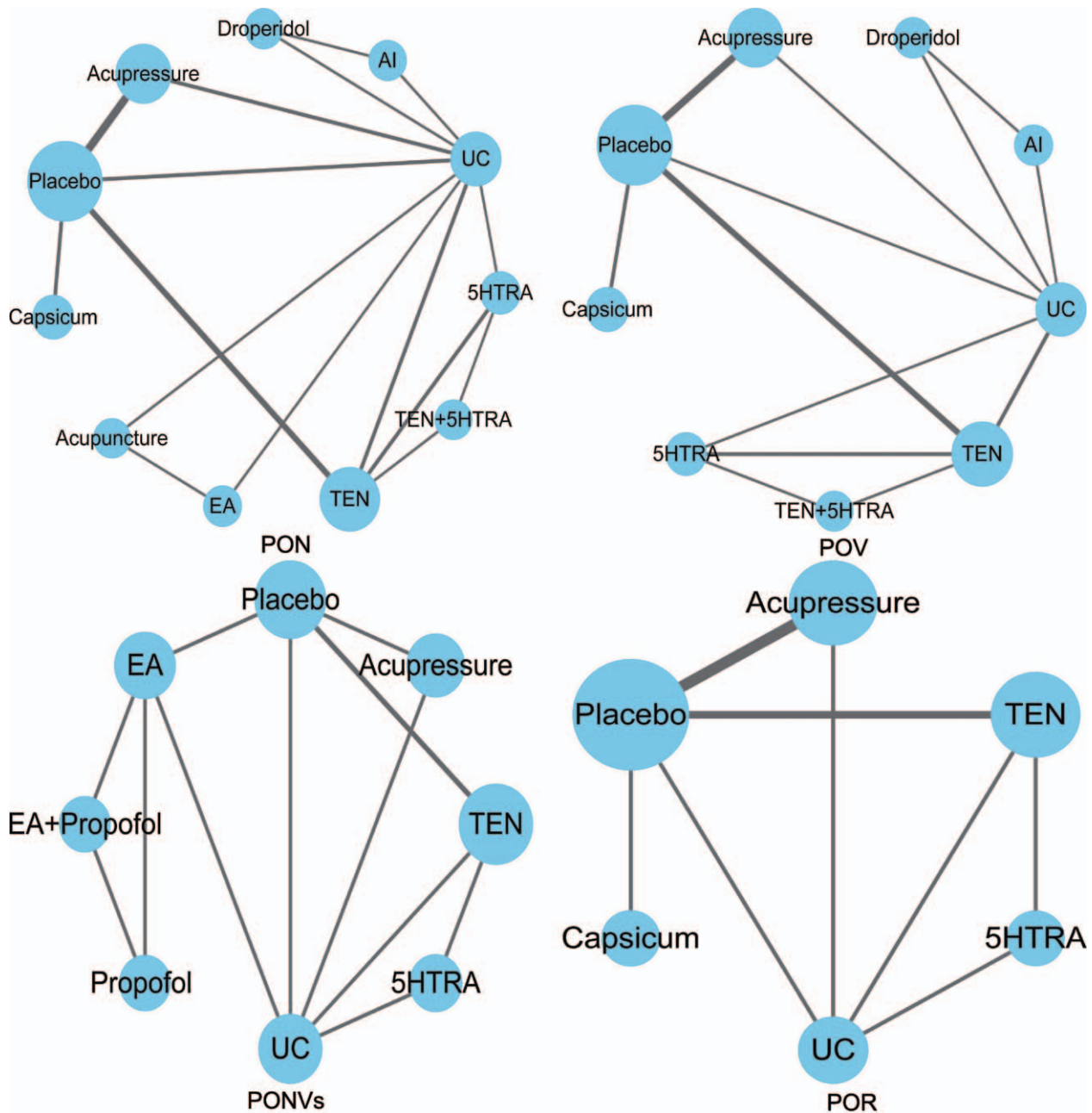


Figure 2. Network plots of interventions.

acupoints cannot, the mechanism may associate with the modulation of coupling between the cerebellum and insula, which is the specific neural basis.<sup>[39]</sup> In addition, ST36 is traditionally considered to be an effective acupoint in treating gastrointestinal diseases, and the main symptom of nausea and vomiting is epigastric discomfort. Stimulating ST36 may adjust the gastrointestinal motility by modulating gastric motility via vagovagal and sympathetic reflexes.<sup>[40,41]</sup> Xu used ST36 and PC6 to treat hiccups, which has similar mechanism with nausea and vomiting in traditional Chinese medicine.<sup>[42]</sup>

What is more, it is out of our expectation that invasive and non-invasive therapies are comparable in effect. It is well known that pain, bleeding and invasiveness restrict the promotion of acupuncture therapy, and people are more willing to accept non-

invasive intervention. Our result provides evidence for this method but further study should be carried out.

To be honest, this study has several limitations. First, a potential limitation was that only 24 hours post operation was considered in the present network meta analysis, acute-PONV, and delayed-PONV were not separated for the lack of data, thus further subgroup analysis was not conducted. Furthermore, except TEN and acupressure, few studies about acupuncture therapies were included, which may limit the credibility of the present results. Another limitation was the unevenness in intervention time, duration, selection of acupoint among clinical trials, which makes it harder to determine the best therapeutic option.<sup>[43]</sup> Finally, although the ADDIS software is easy to use, it can be constrained by the fact that it cannot be programmed

**Table 2**  
Quality evaluation of enrolled studies.

Author	Yr	R	D	MI	ME	S	O
Chen	1998	Some Concern	Low	Low	Low	Some Concern	Some Concern
Alkaissi	1999	Some Concern	Some Concern	Low	High	Low	High
Harmon	1999	Low	Low	Low	Low	Low	Low
Agarwal	2000	Low	Low	Low	Low	Low	Low
Alkaissi	2002	Low	Some Concern	Low	High	Low	High
Coloma	2002	Low	Low	Low	Low	Low	Low
Kim	2002	Low	Low	Low	Low	Low	Low
Lin	2002	Low	Some Concern	Low	High	Low	High
Sim	2002	Some Concern	Low	Low	Low	Low	Some Concern
Turgut	2007	Low	Low	Low	Low	Low	Low
Arnberger	2008	Low	Low	Low	Low	Low	Low
Zhu	2010	Some Concern	Some Concern	Low	High	Some Concern	High
Kim	2011	Low	Low	Low	Low	Low	Low
White	2012	Some Concern	Low	Low	Low	Low	Some Concern
Tang	2013	Some Concern	Some Concern	Low	High	Some Concern	High
Yin	2013	Some Concern	Some Concern	Low	High	Some Concern	High
Yang	2014	Some Concern	Some Concern	Low	High	Some Concern	High
Kim	2015	Low	Low	Low	Low	Low	Low
Yang	2015	Low	Low	Low	Low	Low	Low
Yao	2015	Low	Low	Low	Low	Low	Low

R: bias arising from the randomisation process.

D: bias due to deviations from intended interventions.

MI: bias due to missing outcome data.

ME: bias in measurement of the outcome.

S: bias in selection of the reported result.

O: overall risk of bias.

freely. A random effects model can only be reported when estimating the effect size, which may be conservative in estimating our results.<sup>[44]</sup> Despite these limitations, the comparison of acupuncture therapy in managing PONV was systematically and comprehensively analyzed, which is quite fresh in related research. The results may provide guidance for the prevention of PONV.

In conclusion, the present comprehensive network meta analysis indicates that acupuncture therapies, particularly AI and Capsicum has greater advantages for preventing PONV in abdominal operation compared with placebo and UC. In the light of the increasing importance and interest in PONV, there is a need for high-quality trials to confirm the best choice of acupuncture therapy.

**Table 3**  
Pairwise meta analysis.

Comparison (A vs B)	Effect model	Pairwise OR (95%CI)	[0,4-5]Number of patients		Number of studies		[0,7-8]Heterogeneity test	I <sup>2</sup>	P value
			A(E/T)	B(E/T)	B(E/T)	B(E/T)			
PON									
Acupressure vs placebo	Random	0.61 [0.35, 1.05]	94/399	123/398	6	57%	.04		
Acupressure vs UC	Random effect	0.30 [0.04, 2.34]	33/155	51/156	2	71%	.06		
TEN vs 5HTRA	Fixed effect	0.75 [0.39, 1.44]	26/80	32/83	2	40%	.20		
TEN vs UC	Fixed effect	0.50 [0.25, 1.01]	39/80	50/80	2	26%	.24		
TEN vs placebo	Fixed effect	<b>0.42</b> [0.30, 0.60]	139/380	179/275	4	0%	.98		
Capsicum vs placebo	Fixed effect	<b>0.16</b> [0.09, 0.28]	25/110	78/120	2	0%	.38		
placebo vs UC	Random effect	0.29 [0.04, 1.96]	31/159	51/156	2	68%	.08		
POV									
Acupressure vs placebo	Fixed effect	<b>0.42</b> [0.25, 0.70]	29/382	56/386	5	12%	.34		
TEN vs 5HTRA	Fixed effect	1.22 [0.56, 2.65]	17/80	15/83	2	0%	.97		
TEN vs placebo	Fixed effect	<b>0.53</b> [0.36, 0.78]	72/380	88/274	4	30%	.23		
TEN vs UC	Fixed effect	0.50 [0.24, 1.01]	20/80	31/80	2	0%	.32		
Capsicum vs placebo	Fixed effect	<b>0.23</b> [0.12, 0.45]	17/110	51/120	2	0%	.58		
PONVs									
TEN vs placebo	Fixed effect	<b>0.46</b> [0.31, 0.68]	125/320	99/164	2	0%	.50		
POR									
Acupressure vs placebo	Fixed effect	<b>0.42</b> [0.27, 0.64]	43/387	81/391	5	40%	.16		
TEN vs placebo	Fixed effect	<b>0.61</b> [0.41, 0.90]	82/345	94/239	3	0%	.79		

5HTRA = 5-hydroxytryptamine receptor antagonists, ASA = American Society of Anesthesiologists, E = events, EA = electroacupuncture, F = female, M = male, PON = postoperative nausea, PONV = postoperative nausea and vomiting, POR= postoperative rescue, POV = postoperative vomiting, TEN = transcutaneous electric nerve stimulation, T = total, UC = usual care.

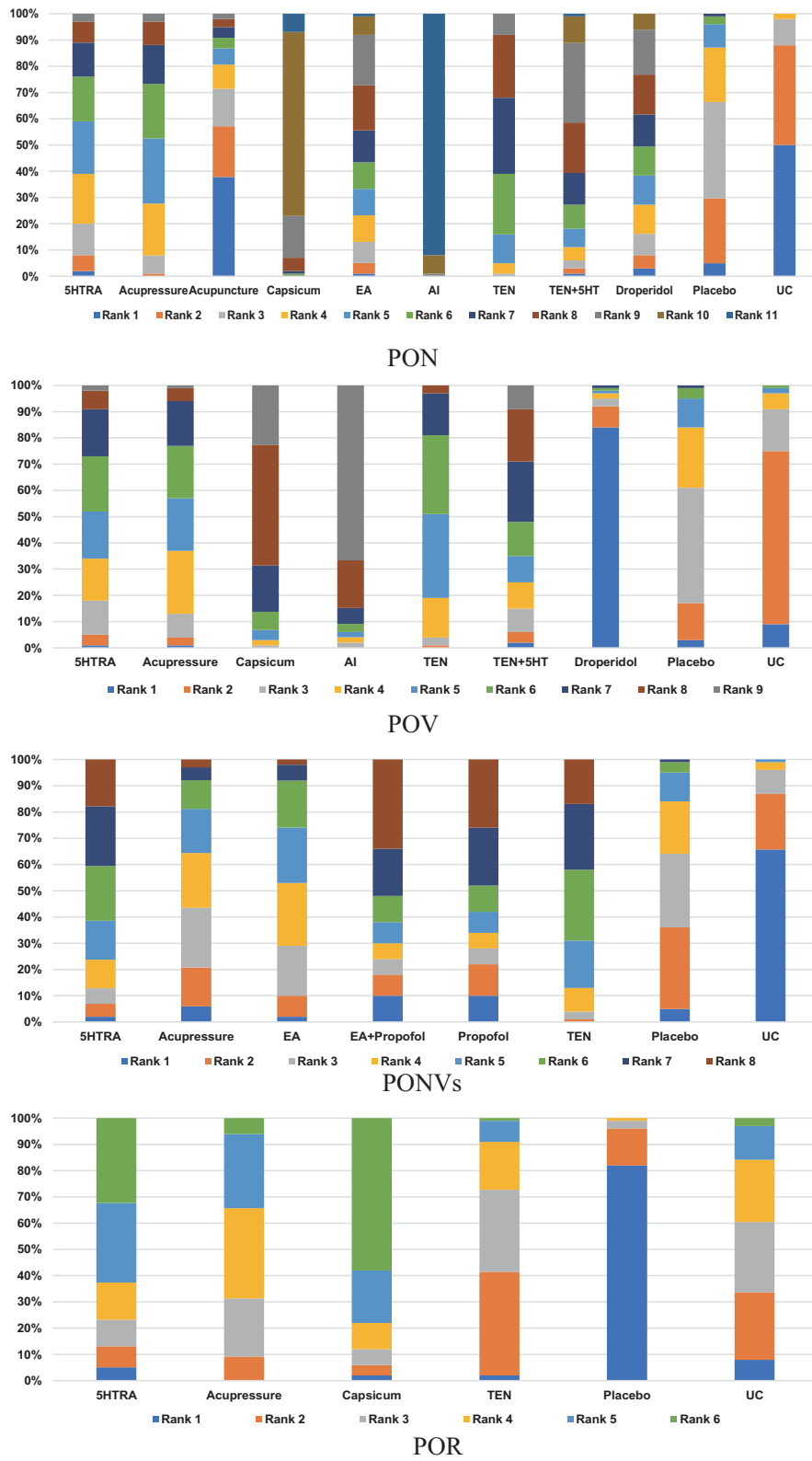


Figure 3. Rank probability plots.



**Table 4****Network meta analysis for postoperative nausea.**

5HTRA										
1.06 (0.37, 3.38)	Acupressure									
0.52 (0.08, 3.05)	0.48 (0.08, 2.48)	Acupuncture								
<b>4.26</b> <b>(1.16, 17.31)</b>	<b>4.01 (1.41, 10.86)</b>	<b>8.54 (1.35, 51.78)</b>	Capsicum							
1.41 (0.26, 8.04)	1.32 (0.25, 6.23)	2.74 (0.65, 11.17)	0.33 (0.05, 1.96)	EA						
<b>17.38 (2.78, 126.45)</b>	<b>16.05 (2.86, 103.69)</b>	<b>34.05 (3.88, 330.09)</b>	4.07 (0.61, 30.12)	<b>12.41 (1.51, 118.47)</b>	AI					
1.37 (0.57, 3.33)	1.29 (0.59, 2.54)	2.66 (0.51, 13.56)	<b>0.32 (0.11, 0.87)</b>	0.98 (0.20, 4.62)	<b>0.08 (0.01, 0.44)</b>	TEN				
1.77 (0.50, 6.47)	1.66 (0.37, 6.66)	3.45 (0.46, 26.45)	0.41 (0.08, 2.06)	1.26 (0.18, 9.12)	<b>0.10 (0.01, 0.80)</b>	1.30 (0.36, 4.62)	TEN+5HTRA			
1.28 (0.25, 6.94)	1.20 (0.26, 5.44)	2.54 (0.34, 18.58)	0.30 (0.05, 1.74)	0.92 (0.13, 6.46)	<b>0.07 (0.01, 0.33)</b>	0.93 (0.20, 4.36)	0.73 (0.11, 5.15)	Droperidol		
0.64 (0.24, 1.80)	0.61 (0.35, 1.00)	1.27 (0.24, 6.49)	<b>0.15 (0.06, 0.36)</b>	0.46 (0.09, 2.29)	<b>0.04 (0.01, 0.20)</b>	<b>0.47 (0.27, 0.85)</b>	0.37 (0.10, 1.47)	0.51 (0.11, 2.33)	Placebo	
0.43 (0.15, 1.14)	<b>0.40 (0.18, 0.79)</b>	0.84 (0.19, 3.62)	<b>0.10 (0.03, 0.29)</b>	0.31 (0.07, 1.24)	<b>0.02 (0.00, 0.11)</b>	<b>0.31 (0.15, 0.62)</b>	<b>0.24 (0.06, 0.96)</b>	0.34 (0.08, 1.29)	0.66 (0.32, 1.25)	UC

5HTRA = 5-hydroxytryptamine receptor antagonists, TEN = transcutaneous electric nerve stimulation, UC = usual care

**Table 5****Network meta analysis for postoperative vomiting.**

5HTRA										
0.95 (0.16, 5.26)	Acupressure									
2.74 (0.39, 21.32)	2.88 (0.63, 14.71)	Capsicum								
5.77 (0.40, 79.19)	6.11 (0.44, 82.52)	2.12 (0.12, 34.14)	AI							
1.04 (0.28, 3.90)	1.10 (0.35, 3.70)	0.39 (0.08, 1.67)	0.18 (0.02, 2.18)	TEN						
1.39 (0.22, 9.39)	1.47 (0.17, 13.60)	0.51 (0.04, 5.44)	0.24 (0.01, 5.26)	1.32 (0.22, 8.80)	TEN+5HTRA					
0.13 (0.01, 1.33)	0.14 (0.01, 1.42)	<b>0.05 (0.00, 0.58)</b>	<b>0.02 (0.00, 0.17)</b>	0.12 (0.01, 1.08)	0.09 (0.01, 1.42)	Droperidol				
0.59 (0.13, 2.87)	0.63 (0.28, 1.55)	<b>0.22 (0.06, 0.76)</b>	0.10 (0.01, 1.35)	0.57 (0.25, 1.38)	0.43 (0.06, 3.24)	4.64 (0.50, 48.27)	Placebo			
0.36 (0.07, 1.43)	0.38 (0.08, 1.57)	<b>0.13 (0.02, 0.73)</b>	<b>0.06 (0.01, 0.49)</b>	<b>0.34 (0.10, 0.99)</b>	0.26 (0.03, 1.79)	2.72 (0.43, 16.54)	0.60 (0.15, 2.01)	UC		

5HTRA = 5-hydroxytryptamine receptor antagonists, AI= Acupoint Injection, TEN = transcutaneous electric nerve stimulation, UC = usual care

**Table 6****Network meta analysis for postoperative nausea and vomiting.**

5HTRA										
0.60 (0.13, 2.58)	Acupressure									
0.67 (0.16, 2.99)	1.15 (0.30, 4.41)	EA								
1.19 (0.09, 22.08)	2.01 (0.17, 33.35)	1.79 (0.21, 21.24)	EA+Propofol							
1.06 (0.10, 17.49)	1.76 (0.17, 26.40)	1.55 (0.20, 14.60)	0.87 (0.07, 10.40)	Propofol						
1.05 (0.31, 3.35)	1.76 (0.54, 5.93)	1.52 (0.48, 4.93)	0.87 (0.06, 9.85)	0.98 (0.07, 9.73)	TEN					
0.50 (0.14, 1.76)	0.84 (0.31, 2.55)	0.73 (0.28, 2.09)	0.42 (0.03, 4.51)	0.48 (0.04, 4.48)	0.48 (0.24, 1.01)	Placebo				
0.32 (0.10, 1.05)	0.54 (0.19, 1.55)	0.47 (0.18, 1.29)	0.27 (0.02, 2.74)	0.31 (0.02, 2.67)	<b>0.31 (0.13, 0.75)</b>	0.64 (0.29, 1.37)	UC			

**Table 7****Network meta analysis for postoperative rescue.**

5HTRA										
0.74 (0.12, 3.74)	Acupressure									
1.47 (0.14, 11.87)	1.99 (0.39, 10.22)	Capsicum								
0.52 (0.11, 2.45)	0.71 (0.32, 1.77)	0.37 (0.07, 1.84)	TEN							
0.30 (0.06, 1.45)	0.41 (0.23, 0.77)	0.21 (0.05, 0.92)	0.57 (0.29, 1.09)	Placebo						
0.58 (0.12, 2.64)	0.79 (0.28, 2.39)	0.39 (0.07, 2.33)	1.09 (0.37, 3.19)	1.89 (0.71, 5.48)	UC					

5HTRA = 5-hydroxytryptamine receptor antagonists, TEN = transcutaneous electric nerve stimulation, UC = usual care.

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