

Dexamethasone alone vs in combination with transcutaneous electrical acupoint stimulation or tropisetron for prevention of postoperative nausea and vomiting in gynaecological patients undergoing laparoscopic surgery

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Abstract

Background: Postoperative nausea and vomiting (PONV) is commonly reported after surgery and anaesthesia. We compared the effects of combinations of electrical acupoint stimulation or tropisetron with dexamethasone with the effects of dexamethasone alone, for inhibition of PONV in gynaecological patients undergoing laparoscopic surgery.

Methods: We randomized 157 patients undergoing elective gynaecological laparoscopic surgery under general anaesthesia into the following three groups: acupoint stimulation+dexamethasone (Group Acu, $n=53$), tropisetron+dexamethasone (Group Trp, $n=53$), and dexamethasone alone (Group Dxm, $n=51$). The incidence of nausea, vomiting, and need for rescue antiemetics was recorded 2, 6, 24, and 48 h after surgery.

Results: We found significant differences in the incidence of PONV during 24 h after surgery between the combination therapy groups and the dexamethasone-alone group ($P=0.021$). In the first 24 h, 28% of patients in Group Acu, 26% of patients in Group Trp, and 50% of patients in Group Dxm experienced nausea, vomiting, or both. The incidence of 24 h PONV in Group Acu was significantly lower than that in Group Dxm ($P=0.048$; odds ratio 0.389; 95% CI 0.170–0.891). The incidence of 24 h PONV in Group Trp was also significantly lower than that in Group Dxm ($P=0.042$; odds ratio 0.359; 95% CI 0.157–0.819). There was no significant difference between Group Acu and Group Trp ($P=0.857$). The need for antiemetic rescue medication was similar in the three groups. All groups expressed similar patient satisfaction.

Conclusions: Combined with dexamethasone, electrical acupoint stimulation or tropisetron is more effective in PONV prophylaxis than dexamethasone alone in gynaecological patients undergoing laparoscopic surgery.

Clinical trial registration: NCT 02096835.

Key words: acupuncture points; antiemetics; dexamethasone; electric stimulation therapy; postoperative nausea and vomiting; serotonin antagonists; tropisetron

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Editor's key points

- Postoperative nausea and vomiting frequently occur in women undergoing gynaecological surgery.
- In women undergoing laparoscopic gynaecological surgery under general anaesthesia, the antiemetic effects were compared between electrical acupoint stimulation versus tropisetron, both in combination with dexamethasone.
- Electrical acupoint stimulation may be as effective as tropisetron in antiemetic effect.

Postoperative nausea and vomiting (PONV) is one of the most common and unpleasant complications after surgery under general anaesthesia. The incidence of PONV after general anaesthesia is ~30% when inhalation anaesthetics are used with no prophylaxis.¹ In certain high-risk patients, this incidence is as high as 70–80%.² Postoperative nausea and vomiting reduces patient satisfaction,³ with some patients rating it worse than postoperative pain.⁴ Postoperative nausea and vomiting may cause dehydration and electrolyte imbalance, aspiration of gastric contents, increased intracranial pressure, suture dehiscence, and bleeding.^{1–5} In addition to causing a sense of discomfort, PONV and its resulting complications delay recovery and hospital discharge time, adding to hospital costs.^{6–7} Although hundreds of randomized controlled trials have focused on prophylaxis of PONV, and management guidelines have been established,⁸ optimal PONV prevention remains elusive, and inadequate management of these symptoms is common.⁹

The 5-hydroxytryptamine type 3 (5-HT₃) receptor antagonists and dexamethasone are two antiemetic drugs with similar efficacy in patients with one or two risks for PONV after single-dose administration.^{10–12} However, these drugs are only partly effective for patients at high risk for PONV and may produce undesirable adverse effects. As an alternative approach to preventing PONV, acupuncture and other non-pharmacological techniques have gained increasing attention for their possible value in reducing the requirement for antiemetics and their minimal adverse effects.^{1–13–14} Studies have suggested that stimulation of Pericard 6 (P6; also known as Nei Guan) is as effective as medication prophylaxis.^{15–16} The efficiency of acupoint stimulation of P6 in gynaecological patients undergoing laparoscopic surgery is widely documented. It is not known whether P6 stimulation would provide additional benefits in reduction of PONV when combined with dexamethasone, and importantly, whether it could exert an effect equal to that of a 5-HT₃ receptor antagonist when either is combined with dexamethasone.

We designed a prospective double-blind randomized controlled study to compare the effects of P6 stimulation+dexamethasone with tropisetron+dexamethasone, and with dexamethasone alone, in the inhibitory effect on PONV in women undergoing elective gynaecological laparoscopic surgery under general anaesthesia. The primary end point was the incidence of any nausea, vomiting, or both within the first 24 h after surgery. The secondary end points were administration of rescue antiemetic medication and patient satisfaction.

Methods**Study design**

This study was reviewed and approved by the institutional ethics committee of Huashan Hospital, Fudan University (KY2014-007), and written informed consent was obtained from all patients

participating in the study. From the beginning of January 2014 to the end of December 2014, 157 consecutive female patients (age 18–60 yr), ASA physical status class I or II, undergoing elective gynaecological laparoscopic surgery under general anaesthesia, were included. They were randomly allocated using a computer-generated table into the following three groups: acupoint stimulation+dexamethasone group (Group Acu), tropisetron+dexamethasone group (Group Trp), or dexamethasone alone group (Group Dxm). Exclusion criteria were as follows: pregnancy or breastfeeding; mental retardation, psychiatric, or neurological disease; use of antiemetics, emetogenic drugs, opioids, or glucocorticoids within 3 days before surgery; known allergy to tropisetron or dexamethasone; nausea, vomiting, or both within 24 h before surgery; implantation of a cardiac pacemaker, cardioverter, or defibrillator; rash or local infection over the acupoint stimulation skin area; or having any diseases that could influence sensibility in wrists and hands. We decided to exclude patients if they unexpectedly developed intraoperative drug allergy, converted to open procedures, or had surgery-related postoperative complications. Data on patient characteristics and risk factors that may influence PONV (age, height, weight, a history of PONV and motion sickness, and smoking status) were collected from the patients' records and by preoperative interview.

Randomization was conducted on the day of surgery as the patient arrived at the operating room. Both acupoint stimulation and placebo treatment were performed by the same investigator, who was not involved in the anaesthesia and surgery. Transcutaneous electrical acupoint stimulation (TEAS) was achieved by an electrical neuromuscular stimulation device (JNR2; designed by the Department of Hand Surgery, Huashan Hospital, Fudan University, manufactured by Energy Conservation and Environment Protection Technology Company, Jiatong University, Shanghai, China). In Group Acu, a surface electrode was applied in the induction room to the P6 acupoint on the dominant upper extremity, located ~4 cm proximal to the distal wrist crease between the tendons of the flexor carpi radialis and the palmaris longus, and a negative surface electrode on the opposing dorsal aspect of the forearm. About 30 min before induction, an investigator connected the device to both electrodes with electrical wires, set initial electric stimulating current at 1 mA with the frequency at 2 Hz (square-wave pulses of 0.2 ms), gradually increased the current intensity until the patient felt pain or reached the discomfort threshold (ranging from 6 to 20 mA), and maintained the stimulation until the patient was discharged from the postanesthesia care unit (PACU). In Group Trp and Group Dxm, the same protocol was applied, but silicone covers were attached to both electrodes in order to achieve an inert control. The device was also turned on during the procedure, and electric current was set at between 6 and 20 mA. For adequate blinding, an opaque tape was applied to the patient's wrist above the electrodes, and the patient's arm was wrapped in a blanket. All patients were informed that they might or might not feel a tingling sensation around the wrist when the TEAS device was working.

A standardized anaesthetic protocol was followed. All patients were fasted for at least 8 h before anaesthesia. General anaesthesia was induced with midazolam 0.05 mg kg⁻¹ i.v., propofol 2–3 mg kg⁻¹ i.v., fentanyl 2–3 µg kg⁻¹ i.v., succinylcholine 1 mg kg⁻¹ i.v., and lidocaine 1 mg kg⁻¹ i.v. After induction, dexamethasone 10 mg i.v. was administered to all groups. Anaesthesia was maintained with sevoflurane (1.0–1.5 minimal alveolar concentration expired) and oxygen (fractional inspired O₂=1.0). Additional doses of fentanyl and rocuronium were titrated to maintain an adequate level of anaesthesia and muscle relaxation. Standard monitoring procedures were followed, including

ECG, non-invasive blood pressure, pulse oximetry, capnography, and inspiratory and expiratory sevoflurane concentrations. All patients received lactated Ringer's solution i.v. based on calculated preoperative deficits, surgical procedure, and estimated intraoperative blood loss. All laparoscopies were performed with CO₂ insufflation, and patients were placed in the Trendelenburg position. Patients' lungs were mechanically ventilated, and the respiratory rate was adjusted to maintain normocapnia (end-tidal CO₂ between 4.3 and 5.1 kPa). Parecoxib 40 mg i.v. and incision infiltration of ropivacaine 0.5% (10 ml) were used for postoperative analgesia at the end of surgery. Residual muscle relaxant effects were reversed with neostigmine 0–5 mg and atropine 0–2.5 mg.

At the start of skin closure, saline (5 ml; Group Acu and Group Dxm) or tropisetron (5 mg; Group Trp) was administered i.v. The syringe with the drug was prepared by a study coordinator according to group allocation. The anaesthetists who managed the patient were thus blinded to group assignment.

The patients were transported to the PACU after tracheal extubation. Administration of lactated Ringer's solution was continued at 2 ml kg⁻¹ h⁻¹ i.v. Analgesic therapy with morphine was administered upon patient's request. Metoclopramide 10 mg i.v. was administered as a rescue therapy to any patient who experienced nausea, an episode of vomiting, or both and requested rescue medication.

The patients, the anaesthetists, and the nursing staff were unaware of the group assignments. Nothing-by-mouth fasting was continued after surgery for 6 h after the laparoscopic procedure. All patients stayed in the hospital for at least 24 h after surgery.

Data collection

An anaesthetic nurse (Y.-H.C.) who was trained for the study and blinded to the randomization did the follow-up and data collection. All patients were interviewed at 2, 6, 24, and 48 h after surgery for any symptoms of nausea, retching, or vomiting, and potential side effects of TEAS and antiemetics, according to both medical records and accounts from patients. At these time points, patients were asked to score the worst nausea according to a visual analog scale score (from 0=no nausea to 10=the worst imaginable nausea) and the episodes of vomiting in the last time period (0–2, 2–6, 6–24, and 24–48 h), if they experienced any. A visual analog scale score of pain (from 0=no pain to 10=the worst imaginable pain) was also recorded at the same time points.

Nausea was defined as an unpleasant sensation associated with awareness of an urge to vomit without the presence of expulsive muscular movements. Retching and vomiting were defined as laboured, spasmodic rhythmic contraction of respiratory muscle without or with expulsion of gastric content, respectively.¹⁷ Postoperative nausea and vomiting was defined as at least one episode of nausea, retching, or vomiting, or any combination of these after surgery. Postoperative nausea (PON) was defined as at least one episode of nausea that occurred after surgery. Postoperative vomiting (POV) was defined as at least one incidence of vomiting or retching that occurred after surgery.

Additionally, the medical records were screened for administration of analgesics (morphine) and antiemetics (metoclopramide) within 48 h after surgery in the ward. The duration of anaesthesia and surgery, fentanyl dose during anaesthesia, extubation time after surgery, duration of stay in the PACU, time to food intake, time to resume walking after surgery, and time to discharge from the hospital were also collected in the PACU and in the ward or through telephone contact for discharged patients.

The patient satisfaction was evaluated 48 h after the procedure by asking patients how they would describe the experience during the whole study period using a 0–100 mm visual analog scale (from 0=very dissatisfied to 100=most satisfied imaginable).

Power calculation

Based on a previous study of women undergoing laparoscopic gynaecological surgery, the incidence of PONV in the first 24 h was 55% when prevented with dexamethasone.¹⁸ We assumed that a 35% absolute reduction (20% expected) of PONV incidence was of clinical significance when combined with use of TEAS or tropisetron. Power analysis calculation suggested that 41 patients should be recruited to each group to provide a power of 80% ($\beta=0.2$), with a two-sided confidence interval of 95% ($\alpha=0.05$). To allow a margin of 'statistical safety' and compensate for drop-outs, we aimed to include at least 150 patients in the study.

Statistical analysis

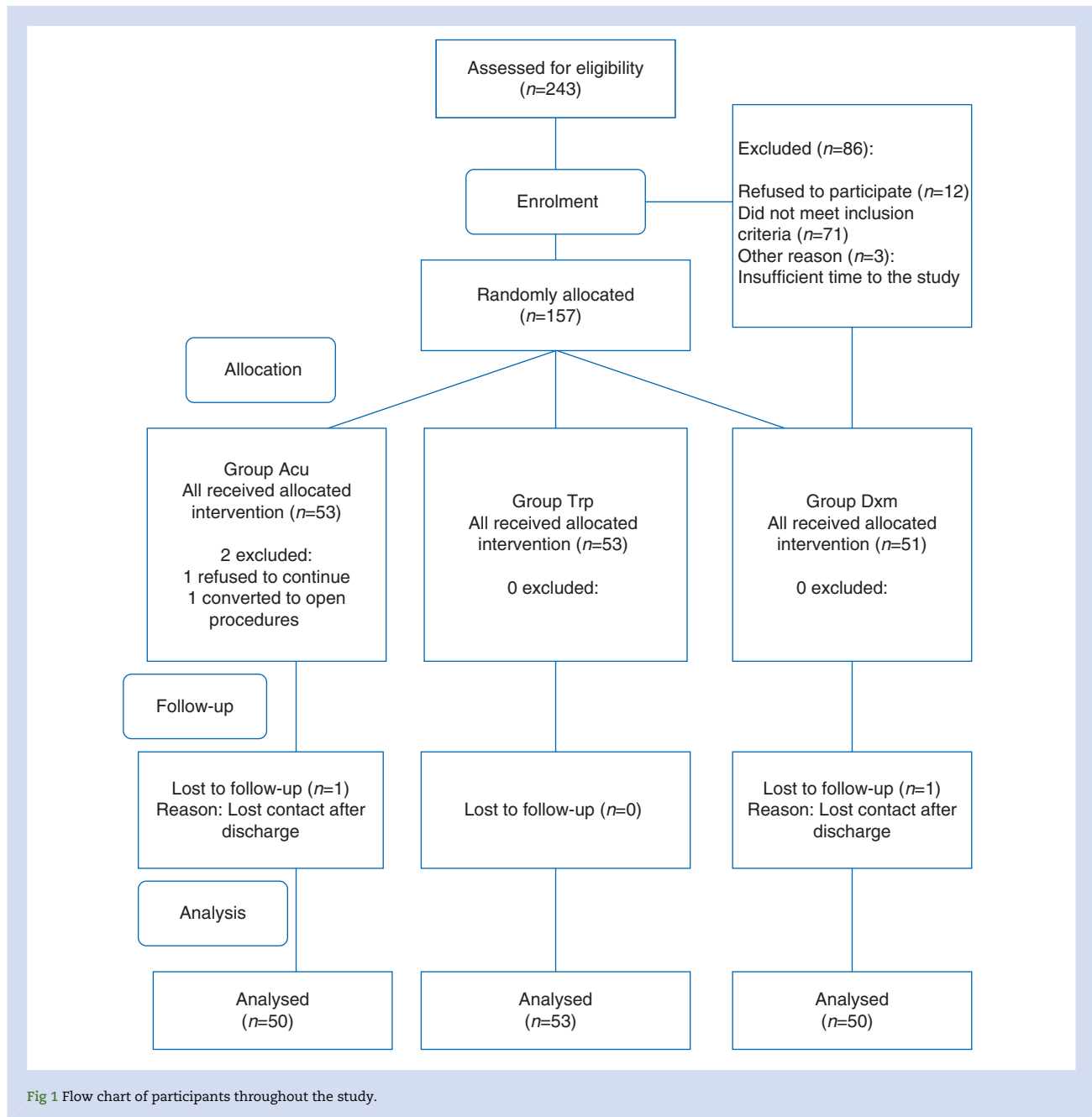
Descriptive statistics were presented as median (minimum–maximum) for continuous data. Categorical outcomes were summarized as number (proportion, 95% CI). All data were processed in SPSS 18.0 (SPSS Inc., Chicago, IL, USA). Normality was tested by the Kolmogorov–Smirnov analysis. Comparisons of continuous outcomes among groups were examined using the Kruskal–Wallis test. A χ^2 analysis or Fisher's exact test was used to assess categorical outcomes among groups. The P-value was adjusted using the Holm–Bonferroni correction for multiple comparisons. A P-value of <0.05 was considered statistically significant.

Results

A total of 157 female patients were initially included in our study, and 153 completed the study. Four patients were excluded from the study because they refused to continue the study, had insufficient follow-up, or converted to open surgery (see Fig. 1). The types of surgery included diagnostic laparoscopy, laparoscopic hysterectomy, laparoscopically assisted vaginal hysterectomy, laparoscopic oophorectomy, and laparoscopic myomectomy. The flow chart of the study is shown in Figure 1. The clinical characteristics are presented in Table 1. The groups were similar in terms of PONV risk factors and surgery- and anaesthesia-related profiles.

For all patients enrolled in the study, the overall incidence of PONV was 35% within the first 24 h (19% vomiting incidence). Both combination therapies provided significantly better prophylaxis against PONV than dexamethasone alone (Table 2). In the first 24 h after operation, 28% (95% CI 15–41%) of patients in Group Acu, 26% (95% CI 14–39%) of patients in Group Trp, and 50% (95% CI 36–64%) of patients in Group Dxm experienced nausea, vomiting, or both. Separately, the incidence of 0–24 h PONV in Group Acu was significantly lower than that in Group Dxm ($P=0.024$ without Holm–Bonferroni correction; odds ratio 0.389; 95% CI 0.170–0.891; relative risk reduction 44%; number needed to treat 4.5). The incidence of 0–24 h PONV in Group Trp was also significantly lower than that in Group Dxm ($P=0.014$ without Holm–Bonferroni correction; odds ratio 0.359; 95% CI 0.157–0.819; relative risk reduction 47%; number needed to treat 4.2), whereas the incidences were comparable between Group Acu and Group Trp ($P=0.857$ without Holm–Bonferroni correction).

The requirement for antiemetic rescue medication was similar among groups, respectively, 10% (95% CI 1–19%) in Group Acu, 8% (95% CI 0–15%) in Group Trp, and 14% (95% CI 4–24%) in Group



Dxm. The total dosage of metoclopramide among the three groups was also similar. We did not find significant differences in patient satisfaction between groups ($P=0.230$; Table 2).

The length of stay in the PACU was significantly different among three groups ($P=0.005$); 30 min in Group Acu and Group Trp and 35 min in Group Dxm (Supplementary Table S1). The pain scores 0–2 h ($P=0.002$) and 2–6 h ($P=0.004$) after surgery were statistically significantly different among the three groups (Supplementary Table S1). Intraoperative fentanyl dose and postoperative morphine dose were comparable between the groups (Table 1).

Several patients in Group Acu reported side effects in the skin area under electrodes, such as redness (four patients), swelling (one patient), and itching (one patient), all of which were mild, bearable, and alleviated within 6 h.

Discussion

In this single-centre, prospective, randomized, double-blind clinical study, we showed that TEAS of P6 combined with dexamethasone produced an antiemetic effect in patients undergoing elective gynaecological laparoscopic surgery. This effect was better than that with dexamethasone alone and similar to that with tropisetron combined with dexamethasone. The need for rescue medicine and the patient satisfaction score were similar among groups.

In the absence of prophylactic antiemetics, the incidence of PONV in gynaecological patients undergoing laparoscopic surgery was 40–77%.^{19 20} This was also true for high-risk patients who received a single drug for prevention of PONV.²¹ Growing evidence has demonstrated the antiemetic effect of acupuncture

Table 1 Baseline characteristics: patient characteristics and perioperative variables. Values are median (minimum–maximum) or n (%). [†]P-value refers to Fisher's exact test, and [‡]P-value refers to Kruskal–Wallis H-test. Group Acu, P6 acustimulation and dexamethasone group; Group Dxm, dexamethasone alone group; Group Trp, tropisetron and dexamethasone group; PONV, postoperative nausea and vomiting

Variable	Group Acu (n=50)	Group Trp (n=53)	Group Dxm (n=50)	P-value
Preoperative factors				
Age [yr; median (range)]	37 (24–60)	35 (23–60)	35 (22–60)	–
History of previous PONV, motion sickness, or both [n (%)]	7 (14)	8 (15)	9 (18)	–
Smokers [n (%)]	2 (4)	0 (0)	1 (2)	–
BMI [kg m ⁻² ; median (range)]	22.1 (16.9–30.5)	21.7 (18.3–30.0)	22.3 (16.4–33.1)	–
Operation and anaesthesia				
Duration of anaesthesia [min; median (range)]	98 (53–195)	109 (50–251)	100 (23–219)	0.488 [‡]
Duration of surgery [min; median (range)]	70 (35–166)	88 (30–210)	73 (20–199)	0.279 [‡]
Intraoperative fentanyl [mg; median (range)]	0.35 (0.20–0.50)	0.35 (0.15–0.65)	0.40 (0.15–0.70)	0.118 [‡]
Neostigmine [mg; median (range)]	2.0 (0.0–4.0)	2.0 (0.0–3.0)	2.0 (0.0–3.0)	0.653 [‡]
I.V. fluid [ml; median (range)]	1500 (950–2250)	1500 (600–2500)	1500 (1000–3100)	0.207 [‡]
Extubation time [min after surgery; median (range)]	7.5 (1.0–36.0)	10.0 (2.0–22.0)	7.0 (1.0–30.0)	0.484 [‡]
P6 stimulation time [min; median (range)]	165 (105–238)	–	–	–
P6 stimulation intensity [mA; median (range)]	11 (6–20)	–	–	–
Postoperative period				
Morphine 0–48 h after surgery [n (%)]	1 (2)	2 (4)	3 (6)	0.694 [†]
Morphine 0–48 h after surgery [mg; median (range)]	0 (0–10)	0 (0–10)	0 (0–20)	0.595 [†]
Time to food intake [h after surgery; median (range)]	6 (6–15)	6 (6–15)	6 (6–26)	0.729 [†]
Time to resume walking [h after surgery; median (range)]	14 (7–48)	14 (6–24)	15 (6–50)	0.848 [†]

Table 2 Postoperative nausea and vomiting in the first day (0–24 h), patients' needs for rescue antiemetics, and patient satisfaction scores. Values are median (minimum–maximum) or n (%; 95% CI). Group Acu, P6 acustimulation and dexamethasone group; Group Dxm, dexamethasone alone group; Group Trp, tropisetron and dexamethasone group; PONV, postoperative nausea and vomiting. *P-value represents χ^2 analysis and [†]P-value refers to Kruskal–Wallis H-test. [‡]Significant difference vs Group Dxm with Holm–Bonferroni correction

Variable	Group Acu (n=50)	Group Trp (n=53)	Group Dxm (n=50)	P-value
0–24 h PONV				
Nausea, vomiting, or both [incidence; n (%; 95% CI)]	14 (28, 15–41) [‡]	14 (26, 14–39) [‡]	25 (50, 36–64)	0.021*
Nausea [incidence; n (%; 95% CI)]	14 (28, 15–41) [‡]	14 (26, 14–39) [‡]	25 (50, 36–64)	0.021*
Vomiting [incidence; n (%; 95% CI)]	9 (18, 7–29)	8 (15, 5–25)	12 (24, 12–36)	0.503*
Need for rescue antiemetics				
Metoclopramide [proportion; n (%; 95% CI)]	5 (10, 1–19)	4 (8, 0–15)	7 (14, 4–24)	0.560*
Metoclopramide [mg; median (range)]	0 (0–50)	0 (0–20)	0 (0–40)	0.581 [†]
Patient satisfaction [median (range)]	95 (85–100)	92 (80–100)	94 (85–100)	0.230 [†]

alone after various types of surgery.^{13 15 22} Several studies have also documented the role of P6 stimulation combined with the antiemetic droperidol²³ or ondansetron²⁴ for the prevention of PONV. To our knowledge, however, no study has ever investigated the preventive effect of P6 stimulation in combination with dexamethasone and compared their effect with other combined drug prophylaxis. In our study, subgroup analysis revealed that TEAS of P6 was more effective in reducing nausea than in decreasing retching and vomiting when used together with dexamethasone. Our results support previous findings, which showed that P6 stimulation was particularly effective in reducing the incidence of postoperative nausea.^{25–27} Given that only a few patients vomited without experiencing nausea, the result from the PON subgroup was very similar to the PONV result in our study. Several meta-analyses support the preventive effect of P6 stimulation in POV when used alone.^{15 16} Therefore, a possible explanation for our results is that P6 stimulation combined with dexamethasone has little cumulative effect in preventing POV.

Certainly, owing to the comparatively low onset of POV in this study, we also cannot rule out the possibility that the sample size in this subgroup is underpowered to detect such an effect.

The duration of TEAS in our study was from 30 min before anaesthesia to discharge from the PACU. The median stimulation time was 165 min. There is limited information available regarding the optimal timing and duration of P6 stimulation to optimize its antiemetic effect, although the timing of application of TEAS is thought to be of some importance. One study showed that acupoint stimulation should be started before any emetic stimuli.²⁸ One study showed that P6 stimulation was more effective in reducing PONV when it was administered after surgery.²⁹ However, another study showed no significant difference in reduction of PONV between its application before or after induction.¹⁴ The duration of acupressure and TEAS application in most studies lasted from 6 to 24 h.^{14 16 24 27 30} White and colleagues²⁹ thought that TEAS had little pre-emptive antiemetic effect. In contrast with this, Arnberger and colleagues²⁶ applied

P6 stimulation only during the course of the anaesthesia. Even so, there was substantial carryover effect into the postoperative recovery phase. If we used TEAS for a longer time, the PONV preventive effect could be better and last much longer. However, use of TEAS after surgery might cause inconvenience to patients by adversely influencing sleep quality and limiting mobility. Many studies reported minor to no local side effects at the acustimulation site.^{15 29 31} Our study reconfirmed that this method has good tolerability and safety.

In the present study, a majority of the patients experiencing PONV refused to receive antiemetic treatment either because the symptoms were mild and transient or because they were worried about the adverse effects of antiemetics. Once PONV occurs, the likelihood of PONV to persist or to recur is at least 65%.³² Although the dose and proportion of rescue medication did not differ between groups in our study, the timing of treatment might be different. Patients in Group Dxm might receive the first metoclopramide dose earlier than those in other two groups because of more severe symptoms. Therefore, the 24 h assessment might be influenced by the use of rescue medication, which resulted in fewer differences between groups after surgery. Thus, compared with the genuine situation, our results might appear to be conservative.

Our study has several limitations. First, although patients were told that they might or might not feel a sensation with the P6 stimulation device before the study, those patients receiving the active P6 stimulation were more likely to detect a tingling sensation. Therefore, a potential placebo effect may contribute to the greater antiemetic efficacy in the acustimulation group. Furthermore, we limited our study to a single type of short-duration surgery. It is unclear whether our findings could be extended to other surgical populations. Finally, we did not find a significant difference between Group Acu and Group Trp in PONV prevention, indicating that TEAS of P6 and tropisetron both in combination with dexamethasone have similar effects. However, it is possible that we failed to find a difference between them because of insufficient sample size.

Conclusion

In summary, the effect of TEAS of P6 in combination with dexamethasone is better than dexamethasone alone, and similar to tropisetron in combination with dexamethasone for the prevention of PONV in gynaecological patients undergoing laparoscopic surgery. Our findings suggest that P6 stimulation might be an alternative to the 5-HT₃ antagonists for patients at high risk of PONV in a multimodal antiemetic approach. Unfortunately, P6 stimulation is not yet a routine procedure for PONV prophylaxis, although it seems to have good cost-effectiveness.

Authors' contributions

Study conception: J.Z.

Study design: X.-Y.Y., D.-H.H., J.Z.

Study direction: J.Z.

Study coordination: D.-H.H.

Patient recruitment: D.-H.H.

Study execution: J.X., Z.-T.W., H.-L.W.

Data collection: Y.-H.C.

Data preparation: Z.-T.W., H.-L.W.

Data analysis: J.X., Y.-H.C.

Data analysis/interpretation: X.-Y.Y.

Paper writing: X.-Y.Y., Y.-H.C., J.Z.

Paper revision: J.X., Z.-T.W., H.-L.W., D.-H.H.

Supplementary material

Supplementary material is available at *British Journal of Anaesthesia* online.

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Declaration of interest

None declared.

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References

- Rüsch D, Eberhart LHJ, Wallenborn J, Kranke P. Nausea and vomiting after surgery under general anesthesia: an evidence-based review concerning risk assessment, prevention, and treatment. *Dtsch Arztebl Int* 2010; **107**: 733–41
- Apfel CC, Korttila K, Abdalla M, et al. A factorial trial of six interventions for the prevention of postoperative nausea and vomiting. *N Engl J Med* 2004; **350**: 2441–51
- Apfel CC, Laara E, Koivuranta M, Greim CA, Roewer N. A simplified risk score for predicting postoperative nausea and vomiting: conclusions from cross-validations between two centers. *Anesthesiology* 1999; **91**: 693–700
- Macario A, Weinger M, Carney S, Kim A. Which clinical anesthesia outcomes are important to avoid? The perspective of patients. *Anesth Analg* 1999; **89**: 652–8
- Apfel CC, Heidrich FM, Jukar-Rao S, et al. Evidence-based analysis of risk factors for postoperative nausea and vomiting. *Br J Anaesth* 2012; **109**: 742–53
- Carroll NV, Miederhoff PA, Cox FM, Hirsch JD. Costs incurred by outpatient surgical centers in managing postoperative nausea and vomiting. *J Clin Anesth* 1994; **6**: 364–9
- Watcha MF. The cost-effective management of postoperative nausea and vomiting. *Anesthesiology* 2000; **92**: 931–3
- Gan TJ, Diemunsch P, Habib AS, et al. Consensus guidelines for the management of postoperative nausea and vomiting. *Anesth Analg* 2014; **118**: 85–113
- Myklejord DJ, Yao L, Liang H, Glurich I. Consensus guideline adoption for managing postoperative nausea and vomiting. *WMJ* 2012; **111**: 207–13
- Ho KY, Gan TJ. Pharmacology, pharmacogenetics, and clinical efficacy of 5-hydroxytryptamine type 3 receptor antagonists for postoperative nausea and vomiting. *Curr Opin Anaesthesiol* 2006; **19**: 606–11
- Ho CM, Wu HL, Ho ST, Wang JJ. Dexamethasone prevents postoperative nausea and vomiting: benefit versus risk. *Acta Anaesthesiol Taiwan* 2011; **49**: 100–4
- De Oliveira GS Jr, Castro-Alves LJ, Ahmad S, Kendall MC, McCarthy RJ. Dexamethasone to prevent postoperative nausea and vomiting: an updated meta-analysis of randomized controlled trials. *Anesth Analg* 2013; **116**: 58–74
- Boehler M, Mitterschiffthaler G, Schlager A. Korean hand acupressure reduces postoperative nausea and vomiting after

- gynaecological laparoscopic surgery. *Anesth Analg* 2002; **94**: 872–5
14. Frey UH, Scharmann P, Löhlein C, Peters J. P6 acustimulation effectively decreases postoperative nausea and vomiting in high-risk patients. *Br J Anaesth* 2009; **102**: 620–5
 15. Lee A, Fan LT. Stimulation of the wrist acupuncture point P6 for preventing postoperative nausea and vomiting. *Cochrane Database Syst Rev* 2009; **2**: CD003281
 16. Shiao SY, Dune LS. Metaanalyses of acustimulations: effects on nausea and vomiting in postoperative adult patients. *Explore (NY)* 2006; **2**: 202–15
 17. Watcha MF, White PF. Postoperative nausea and vomiting: its etiology, treatment, and prevention. *Anesthesiology* 1992; **77**: 162–84
 18. Yuksek MS, Alici HA, Erdem AF, Cesur M. Comparison of prophylactic anti-emetic effects of ondansetron and dexamethasone in women undergoing day-case gynaecological laparoscopic surgery. *J Int Med Res* 2003; **31**: 481–8
 19. Lerman J. Surgical and patient factors involved in postoperative nausea and vomiting. *Br J Anaesth* 1992; **69**: 24S–32S
 20. Kim YH, Kim KS, Lee HJ, Shim JC, Yoon SW. The efficacy of several neuromuscular monitoring modes at the P6 acupuncture point in preventing postoperative nausea and vomiting. *Anesth Analg* 2011; **112**: 819–23
 21. Lichtor JL. Nausea and vomiting after surgery: it is not just postoperative. *Curr Opin Anaesthesiol* 2012; **25**: 673–9
 22. Turgut S, Ozalp G, Dikmen S, Savli S, Tunkel G, Kadiogullari N. Acupressure for postoperative nausea and vomiting in gynaecological patients receiving patient-controlled analgesia. *Eur J Anaesthesiol* 2007; **24**: 87–91
 23. White PF, Issioui T, Hu J, et al. Comparative efficacy of acustimulation (ReliefBand®) versus ondansetron (Zofran®) in combination with droperidol for preventing nausea and vomiting. *Anesthesiology* 2002; **97**: 1075–81
 24. White PF, Zhao M, Tang J, et al. Use of a disposable acupressure device as part of a multimodal antiemetic strategy for reducing postoperative nausea and vomiting. *Anesth Analg* 2012; **115**: 31–7
 25. Gan TJ, Jiao KR, Zenn M, Georgiade G. A randomized controlled comparison of electro-acupoint stimulation or ondansetron versus placebo for the prevention of postoperative nausea and vomiting. *Anesth Analg* 2004; **99**: 1070–5
 26. Arnberger M, Stadelmann K, Alischer P, Ponert R, Melber A, Greif R. Monitoring of neuromuscular blockade at the P6 acupuncture point reduces the incidence of postoperative nausea and vomiting. *Anesthesiology* 2007; **107**: 903–8
 27. Frey UH, Funk M, Löhlein C, Peters J. Effect of P6 acustimulation on post-operative nausea and vomiting in patients undergoing a laparoscopic cholecystectomy. *Acta Anaesthesiol Scand* 2009; **53**: 1341–7
 28. Vickers AJ. Can acupuncture have specific effects on health? A systematic review of acupuncture antiemesis trials. *J R Soc Med* 1996; **89**: 303–11
 29. White PF, Hamza MA, Recart A, et al. Optimal timing of acustimulation for antiemetic prophylaxis as an adjunct to ondansetron in patients undergoing plastic surgery. *Anesth Analg* 2005; **100**: 367–72
 30. Xu M, Zhou SJ, Jiang CC, et al. The effects of P6 electrical acustimulation on postoperative nausea and vomiting in patients after infratentorial craniotomy. *J Neurosurg Anesthesiol* 2012; **24**: 312–6
 31. Streitberger K, Ezzo J, Schneider A. Acupuncture for nausea and vomiting: an update of clinical and experimental studies. *Auton Neurosci* 2006; **129**: 107–17
 32. Eberhart LH, Frank S, Lange H, et al. Systematic review on the recurrence of postoperative nausea and vomiting after a first episode in the recovery room: implications for the treatment of PONV and related clinical trials. *BMC Anesthesiol* 2006; **6**: 14

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