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Research Article

Efficacy of laser acupuncture in attenuating hemodynamic response to orotracheal intubation and postoperative nausea and vomiting in children undergoing strabismus surgery

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KEYWORDS

Laser;
Acupuncture;
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Abstract *Background:* Laser acupuncture may be offered to patients with needle phobia and children. This study aimed to investigate efficacy of the acupuncture point stimulation (Liv3 and P6) in preventing PONV and hemodynamic response to intubation in children.
Methods: Sixty children, ASA I or II aged 3–12 years, undergoing strabismus surgery were divided into 3 equal groups; 20 child each Group I (laser acupuncture group), Group II (ondansetron group) 0.15 mg/kg IV group and Group III (control group). Laser stimulation was performed bilaterally over 30 s, 15 min before induction of anesthesia and 15 min after arriving in the recovery room. Systolic, mean and diastolic BP and HR were measured in groups I and III before induction (times 1, 2), before intubation (time 3) and every minute after intubation for 5 min (times 4–8). 0–3 PONV scale was reported in all 3 groups I, II and III at 0–1 h, 1–6 h and 0–12 h postoperatively.
Results: MABP and HR were significantly less in the acupuncture group at T4, T5 (P values are < 0.05) as compared with the control group. Nausea, retching and vomiting in the control group were statistically significantly higher than both acupuncture and ondansetron groups at all intervals.
Conclusion: Laser stimulation of acupuncture points P6 and Liv3 decreases but does not prevent hemodynamic stress-response to endo-tracheal intubation in children, and effectively decreases postoperative nausea, retching, and vomiting in children undergoing strabismus surgery.

1. Introduction

Acupuncture, one of the leaders in alternative medicine, was approved by the WHO as a complementary management method in several diseases and painful conditions. Being likely simple and nearly without untoward responses acupuncture was attempted in nearly most medical diseases [1]. When a

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child is anesthetized for strabismus or middle ear surgery, anesthetist may face several difficulties: hypertension and tachycardia accompanying intubation, hemodynamic responses accompanying ocular muscles traction as well as higher prevalence of postoperative nausea and vomiting [2].

Laryngoscopy and orotracheal intubation are coupled with hemodynamic reflexes and rise in plasma concentrations of catecholamines [3]. The resulting tachycardia and hypertension may be coupled with an increased morbidity in some of the patients [4,5]. Post-operative nausea and vomiting (PONV) have an incidence between 40% and 90% without antiemetic prophylaxis [6,7]. Although pro-emetic rationale of squint surgery is still not clear, drugs acting on serotonergic, histaminic, or dopaminergic receptors in the chemoreceptor trigger zone decrease PONV after squint surgery [8,9]. Different non-pharmacological methods have been investigated as substitutes to antiemetic medications, these comprise acupuncture, electro-acupuncture, laser acupuncture, transcutaneous electrical nerve stimulation, acupuncture point stimulation as well as acupressure [10]. Most non-pharmacological clinical trials have focused on the stimulation of the wrist at the Pericardium (P6) acupuncture point to decrease nausea and vomiting. The rationale by which P6 acupuncture point stimulation reduces PONV has not been established. There are twelve major meridians in the human body, which are regarded as channels for the flow of vital energy named qi (also written ch'i or ki, and pronounced "chee" or "kee") in living organisms. Meridians represent an internal communication system between specific organs and networks of organs. Regarding traditional Chinese medicine, illness arises as a block or imbalance in energy flow along one or more meridians occurs. Acupuncture restores energy flow well being and balance. Acupuncture is claimed to treat physical illness, addiction, as well as mental illness [11]. Vital energy is claimed to modify spiritual, emotional, mental, as well as physical health and to influence yin and yang, as disease is postulated to emerge from restrictions in qi flow in addition to yin and yan imbalance [12].

Postoperative nausea and vomiting (PONV) are two of the most common complications after anesthesia and surgery. Medications only partly prevent PONV and may cause side effects. Alternative modalities as wrist acupuncture point (P6 acupuncture point) stimulation have been investigated in many studies. This can decrease the risk of postoperative nausea and vomiting with least side effects. The risks of postoperative nausea and vomiting were comparable after P6 acupuncture and antiemetic medications. A laser (light amplification by stimulated emission of radiation) is a light amplifier. Low-level lasers are mostly with divergent beams for safety as well as operating at very low power levels (0.05–0.5 W) [13].

Post-operative nausea and vomiting (PONV) and pressor response to laryngoscopy and endotracheal intubation are serious events accompanying surgeries and drug therapies only partially effective. An alternative approach is acupuncture points stimulation [14].

The aim of work was to investigate the efficacy of the acupuncture point stimulation (Liv3 and P6) in preventing the hemodynamic response to laryngoscopy and orotracheal intubation in healthy children, and to assess the efficacy of laser stimulation of P6 in prevention of PONV.

2. Patients and methods

After the study was approved by the Ethical Committee of the anesthesia department, Cairo University, written informed consents were obtained from the parents of children. We studied 60 children, ASA I or II, aged 3–12 years, undergoing strabismus surgery.

Exclusion criteria are as follows:

- Children with any cardiovascular disease.
- Children received antiemetic or antihistaminic in the 24 h before the surgery.
- Children with gastro-esophageal reflux.
- Children with D.M.

Laser acupuncture device:

Laser stimulation of P6 and Liv3 was performed by using laser acupuncture device (Petra electric AL10, Germany) which produces a low level laser with the following characteristics; continuous laser beam; red light with wave length between 635 and 670 nm (Fig. 1).

Patients were assigned randomly by computer into three groups:

Group I (acupuncture group $n = 20$ children).

Laser stimulation was performed on each of the acupuncture points (Liv3 and P6) bilaterally over 30 s, 15 min before induction of anesthesia and 15 min after arriving in the recovery room.

The acupuncture points are:

- Pericard 6 (P6) is located at the wrist between the tendons of palmaris longus and flexor carpi radialis, 2 Cun proximal from the distal palmar crease. 1 Cun is equivalent to the width of the patient's thumb across the interphalangeal joint.
- Point Liv3 is located in the first metatarsal space 1–2 Cun proximal to the web space (Fig. 2).
- Group II (ondansetron group $n = 20$ children).

The children received ondansetron hydrochloride 0.15 mg/kg IV (Glaxo Wellcome Schere DDS, UK), 15 min before induction of anesthesia.

- Group III (control group $n = 20$ children).

Figure 1 Laser acupuncture device.

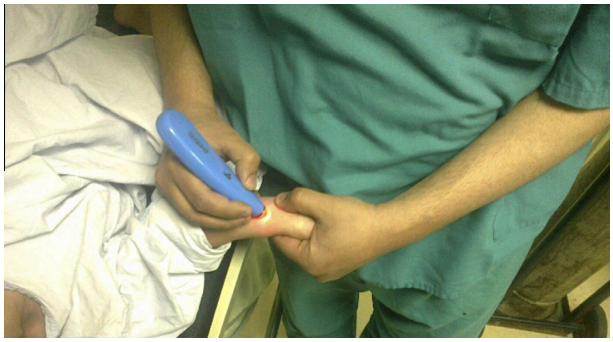

Figure 2 Laser stimulation of acupuncture point P6.

Low-level laser was held on P6 and Liv3 but the laser beam was not activated. Neither the children nor their parents were able to tell whether the laser was active. Both laser and placebo acupuncture were performed by the same investigator.

3. Anesthetic management

All patients were allowed solid food up to 6 h before anesthesia, and clear fluid up to 4 h before induction of anesthesia. Premedication with midazolam 0.2 mg/kg IM with atropine 0.02 mg/kg was given 1 h before transfer to the operating room. For painless placement of an intravenous line, each child received 5% EMLA cream (Astra, Austria) on a vein on the back of the left hand. Non-invasive systolic and diastolic arterial pressure, heart rate and oxygen saturation were monitored before and throughout the anesthesia. The operation was performed under general anesthesia. Thiopental 4–7 mg/kg, atracurium 0.5 mg/kg and fentanyl 1 μg/kg were administrated for induction of anesthesia. After intubation, anesthesia was maintained with 2–3% sevoflurane with controlled ventilation. Lactated Ringer's solution (4 ml/kg) was infused intraoperatively, and thereafter at a maintenance rate until discharge. Residual neuromuscular block was antagonized with prostigmine 0.05 mg/kg and atropine 0.025 mg/kg.

Postoperatively, all children were transported to the postanesthesia care unit (PACU) after achieving complete recovery (score of 10) using the postanesthetic recovery scoring system of Aldrete [15].

Immediately after arrival in the recovery room, all patients received paracetamol suppository 10 mg/kg for postoperative analgesia.

The second laser stimulation was performed to P6 only 15 min after arrival in the recovery room.

An evaluation of nausea and vomiting was made by an anesthesia assistant, who did not know the trial technique.

The evaluation, on a scale of 0–3
0 = no nausea
1 = nausea
2 = retching
3 = vomiting
The scale was evaluated at three periods
In the recovery room (0–1 h)
In the ward (1–6 h)
Total (0–12 h)

Metoclopramide 0.1 mg /kg intravenously was given as a rescue drug for a score of 2 or more, or if the child requests an antiemetic.

The criteria for discharge from the PACU to the ward included maintenance of patent airway without assistance, stable vital signs, adequate pain control, and no nausea and vomiting in the first 2 h after surgery. Those children who had PONV in first 2 h of stay were observed in the PACU until they remain PONV free for 1 h. Oral intake was not allowed until 4 h after recovery from anesthesia.

4. Measurements

I Measuring the efficacy of laser acupuncture in attenuating pressor response during laryngoscopy and orotracheal intubation. Systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial blood pressure (MAP) and heart rate (HR) were measured at the following time intervals in groups I and III
Time 1: 10 min after pre-medication.
Time 2: 15 min after laser acupuncture & before induction of anesthesia.
Time 3: 1 min after induction (just before intubation).
Time 4–8: every minute after intubation for 5 min.

II Measuring the efficacy of laser acupuncture in prevention of PONV.
The incidence of PONV using 0–3 scale at the following intervals in groups I, II and III
1 h (in the recovery room).
1–6 h (in the ward).
0–12 h (in the ward).
The time and frequency of using rescue antiemetic therapy.

5. Statistical analysis

Data were statistically described in terms of mean standard deviation (SD), median and range, or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using Student's t test for independent samples. For comparing categorical data, Chi square (X^2) test was performed. Exact test was used instead when the expected frequency is less than 5. Within group comparison was done using paired t test comparing baseline values with all follow up time points. P values less than 0.05 were considered statistically significant. All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

6. Results

The demographic data between groups regarding age, sex, duration of surgery and number of muscles repaired as shown in (Table 1) were comparable.

In the Acupuncture group, compared to base line (T1), there was insignificant decrease in the mean arterial blood pressure (MBP) at poststimulation time (T2) ($P = 0.115$), and significant decrease at post-induction time (T3)

Table 1 Patient's demographic data numbers and mean (SD).

	Acupuncture	Ondansetron	Control
Age	5.67 (3.4)	6.52 (2.8)	6.43 (3.9)
Sex (females/males)	9/11	8/12	10/10
Surgery duration (min)	69.3 (13.6)	70.4 (10.3)	79.3 (12.3)
Muscles repaired No.	2.1 (1.1)	1.9 (1.7)	2.4 (1.2)

($P < 0.001$) while there is significant increase in the mean arterial blood pressure in T4 and T5 (1 and 2 min after intubation) ($P < 0.001$) and MBP gradually return to the base line values at T6–T8.

In the control group, compared to base line (T1), there is significant decrease in MBP at postinduction time (T3) ($p = 0.027$), then there was statistically significant increase in MBP in all postintubation times (T4–T8). Comparing the two groups, MBP was significantly less in the acupuncture group at T4, T5, T6 (P values are < 0.001) (Fig. 3).

In the Acupuncture group, compared to base line (T1), there was statistically insignificant decrease in the heart rate (HR) at poststimulation time (T2) ($P = 0.4$), while there is significant increase in the HR in T4 and T5 (1 and 2 min after intubation) ($P = 0.01$ and 0.03 respectively) and HR decrease gradually at T6–T8. In the control group, compared to base line (T1), there is significant increase in HR in postintubation times (T4–T8).

Comparing the two groups, HR was significantly less in the acupuncture group at T4 and T5 (P values are 0.001 and 0.007 respectively) (Fig. 4).

At the immediate postoperative period in the recovery room (0–1 h). The incidence of nausea, retching and vomiting in the control group was statistically significant higher than both acupuncture and ondansetron groups (Table 2).

At late postoperative time in the ward (1–6 h) there was a statistically significant less incidence of nausea, retching and vomiting in both acupuncture and ondansetron groups (Table 3).

At the overall postoperative period in the recovery room and in the ward (0–12 h) the incidence of nausea, retching, vomiting and need of rescue therapy in the control is statistically significant higher than acupuncture and ondansetron group (Table 4).

There is no statistically significant difference between acupuncture group and ondansetron group in all postoperative times.

7. Discussion

This study was prospective, randomized and patient-blinded, but observer blinded only for the postoperative period as blinding the anesthetist would have been difficult. Reproducibility was attempted by precise specification of acupuncture points, time and length of stimulation and assessment of effects by the use of both subjective and objective measures.

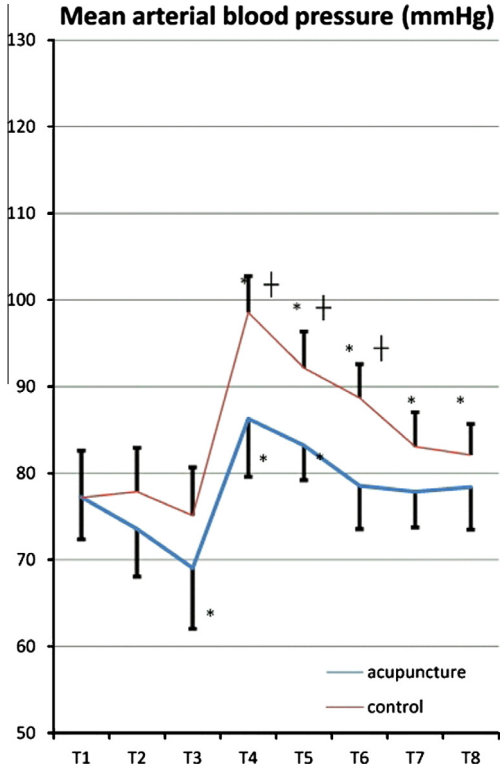

Figure 3 Mean arterial blood pressure (mmHg) in the two groups of the study. Vertical bars represent SD. T1 (base line), T2 (before induction), T3 (before intubation), T4 (1 min after intubation), T5 (2 min after intubation), T6 (3 min after intubation), T7 (4 min after intubation), T8 (5 min after intubation). *Significant value ($p < 0.05$) compared to base line in the same group. †Significant value ($p < 0.05$) compared to the other group at the same measurement time.

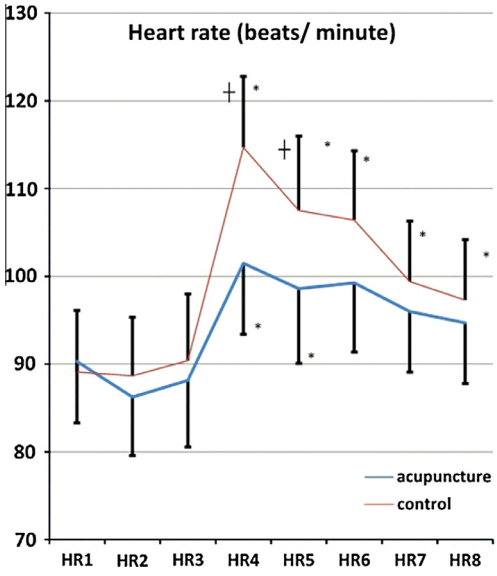

Figure 4 Heart rate (beats/minute) in the two groups of the study. Vertical bars represent SD. HR1 (base line), HR2 (before induction), HR3 (before intubation), HR4 (1 min after intubation), HR5 (2 min after intubation), HR6 (3 min after intubation), HR7(4 min after intubation), HR8 (5 min after intubation). *Significant value ($p < 0.05$) compared to base line in the same group. †Significant value ($p < 0.05$) compared to the other group at the same measurement time.

Table 2 Incidence of nausea, retching and vomiting (0–1 h) numbers (%).

	Acupuncture	Ondansetron	Control
Nausea (%)	3 (15%)	2 (10%)	7 (35%)**
Retching (%)	1 (5%)	1 (5%)	4 (20%)**
Vomiting (%)	3 (15%)	3 (15%)	6 (30%)**
Total (%)	7 (35%)	6 (30%)	17 (85%)**

** Highly significant (P value < 0.046).

Table 3 Incidence of nausea, retching and vomiting (1–6 h) numbers (%).

	Acupuncture	Ondansetron	Control
Nausea (%)	3 (15%)	3 (15%)	6 (30%)**
Retching (%)	1 (5%)	3 (15%)	5 (25%)**
Vomiting (%)	2 (10%)	1 (5%)	6 (30%)**
Total (%)	6 (30%)	7 (35%)	17 (85%)**

** Highly significant (P value < 0.027).

Table 4 Incidence of nausea, retching, vomiting and need of rescue therapy (1–12 h) numbers (%).

	Acupuncture	Ondansetron	Control
Nausea (%)	4 (20%)	3 (15%)	7 (35%)**
Retching (%)	2 (10%)	3 (15%)	4 (20%)
Vomiting (%)	3 (15%)	2 (10%)	6 (30%)**
Rescue therapy (%)	8 (40%)	7 (35%)	17 (85%)**

** Highly significant (P value < 0.034).

In this study we found that bilateral laser stimulation of acupuncture points P6 and Liv3 can decrease hemodynamic stress response to endotracheal intubation compared with control group, however in the acupuncture group there was increase in both blood pressure and heart rate at 1 and 2 min after intubation respectively which means that laser stimulation to these acupuncture points can only decrease but not prevent hemodynamic stress response to intubation.

This is supported by other study [16], which declared the efficacy of acupuncture point stimulation on the hemodynamic pressor response.

Srijin-Hua et al. 2008 performed a randomized clinical trial on 207 operative cases to test the effect of electro-acupuncturing (EA) at Neiguan (P6) and Quchi (Li 11) in preventing the stress of endotracheal intubation. They reported increase in SP, DP and MAP in both electro-acupuncture group and control group during tracheal intubation. The rise in the electro-acupuncture group was lower than the control group, with a significant difference between the two groups ($P < 0.05$) [17].

Ma Fu-Guoin et al. [18] in 2009 investigated the effect of transcutaneous electrical acupoint stimulation (TEAS) on pressor response in 40 patients undergoing abdominal surgery. They reported that TEAS abolishes but not avoids stress response to tracheal intubation.

No previous study investigated the efficacy of acupuncture on hemodynamic stress response in children, thus the importance of this study is to give evidence that perioperative acupuncture in children is as effective as in adult in blunting but not preventing hemodynamic stress response to intubation.

Our study suggested that laser acupuncture is as effective as ondansetron in decreasing postoperative nausea, retching and vomiting compared with control group. It also suggested that both laser acupuncture and ondansetron decrease the need of rescue therapy.

Previous study reported the effect of acupuncture point 6 stimulation in preventing PONV in pediatrics [19].

Schlager and collaborates [20] studied the use of acupuncture for post-operative vomiting in children undergoing squint surgery. Test group ($n = 25$, mean age = 6.5) received Korean hand acupressure, 30 min before induction of anesthesia via a disc secured in place for at least 24 h. Control group ($n = 25$, mean age = 6.5) was applied as well. Significant difference in the incidence of post-operative vomiting existed between the two groups.

Another investigation studied electroacupuncture [21] at P6 in120, 4–8 years old children following tonsillectomy. They were randomly enrolled to acupuncture group, a sham acupuncture group, in which needles where inserted in acupuncture points not proposed for antiemetics, or a needle-free control group. Findings revealed significantly lower PONV incidence in acupuncture group (63%) as compared with the control group (93%). No significant difference in PONV was observed between the sham acupuncture group (88%) and controls.

Wang et al. [22] performed a pediatric double-blind investigation on 187, 6–16 years, patients. Acupuncture point injections were compared to droperidol for PONV control in general outpatient surgery. Children were randomly assigned to acupuncture point, droperidol, and sham point groups. In the early postoperative period, PONV significantly decreased in the acupuncture point group as compared to the sham groups, but there was no significant difference between the acupuncture point and droperidol groups.

Liodden et al. [23] in 2011 conducted a clinical trial to test the effectiveness of acupuncture and acupressure supplementing standard treatment for PONV in children undergoing tonsillectomy and/or adenoidectomy. The study group received acupuncture at P6 bilaterally during anesthesia, then acupressure wristbands for 24 h in addition to standard treatment. The control group merely received standard treatment. Results showed that study group experienced less retching and vomiting than the control group 46.8% versus 66.2% ($p = 0.015$).

Soltani et al. [24] performed a placebo-controlled investigation on 200 patients and revealed that acupressure at P6 leads to a significant decrease in the incidence of PONV 24 h after squint surgery as well as metoclopramide 0.2 mg/kg and ondansetron 0.15 mg/kg iv for patients aged 10 years or more.

Overall, these investigations reported that acupuncture can be effective in decreasing PONV, and may be superior to current antiemetic drugs administered, as variable clinical trials have claimed less side effects for acupuncture compared to medication. These conclusions are potent due to the use of randomization, double blinding, and substantial sample sizes for most investigations. Thus repeated trials yield similar results recommending acupuncture consideration before or with drugs for managing nausea and vomiting.

However, there are wide variations in treatment applications with acupressure, electrical stimulation, intradermal acupuncture, acupuncture point injections as well as laser

acupuncture, all employed. Further research should clarify which specific method is superior.

8. Conclusion

Laser stimulation of acupuncture points P6 and Liv3 can decrease but does not prevent hemodynamic stress response to endotracheal intubation in children, and effectively decreases postoperative nausea, retching, vomiting and the need of rescue therapy in children undergoing strabismus surgery.

References

[1] Terganon Ltd., Maxwel House. Essentials of Chinese acupuncture. New York 1998; 1: 57.

[2] Derbyshire DR, Chmielewski A, Smith G, et al. Plasma catecholamine responses to tracheal intubation. Br J Anesth 1983;55:855–60.

[3] Russell WJ, Morris RG, Erewin DR, et al. Changes in plasma catecholamine concentrations during endotracheai intubation. Br J Anesth 1981;53:837–9.

[4] Fox EJ, Sklar GS, Hill C, et al. Complications related to the pressor response to endotracheai intubation. Anesthesiology 1977;47:524.

[5] Edwards DN, Alford AM, Dobson PM. Myocardial ischaemia during tracheal intubation and extubation. Br J Anesth 1994;73:537–9.

[6] Sadhasivam S, Shende D, Madan R. Prophylactic ondansetron in prevention of postoperative nausea and vomiting following pediatric strabismus surgery: a dose–response study. Anesthesiology 2000;92:1035–42.

[7] Bowhay AR, May HA, Rudnicka AR, Booker PD. A randomized controlled trial of the antiemetic effect of three doses of ondansetron after strabismus surgery in children. Paediatr Anaesth 2001;11:215–21.

[8] Klockgether-Radke A, Feldmann M, Braun U, Muhlendyck H. Droperidol versus metoclopramide: prevention of emesis following strabismus surgery in children. Anaesthesist 1992;41:254–9.

[9] Schlager A, Mitterschiffthaler G, Puhringer F. Rectally administered dimenhydrinate reduces postoperative vomiting in children after strabismus surgery. Br J Anaesth 2000;84:405–6.

[10] Lee A, Done ML. Stimulation of the wrist acupuncture point P6 for preventing postoperative nausea and vomiting. Cochrane Database Syst Rev 2004(3). Art. No: CD003281. DOI: 10.1002/14651858. CD003281.pub2.

[11] MacPherson H, Thomas K. Short-term reactions to acupuncture—a cross-sectional survey of patient reports. Acupuncture Med 2005;23(3):112–20.

[12] Tuner J, Hode L. Laser therapy: clinical practice and scientific background. Gransgesberg, Sweden: Prima Books; 2002.

[13] Karu T. The science of low power laser therapy. Amsterdam, The Netherlands: Gordon and Beach Science Publishers; 1998.

[14] Quinn AC, Brown JH, Wallace PG, Asbury AJ. Studies in postoperative sequelae. Nausea and vomiting still a problem. Anaesthesia 1994;49:62–5.

[15] Aldrete JA. The post-anesthesia recovery score revisited. J Clin Anesth 1995;7:89–91.

[16] Zhu Hong-sheng. Application of electroacupuncture to anesthesia induction and endotracheal intubation [J]. J Acupuncture Moxibustion 2005:03.

[17] Shi Jin-hua, Sun You-qian, Gao Yin-qiu, et al. Multicenter studies of clinical curative effect of electroacupuncture interferes the stress of trachea cannula in general anesthesia [J]. J Clin Acupuncture Moxibustion 2008.

[18] Ma Fu-Guo, Wang M, et al. Effect of transcutaneous electrical acupoint stimulation on bispectral index and stress reaction in patient undergo tracheal intubation. J Acupuncture Moxibustion 2009:04.

[19] Schlager A, Offer T, Baldissera I. Laser stimulation of acupuncture point P6 reduces postoperative vomiting in children undergoing strabismus surgery. Br J Anaesth 1998;81:529–32.

[20] Schlager A, Boehler M, Puhringer F. Korean hand acupressure reduces postoperative vomiting in children after strabismus surgery. Br J Anaesth 2000;85:267–70.

[21] Rusy LM, Hoffman GM, Weisman SJ. Electroacupuncture prophylaxis of postoperative nausea and vomiting following pediatric tonsillectomy with or without adenoidectomy. Anesthesiology 2002;96:300–5.

[22] Wang SM, Kain ZN. P6 acupoint injections are as effective as droperidol in controlling early postoperative nausea and vomiting in children. Anesthesiology 2002;97:359–66.

[23] Liodden I, Howley M, Norheim AJ, et al. Perioperative acupuncture and postoperative acupressure can prevent postoperative vomiting following paediatric tonsillectomy or adenoidectomy: a pragmatic randomised controlled trial. Acupunct Med 2011;29:9–15.

[24] Soltani A, Mohammadinasab H, Goudarzi A, et al. Comparing the efficacy of prophylactic P6 acupressure, ondansetron, metoclopramide and placebo in the prevention of vomiting and nausea after strabismus surgery. Acta Med Iranica 2011:49.