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Effects of electroacupuncture on gastric myoelectrical activity in healthy humans

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Abstract *The acupuncture point of the wrists (PC6) and the lower legs (ST36) are common points for the treatment of gastric symptoms. However, it remains unclear whether these two acupoints have different effects on gastric myoelectrical activity. We compared the effect of electroacupuncture (EAP) between PC6 and ST36 on gastric myoelectrical activity using surface electrogastrography (EGG). EAP (1 Hz, for 30 min) was applied at either ST36, or PC6, or both acupoints in eight healthy volunteers. EAP at both PC6 and ST36 did not change the percentage of normal slow waves and tachygastria. While EAP at either PC6 or ST36 did not change period dominant frequency (PDF), EAP at both PC6 and ST36 significantly decreased PDF to 78.1 ± 8.4% of baselines. EAP at PC6 reduced period dominant power (PDP) to 47.2 ± 5.3% of baselines, while EAP at ST36 increased PDP to 153.6 ± 28.3% of baselines. EAP at shoulders (sham acupuncture) did not affect the gastric myoelectrical activity. EAP at either PC6 or ST36 shows an opposite effect on PDP, whereas EAP at both PC6 and ST36 has a synergistic effect on PDF. Understanding site-specific effects of acupuncture may contribute to the selection of appropriate acupoints for treating functional GI disorders.*

Keywords *electrogastrography, PC6, period dominant frequency, period dominant power, ST36.*

INTRODUCTION

Acupuncture has been used empirically in clinical practice in China for several millennia.[1–3] Acupuncture has been used to treat different gastrointestinal (GI) disorders and evidence of its effects by scientific studies are now being accumulated.[4–7] The point of the wrists (Neiguan; PC6) and the lower legs (Zusanli; ST36) are the common points for the treatment of gastric symptoms such as nausea and vomiting. It has been shown that stimulation of PC6 can prevent vomiting caused by early pregnancy, surgical procedures and chemotherapy.[8–10] Acupuncture at ST36 enhances the regularity of gastric myoelectrical activity in diabetic patients.[11]

Electrogastrography (EGG) provides an accurate measurement of the gastric slow waves and is a non-invasive method for assessing gastric myoelectrical activity which modulates gastric motor activity.[12] It has been shown that abnormal gastric myoelectrical activity is associated with gastric motility disorders and GI symptoms such as nausea and vomiting.[13–17]

Combined acupuncture at points ST36 and PC6 increases the percentage of regular slow waves, resulting in the normalization of arrhythmia in healthy human subjects.[5] However, it remains unclear whether these two acupoints have different effects on gastric myoelectrical activity. The impact of acupuncture on upper GI activity is variable and depends on various factors such as species, acupoints used, acupuncture procedure, and underlying GI motor activity.[18,19]

The aim of this study was to compare the effect of electroacupuncture (EAP) between PC6 and ST36 on gastric myoelectrical activity in healthy humans. We also studied whether EAP at both points has a synergistic effect on the gastric myoelectrical activity.

METHODS

Study subjects

The study performed on eight healthy *Helicobacter pylori*-negative Japanese subjects (seven men and one

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woman, age 22–52 years: mean age of 35 years). All subjects fasted for 12 h or more before the study and had no medications during the 30 days before the study. The study protocol was approved by the local ethics review committee and informed consent was obtained from each subject. None of the subjects has previously received acupuncture on PC6 or ST36. All subjects were blind to the purpose of the study.

Electrical stimulation of acupuncture

Two acupuncture points (ST36 and PC6) and one sham point were used in this study. The location of ST36 is at the proximal one-fifth of craniolateral surface of the leg distal to the head of the tibia in a depression between the muscles of the cranial tibia and the long digital extensor (Fig. 1A). PC6 is located in the groove caudal to the flexor carpi radialis and cranial to the superficial digital flexor muscles, 3 cm proximal to the corpus (Fig. 1B). The junction between the shoulder and neck where no known acupuncture points existed was used as a sham point. The acupuncture needles were made of stainless steel 0.2 mm in diameter and they were inserted into the skin 5 mm in depth. After the acupuncture needles were inserted into the acupoints or the sham point, the points were stimulated via the needles by the repeated electrical current (1 Hz, 10–20 mA) for 30 min.

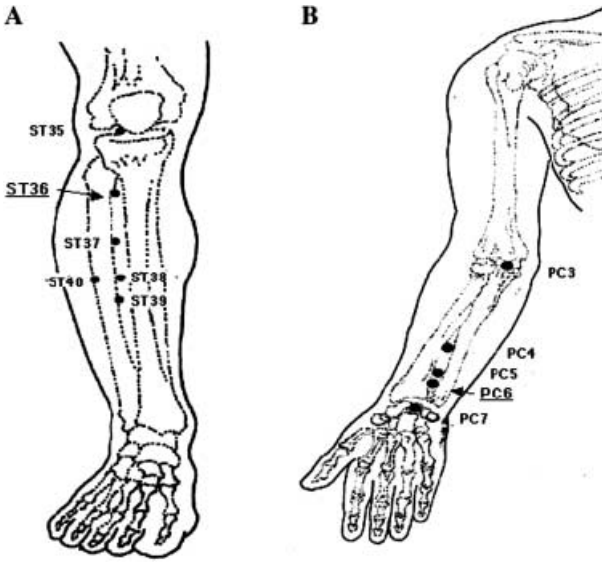

Figure 1 The location of acupoints of ST36 (A) and PC6 (B) in humans. ST36 is located at the proximal one-fifth of craniolateral surface of the leg distal to the head of the tibia in a depression between the muscles of the cranial tibia and the long digital extensor (A). PC6 is located in the groove caudal to the flexor carpi radialis and cranial to the superficial digital flexor muscles, 3 cm proximal to the corpus (B).

Electrogastrogram

Surface EGG was used to record gastric myoelectrical activity. Three silver-chloride ECG electrodes were placed on the abdominal surface over the stomach, one each on the epigastric area bilaterally, just below the lower rib, and a reference electrode was positioned at the midpoint above the umbilicus. The two epigastric electrodes were connected to yield a bipolar EGG signal, which was amplified using a portable EGG recorder (Digitrapper EGG, Synetics Medical Inc, Irving, TX, USA) with low and high cut-off frequencies of 0.5 and 10 cpm, respectively. On-line digitization with a sampling frequency of 1 Hz was performed using an analogue-to-digital converter installed on the recorder, with digitized samples stored in the recorder. At the end of each study, the stored data were downloaded to a personal computer and were analysed using a software polygram (Synetics Medical, Inc.).

Study protocol

On separate days, four sessions of EAP (1 Hz, 30 min) were randomly performed to each subject after 12 h fasting. EAP was applied at bilateral ST36, PC6 or both. As a control, EAP was also applied at bilateral shoulders (sham acupuncture). EGG was recorded for 30 min at baseline, for 30 min during EAP, and for 180 min after EAP. Blood pressure was measured before, during and after EAP at 10 min interval. All recordings were made in a quiet environment. The subjects were in a sitting position and were asked to remain as still as possible during the recording to avoid motion artefacts.

Data analysis

The percentage of normal 2–4 cpm gastric waves was defined as the percentage of time during which regular 2–4 cpm slow waves were present over the entire observation period. This ratio reflects the regularity of gastric myoelectrical activity and was computed using adaptive running spectral analysis methods. If the peak power of 1-min EGG was within the range of 0.5–2 cpm, the corresponding EGG was considered to show bradygastria. If the peak power was within the range of 4–10 cpm, that portion was called tachygastria. The percentage of tachygastria was defined as the percent of time during which tachygastria was present over the entire observation period. The frequency at which EGG power spectrum had a peak power in this range of 0.5–10 cpm was defined as the period dominant frequency (PDF) which was computed using the

smoothed power spectral analysis method.[20] The dominant frequency of EGG has been shown to be equal to the frequency of the gastric slow wave measured from implanted serosal electrodes.[21] The power at the dominant frequency in the power spectrum of EGG was defined as the period dominant power (PDP). The relative change of EGG dominant power has been shown to be associated with gastric contractility.[12,20,22] The percentage of normal slow waves (2–4 cpm), tachygastria, PDF and PDP were assessed by spectral analysis.

Helicobacter pylori diagnosis

It has been shown that the percentage of tachygastria is significantly higher in *H. pylori*-positive patients than that of *H. pylori*-negative patients.[23] Therefore, healthy volunteers were first tested whether they were infected by *H. pylori*.

Helicobacter pylori infection was diagnosed using a rapid detection kit (Rapirun *H. pylori* antibody, Otsuka Pharmaceutical Co., Tokyo, Japan). The kit used an immuno-chromatography method in which dried anti-human IgG antibody-binding gold colloidal particles were placed between the site of sample addition and a nitrocellulose membrane.[24]

Statistical analysis

ANOVA and paired *t*-test were used to compare the EGG data and blood pressure and pulse rate obtained by EAP at three different points. Statistical significance was assigned for $P < 0.05$. If significant difference was found by ANOVA, the groups were identified using Bonferroni's correction. All data were presented as mean values ± SE.

Table 1 Effects of EAP at different acupoints on systolic and diastolic blood pressure (mmHg)

	Systolic		Diastolic	
	Before EAP	At the end of EAP	Before EAP	At the end of EAP
Shoulder	103 ± 4	101 ± 4	65 ± 1	64 ± 3
ST36	111 ± 7	108 ± 2	73 ± 6	68 ± 3
PC6	104 ± 4	96 ± 4**	66 ± 2	63 ± 2*
ST36+PC6	107 ± 4	108 ± 3	69 ± 3	74 ± 3

** $P < 0.01$, * $P < 0.05$ by paired *t*-test.

RESULTS

All subjects were negative for *H. pylori* infection. The systolic and diastolic blood pressures were significantly decreased by EAP at PC6. Systolic blood pressure was decreased from 104 ± 4 to 96 ± 4 mmHg ($P < 0.01$ by paired *t*-test) and diastolic blood pressure was decreased from 66 ± 2 to 63 ± 2 mmHg ($P < 0.05$ by paired *t*-test) at the end of EAP at PC6 (Table 1). The inhibitory effect of EAP at PC6 on the blood pressure disappeared within 10 min after the cessation of EAP. In contrast, combined EAP at ST36 and PC6 had no more inhibitory effects on the systolic and diastolic blood pressure. EAP at ST36 or shoulders had also no significant effects on the blood pressure (Table 1). EAP had no effects on the pulse rates at any time.

EAP at either PC6 or ST36 and simultaneous stimulation at both acupoints did not change the percentage of tachygastria and regular slow waves (Fig. 2A and B).

EAP at either PC6 or ST36 did not change PDF as well. In contrast, PDF was significantly decreased to 78.1 ± 8.4% of baselines ($P < 0.05$ by Bonferroni) during

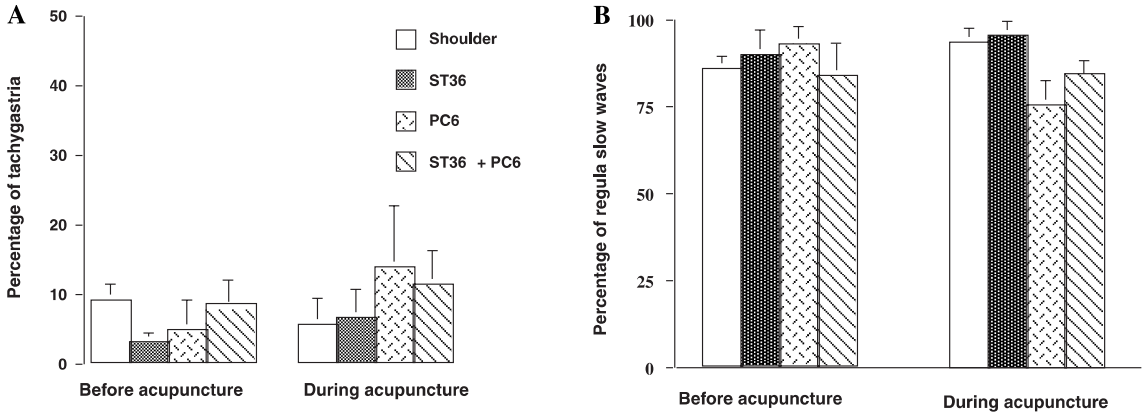

Figure 2 Effects of EAP at different acupoints on the percentage of tachygastria (A) and regular slow waves (B). EAP at either PC6 or ST36, and both PC6 and ST36 did not change the percentage of tachygastria and regular slow waves.

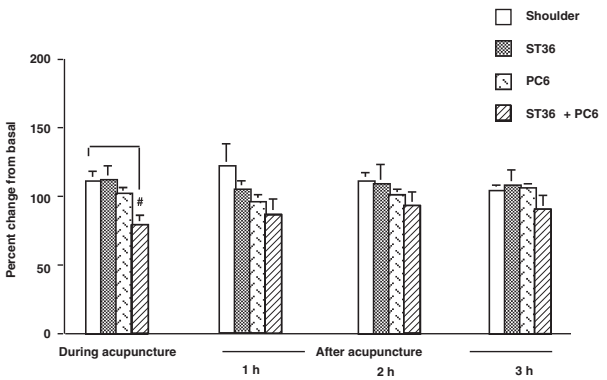

Figure 3 Changes of period dominant frequency (PDF) by EAP at different acupoints. EAP at either PC6 or ST36 did not change PDF. In contrast, EAP at both acupoints significantly decreased PDF to 78.1 ± 8.4% of baselines (*P < 0.05, by Bonferroni).

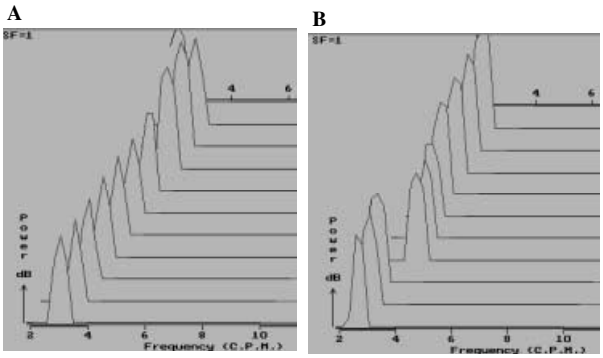

Figure 4 Pseudo-three-dimensional representations of an analysed EGG of a subject who received EAP at PC6 and ST36. During EAP (B), period dominant frequency (PDF) was significantly reduced (from 3.7 ± 0.4 to 2.7 ± 0.2 cpm, P < 0.05, by paired t-test).

the simultaneous stimulation at both acupoints of ST36 and PC6 (Fig. 3). The inhibitory effect of EAP was no longer observed 1 h after the cessation of EAP at PC6 and ST36 (Fig. 3). Pseudo-three-dimensional representations showed that PDF was significantly reduced from 3.7 ± 0.4 to 2.7 ± 0.2 cpm during EAP at PC6 and ST36 (P < 0.05, by paired t-test) (Fig. 4).

EAP at PC6 significantly reduced PDP to 47.2 ± 5.3% (P < 0.05 by paired t-test) of baselines, while EAP at ST36 significantly increased PDP to 153.6 ± 28.3% (P < 0.05 by paired t-test) of baselines (Fig. 5). The EGG recording of a subject performed EAP at ST36 and PC6 was shown in Fig. 6. The amplitude of PDP was increased during EAP at ST36, while it was decreased during EAP at PC6 (Fig. 6). The stimulatory effect of EAP at ST36 on PDP was no longer observed 1 h after the cessation of EAP, while the inhibitory effect of EAP at PC6 on PDP was still present 1 h after

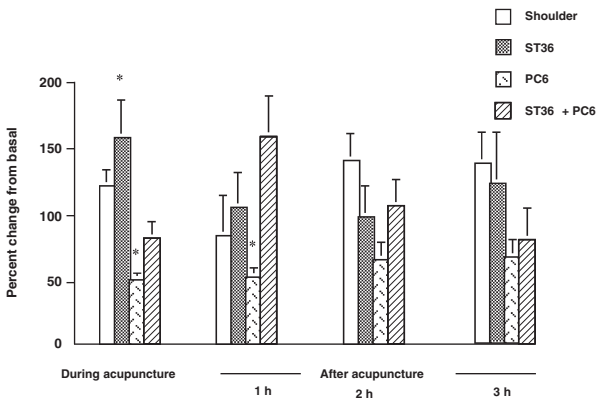

Figure 5 Changes of period dominant power (PDP) by EAP at different acupoints. EAP at PC6 significantly reduced PDP to 47.2 ± 5.3% of baselines, while EAP at ST36 significantly increased PDP to 153.6 ± 28.3% of baselines. EAP at both acupoints, however, had no more significant effects on PDP. EAP at shoulders did not change PDP (*P < 0.05 by paired t test).

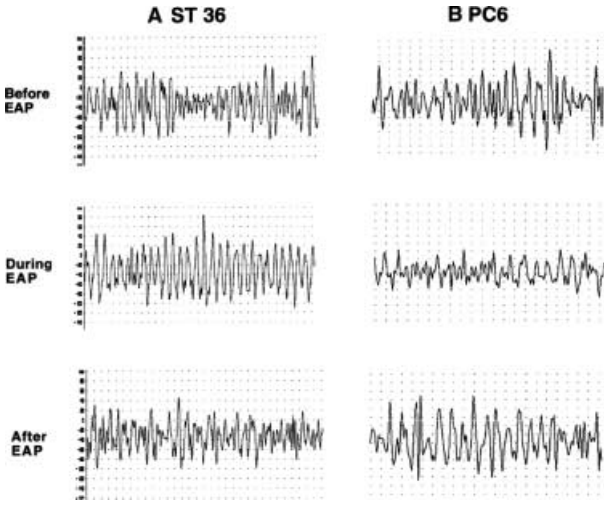

Figure 6 The EGG recording of a subject performed EAP at ST36 (A) and PC6 (B). The amplitude was increased during EAP at ST36, while it was inhibited during EAP at PC6.

the cessation of EAP (Fig. 5). Simultaneous stimulation of both acupoints, however, had no significant effects on PDP (Fig. 5).

EAP at shoulders did not change the percentage of normal slow wave and tachygastria (Fig. 2), PDP (Fig. 3) and PDF (Fig. 5).

DISCUSSION

It has been shown that manual acupuncture at PC6 resulted in a significant reduction in postoperative nausea and vomiting, compared with the patients who received no acupuncture.[25] In the patients with motion

sickness, EAP at PC6 reduced the severity of symptoms and decreased gastric tachyarrhythmia.[10] In diabetic patients with gastric motor dysfunction, EAP at ST36 increased the percentages of regular slow waves and decreased the percentage of tachygastria.[11] The acupuncture at ST36 normalized atropine-induced gastric dysrhythmia.[26]

Combined EAP at ST36 and PC6 has been shown to enhance the gastric migrating motor complex by reducing the length of phase I and increasing the length of phases II and III in conscious dogs.[7] Combined EAP at ST36 and PC6 also accelerated liquid gastric emptying, improved gastric slow-wave rhythmicity and increased peripheral vagal activity in conscious dogs.[27]

However, it remains unclear whether the stimulation of PC6 is different from that of ST36 and whether the two acupoints have synergistic effects on gastric motility and myoelectrical activity.

It has been shown that PDF, especially tachygastria, is related to the symptoms of gastric retention, nausea and vomiting associated with gastric motor dysfunction.[11,28–30] In our present study, EAP at either PC6 or ST36 did not change PDF. In contrast, combined EAP at both PC6 and ST36 significantly decreased PDF to 78.1% of baselines. These findings suggest that EAP at both PC6 and ST36 have a synergistic effect on PDF.

EAP at neither ST36 nor PC6 affected percentages of regular slow waves and tachygastria in healthy Japanese subjects who were *H. pylori*-negative. In contrast, it has been shown that combined EAP at ST36 and PC6 significantly increase the percentage of regular slow waves from 64.8 to 74.3% and that the percentage of tachygastria is decreased from 26.9 to 10.8% by EAP in healthy Chinese subjects.[5] The different results of the present study from the Chinese study may be explained by the presence or absence of *H. pylori* infection, as it is known that Chinese have a higher infection rate of *H. pylori* than Caucasians.

The effects of *H. pylori* infection on EGG recording seem to be controversial.[31,32] It has been shown that *H. pylori* related gastritis does not influence any EGG parameters in Chinese patients with functional dyspepsia.[32] In contrast, we have previously shown that the percentage of tachygastria in the fasting state is significantly higher in *H. pylori*-positive patients (27.2%) than in *H. pylori*-negative patients (10.4%).[23] Further study is necessary to clarify whether EAP on PC6 and ST36 improves tachygastria in *H. pylori*-positive patients.

Our present study demonstrated that EAP at ST36 significantly increased PDP to 153.6% of baselines. In general, increase of PDP does not necessarily indicate the increase of gastric contractility. It has been demonstrated that atropine decreases, whereas bethanechol increases, the antral manometric motility index and PDP.[12] This suggests that PDP is, at least in part, associated with the gastric contractility.[15,33]

Plasma concentration of pancreatic polypeptide (PP) was shown to increase when acupuncture at ST36 is performed in humans.[11] It has been well demonstrated that PP release is dependent on the vagal cholinergic pathway.[34] This suggests that acupuncture at ST36 could stimulate the vagal efferent activity in humans. It has been demonstrated that the stimulatory effects of acupuncture at ST36 on gastric motility is mediated via vagal efferent in rats.[35,36] It is conceivable that the stimulatory effects of EAP and PDP may be mediated via vagal pathway in humans.

In the present study, systolic and diastolic blood pressure was significantly decreased by EAP at PC6. Acupuncture at PC6 has been used to treat coronary heart disease and hypertension as well in traditional Chinese medicine.[37] Although the mechanism of effects of acupuncture on cardiovascular system is not well understood, it has been suggested that acupuncture alters the activity of the sympathetic nervous system.[38,39] It is conceivable that the altered sympathetic nerve activity is involved in the inhibitory effect of EAP at PC6 on the PDP and blood pressure. We have recently shown that acupuncture-induced gastric relaxations are mediated via somato-sympathetic reflex in anaesthetized rats. Its afferent limb is composed of abdominal cutaneous and muscle afferent nerves and its efferent limb is the gastric sympathetic nerve.[40]

Further measurements of autonomic tone, such as capillary pulse, blood flow, R to R interval of ECG, plasma catecholamine levels, skin conductance, etc. are needed to clarify the mechanism of acupuncture on gastric myoelectrical activity.

In conclusion, EAP at either PC6 or ST36 shows an opposite effect on PDP, whereas that EAP at both PC6 and ST36 has a synergistic effect on PDF of gastric myoelectrical activity. Understanding site-specific effects of acupuncture on gastric motility contributes to the selection of appropriate acupoints for treating functional GI disorders.

REFERENCES

1 Rubin P. Therapeutic acupuncture: a selective review. *South Med J* 1977; **70**: 974–7.
2 Li Y, Tougas G, Chiverton SG, Hunt RH. The effect of acupuncture on gastrointestinal function and disorders. *Am J Gastroenterol* 1992; **87**: 1372–81.
3 Yang SM, Xu SQ, Huang YH, Luo CJ, Lan FR. Observations on the effects of acupuncture at Neiguan point on the left ventricle functions in 106 normal persons and 100

patients with heart disease. *J Tradit Chin Med* 1985; **5**: 249–52.
4 Matsumoto T, Hayes MF, Jr. Acupuncture, electric phenomenon of the skin, and postvagotomy gastrointestinal atony. *Am J Surg* 1973; **125**: 176–80.
5 Lin X, Liang J, Ren J, Mu F, Zhang M, Chen JD. Electrical stimulation of acupuncture points enhances gastric myoelectrical activity in humans. *Am J Gastroenterol* 1997; **92**: 1527–30.
6 Jin HO, Zhou L, Lee KY, Chang TM, Chey WY. Inhibition of acid secretion by electrical acupuncture is mediated via beta-endorphin and somatostatin. *Am J Physiol* 1996; **271**: G524–30.
7 Qian L, Peters LJ, Chen JD. Effects of electroacupuncture on gastric migrating myoelectrical complex in dogs. *Dig Dis Sci* 1999; **44**: 56–62.
8 Dundee JW, Ghaly RG, Bill KM, Chestnutt WN, Fitzpatrick KT, Lynas AG. Effect of stimulation of the P6 antiemetic point on postoperative nausea and vomiting. *Br J Anaesth* 1989; **63**: 612–8.
9 Dundee JW, Yang J, McMillan C. Non-invasive stimulation of the P6 (Neiguan) antiemetic acupuncture point in cancer chemotherapy. *J R Soc Med* 1991; **84**: 210–2.
10 Hu S, Stern RM, Koch KL. Electrical acustimulation relieves vection-induced motion sickness. *Gastroenterology* 1992; **102**: 1854–8.
11 Chang CS, Ko CW, Wu CY, Chen GH. Effect of electrical stimulation on acupuncture points in diabetic patients with gastric dysrhythmia: a pilot study. *Digestion* 2001; **64**: 184–90.
12 Parkman HP, Trate DM, Knight LC, Brown KL, Maurer AH, Fisher RS. Cholinergic effects on human gastric motility. *Gut* 1999; **45**: 346–54.
13 Koch KL, Stern RM, Stewart WR, Vasey MW. Gastric emptying and gastric myoelectrical activity in patients with diabetic gastroparesis: effect of long-term domperidone treatment. *Am J Gastroenterol* 1989; **84**: 1069–75.
14 Chen J, McCallum RW. Gastric slow wave abnormalities in patients with gastroparesis. *Am J Gastroenterol* 1992; **87**: 477–82.
15 Chen JD, Richards RD, McCallum RW. Identification of gastric contractions from the cutaneous electrogastrogram. *Am J Gastroenterol* 1994; **89**: 79–85.
16 Geldof H, van der Schee EJ, van Blankenstein M, Grashuis JL. Electrogastrographic study of gastric myoelectrical activity in patients with unexplained nausea and vomiting. *Gut* 1986; **27**: 799–808.
17 Lin X, Levanon D, Chen JD. Impaired postprandial gastric slow waves in patients with functional dyspepsia. *Dig Dis Sci* 1998; **43**: 1678–84.
18 Zhou L, Chey WY. Electric acupuncture stimulates nonparietal cell secretion of the stomach in dog. *Life Sci* 1984; **34**: 2233–8.
19 Lux G, Hagel J, Backer P *et al.* Acupuncture inhibits vagal gastric acid secretion stimulated by sham feeding in healthy subjects. *Gut* 1994; **35**: 1026–9.
20 Chen J. A computerized data analysis system for electrogastrogram. *Comput Biol Med* 1992; **22**: 45–57.
21 Chen JD, Schirmer BD, McCallum RW. Serosal and cutaneous recordings of gastric myoelectrical activity in patients with gastroparesis. *Am J Physiol* 1994; **266**: G90–8.
22 Smout AJ, van der Schee EJ, Grashuis JL. What is measured in electrogastrography? *Dig Dis Sci* 1980; **25**: 179–87.
23 Shiotani A, Iguchi M, Inoue I *et al.* Association between gastric myoelectrical activity and intraluminal nitric oxide. *Aliment Pharmacol Ther* 2002; **16**(Suppl. 2): 44–51.
24 Graham DY, Reddy S. Rapid detection of anti-Helicobacter pylori IgG in urine using immunochromatography. *Aliment Pharmacol Ther* 2001; **15**: 699–702.
25 Dundee JW, Chestnutt WN, Ghaly RG, Lynas AG. Traditional Chinese acupuncture: a potentially useful antiemetic? *Br Med J* 1986; **293**: 583–4.
26 Chang CS, Chou JW, Ko CW, Wu CY, Chen GH. Cutaneous electrical stimulation of acupuncture points may enhance gastric myoelectrical regularity. *Digestion* 2002; **66**: 106–11.
27 Ouyang H, Yin J, Wang Z, Pasricha PJ, Chen JD. Electroacupuncture accelerates gastric emptying in association with changes in vagal activity. *Am J Physiol Gastrointest Liver Physiol* 2002; **282**: G390–6.
28 Telander RL, Morgan KG, Kreulen DL, Schmalz PF, Kelly KA, Szurszewski JH. Human gastric atony with tachygastria and gastric retention. *Gastroenterology* 1978; **75**: 497–501.
29 You CH, Chey WY, Lee KY, Menguy R, Bortoff A. Gastric and small intestinal myoelectric dysrhythmia associated with chronic intractable nausea and vomiting. *Ann Intern Med* 1981; **95**: 449–51.
30 Stern RM, Koch KL, Stewart WR, Lindblad IM. Spectral analysis of tachygastria recorded during motion sickness. *Gastroenterology* 1987; **92**: 92–7.
31 Budzynski A, Bobrzynski A, Lorens K, Konturek PC, Thor P, Konturek SJ. The influence of cholecystokinin on gastric myoelectrical activity in duodenal ulcer following Helicobacter pylori eradication–an electrogastrographic study. *J Physiol Pharmacol* 2002; **53**: 171–82.
32 Lu CL, Chen CY, Chang FY *et al.* Impaired postprandial gastric myoelectrical activity in Chinese patients with nonulcer dyspepsia. *Dig Dis Sci* 2001; **46**: 242–9.
33 Chen JD, Lin ZY, Parolisi S, McCallum RW. Inhibitory effects of cholecystokinin on postprandial gastric myoelectrical activity. *Dig Dis Sci* 1995; **40**: 2614–22.
34 Schwartz TW, Holst JJ, Fahrenkrug J *et al.* Vagal, cholinergic regulation of pancreatic polypeptide secretion. *J Clin Invest* 1978; **61**: 781–9.
35 Sato A, Sato Y, Suzuki A, Uchida S. Neural mechanisms of the reflex inhibition and excitation of gastric motility elicited by acupuncture-like stimulation in anesthetized rats. *Neurosci Res* 1993; **18**: 53–62.
36 Tatewaki M, Harris M, Uemura K *et al.* Dual effects of acupuncture on gastric motility in conscious rats. *Am J Physiol Regul Integr Comp Physiol* 2003; **285**: R862–72.
37 Syuu Y, Matsubara H, Kiyooka T *et al.* Cardiovascular beneficial effects of electroacupuncture at Neiguan (PC-6) acupoint in anesthetized open-chest dog. *Jpn J Physiol* 2001; **51**: 231–8.
38 Sugiyama Y, Xue YX, Mano T. Transient increase in human muscle sympathetic nerve activity during manual acupuncture. *Jpn J Physiol* 1995; **45**: 337–45.
39 Chao DM, Shen LL, Tjen ALS, Pitsillides KF, Li P, Longhurst JC. Naloxone reverses inhibitory effect of electroacupuncture on sympathetic cardiovascular reflex responses. *Am J Physiol* 1999; **276**: H2127–34.
40 Tada H, Fujita M, Harris M *et al.* Neural mechanism of acupuncture-induced gastric relaxations in rats. *Dig Dis Sci* 2003; **48**: 59–68.

