EFFECT OF ACUPUNCTURE/ELECTROACUPUNCTURE ON GASTRIC PRESSURE AND CONTRACTION OF DOGS MEASURED BY ALTERNATE CURRENT SUSCEPTOMETRY AND MANOMETRY

EFEITO DA ACUPUNTURA / ELETROACUPUNTURA NA CONTRAÇÃO E PRESSÃO GÁSTRICA DE CÃES, MEDIDAS POR SUSCEPTOMETRIA DE CORRENTE ALTERNADA E MANOMETRIA

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SUMMARY

The effect of acupuncture, false acupuncture and low frequency electroacupuncture on gastric contraction amplitude and pressure was investigated in dogs. A cuffed gastric tube was inserted in 17 dogs anesthetized with pentobarbitone and a magnetic tracer (manganese ferrite) was administered into the cuff. Gastric contraction was measured using a biosusceptometer positioned at the epigastric region, based on the magnetic flux transformer with differential coil using a sample frequency of 10 Hz. The magnetic signal was detected by a lock-in amplifier, using a Butterworth bi-direction 2 pole pass-band filter (30 to 70 mHz) in the digital signals. The FFT (Fast Fourier Transformer) and running spectrum analysis (RSA) were used to evaluate the amplitude of the signal before and after acupuncture. Gastric pressure was measured attaching the cuffed inflated tube in the stomach to a pressure monitor. The dogs were treated with false manual acupuncture, followed by real manual acupuncture and low frequency electroacupuncture (5 Hz, 5 V, and alternate current stimulation) at the ST 36 and LI 4 acupoints. Gastric contraction amplitude and pressure raised in an increasing way after false manual acupuncture, followed by real manual acupuncture and electroacupuncture. Electroacupuncture was the only protocol to produce a statistically significant increase in these variables when compared to both false and real manual acupuncture, showing that electroacupuncture was the most effective to increase both gastric contraction amplitude and pressure.

KEY-WORDS: Traditional Chinese medicine. Canine. Peristaltism.

RESUMO

Foi investigado o efeito da acupuntura, falsa acupuntura e eletroacupuntura de baixa freqüência na amplitude e pressão de contração gástrica de cães. Dezessete animais foram anestesiados com pentobarbital e um tubo gástrico com balonete foi inserido para administração de traçador magnético (manganês ferrita). Com o biosusceptometro posicionado na região epigástrica, a contração gástrica foi mensurada baseada na transformação do fluxo magnético usando a freqüência padrão de 10 Hz. O sinal magnético foi detectado por um amplificador usando um filtro bidirecional de dois pólos do tipo Butterworth (30 a 70 mHz) nos sinais digitais. A pressão gástrica foi medida com monitor de pressão ligado ao balonete intragástrico. O tratamento consistiu na seguinte seqüência: falsa-acupuntura, acupuntura e eletroacupuntura (5 Hz, 5 V, corrente alternada) nos pontos de acupuntura E36 e IG4. Houve aumento paulatino da amplitude de contração e da pressão gástricas depois de cada tratamento. Porém, tal aumento só teve significância estatística após a eletroacupuntura. A eletroacupuntura mostrou ser o tratamento mais efetivo para o aumento da contração e pressão gástricas em cães.

PALAVRAS-CHAVE: Medicina tradicional chinesa. Cães. Peristaltismo.

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INTRODUCTION

A great interest has been paid to the study of gastrointestinal transit in several domestic species, with an increasing development of pro-kinetic drugs. However many side effects have been described when pro-kinetic drugs are used (GWEE & READ, 1994, WISEMAN & FAULD, 1994).

Acupuncture has been successfully used to modify the gastrointestinal motility in several species. Diarrhea in pigs may be treated with the acupoints HO HAI (Governing Vessel 1) and/or Stomach 36 (YANN-CHING & JENKINS 1987). The main points used to increase intestinal motility are Stomach 36, Large Intestine 4 and Bladder 25 (SCHOEN 2001). Stimulation of the Stomach 36 acupoint increased postoperative intestinal transit in man (LIU & ZHAO 1991), gastric motility in dogs (KUDO et al 1991) and gastric migrating myoeletric complex in dogs (QIAN et al 1999) and this effect appears to be vago-mediated (IWA & SAKITA, 1994)

Electroacupuncture (4.5 v; 5 Hz) for 30 minutes at the ST 36, LI 4 and Bl 25 acupoints (LUNA & JOAQUIM, 1998), but not sham (false) electroacupuncture in the same dogs, increased the frequency of defecation and the excretion rate of the marker chromic oxide, confirming that electroacupuncture increases gastrointestinal motility in dogs.

Low voltage and frequency (2 V – 1 Hz) electroacupuncture produced higher gastric and cecal contraction amplitude in horses when compared to high voltage and frequency of electrical stimulation (2 V-30 Hz or 4 V-30 Hz) (BYUNGSUN & HEEIN, 1998a).

A novel non-invasive biomagnetic method has been successfully used to measure gastric contraction. The method is based on magnetic flux changes detected by an alternate current biosusceptometer, produced by a magnetic test meal (magnetic tracer) within the stomach (MIRANDA et al 1992, BAFFA et al 1995, OLIVEIRA et al 1996, MIRANDA et al, 1997). This detector is extremely dependent on the distance from the magnetic tracer (MIRANDA et al, 1997), which provides a very sensitive technique to any change in the magnetic tracer position (MIRANDA et al, 1992; MIRANDA, 1995). The gastric mechanical activity produces a rhythm movement of 5 cycles/minute in dogs (MALAGELADA & AZPIROZ, 1985) and the sign detected by the biosusceptometer is molded according to this gastric wall variation, to obtain the registration of the gastric contraction activity.

The aim of this study was to investigate the effect on gastric pressure and motility in dogs produced by needle insertion in non acupuncture (false) points (sham effect) close to real points, comparing these effects of false manual acupuncture with real manual acupuncture and with low frequency electroacupuncture.

MATERIALS AND METHODS

Seventeen clinically health crossbred dogs weighing 12.28 ± 1.37 kg were used. The dogs were fed with pet food 30 minutes before the study. A catheter was placed in the cephalic vein and the dogs were anesthetized with 30 mg/kg of pentobarbitone IV (Hypnol, Cristalia, Brazil). A cuffed tube was inserted in the stomach. Particles measuring125 μm of a magnetic tracer (3% manganese ferrite - $MnFe_2O_4$) mixed with a lactic solution was administered into the cuff, which was connected to a strain gauge digital manometer (Biotest Inc.®) attached to a computer.

Gastric contraction was measured continuously using a biosusceptometer positioned at the epigastric region. The AC biosusceptometer employed in this study was based on the magnetic flux transformer with differential coil (first order gradiometer to the coil detection) arrangement of two air core, with one transformer for reference, and the other working as a measuring transformer, on which the magnetic tracer having a high magnetic permeability acts like an external nucleus. A sample frequency of 10 Hz was used. The magnetic signal was detected by a lock-in amplifier, using a Butterworth bi-direction 2 pole pass-band filter (30 to 70 mHz) in the digital signals and a digital/analogical plate attached to a computer (Figure 1). The FFT (Fast Fourier Transformer) and running spectrum analysis (RSA) were used to evaluate the amplitude of the signal before and after acupuncture.

Gastric pressure and contraction basal measurements were performed continuously for 10 minutes before any stimulus was given, for comparison with the effects of the other treatments.

Needles were introduced in false St 36 and LI 4 points (1.5 cm lateral to the real ones, making sure that there were no located in any other meridians) in 17 dogs, after 10 minutes of continuous basal measurements. Needles were manipulated using left and right movements for 5 minutes, removed and measurements were performed continuously for 10 minutes. Needles were then inserted in the St 36 and LI 4 real points according to IVAS anatomical description, manipulated again for 5 minutes and removed, followed by 10 minute continuous measurement. Needles were introduced again and a low frequency (5 Hz) intermittent biphasic square wave electrical stimulus was applied for 5 minutes, followed by 15 minute continuous measurement.

Motility Index

To express the amplitude of gastric contraction in this study with susceptometry and manometry it was used the Motility Index, which can be characterized by the formula:

$$mi = \log [(\Sigma A) \times (c) + 1].$$

Where: (Σ A) is the sum of amplitudes on the time considered and (c) is the number of contractions in the time considered (RICHARDS et al, 1990).

Statistical analysis

Statistical analysis was performed by repeated measures ANOVA followed by Student-Newman-Keuls test. A $p < 0.05$ was considered significant.

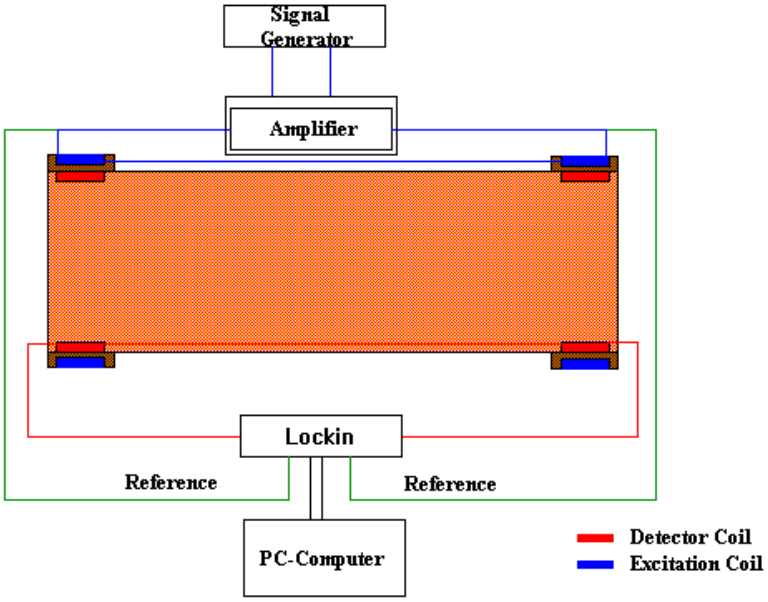

Figure 1- Alternate current biosusceptometer

RESULTS

The median values from crest to crest of the filtered temporal signs before and after acupuncture/ electroacupuncture were compared and the results expressed in Motility index and frequency (c/s) as showed in figure 2 and 3.

A crescent increase in gastric contraction amplitude and pressure was observed after false manual acupuncture, followed by real manual acupuncture and low frequency electroacupuncture in St 36 and LI 4 acupoints (Figures 2 and 3). The increase in gastric contraction amplitude and pressure was statistically significant only after electroacupuncture when compared to the basal measurements. Gastric pressure was significantly greater after low frequency electroacupuncture when compared to basal measurements, false manual acupuncture and real manual acupuncture.

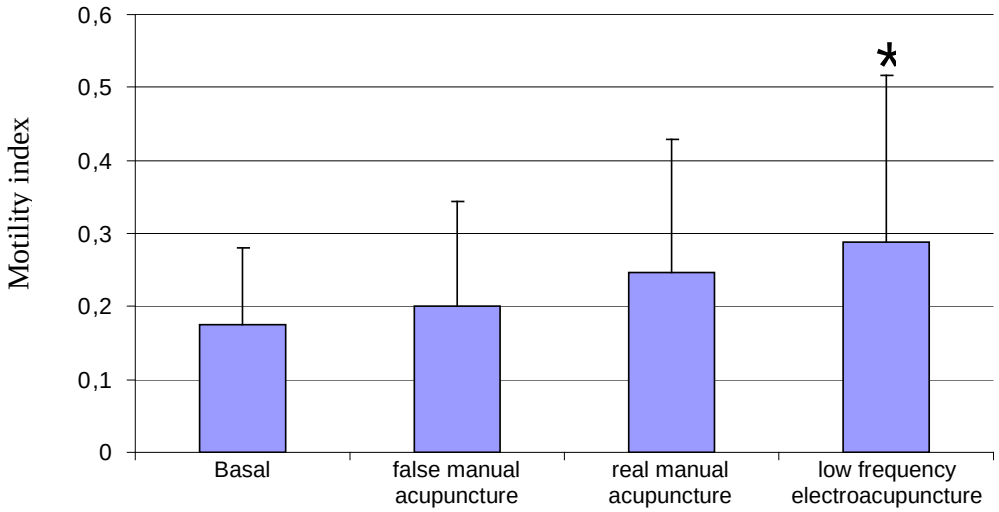

Figure 2- Mean gastric contraction amplitude of dogs treated with false manual acupuncture, real manual acupuncture and low frequency electroacupuncture expressed in motility index. * indicates difference between low frequency electroacupuncture and basal measurements performed for 10 minutes each ($p<0.05$).

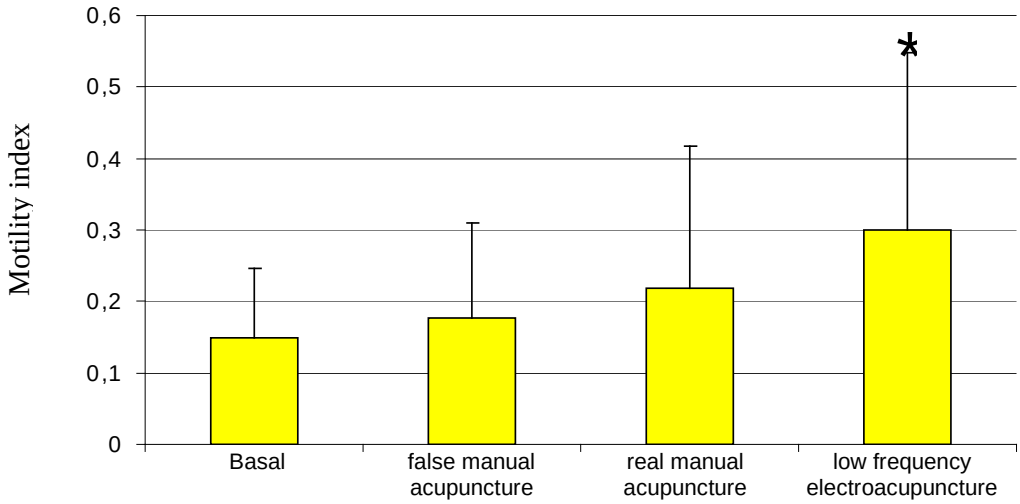

Figure 3- Gastric pressure of dogs treated with false manual acupuncture, real manual acupuncture and low frequency electroacupuncture expressed in motility index. * indicates difference between low frequency electroacupuncture and all other measurements ($p<0.05$).

When the results were considered individually, gastric contraction amplitude increased in 65% and 76% of the animals after treatment with electroacupuncture and real manual acupuncture respectively, against 53% of the dogs after false manual acupuncture. Gastric pressure increased between 65 and 70% of the dogs in all cases.

DICUSSION

Although false manual acupuncture slightly increased gastric contraction amplitude and pressure, the effect was not so pronounced as manual acupuncture. Low frequency electroacupuncture was the only effective treatment to statistically increase gastric contraction amplitude and pressure when compared to basal measurements.

Several mechanisms may explain the effect of acupuncture and electroacupuncture on gastrointestinal motility. A local effect has been described (SHOEN, 1994a, b), release of acetylcholine from the hypothalamus (POMERANS and NGUYEN 1987, CHAKRABARTI et al 1988) and release of serotonin and endogenous opiods, like endorphins and encephalin (HAN et al 1980, ULETT, 1998). These neurotransmitters and hormones act at the gastrointestinal mesenteric muscles (GERSHON, 1991, DUMITRESC, 1996).

Some studies dealing specifically with the effect of acupuncture on gastrointestinal motility have been performed. Still (1984) and Lin et al (1997) reported an increase in gastric motility in dogs and men respectively. Xiaopeng & Tie (1997) reported that the increased gastric peristalsis produced by electro stimulation of St 36 was antagonized by atropine, but not by propanolol, showing that the effect of St 36 is mediated by cholinergic receptors.

The slight increase in gastric contraction amplitude and pressure produced by false manual acupuncture close to real acupoints may be explained by studies which showed that gastric motility may be increased by stimulation of the limbs. This stimulatory gastric response was followed by increased vagal nerve efferent activity and was abolished by bilateral vagal, femoral or sciatic neurectomy (SATO et al, 1993).

Another study also confirmed that the vagal nerve plays an important role on the acupuncture influence on gastric contraction in rabbits (XU, 1994a). The participation of the CNS on the gastric reflex induced by acupuncture was also confirmed by a study in cats (XIE et al, 1987a).

According to the above comments, both the central as well as the peripheral nervous system play a role on the effect of acupuncture on gastric motility. The effect of false manual acupuncture may also be explained by the proximity to the real points and possible stimulation of the same somatovisceral reflex. However it was clearly observed a greater effect of real manual acupuncture when compared to false manual acupuncture and much greater effect of low frequency electroacupuncture.

It seems that part of the effect of acupuncture/electroacupuncture on gastric contraction amplitude and pressure was due to stimulation of femoral and sciatic afferent nerves and that the gastric stimulation is a reflex response of the efferent vagal nerve with CNS participation (SATO et al, 1993). The muscle fibers may also take part on this effect, as acupuncture induces muscle action potentials (KENDALL, 1989). This phenomenon is related to the intrafusal muscular tissue and with gamma 2 motor fibers, remaining even after interruption of the nervous and vascular supply (KENDALL, 1989). Yan et al (1984) reported that intense mechanical manipulation of the needles produces a great muscular action potential which is dependent on the quantity, presence and distribution of the intrafusal muscular fibers in specific points of acupuncture. As an example, the St 36 and LI 4 acupoints stimulated 35% and 53% of the muscular action potentials and the Ki 3 acupoint none, because there is no muscle in the region. These observations also lead to the conclusion that a simple

introduction of needles in areas not recognized as acupoints, but in the same motor fibers, may produce a visceral reflex response.

When the humoral aspects are concerned, Liu (1995) observed that the use of moxibustion in the St 36 acupoint increased acetyl cholinesterase activity and inhibited gastrointestinal motility. A close relationship was observed between equine gastrointestinal motility and endocrine blood variables (BYUNGSUN & HEEIN 1998a). Nam et al (1987) also demonstrated that atropine reduced acupuncture-induced ruminal contraction in goats, showing that acetylcholine plays a definite role on the effect of acupuncture on peristalsis.

Sato et al (1993) reported that naloxone did not modify the acupuncture effect on gastric motility, which might suggest that the endogenous opioids do not play a role on this effect, as it plays in analgesia (LUNA, 1993). Byungsun & Heein (1998b) also reported that the low frequency electroacupuncture-induced increase in intestinal motility in horses was followed by a decrease in ACTH, beta-endorphin, adrenaline and noradrenaline.

This study concluded that both manual and low frequency electroacupuncture may be used to increase gastric motility in dogs, however electroacupuncture was more efficacious for this purpose.

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