

## Effect of Traditional Acupuncture on Proximal Colonic Motility in Conscious Dogs

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**ABSTRACT.** Acupoints on the Large Intestine Meridian and specific acupoints related with large intestine have been empirically used to treat large intestinal disease. However, the relationship between acupoints related with large intestine and their functions has not been investigated fully. We investigated whether large intestine-related acupoints affect colonic motility in conscious dogs implanted with electrodes at the proximal colon. Manual acupuncture was applied at the following acupoints: 7 main points on the Large Intestine Meridian (LI1, LI2, LI3, LI4, LI5, LI6, and LI11), ST25, BL25 or GV1. Acupuncture at the Large Intestine Meridian acupoints, ST25 and BL25 had no significant effects on the proximal colonic motility. However, acupuncture at GV1 depressed the proximal colonic motility by decreasing the total duration and the frequency of contractile states, which may contribute to the therapeutic effects of GV1. This study also revealed that there was no clear correlation between Large Intestine Meridian and the proximal colonic motility in conscious dogs.

**KEY WORDS:** canine, colonic motility, electromyography, traditional acupuncture.

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According to the Oriental medical theory, the Meridian (Qi channel) system comprises the 12 regular Meridians, each one corresponding to one of the 12 internal organs. Acupoints exist along the superficial pathway of each Meridian. Oriental medicine routinely uses acupoint stimulation to treat internal organ-related diseases [4, 12]. It has been reported that acupuncture of Heart Meridian points improved myocardial function [7, 18, 19, 24], and acupuncture of Stomach Meridian points, like ST36, increased or decreased gastric motility in human and animal models, depending on whether or not the stomach was hypoactive or hyperactive, respectively [5, 15, 25].

Oriental medicine uses Large Intestine Meridian to alleviate colon pathologic conditions [4, 14]. The acupoints such as LI4 and LI11 are applied to alleviate diarrhea, move stools and stop pain [17]. Although acupoints on the Large Intestine Meridian and specific acupoints related with large intestine have been empirically used to treat large intestinal disease such as colitis, diarrhea and constipation, which disturb large intestinal motility [4], the relationship between acupoints related with large intestine and their functions has not been investigated fully. In this study, we investigated whether large intestine-related acupoints affect colonic motility in conscious dogs.

### MATERIALS AND METHODS

The experiments were conducted in 5 healthy mongrel dogs of either sex weighing 8–10 kg. The experimental procedures were carried out according to the animal care guidelines of the NIH and the Kyung Hee University Institutional

Animal Care and Use Committee. Each dog was anesthetized with acepromazine (0.05 mg/kg), xylazine (1 mg/kg) and ketamine (20 mg/kg). The proximal colon was exposed through a midline ventral incision. Atropine sulfate (0.05 mg/kg, i.v.) was administered to minimize shortening of the colon caused by spasm during handling. A pair of stainless electrodes was inserted into the serosal layer 5 cm distal to the ileocolic junction. The lead wires from the electrodes were brought out from a stab incision between the scapulas through a subcutaneous tunnel. The dogs were allowed 8–10 days to recover from surgery.

**Recording of colonic electromyographic activity:** The dogs were fasted for 14–16 hr before each recording session that lasted for 4–5 hr. The dogs were studied in the conscious state without sedation. All recordings were made using Grass 79 polygraph (Grass instruments Co., Massachusetts, U.S.A.) with lower and upper cutoff frequencies set at 3 and 30 Hz. After control recording of 2 hr was made, recordings after acupuncture were continued for further 2 hr.

Acupuncture was performed at the following acupoints: 7 main points on the Large Intestine Meridian (LI1, LI2, LI3, LI4, LI5, LI6 and LI11), ST-25 (Abdominal alarm point of large intestine), BL25 (Back association point of large intestine) and GV1 (*Luo*-connecting Point of the Governing Vessel). Stainless acupoint needle (0.25 mm diameter, 30 mm length) was simply inserted at an acupoint for 20 min. One acupuncture trial in each dog was performed for each acupoint. Each acupoint was confirmed by Acupuncture-point locator (Haeng Lim Co, Seoul, Korea) prior to acupuncture and acupuncture was performed by two well-trained practitioners as described in veterinary acupuncture books [12, 17] (Fig. 1).

**Data analysis:** The method used to quantify the proximal

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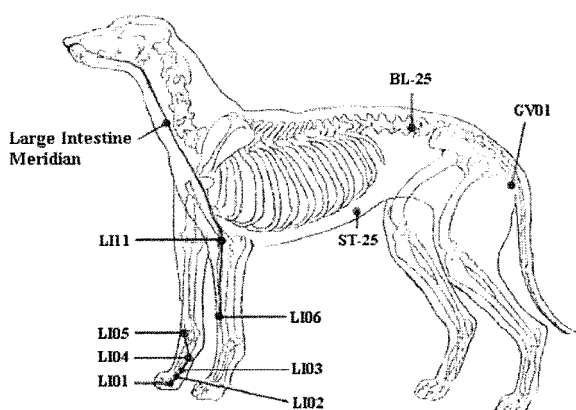


Fig. 1. Acupoints used to stimulate colonic motility in this study. The black line indicates the superficial pathway of the Large Intestine Meridian.

colonic motility has previously been described by Sarna *et al.* [21–23]. Proximal colonic myoelectrical activity consisted of alternating periods of quiescent and contractile states (Fig. 2). A contractile state consisted of a burst of contractions that lasted for at least 1 min. Two contractile states were considered different if there was a quiescent period of at least 2 min between them [21, 23]. The contrac-

tile states were quantified by determining the total duration/hr, mean duration, cycle length and the frequency/hr [22]. The total duration/hr was obtained by adding up the durations of all contractile states during each hour of recording. The cycle length of a contractile state at a given recording site is the time difference between the start of two consecutive contractile states. The data from each dog ( $n=5$ ) were averaged to obtain a single value and expressed as the mean  $\pm$  SE. The paired Student's *t* test and analysis of variance were used for the statistical analysis of data. *P* values  $\leq 0.05$  were considered statistically significant.

## RESULTS

All dogs exhibited spontaneous colonic activity (Fig. 2). Episodes of colonic myoelectrical activities occurred periodically as reported previously [21]. The effects of each acupoint on the total duration of proximal colonic myoelectrical activity are shown in Fig. 3. Acupuncture at LI1, LI2, LI3, LI4, LI5, LI6, LI11, ST25 and BL25 caused no significant effects on the total durations of colonic activity. However, only acupuncture at GV1 significantly decreased colonic activities, compared with pre-treatment value ( $32.0 \pm 6.7$  min/h before vs.  $22.5 \pm 6.2$  min/hr after acupuncture,  $P < 0.05$ , respectively; Fig. 3).

Compared with pre-treatment values, acupuncture at LI3,

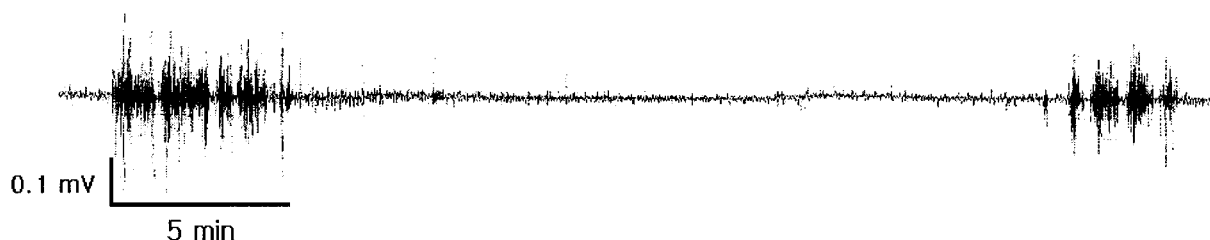


Fig. 2. Electromyogram of the proximal colon in a 14-hr fasted conscious dog. Colonic myoelectrical complexes occurred at 20–30 min intervals ( $22.4 \pm 1.44$  min).

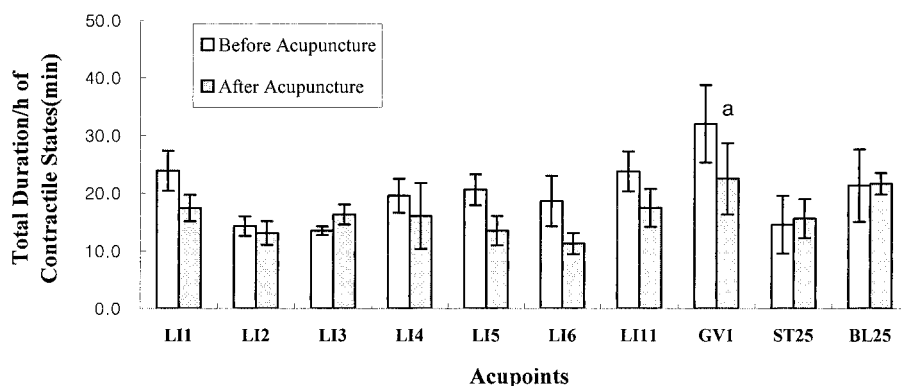


Fig. 3. Effect of acupuncture on the total duration of colonic myoelectrical complexes in the proximal colon of conscious dogs. Compared with pre-treatment values, acupuncture at GV1 significantly decreased the total duration in proximal colon. Values are means  $\pm$  SE. <sup>a</sup>  $P < 0.05$  compared with control (open bar).

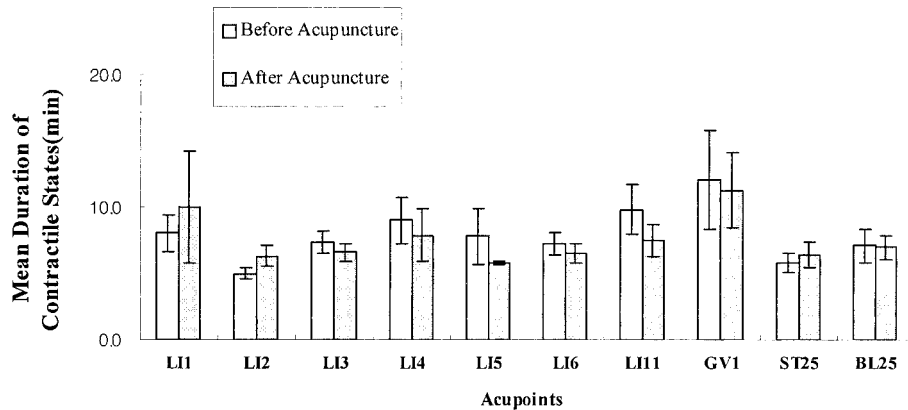


Fig. 4. Effect of acupuncture on the mean duration of contractile states in the proximal colon of conscious dogs. No statistically significant difference was detected between the values before and after acupuncture. Values are means  $\pm$  SE.

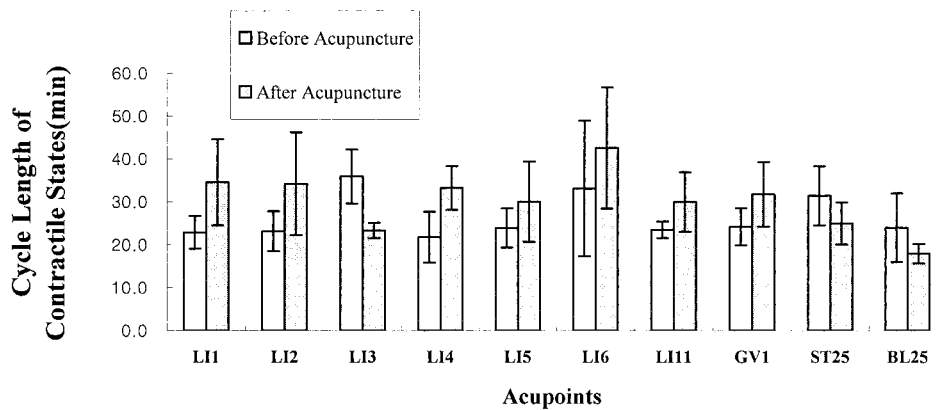


Fig. 5. Effect of acupuncture on the cycle length of proximal colonic myoelectrical activity. No statistically significant difference was detected between the values before and after acupuncture.

LI4, LI5, LI6, LI11, GV1 and BL25 tended to shorten the mean durations of colonic motility slightly, whereas acupuncture at LI1, LI2 and ST25 tended to lengthen the values (Fig. 4). However, these effects were not significant statistically.

Figure 5 shows the effects of acupuncture on the cycle length of proximal colonic myoelectrical activity. The cycle length of colonic activity after acupuncture was not changed from values before acupuncture.

Only acupuncture at GV1 inhibited the frequencies/hr of contractile states ( $2.88 \pm 0.31$ /hr before vs.  $2.00 \pm 0.35$ /hr after acupuncture, respectively,  $P < 0.05$ ; Fig. 6).

## DISCUSSION

Oriental medicine teaches that each of the 12 Main Meridians (Lung, Large Intestine, Stomach, Spleen-Pancreas, Heart, Small Intestine, Bladder, Kidney, Pericardium, San Jiao, Gallbladder and Liver) connects with its specific internal organ. It also teaches that acupuncture at any point

on a given Meridian influences both its related organ and the pathways (superficial Meridian and its other internal pathways) [4, 14]. According to the Oriental medical theory, Large Intestine Meridian is connected with the large intestine and can be applied to alleviate large intestinal symptoms such as colitis, diarrhea and constipation, which disturb large intestinal motility [4]. In the present study, however, acupuncture along the Large Intestine Meridian did not affect the proximal colonic motility in conscious dogs.

Although the Oriental medical theory states the connection of Large Intestine Meridian and large intestine, acupoints on Large Intestine Meridian have been clinically used for pathological conditions such as pain in the forelimb, dermatological problem and epistaxis rather than large intestinal problems [1]. The current study showed that there was no clear correlation between Large Intestine Meridian and the proximal colonic motility from our limited data. Acupuncture can affect a variety of intestinal functions, such as visceral pain, gut motility, absorption and secretion [10, 16,

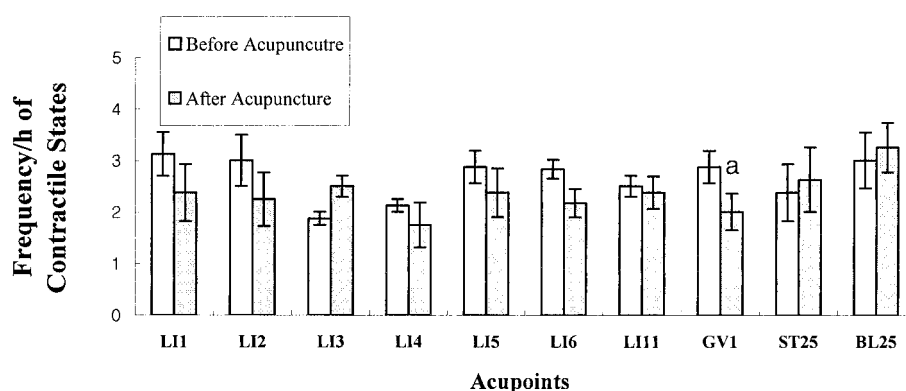


Fig. 6. Effect of acupuncture on the frequencies of proximal colonic myoelectrical activity. Acupuncture at GV1 significantly reduced the frequency of contractile states/hr. Values are means  $\pm$  SE. <sup>a</sup>  $P < 0.05$  compared with control (open bar).

20]. The previous studies have shown that acupuncture had antisecretory effects on the fluid loss in cholera-induced diarrhea [10] and alleviated visceral pain by colorectal distention in rat [20]. LI4 of Large Intestine Meridian points has been reported to relieve pain [8] and regulate sympathetic activity [6]. If acupoints on Large Intestine Meridian alleviate the pathological condition of large intestine, it may be due to mechanisms such as pain relief and regulation of absorption and secretion, but not colonic motility in large intestinal diseases. Further research is needed to confirm whether or not acupuncture at those acupoints can influence colonic motility, pain, absorption and secretion in dogs with colonic dysfunction.

Klauser *et al.* [13] showed electroacupuncture at LI4, ST25 and BL25 had no significant effect on stool frequencies and colonic transit times in 8 constipated patients. Segmental transit times for right and left hemicolon, and rectosigmoid colon did not significantly differ either. Acupuncture at LI4, ST25 and BL25 did not influence objective parameters of colonic function to a clinically relevant degree. Similarly, our findings showed that acupuncture at LI4, ST25 or BL25 had no significant effect on colonic motility in normal dogs.

Luna *et al.* [16] reported that electroacupuncture for 30 min at ST36, LI4 and BL25 significantly increased the fecal excretion rate of orally administered chromic oxide in dogs. In our study, however, manual acupuncture at LI4 or BL25 did not accelerate the colonic motility. This discrepancy might be caused by electroacupuncture or addition of ST36 in the study of Luna *et al.* [16]. Electroacupuncture can be more effective than manual acupuncture to produce acupuncture effects [27] although there are little reports about comparison of them on gastrointestinal functions. Additionally, acupuncture at ST36 has been reported to increase intestinal motility [3, 26]. Thus, the increase in intestinal motility reported by Luna *et al.* [16] is presumed to be due to electroacupuncture or ST36 acupoint.

GV1 has been used effectively for diarrhea in Oriental

medicine. Choi *et al.* [2] reported that acupuncture at GV1 is very effective to cure viral diarrhea in young calves that had shown severe watery diarrhea. Aqua-acupuncture at GV1, with 0.2 ml of 3% saline, significantly reduced the duration of preweaning diarrhea in piglets when compared with control piglets that received 0.5 g lactose orally [9]. Acupuncture at GV1, plus bilateral ST25 and ST36 was markedly effective in a clinical study of diarrhea in 500 infants [28]. Although some studies support the efficacy of acupuncture at GV1 for colitis or diarrhea, little is known about the underlying mechanisms. In a recent publication, we reported that acupuncture at GV1 decreased colonic motility and had anti-inflammatory effects by alleviating colonic lesions and decreasing myeloperoxidase activity on experimentally induced colitis in rats, and it might be mediated through endogenous opioid system [11]. The present study showed that GV1 depressed colonic motility by decreasing the total duration and the frequency of contractile states in conscious dogs. Such results may explain the therapeutic effects of GV1 acupoint on colitis or diarrhea. Further observations on segmental transit time should be made to demonstrate the anti-diarrheal effects of GV1 acupoint in dogs with diarrhea.

In summary, this study demonstrated that there was no clear correlation between Large Intestine Meridian and the proximal colonic motility in conscious dogs. On the other hand, acupuncture at GV1 depressed colonic motility by decreasing the total duration and the frequency of contractile states, which may contribute to the therapeutic effects of GV1.

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