Mechanism of acupuncture on GI motility (supported by NIH R21)

Although acupuncture has been used to treat gastrointestinal symptoms in China for more than 3,000 years, mechanism of the beneficial effects of acupuncture remains unclear. According to the Traditional Chinese Medicine, the energy force (known as Qi) runs through the body. This Qi energy enters the body through specific acupuncture points and flows to deeper organ structures, bringing life-giving nourishment of a subtle energetic nature. Meridians are classified on the basis of the direction in which Qi flows on the surface of the body. If the flow of Qi is insufficient, unbalanced or interrupted, illness may occur. However, these ancient concepts of Qi and meridians have no counterpart in modern studies of chemistry, biology and physics. To date, scientists have been unable to find evidence that supports their existence. In humans, more than 300 acupuncture points are located along the meridians. Despite the fact that the specific acupuncture points are used for treating specific symptoms and/or diseases, it is not fully understood how their specificity applies and how the needling at acupuncture points works. There was no clear evidence to demonstrate the existence of acupuncture points or meridians. Present evidence does not conclusively support that acupuncture points or meridians are electrically distinguishable.

On the other hand, numerous studies demonstrated that somatic afferents from the skin and muscle are involved in the control of GI motor functions. Acupuncture treatment involves the insertion of thin needles into the skin and underlying muscle layer. Inserted acupuncture needles are now often stimulated by electricity under various frequencies of 1-100 Hz (electroacupuncture; EA). Thus, this procedure stimulates the somatic afferent nerves of the skin and muscles [28, 29].

We showed that acupuncture on the ST-25 (abdomen) causes a relaxation of the stomach [30], while acupuncture on the lower leg (ST-36) causes a contraction in rats [31]. Acupuncture-induced gastric relaxation is mediated via somato-sympathetic reflex. Its afferent limb is composed of abdominal cutaneous and muscle afferent nerves and its efferent limb is the gastric sympathetic nerve. The reflex center is within the medulla [30, 32]. In contrast, the contractile effects of acupuncture at ST-36 are mediated via vagal efferent pathway [31, 33].

Nucleus tractus solitarius (NTS) is the primary brainstem relay for visceral information from cardiovascular, respiratory and GI systems. NTS is adjacent to the dorsal motor nucleus of the vagus (DMV) and composes the dorsal vagal complex (DVC). DVC integrates vago-vagal reflex which play a major role in the regulation of GI function. NTS also receives somatic afferent inputs. NTS neurons are activated by cutaneous mechanical stimulus, suggesting that somatic stimulation induced by acupuncture is conveyed to the NTS through the spinal cord. To obtain the anatomical evidences of possible neural pathways in mediating acupuncture-induced gastric motor responses, we studied c-Fos immunohistochemistry of the brain stem in response to acupuncture. We showed that somatic afferents activated by acupuncture at ST-36 is conveyed to the medio-caudal and caudal NTS and stimulates the DMV neurons. In contrast, somatic afferents activated by acupuncture at ST-25 is conveyed to the medio-caudal NTS and stimulates the rostral ventrolateral medulla (RVLM) neurons. The RVLM neurons are

known as premotor sympatho-excitatory neurons that provide drive to the sympathetic preganglionic neurons in the intermediolateral nucleus of the spinal cord [34].

Acupuncture at ST-36 accelerates colonic motility and transit in normal conditions in conscious rats. The stimulatory effect acupuncture is mediated via a sacral parasympathetic efferent pathway (pelvic nerve) [35]. On the other hand, acupuncture at ST-36 attenuates accelerated colonic transit induced by restraint stress in rats [32]. Acupuncture improves imbalance of autonomic function under the restraint stress in rats [36]. Our recent study showed that acupuncture upregulates hypothalamic oxytocin expression which acts as an anti-stressor agent and mediates restored colonic dysmotility following chronic stress [37].

In conscious dogs, acupuncture at the wrist prevents emesis induced by vasopressin. The anti-emetic effect of acupuncture is mediated via a central opioid pathway [38, 39]. Acupuncture at ST-36 reduces rectal distension-induced blood pressure changes in conscious dogs. The anti-nociceptive effect of acupuncture is also mediated via a central opioid pathway [40]. Migrating motor complex (MMC) is well characterized by the appearance of GI contractions in the interdigestive state. Maintaining gastric MMC is an important factor to prevent the postprandial dyspeptic symptoms [41-43]. Acupuncture at ST-36 restores impaired interdigestive gastric MMC induced by acoustic stress via increasing vagal activity in dogs [44].

Our studies suggest that acupuncture is useful to treat the patients with functional GI disorders, like functional dyspepsia (FD) and irritable bowel syndromes (IBS) [28, 29, 45].

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