The Beneficial Effect of ST-36 (Zusanli) Acupressure on Postoperative Gastrointestinal Function in Patients With Colorectal Cancer

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Purpose/Objectives: To evaluate the effectiveness of ST-36 (Zusanli) acupressure on recovery of postoperative gastrointestinal function in patients with colorectal cancer.

Design: A longitudinal, randomized, controlled trial design.

Setting: An urban medical center in Taiwan.

Sample: 60 patients with colorectal cancer who had undergone abdominal surgery.

Methods: Patients were randomly assigned to two groups, the ST-36 acupressure group (n = 30) and a sham acupressure group (n = 30). Patients in the ST-36 group received an acupressure procedure in a three-minute cycle performed three times per day during the five days after surgery. Patients in the control group received routine postoperative care and sham acupressure. Generalized estimating equations (GEEs) were used to gauge longitudinal effects of the two groups of patients.

Main Research Variables: Frequency of bowel sounds, the time to first flatus passage, first liquid intake, solid intake, and defecation.

Findings: Patients who received acupressure had significantly earlier flatus passage and time to liquid intake as compared to patients in the control group. Other main variables, including the first time to solid intake and defecation, did not show significant difference between the two groups. The GEE method revealed that all patients had increasing bowel sounds over time, and the experimental group had greater improvement of bowel motility than the control group within the period of 2–3 days postoperatively.

Conclusions: ST-36 acupressure was able to shorten the time to first flatus passage, oral liquid intake, and improve gastrointestinal function in patients after abdominal surgery.

Implications for Nursing: ST-36 acupressure can be integrated into postoperative adjunct nursing care to assist patients' postoperative gastrointestinal function.

Knowledge Translation: Few studies have explored the effectiveness of acupressure techniques on promoting bowel sounds. Evidence from this study suggests stimulation of the ST-36 acupressure point can increase bowel sound frequency for patients with colorectal cancer in the first three days after surgery. Application of this technique may improve a patient's comfort after surgery.

A loss of bowel peristalsis is common after abdominal surgery and can lead to abdominal distention, pain, reduced bowel sounds, emesis, or other discomforts. If patients do not have bowel sounds or bowel movement by the fourth day postsurgery, they are considered to be at risk for postoperative ileus (POI). POI is a significant clinical consequence and can prolong hospitalization, which is a financial burden on patients and the healthcare system (Behm & Stollman, 2003; Chen et al., 2003; Delaney, Senagore, et al., 2006; Meng et al., 2010).

After surgical stress, which is the hormonal and metabolic changes following an injury or operation, large amounts of catecholamines release because of overactive sympathetic tone and result in suppressed bowel function (Behm & Stollman, 2003). Inflammatory response following abdominal surgery also can stimulate the release of prostaglandins and cytokines, which inhibit bowel activity (Delaney, Kehlet, et al., 2006). The intestine is more sensitive to anesthetic drugs because of a lack of gaps between neuronal cells in the bowel. Anesthetics such as atropine, enflurane, and halothane can inhibit gastrointestinal (GI) function (Baig & Wexner, 2004). Analgesics, particularly opioids such as morphine, also can inhibit bowel sound (Baig & Wexner, 2004). Nasogastric intubation is a supportive therapy to prevent abdominal distension, vomiting, and POI, which may complicate the postoperative course after abdominal surgery; however, studies have shown that the use of nasogastric intubation does not shorten the bowel function recovery time. Instead, intubation further slows the passage of flatus and can interfere with food intake (Lee, Hyung, & Noh, 2002; Vermeulen, Storm-Versloot, Busch, & Ubbink, 2006).

Voluntary flatus passage is an important indicator of postoperative bowel function recovery. According to the literature, the recovery of small intestine motility is the earliest activity in the postoperative period; stomach motility returns within 24–48 hours and colonic motility recovers within 3–5 days (Carroll & Alavi, 2009; Nachlas, Younis, Roda, & Wityk, 1972; Wilson, 1975). No consensus exists on a guideline for treatment of postoperative GI function recovery; however, and current clinical interventions of GI function recovery include restricting oral intake of food and liquid, increasing physical activity, and prescribing prokinetics, laxatives, or enemas (Behm & Stollman, 2003; Delaney, Kehlet, et al., 2006). The effectiveness of these approaches on restoring GI function is still in question. Therefore, knowing what care the nursing staff can apply to promote postoperative GI recovery is crucial.

Studies have shown that stimulations from acupuncture and electro-acupuncture can increase bowel sounds. In an animal study by Iwa et al. (2006), electro-acupuncture of ST-36, or Zusanli, stimulated terminal rectal activity through parasympathetic transmission. A study by Chen, Song, Yin, Koothan, and Chen (2008) on canines suggested that, by stimulating ST-36, impaired gastric motility from rectal distension could be restored by exerting a modulating effect on gastric dysrhythmia. One approach in human studies is to measure the period dominant power, which is defined as the power at the dominant frequency in the power spectrum of electrogastrogram (EGG). The dominant frequency of EGG has been shown to be equal to the frequency of the gastric slow wave measured from implanted serosal electrodes (Chen, Schirmer, & McCallum, 1994). A study by Shiotani, Tatewaki, Hoshino, and Takahashi (2004) used a single-group, pre-/post-test design to assess the level of change in gastric musculature before and after stimulation of ST-36 and PC-6 (Neiguan). The EGG assessment demonstrated that stimulating ST-36 alone could increase the gastric period dominant power by 154% (SD = 28%). However, simultaneous stimulation of both ST-36 and PC-6 did not change the percentage of normal slow waves or the percentage of tachygastria (Shiotani et al., 2004). The findings suggested that stimulation of ST-36 alone could increase gastric motility. Chang, Ko, Wu, and Chen (2001) indicated that electrical acupuncture stimulation at the ST-36 points could significantly increase the percentages of normal EGG frequency, suggesting that stimulation of ST-36 alone could increase gastric motility. Therefore, electrical acupuncture stimulation at ST-36 could significantly increase the percentages of normal EGG frequency (Chang et al., 2001). Another study using healthy human participants found that electrical stimulation of acupuncture points may enhance the regularity of gastric myoelectrical activity, which increases bowel movement (Chou, Chang, Chang, & Chen, 2003).

All of the studies involved either acupuncture or electro-acupuncture at ST-36 to increase GI motility. Acupuncture and electro-acupuncture, however, are not suitable for clinical nursing care because they are invasive techniques that require specialized training. Acupressure is a form of Chinese traditional medicine therapy and is based on the same principles as acupuncture. However, acupressure is a noninvasive technique that uses fingers to rub, knead, nail pinch, and press instead of using needle insertion at the different acupressure points on the body. Acupressure involves stimulating surface acupoints to stimulate the energy, or Qi, of the body to achieve comfort and relief (Chang, Liu, Li, Chen, & Chou, 2006; Takahashi, 2006). A study by Chen et al. (2003) demonstrated that acupressure at ST-36, PC-6, and SP-6 (Sanyinjiao) applied after surgery increased GI motility in patients who underwent hysterectomy. Acupressure was continued for three days twice a day on the three acupoints for three minutes each, and the increase in GI motility in the experimental group was found to be significant ($p < 0.05$). However, researchers from that study were unable to tell which acupoint is predominant in improving bowel sounds.

To fill the gaps in knowledge, the current study was conducted to test whether ST-36—being one of the most important "hubs" in the various acupressure points—can be used alone to improve bowel sounds. ST-36 is used primarily for treating ailments related to the digestive, neurologic, and respiratory systems (Chang et al., 2006). ST-36 is located lateral to the tibia and is four finger breadths down from the patella (see Figure 1). The acupressure practitioner can apply pressure on ST-36 using his or her thumb, which makes it a more suitable nursing care skill because of the less-invasive nature and being a simpler technique to perform than acupuncture.

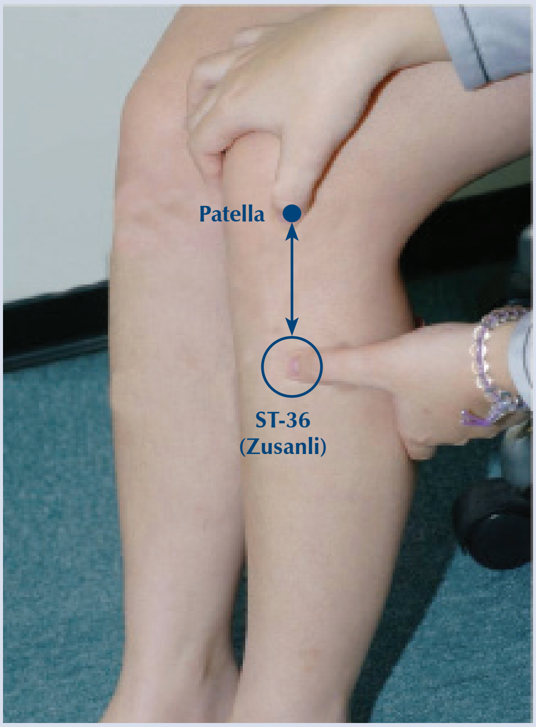
The purpose of the current study was to compare the effectiveness of ST-36 acupressure with that of sham acupressure on the frequency of bowel sounds, time to first passage of flatus, time to first oral liquid intake, time to first solid intake, and time to first defecation in patients with colorectal cancer after abdominal surgery. Based on the effects of ST-36 acupressure on increasing bowel sound (Chang et al., 2006), the authors hypothesized that stimulation of ST-36 can promote bowel sounds and reduce the time required for solid food intake and bowel movement.

Methods

Sample and Setting

The study used a randomized, controlled trial, repeated-measures, random-sequencing design to compare the frequency of bowel sounds, the time to first passage of flatus, and the time to oral liquid and solid intake and defecation in patients with colorectal cancer after abdominal surgery between the ST-36 experimental and control groups. Participants were recruited by convenience sampling from an urban medical center in Taipei, Taiwan, and were limited to patients with colorectal cancer who had undergone either colectomy or rectal resection. All participants met the following inclusion criteria: (a) aged 18 years or older, (b) underwent colorectal surgery for the first time, (c) had only one surgery while hospitalized, (d) and had no lower limb defects or infections that would hinder the accuracy of ST-36 identification and pressure or worsen local infections. Patients with chronic pain requiring long-term use of analgesics or sleeping pills, those with mental disabilities, or those with communication and compliance difficulty also were excluded.

Eighty patients with colorectal cancer who were about to undergo abdominal surgery were recruited. A total of 66 participants fit the inclusion criteria. In the follow-up period, three patients underwent a second surgery, and three patients refused participation, and were therefore excluded from the study. The total number of participants included for final analysis was 60, with 30 in the ST-36 experimental group and 30 in the control group. The study was approved by the institutional review board and research committee at Cathay General Hospital. The first author explained the study in detail and obtained informed consent from participants who met the study criteria.



Note. ST-36 (Zusanli) is bilaterally located about four finger breadths from the lower border of the patella, lateral to the tibia.

Figure 1. Acupressure at ST-36 (Zusanli)

Note. Photo courtesy of Pei-Fen Liu. Used with permission.

ST-36 Acupressure Method

Patients in the experimental group received routine postoperative care and ST-36 acupressure. Before applying acupressure, a licensed physician of traditional Chinese medicine would locate and mark the ST-36 acupressure point, and the trained research nurse applied acupressure on the ST-36 point. The acupressure procedure involved one press per second, and, after five continuous one-second presses and a two-second rest, the cycle was repeated for three minutes. The depth of each press had a reach of 1–1.5 cm and the force was about 3–5 kg. The procedure was repeated on the contralateral leg (Chen et al., 2003; Chen, Wang, & Tsai, 1998; Ma, Chang, & Lin, 2007). During each two-second rest period, the patient was asked whether he or she felt soreness, fullness, or heat sensation, which are indicative of the correct ST-36 site. If the patient answered "yes," the acupressure session continued; if the patient answered "no," the location of acupressure was readjusted until the patient responded with positive soreness, fullness, or heat sensation before applying the same cycles once more. Patients in the control group received routine postoperative care and sham acupressure, which applied pressure on a location along the nonacupressure point of the tibia and in the same way as the experimental group, but participants were only asked whether the pressure was causing any discomfort.

Measurements

The data categories of the current study are patient's basic information, medical history, clinical information, and measurement of the effectiveness of acupressure. The basic information and medical history included gender, age, highest level of education achieved, whether or not the patient had regularly exercised in the past six months, a history of diseases related to the gastrointestinal tract, and whether the patient had taken any drugs in the past weeks that could affect defecation. The clinical information included cancer TNM (tumor size, lymph node involvement, and distant metastases) staging, primary cancer location, surgery method, whether a nasogastric tube was in place, and whether opioid analgesics and sedatives had been used. Measurements of acupressure effectiveness made by a research nurse included (a) a daily record of the frequency of bowel sounds during the three-minute observation period, (b) the time to the first flatus passage and defecation, and (c) the time to oral liquid and solid intake. Bowel sounds were auscultated and measured at each of the four quadrants of the abdomen using a stethoscope. A timer was set for three minutes for each assessment. The frequency of bowel sounds per minute was counted and recorded. To prevent assessment error, a physician concomitantly confirmed the accuracy of measurement by performing the assessments simultaneously. The interobserver correlation was 0.95.

Procedures

Two trained research nurses were involved in this study. One research nurse performed acupressure on all of the patients; the other research nurse, who was blinded to patients' assigned groups, did not perform acupressure but was, instead, responsible for bowel sounds measurement and general data collection. After abdominal surgery, patients in both the ST-36 experimental and control groups had their first baseline (T0) bowel sounds assessment after returning to the general surgical ward from the postoperative recovery room. Taking into consideration that the patients were not fully recovered from the effect of anesthesia, and to ensure that the patients were not disturbed on their first night after surgery, the intervention was begun at 6:30 am on the first day after surgery. Acupressure was performed every eight hours at three different times, 6:30 am, 3:30 pm, and 11:30 pm, for five consecutive days, yielding 15 measurements (T1–T15). After each session of ST-36 or sham acupressure was completed, the blinded research nurse then measured the frequency of bowel sounds, the time to first flatus passage, defecation, and when oral liquid and solid intake started after surgery. The research nurse then recorded the data on an electronic spreadsheet.

Data Analysis

Demographic and clinical data were summarized with descriptive statistics such as frequency, percentages, and means. The chi-square test or Fisher's exact test was used to compare the categorical data between experimental and control groups. For continuous data, the independent t test was used to compare the time to first passage of flatus, defecation, and oral liquid and solid intake between the two groups. The authors also used the independent t test to compare the bowel sounds between the two groups at each observation time point. GEE method's generalized linear models were used to estimate longitudinal effects of ST-36 point acupressure on bowel sounds. Independent variables were two groups each with 15 observation points; the interaction variable was 15 observation points by two groups. Potential control variables were age, location of the tumor, cancer stage, surgical procedure, use of a nasogastric tube, patient-controlled analgesia (PCA), and opioid analgesics or sedative medicine. SPSS®, version 17.0, statistical analysis program was used for data management and analysis. The p values were two-tailed, and $p < 0.05$ was considered statistically significant.

Results

Demographic and Clinical Data

Sixty participants were included for analysis; 30 in the experimental group and 30 in the control group. The mean age was 61.9 years (SD = 13.3 years) in the experimental group and 62.8 years (SD = 15.7 years) in the control group. Fourteen patients (47%) in the experimental group were men, as were 17 (57%) in the control group. The highest education level for both the experimental and control groups was primary or junior high school (47% and 53%, respectively). Twenty-eight patients (93%) in both groups had no history of disease related to the gastrointestinal tract. In the experimental group, 16 (53%) exercised regularly, compared to 12 (40%) in the control group. Most patients in the experimental and control groups had not taken any medication that affects defecation one week prior to hospitalization (90% and 87%, respectively). When all of the variables were analyzed with the independent t test and the Chi-square test, no differences were found between the demographic characteristics of the two groups.

Colon cancer was indicated in 21 (70%) of the patients in the experimental group, compared to 23 (77%) in the control group. Patients in this study all underwent open abdominal colectomy or rectal resection. Fifteen patients (50%) in the experimental group had right or left hemicolectomy, compared to 13 (43%) in the control group. Low anterior resection accounted for 11 patients (37%) in the experimental group compared to 10 (33%) in the control group. As for cancer stage distribution, seven participants (23%) in the experimental group and 11 (37%) in the control group had clinical TNM stages 0 and I. TNM stage II was noted in 12 participants (40%) from the experimental group and 13 (43%) of the control group. TNM stage III was noted in six participants (20%) of the experimental group and four (13%) of the control group. TNM stage IV occurred in five participants (16%) of the experimental group and three (7%) of the control group.

Twenty-nine patients in the experimental and twenty-seven patients in the control groups received PCA (97% and 90%, respectively), and 29 patients in the experimental and 28 in the control groups were given analgesics (meperidine 1 mg/kg every three hours) as needed (97% and 93%, respectively). As for sedatives, two patients (7%) in the experimental group and three patients (10%) in the control group had sedative drugs prescribed. A nasogastric tube had been placed in 14 patients (47%) in the experimental group compared to 17 (57%) in the control group. After chi-square test analysis, no differences were found between the clinical data in the two groups.

Effects of Acupressure

The frequency of bowel sounds increased in all patients after surgery (see Table 1). The independent t test was used to evaluate the differences in frequency of bowel sounds in both groups. The frequency of bowel sounds in the experimental group was significantly higher than in the control group for the first two days (T1–T7) after surgery, but not after.

GEE was used to estimate group longitudinal effects of ST-36 acupressure on bowel sounds, and the model indicated no statistically significant differences between the two groups in frequency of bowel sounds. For time effects, both groups showed an increasing trend of bowel sounds with time since surgery. From T1 to T7, the changes in bowel sound frequency of the experimental group were significantly better than in the control group ($p < 0.001$, $p < 0.001$, $p < 0.001$; $p = 0.002$, $p = 0.001$, $p = 0.01$, and $p = 0.041$). The changing pattern at the remaining time points (T8–T15) did not show any difference between the control and experimental groups. Based on these findings, the authors concluded that the ST-36 acupressure can stimulate increased and earlier bowel sounds, extending to two to three days after abdominal surgery. In the GEE method, after controlling for clinical variables, patients using a PCA device had more bowel sounds compared to those not using it ($p = 0.032$); patients who received meperidine analgesic had fewer bowel sounds than those who did not ($p < 0.001$); patients with nasogastric intubation had fewer bowel sounds than those without ($p = 0.022$) (see Table 2).

Table 1. Difference in the Frequencies of Bowel Sounds Between Experimental and Control Groups Every Eight Hours Postsurgery (N = 60)

Observation Time Point	Experimental (n = 30)			Control (n = 30)			
	$\bar{X}$	SD	Range	$\bar{X}$	SD	Range	p
T0: Baseline	0.93	1.08	0–3	0.9	1.75	0–6	0.522
T1: 6:30 am[a]	4.1	4.12	0–16	1.23	2.49	0–10	0.002
T2: 8 hours after T1	4.53	3.7	0–14	1.57	2.37	0–8	0.001
T3: 16 hours after T1	5.6	4.21	0–15	2.27	3.18	0–10	0.001
T4: 24 hours after T1	5.4	3.1	0–11	2.87	3.67	0–13	0.006
T5: 32 hours after T1	8.3	4.68	2–18	4.77	4.09	0–12	0.003
T6: 40 hours after T1	9.33	5.27	0–23	5.9	5.25	0–23	0.014
T7: 48 hours after T1	10.07	6.21	1–32	6.73	6.31	0–32	0.044
T8: 56 hours after T1	10.47	3.85	4–2	8.33	7.5	0–30	0.106
T9: 64 hours after T1	10.27	3.95	2–18	9.27	7.47	0–28	0.52
T10: 72 hours after T1	10.9	4.53	2–27	9.17	5.65	0–27	0.195
T11: 80 hours after T1	10.73	4.13	4–21	9.47	5.8	2–20	0.334
T12: 88 hours after T1	10.73	3.81	5–22	10.03	5.77	2–22	0.581
T13: 96 hours after T1	11.23	4.43	2–26	10.63	5.6	4–26	0.647
T14: 104 hours after T1	11	3.79	3–19	11.43	5.04	3–20	0.708
T15: 112 hours after T1	12.33	3.37	3–20	11.57	4.22	5–22	0.44

[a] The morning after surgery

The times to first passage of flatus, oral liquid food, solid food intake, and defecation in the patients were evaluated. As seen in Table 3, the mean time to first flatus passage after surgery was 2.78 days (SD = 0.92 days) in the experimental group and 3.61 days (SD = 1.15 days) in the control group ($p = 0.003$). Mean time to first liquid intake was 3.43 days (SD = 0.97 days) in the experimental group, which is earlier than the control group ($\bar{X} = 4.26$ days, SD = 1.42 days, $p = 0.01$). However, no difference was noted between the two groups in the mean time to first solid food intake ($\bar{X} = 4.54$ versus 5.11 days, $p = 0.177$) and the time to first defecation ($\bar{X} = 4.75$ versus 5.25 days, $p = 0.236$).

Discussion

Acupressure therapy, as part of Chinese traditional medicine therapy, is accepted by the local population (Yu et al., 2006) and is commonly sought to relieve GI symptoms in Taiwan (Chen et al., 2003; Ming, Kuo, Lin, & Lin, 2003). The study demonstrated that applying acupressure on ST-36 after colorectal surgery can increase the frequency of bowel sounds, shorten the flatus passage time, and accelerate recovery of bowel function. The findings are consistent with those previously reported in the literature. Another advantage of acupressure of the ST-36 is that this technique can be easily taught and can be used to relieve abdominal bloating, increase the frequency of bowel sounds, and shorten time required for flatus passage after surgery.

The findings support the authors' study hypothesis and demonstrate that changes of bowel sounds at T1 (6:30 am the first day after surgery) to T7 (48 hours after T1) were greater among patients in the experimental group than among patients in the control group, indicating that pressing on ST-36 has a significant effect on bowel sounds within 48 hours after T1. Previous studies (Chang et al., 2001; Shiotani et al., 2004) have indicated that applied acupressure or acupuncture can stimulate several GI hormones (e.g., motility, gastrin, pancreatic polypeptide) that regulate the contraction of gastric smooth muscle or small intestinal mucosa and increase gastric emptying in the human body.

In addition, the current study demonstrated that the time to first flatus passage after surgery in the experimental group was 2.78 days, which is sooner than 3.6–4 days reported in patients who underwent open colectomy (Liu, Lin, Ye, & Teng, 2010; Salimath, Jones, Hunt, & Lane, 2007). In Taiwan, patient solid food intake depends on the individual patient's subjective comfort level with a clear liquid diet after first flatus passage, and no difference was seen between the two groups in terms of the first time to solid food intake and defecation. Two previous studies indicated that first defecation took 4.4 days for open colectomy and that acupuncture did not benefit earlier solid food intake and defecation for postoperative patients (Meng et al., 2010; Salimath et al., 2007). In Taiwan, patient solid food intake depends on the individual patient's subjective comfort level with a clear liquid diet after first flatus passage. On the other hand, patients who have a nasogastric tube in place for several days are given IV fluid or nasogastric feeding, thus leading to prolonged time before solid food intake and defecation.

Opioid analgesics, such as morphine and meperidine, are commonly prescribed postoperatively for pain relief. Their pharmacologic mechanism involves blocking the transmission of pain sensation and reducing the perception of pain by the cerebral cortex (Kharkevich & Churukanov, 1999). Since opioid analgesics act on the central nervous system, aside from complications such as respiratory inhibition, sedation, or addiction, opioid analgesics also can reduce the secretion of intestinal fluids, decrease propulsive motility, and increase absorption of water and salts from feces, causing constipation (Murphy, Sutton, Prescott, & Murphy, 1997). The current study's findings demonstrated that intramuscular injection of meperidine does reduce GI motility, but IV infusion of PCA was associated with increased bowel sounds. The authors postulate that the reason for this was that patients who received PCA in this study were prescribed a regimen that included ketorolac, a nonsteroidal anti-inflammatory drug that mainly acts on the peripheral nervous system and can inhibit the production of prostaglandins, which in turn reduce the inhibitory effects on bowel sound (Lee et al., 2002; Vermeulen et al., 2006). Another clinical study investigated 79 patients who underwent a colectomy and found that adding ketorolac to PCA not only reduced consumption of morphine by 29%, but shortened the time for flatus passage as well (Chen et al., 2005). A combination, therefore, of analgesics can decrease the direct damage of opioid analgesics on intestinal tract function. In contrast to intramuscular injection of meperidine-type drugs, PCA can relieve not only pain but also inflammation, and has a degree of protection on the GI tract. Such a combination of medicine can help patients return to physical function (Chen et al., 2005).

Clinically, nasogastric tube placement, usually after abdominal surgery, is used to decompress the stomach and to avoid postoperative complications such as abdominal bloating, nausea, vomiting, bowel obstruction, and leakage at the site of the anastomosis (Nelson, Tse, & Edwards, 2005; Wolff et al., 1989). Results from this study suggest that the prolonged placement of a nasogastric tube has a negative relationship with the frequency of bowel sounds. That result is consistent with the findings of a meta-analysis study by Yang, Zheng, and Wang (2008) that showed time to flatus was shorter in the group without nastrogastric decompression and that decompression may not prevent but actually facilitate postoperative ileus. Vermeulen et al. (2006) indicated that, after abdominal surgery, patients without nasogastric tubes did not experience more postoperative complications such as pneumonia, wound infection, and leakage at the site of anastomosis compared to those with nasogastric intubation. The studies suggest that no clinical evidence exists showing that a nasogastric tube can be beneficial to postoperative recovery. To the contrary, it might cause some unexpected side effects, such as discomfort, damage to

Table 2. Changes in Bowel Sounds by Generalized Estimating Equation Model

Variable	Estimate	SE	95% CI	p
Intercept	3.56	2.29	[–1, 8.03]	0.118
Group[a]				
Experimental	–0.45	0.62	[–1.6, 0.764]	0.654
Time[b]				
T1	0.33	0.18	[–0.03, 0.7]	0.071
T2	0.67	0.2	[0.26, 1.07]	0.001
T3	1.37	0.37	[0.64, 2.1]	< 0.001
T4	1.97	0.56	[0.87, 3.07]	< 0.001
T5	3.87	0.65	[2.59, 5.15]	< 0.001
T6	5	0.91	[3.22, 6.78]	< 0.001
T7	5.83	1.09	[3.68, 7.99]	< 0.001
T8	7.43	1.34	[4.82, 10.05]	< 0.001
T9	8.37	1.19	[6.03, 10.71]	< 0.001
T10	7.93	0.99	[6.36, 10.17]	< 0.001
T11	8.57	0.98	[6.46, 10.49]	< 0.001
T12	9.13	1.01	[7.15, 11.12]	< 0.001
T13	9.73	0.97	[7.84, 11.63]	< 0.001
T14	10.53	0.87	[8.82, 12.25]	< 0.001
T15	10.67	0.75	[9.19, 12.15]	< 0.001
Interaction[c]				
T0–T1	2.83	0.67	[1.52, 4.15]	< 0.001
T0–T2	2.93	0.64	[1.68, 4.19]	< 0.001
T0–T3	3.3	0.83	[1.67, 4.93]	< 0.001
T0–T4	2.5	0.8	[0.93, 4.07]	0.002
T0–T5	3.5	1.03	[1.48, 5.52]	0.001
T0–T6	3.4	1.33	[0.81, 5.99]	0.01
T0–T7	3.07	1.5	[0.13, 6]	0.041
Control				
Use PCA[d]	1.93	0.9	[0.16, 3.7]	0.032
Inject meperidine[e]	–4.35	0.92	[–6.15, –2.54]	< 0.001
Nasogastric tube[f]	–1.37	0.6	[–2.55, –0.2]	0.022

CI—confidence interval; PCA—patient-controlled analgesia; SE—standard error

[a] Compared to control group

[b] Compared to baseline (T0)

[c] Experimental compared to control group time

[d] Compared to non-use of PCA

[e] Compared to non-use of meperidine

[f] Compared to those without a nasogastric tube

Table 3. Days After Surgery to First Passage of Flatus, Liquid Intake, Solid Intake, and Defecation by Group (N = 60)

	Experimental (n = 30)		Control (n = 30)		
Variable	$\overline{X}$	SD	$\overline{X}$	SD	p
Passage of flatus	2.78	0.92	3.61	1.15	0.003
Liquid intake	3.43	0.97	4.26	1.42	0.01
Solid intake	4.54	1.17	5.11	1.99	0.177
Defecation	4.75	1.17	5.25	1.96	0.236

the nasal cavity and throat, esophageal or gastric ulcers, electrolyte imbalance, restrictions in food intake, pneumonia, and psychological problems such as impaired consciousness (Manning, Winter, McGreal, Kirwan, & Redmond, 2001; Vermeulen et al., 2006). Prolonged nasogastric tube use may interfere with normal physical function (Rao et al., 2011; Sagar, Kruegener, & MacFie, 1992). The effects of early tube removal on the recovery of GI function for patients who remain on gastric intubation after surgery should be assessed in the future.

Strengths and Limitations

The current study was strengthened by (a) the aid of a physician licensed in traditional Chinese medicine to locate the ST-36 acupoint, (b) the use of a single intervener to apply the acupressure technique, (c) a separate outcome assessor and intervener to prevent measurement bias, and (d) five days of continued intervention to discover the full scope of the technique.

One limitation is that only a small and specialized sample was used. This sample included only patients with colorectal cancer; therefore, the authors cannot determine what effect this technique will have on other patients undergoing abdominal surgery. Future studies should target a more diversified sample. Researchers should study the physiological mechanisms of ST-36 acupressure on GI function. Also, ST-36 acupressure for facilitating bowel motility after surgery should be examined with a larger and more diverse sample.

Conclusion

This study demonstrated that ST-36 acupressure alone can improve postoperative GI function in patients with colorectal cancer by increasing the frequency of bowel sounds and shortening the time to first flatus passage and first liquid food intake. Acupressure is a noninvasive, safe, and an easy-to-perform technique. Under guidance, the caretaker or even the patient can be taught to perform the technique to achieve earlier return of bowel function. It also is a simple adjunct technique that nurses can apply. By integrating ST-36 acupressure into nursing care practice, patients' postoperative bowel dysfunction can be reduced.

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