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Effect of transcutaneous electrical acupoint stimulation on accelerating gastrointestinal functions after abdominal operations in women

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ABSTRACT

Objectives: To determine the efficacy of transcutaneous electrical acupoint stimulation (TEAS) on accelerating gastrointestinal tract (GIT) functions after abdominal operation in women.

Methods: Thirty female patients undergoing abdominal operations participated in this study. Their age ranged from 25 to 45 years old, and their body mass index (BMI) was less than 35 kg/m². Patients were selected randomly from surgery department at Shebin El Kom teaching hospital and distributed into two groups of 15 members each. Group (A) treated by TEAS on PC6, ST36 and SP6 acupoints in addition to general advice that would be given to them to accelerate GIT functions. Group (B) followed the same advice that would be given to them to accelerate GIT functions. Outcomes to be studied in this research were first flatus time, first defecation time, first liquid and solid intake time, early mobilization time, as well as the duration of hospital stay.

Results: The result of this study proved that there was significant decrease in first flatus time, first defecation time, first liquid and solid intake time and early mobilization time in group (A) compared to group (B) ($F= 25.042$ $p = 0.0001$, Partial $\eta 2= 0.867$). While there is no difference between the 2 groups regarding the duration of hospital stay ($F= 0.772$, p-value=0.387).

Conclusions: TEAS proved to have a great effect in accelerating GIT function and preventing postoperative ileus (POI) after abdominal operations.

KEYWORDS

Postoperative Ileus; Transcutaneous Electrical Acupoint Stimulation; Gastrointestinal Function

1. INTRODUCTION

Abdominal operations have an important role in the treatment of many benign and malignant gynaecological diseases. There is a popular expectation that paralytic ileus (temporary restriction of bowel functions) come after all abdominal operations. The major cause of this phenomenon is not yet known, but it has been found that exaggerated sympathetic tone, stimulation of pain fibres, and the discharge of inhibitory neurotransmitters from the wall of the gut are all mechanisms related to it [1].

Postoperative ileus (POI) is known as a transitory deterioration of regular gastrointestinal tract (GIT) functions observed after many abdominal operations and frequently after non-abdominal operations, with manifestations including nausea, vomiting, discomfort in the abdomen, bloating, absence of flatus or stool, inflation of gases and fluid in the bowel, and reduced oral flexibility. POI results in prolonged hospital stays and increased medical costs [2].

The ways to prevent POI include the usage of minimally invasive surgeries, the routine use of a prophylactic nasogastric tube (NGT), resuming the intake of food and fluids immediately after the operation, and the use of mechanical bowel preparations in combination with alvimopan for oral antibiotics and opioid-based cases. Treatment for POI mainly involves administering NGT to relieve nausea, vomiting, and bloating; minimizing opioids; moving; restoring electrolyte levels; and chewing gum. However, these measures do not completely prevent POI and do not always provide complete symptom alleviation. Also, some medications used to treat gastrointestinal motility often have unwanted side effects. Therefore, there is an urgent need for an effective prevention and treatment method for POI with fewer side effects [3].

Acupuncture, a significant part of Traditional Chinese Medicine (TCM), not only decreases the intake of analgesics and anaesthetics but also protects the structures during the operation and prevents the complications related to anaesthesia such as postoperative nausea and vomiting (PONV). TEAS is a type of transcutaneous electrical nerve stimulation (TENS) in which acupuncture points are electrically stimulated by electrodes attached directly to the skin, so, it is considered to be a safe, easy, non-invasive, and reliable alternative method to conventional acupuncture and electroacupuncture (EA) [4].

By reviewing literature related to these fields, it is possible to find prove that EA on the Zusanli (ST36) and the Neiguan (PC6) acupoints improved the consistency of electromyographic intestinal activity and regulated gastrointestinal function [4]. It has also been found that electrical stimulation of the Zusanli and other acupoints can activate the vagus nerve fibres and stimulate gastric motility

through spinal reflexes [5]. Thus, acupuncture has been shown to have major bidirectional regulating effects on the digestive system's motility, secretion, and absorption in several experimental and clinical trials. Additionally, acupuncture can have an effect on regularising gastrointestinal function by stimulating nerves, particularly the vagus nerve [6].

Hence, the aim of this study is to investigate the efficacy of TEAS on ST36, PC6 and SP6 on accelerating gastrointestinal functions after abdominal operation in women.

2. METHODS

2.1. Participants

Thirty female patients undergoing abdominal operations with regional anaesthesia were selected to participate in this study from the surgery department at Shebin El Kom teaching hospital in Al Menofia, Egypt. Their age ranged from 25 to 45 years old. They were divided randomly into two groups equal in number by using the sealed envelope system. Group (A) received 4 sessions of TEAS on PC6, ST36 and SP6 acupoints, in addition to general advice on how to accelerate GIT functions. Group (B) received the same advice that would be given to group (A) on how to accelerate GIT functions.

The inclusion criteria were as follows: Only female patients who were undergoing selective or elective abdominal operation with epidural anaesthesia could participate in the study, their age had to range between 25 to 45 years old, their BMI had to be < 35 kg\m², they could not have any gastrointestinal or metabolic diseases, they could not be on or take any drugs for accelerating gastrointestinal functions, they must had fasted for at least 8 hours without solid food and 2 hours without clear fluids before surgery, and they must have enrolled into the study through an informed consent.

The exclusion criteria were as follows: Any patient with diabetes, high blood pressure, previous GIT operations, damaged skin at the relevant points, a local tumour, or pacemakers could not participate. Also, patients who have experienced serious postoperative bleeding or who have been admitted to the critical care unit for any reason would be excluded from the study.

2.2. Materials

A recording data sheet was used to register all the information of each patient who contributed to this study.

A standard weight and height scale was used to calculate the weight and height to calculate BMI for each participant in both groups. The following primary and secondary gastrointestinal outcomes were monitored for and registered:

- Primary outcomes: the first time of passage of flatus.
- Secondary outcomes: first defecation time; oral fluids, and solid food intake time; early mobilization time; and postoperative hospitalization [7].

2.3. Procedures

The research conducted by this study complied with all relevant national regulations and institutional policies, followed the tenets of the Declaration of Helsinki; as well as receiving the approval of the Research Ethics Committee of the Faculty of Physical Therapy at Cairo University.

All women that participated in this study signed an informed consent form before collecting their data, and they were informed about the nature and the effect of the treatment. The patients were instructed to report any side effects that they experience during the treatment.

Group (A): This was the study group, it consisted of fifteen women who were undergoing abdominal operation would get 4 sessions of TEAS on 3 acupoints bilaterally: the Zusanli (ST36), the Neiguan (PC6), and the Sanyinjiao (SP6) acupoints.

PC6 is the acupoint of the pericardial meridian between the palmaris longus tendon and the flexor carpi radialis muscle tendon, 2 cun (a Chinese inch that equates roughly to 3.33 cm each) above the rasceta. ST36 is the point between the tibialis anterior and extensor digitorum longus, which is located on the anterolateral side of the lower leg, 3 cun below the joint, and one cun lateral of the anterior border of the tibia. SP6 is 3 cun straight above the apex of the medial malleolus, on the posterior border of the medial surface of the tibia [9].

The TEAS sessions were conducted as follows:

1- First session: 30 minutes before anaesthetic induction prior to the surgery.
2- Second session: 2 hours after the surgery.
3- Third session: 6 hours after the surgery.
4- Fourth session: 12 hours after the surgery.

The frequency of the electric current was set to 2/100 Hz; and the intensity of the proceadure ranged from 5 to 30 mA, until the participants feel de qi sensations [6].

The patient was placed in a supine lying position with the physiotherapist standing beside her. A three-channel electrical stimulator was used along with three lead cutaneous electrode pads. One channel would be connected to the bilateral ST36 (Zusanli) points, the second channel to the bilateral PC6 (Neiguan) points, and the third channel to the bilateral SP6 points. Each session was performed in the same manner and lasted for 30 minutes. Patients were asked to avoid fluid overload (causing intestinal oedema) and encouraged into early mobilization to help gastrointestinal motility [1].

Group (B): This was the control group, and it consisted of fifteen women who were undergoing abdominal operations under regional anaesthesia would be given only the same advice given to group (A), that aimed to help gastrointestinal motility.

2.4. Statistical Analysis

A statistical analysis was performed using SPSS version 23 for Windows (SPSS, Inc., Chicago, IL). The test had one independent variable on the tested groups (between-subject factor) with two levels: group (A) described as the study group, and group (B) described as the control group. Also, the test included 6 tested dependent variables: time to postoperative hospitalization, time to early mobilization, time to the first intake of oral liquids and solids, and time to first flatus, and defecation time. A normal distribution of data was checked using the Shapiro-Wilk test for all variables. A Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. A one way between subjects MANOVA was performed to compare the mean values of the dependent variables between the two groups.

3. RESULTS

3.1. Subject characteristics

The mean ± SD of age, weight, height, and BMI of group (A) were 32.26 ± 6.07 years, 72.73 ± 4.84 kg, 162.13 ± 4.54 cm, and 27.77 ± 1.93 kg/m² respectively. The mean ± SD of age, weight, height, and BMI of group (B) were 31.66 ± 5.61 years, 74.86 ± 7.67 kg, 166.66 ± 6.77 cm, and 25.36 ± 7.12 kg/m² respectively. There was no significant difference ($p>0.05$) between the two study groups in the mean values of age, weight, height, and BMI (Table 1).

Table 1. Baseline characteristics of participants in both groups

Items	Group A	Group B	Comparison	
	Mean ± SD	Mean ± SD	t-value	P-value
Age (years)	32.26±6.07	31.66±5.61	0.281	0.781
BMI (kg/m^2)	27.77±1.93	25.36±7.12	1.265	0.216
Body mass (kg)	72.73±4.84	74.86±7.67	-0.911	0.37
Height (cm)	162.13±4.54	166.66±6.77	-2.151	0.051

*Note. *SD: standard deviation, P: probability*

Table 2 presents means of primary and secondary GIT outcomes of the group A and B.

Table 2. Mean of primary and secondary GIT outcomes of the group A and B

	Group A	Group B				
	Mean ± SD	Mean ± SD	MD	f- value	p value	Partial η2
First flatus time	6.8 ± 1.14	11.73±1.43	-4.93	107.977	0.0001	0.794
First defecation time	15.13 ± 2.44	27.27±4.26	-12.14	91.287	0.0001	0.765
First oral liquid intake time	6.2 ± 1.37	9.6 ± 1.12	-3.4	55.173	0.0001	0.663
First solid intake time	11.13±1.30	14.27±0.88	-3.14	59.473	0.0001	0.68
Early mobilization time	6.33±0.97	9.13±1.06	-2.8	56.642	0.0001	0.669
Post-operative hospital stay	1.07±0.41	1.2±0.41	-0.13	0.772	0.387	0.027

Note. SD: standard deviation; MD: mean difference; p-value: probability value;

First flatus time

The mean ± SD values of first flatus time in the "group A" and "group B" were 6.8±1.14 and 11.73±1.43 respectively. The univariate tests of one-way MANOVA revealed that there were significant differences in the mean values of first flatus time between both groups (F=107.97, p-value=0.0001). Additionally, multiple pairwise comparison tests (post hoc tests) revealed that there was a significant difference between both groups (p-value=0.0001). This significant reduction of first flatus time was in favour to group A in comparison to group B (Table 2).

First defecation time

The mean ± SD values of first defecation time in "group A" and "group B" were 15.13±2.44 and 27.27±4.26 respectively. The univariate tests of one-way MANOVA revealed that there were

significant differences in the mean values of first defecation time between both groups (F=91.287, p-value=0.0001). Additionally, multiple pairwise comparison tests (post hoc tests) revealed that there was a significant difference between both groups (p-value=0.0001). This significant reduction in first defecation time was in favour to group A in comparison to group B (Table 2).

First oral liquid intake time

The mean ± SD values of first oral liquid intake time in "group A" and "group B" were 6.2±1.37 and 9.6±1.12 respectively. The univariate tests of one-way MANOVA revealed that there were significant differences in the mean values of first oral liquid intake time between both groups (F=55.173, p-value=0.0001). Additionally, multiple pairwise comparison tests (post hoc tests) revealed that there was a significant difference between both groups (p-value=0.0001). This significant reduction in first oral liquid intake time is in favour to group A in comparison to group B (Table 2).

First solid intake time

The mean ± SD values of first solid intake time in the "group A" and "group B" were 11.13±1.30 and 14.27±0.88 respectively. The univariate tests of one-way MANOVA revealed that there were significant differences in the mean values of first solid intake time between both groups (F=59.473, p-value=0.0001). Additionally, multiple pairwise comparison tests (post hoc tests) revealed that there was a significant difference between both groups (p-value=0.0001). This significant reduction in first solid intake time was in favour to group A in comparison to group B (Table 2).

Early mobilization time

The mean ± SD values of early mobilization time in the "group A" and "group B" were 6.33±0.97 and 9.13±1.06 respectively. The univariate tests of one-way MANOVA revealed that there were significant differences in the mean values of early mobilization time between both groups (F=56.642, p-value=0.0001). Additionally, multiple pairwise comparison tests (post hoc tests) revealed that there was a significant difference between both groups (p-value=0.0001). This significant reduction in early mobilization time was in favour to group A in comparison to group B (Table 2).

Post-operative hospital stay

The mean ± SD values of postoperative hospital stay in "group A" and "group B" were 1.07±0.41 and 1.2±0.41 respectively. The univariate tests of one-way MANOVA revealed that there were insignificant differences in the mean values of postoperative hospital stay between both groups

(F=0.772, p-value=0.387). Additionally, multiple pairwise comparison tests (post hoc tests) revealed that there was no significant difference between both groups (p-value=0.387) (Table 2).

4. DISCUSSION

The results of this study support the effect of TEAS on accelerating GIT functions after abdominal operations in women. Regarding the mechanism of TEAS on gastrointestinal function, Acupuncture at the Zusanli (ST36) stimulates the peroneal nerve, which then sends a pulse signal to the vagus nerve through the sciatic nerve, which releases amino acid decarboxylase, which raises neurotransmitter levels. Also, electroacupuncture at the Neiguan (PC6) can stimulate the sensory fibers of the median nerve leading to stimulation of the solitary tract nucleus of the vagus nerve, so the neurotransmitters were released. As a result, TEAS is generally considered to promote gastrointestinal motility by stimulating the vagus nerve and inhibiting sympathetic activity [8,9]

The results obtained in this study are broadly consistent with the major trends observed by: Ouyang et al. [10] who wrote in their paper that electroacupuncture at PC6 and ST36 accelerated gastric emptying and helped in the treatment of gastroparesis, enhanced vagal activity, and led to the regulation of gastric function. Sallam et al. [11] who found that TENS application on GIT acupoints improved GIT symptoms and restored the sympathovagal balance. Lili et al. [12] who wrote in their article that TEAS affected gastrointestinal hormone secretion in elderly patients with gastrointestinal tumours. In which they report that acupuncture significantly increased plasma concentrations of gastrin and motilin hormones, and thus activated the enteric nervous system to initiate GIT contractile activity. Their study showed that electric acupuncture stimulation shortened the time to first flatus, reduced complications, and accelerated the recovery of GIT function after surgery compared to the conventional treatment group.

In another study, Zhou et al. [7] suggested that TEAS accelerated functional recovery of the gastrointestinal tract, shortened postoperative hospital stay, and improved daily activities after caesarean section operation. They found that serum GI hormone levels increased in the TEAS group, which indicated its positive effect on regulating GIT functions. Likewise, Chen et al. [13] stated that EA, when applied appropriately, is expected to have a great potential for treating various functional GI diseases such as GERD (Gastroesophageal reflux disease), IBS (Irritable bowel syndrome), FD (Functional dyspepsia), and functional constipation. Also, Chen et al., [14] said that TEAS is an effective and safe treatment for POI following abdominal surgeries.

Another study that confirms the effectiveness, safety, and feasibility of acupuncture for gastrointestinal dysfunction after laparoscopy is the study of Liu et al. [8], which confirmed the role of TEAS in preventing POI. Furthermore, another finding for Yin et al. [15] presented a statistically significant and evident reduction in the incidence of PONV, and the need postoperative medication; thereby reducing the adverse reactions of drugs. A combination between the Neiguan and the Zusanli acupoint stimulation can reduce the incidence and severity of nausea. Cai et al. [16] suggested that the stimulation of bilateral Zusanli acupoints, when stimulated by TENS, promotes local blood circulation, improve gastrointestinal function and decrease constipation symptoms.

Another study that agreed with this study is the study of Hou et al. [17], that said that the application of TEAS resulted in a decrease in postoperative first fluid and solid intake and early mobilization after the operation. Also, the study reported that its patients had no symptoms of nausea or vomiting in the first 5 days after the operation. The results of the present study can be explained by the findings of Bai et al. [5], who supposed that EA stimulation of the Zusanli and other acupoints could protect from intestinal injury and mucosal barrier dysfunction in patients who are undergoing abdominal operations.

5. CONCLUSIONS

According to the findings of this study, it can be concluded that TEAS could be used to accelerate of the recovery of GIT functions and preventing POI after abdominal operations in women. Therefore, it could be an effective method for the prevention of postoperative complications and improving the quality of life of the patients after this type of operations.

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AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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