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Effects of acupressure on intestinal function in patients with coronary artery bypass graft surgery: a randomized clinical trial

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ABSTRACT

Aim: This study aimed to determine the effects of acupressure on the intestinal function of patients undergoing Coronary Artery Bypass Graft (CABG) surgery.

Background: Studies indicated that cardiovascular patients are prone to constipation. Acupressure is one of the therapeutic and palliative approaches that can be used by doctors, nurses, and even patients themselves.

Methods: The present three-group randomized clinical trial study was conducted on 90 patients undergoing CABG surgery. In the intervention group, 48 hours after surgery the patients received acupressure points LI4 and ST25 twice a day (10 am and 6 pm) for three sequential days. In the sham group, the patients received acupressure at a 1.5 cm distance from the LI4-ST25 points, and the patients in the control group received only the usual care. This research used a demographic and medical information questionnaire, Rome IV scale, Bristol stool scale, symptom registration checklist, and daily excretion assessment checklist. The intestinal function indices were completed 24 hours after surgery (before intervention), 48, 72, 96, and 120 hours after surgery.

Results: All three intervention, sham, and control groups were without defecation in 24 hours (before intervention) and 48 hours after surgery. There was a significant difference between the three intervention, sham, and control groups in the number of stools after 72 hours, 96 hours, and 120 hours after the intervention ($p<0.001$). Also, a significant difference was observed among the three groups in terms of stool consistency 96 hours after the start of the intervention ($p=0.032$) and 120 hours after the start of the intervention ($p<0.001$).

Conclusion: The results showed that patients had a significant improvement in the number of bowel movements and stool consistency in the intervention group. In acute conditions, acupressure on LI4-ST25 points can positively affect intestinal function when patients are hospitalized in the intensive care unit.

Keywords: Coronary artery bypass graft surgery, Acupressure, Constipation, Bowel function.

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Introduction

Constipation is one of the most important symptoms among gastrointestinal tract functional disorders, defined as defecation less than three times a week, and is usually associated with increased stool consistency, a feeling of incomplete and urgent bowel defecation (1). According to a study, the prevalence of

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constipation in adults was estimated at 16% worldwide (2). The prevalence of constipation in Iran has been reported at 4.33% (3). Constipation leads to complications such as increased pressure in the brain, bradycardia in heart, respiratory, and brain injury patients, and Vagus nerve stimulation (VNS) (4). In hospitalized patients, constipation is associated with infection, increased hospitalization time, and increased mortality (5). Reports indicate that cardiovascular patients are prone to constipation (6). This rate increases in patients hospitalized in intensive care units due to immobility, using drugs such as calcium blockers, diuretics, and opiates (7). According to the findings of a study, the frequency of constipation complications after open heart surgery has been reported as 50% (4). In patients after heart surgery, frequent use of narcotic drugs, movement problems before and after surgery, reduction of food intakes such as liquids and fiber, use of bedpan, position during defecation, and lack of privacy increase the probability of constipation in these patients (8).

Medications used in the treatment of constipation included probiotics (9), glycerin (10), lactulose, polyethylene glycol, bisacodyl, and methylcellulose (11). Magnesium hydroxide and lactulose are commonly used in intensive care units. The lactulose causes a decrease in blood potassium and magnesium hydroxide leading to nausea, vomiting, and an increase in blood magnesium, all of which affect cardiac conditions and heart rhythm (12). Some of these drugs are associated with side-effects such as digestive problems and imbalance of fluids and electrolytes, which affect the hemodynamics of heart patients (13). Non-pharmacological methods such as acupressure provide an evidence-based approach and an independent nursing intervention. The acupressure method is a non-invasive, safe, effective, painless, and affordable treatment (14). Considering the holistic nature of nursing care and the responsiveness of complementary medicine to this aspect of care (15), complementary medicine was used in the present study. Acupressure is one of the therapeutic and palliative approaches used by doctors, nurses, and even patients themselves and has a favorable result in nursing interventions and patient care. In acupressure, nurses use fingers to apply pressure without using drugs, needles, or other devices (16). Based on the findings of a study (2019) that examined the effect of acupressure on constipation in patients with advanced cancer, a significant improvement in constipation symptoms for straining during bowel movements, hard stools, feeling the rectal obstruction, Bristol stool scale scores, the level of comfort during defecation was observed in patients receiving acupressure intervention compared to the control group (17). Also, a randomized controlled study in 2021 that examined the effects of acupressure on pregnancy-related constipation showed that after applying acupressure, the severity of constipation in the acupressure group was significantly reduced compared to the control group (18). The literature review that using acupressure on constipation have mostly been conducted in hemodialysis patients (19), cancer patients (17), patients with bone tension (20), and pregnant women (18). Also, the literature review showed acupressure points LIV3 (20), ST36 (20), SP15 (20), CV12 (18), CV4 (18), ST25 (18), SP14 (19), ST37 (21), TH- 6 (19), LI4 (20, 22, 23) and ST25 (24) were related to the reduction of constipation symptoms. Considering the acute condition of the patient after heart surgery, consultation with an acupuncture specialist and the articles reviewed, the acupressure point LI4 and ST25 were selected in the present study.

Considering the high prevalence and complications of constipation in cardiovascular patients, the present study aimed to determine the effects of acupressure in patients undergoing CABG surgery.

Methods

The current three-groups randomized controlled clinical trial (RCT) (IRCT code: 20110906007494N39); was conducted on the patients who underwent CABG surgery. The research environment was the intensive care unit of Semnan Heart Center.

Inclusion criteria

Having written and verbal consent to participate in the study, not suffering from chronic constipation according to the Rome IV criteria, age over 18 years, ability to communicate verbally, not suffering from known neurological and mental diseases under treatment, absence of ulcers, organ defects, tenderness and fractures in the target points of acupressure, failure to participate in other interventional studies at the same time, not suffering from thyroid, incurable, neuromuscular diseases, congenital

abnormalities of the digestive system and kidney failure, not suffering from digestive disorders (peptic ulcer, history of chronic constipation, fissure, hemorrhoids, rectal prolapse, intestinal obstruction) based on the patient's history and physical examination by a doctor, no drug dependence or addiction, no pulmonary drainage and secretions of more than 200 ml per hour, no need for an intra-aortic balloon pump, no intubation for more than 24 hours and no emergency CABG situation.

Exclusion criteria

Patients who needed laxatives other than routine medicine, including magnesium hydroxide, were willing to withdraw from the study and stop cooperation; discharge or transfer the patient to another treatment center, suffering from diarrhea, nausea, vomiting, and other digestive disorders, becoming sick and dying during the study. These patients need laxatives other than magnesium medicine from 96 hours after the operation.

The sample size was calculated as 28 patients for each group according to the mean and standard deviation of defecation frequency reported in the study and a 95% confidence coefficient (19). Finally, 90 eligible patients were selected using convenience sampling and then randomly allocated to three groups (acupressure, sham, and control) by permuted block randomization method (15 blocks, six patients in each group). One of the researchers who was blinded to the patients prepared the non-transparent envelope in which the groups' order was written based on the blocks.

In the present study, the questionnaires were the demographic and medical information, Rome IV scale, Bristol stool scale, and checklist for assessing the patients' daily excretion status (intestinal function).

Demographic and medical information questionnaire

The demographic and medical information questionnaire includes gender, age, living place, history of smoking, employment status, history of underlying diseases, level of education, history of taking neuropsychiatric drugs, use of special medicine or food to facilitate defecation, movement status, history of exercise, history of acupressure, frequency of routine defecation in the last six months, body mass index and duration of illness.

Rome IV scale

The Rome IV scale was presented in 2016 to diagnose constipation (25). Straining, hard or pus-like stools (types one and two according to the Bristol scale), incomplete bowel movement, a feeling of intestinal obstruction, performing manual maneuvers to facilitate bowel movements, bowel movements less than three times a week, not having loose and watery stools, and not having bowel movements. Having irritable bowel syndrome is based on Rome IV. The patient must have had symptoms three months ago, starting at least six months ago, and meeting the above two criteria (26). The scale's reliability was reported with Cronbach's alpha of 0.89 (27).

Bristol stool scale

The Bristol stool scale was developed in 1997 as a clinical assessment tool. Stool consistency was checked at each appointment with the Bristol stool scale. This tool checks the stool consistency in all seven modes. Type one: feces in the form of separate hard lumps, like the parts of nuts (severe constipation = 1) / Type two: sausage-shaped but bulky feces (mild constipation = 2) / Type three: like sausage or snake-shaped with Cracks on the surface of feces (normal excretion = 3) / type four: like a sausage or snake with a soft and smooth surface (normal excretion = 4) / type five: softballs with a well-defined border (low fiber) = 5) / type six: fluff-like pieces with rough edges or pasty feces (mild diarrhea = 6) / type seven: watery stool without any solid pieces of stool (severe diarrhea = 7) (28). The reliability and validity of this measure have been investigated and evaluated in some studies. Blake et al. (2016) examined one hundred and sixty stool samples and used the Bristol scale to classify stool form, which showed significant validity and reliability; The agreement between observers was 95%, and Cronbach's alpha was 0.91 (28). In a study titled Reliability and Agreement of the Bristol scale, the reliability of this instrument with Cronbach's alpha was reported as 0.88 (29). In another study conducted by Khorrami et al. (2018) titled Comparing the effect of Bukhara plum with magnesium hydroxide on constipation in stroke patients, the reliability of the criterion was checked by three observers separately on 10 patients. The coefficient of agreement between them has been estimated by statistical intervention, the correlation coefficient between groups was 0.90 (30). In

order to check and determine the validity and reliability of the Bristol criterion in the present study, first, this criterion was measured and checked experimentally on ten patients. In this study, the validity between observers was checked. The researcher and all nurses working in the cardiac surgery department and Cardiac Care Unit (CCU) were evaluators of the Bristol scale; At first, the stool photos of ten patients were presented to all nurses, and they were asked to score based on the Bristol stool scale. The Cronbach's alpha was 0.89.

Checklist for assessing patients' daily excretion status (intestinal function)

This checklist included the amount and frequency of drugs consumed, fluid intake, and patient's activity status.

The researcher completed the demographic and medical information questionnaire before the intervention in all three groups. At the beginning of the research, to determine which patients could not enter the study, the Rome IV chronic constipation scale was used and completed by the researcher. In addition to the Bristol stool scale, the intestinal function was evaluated 24 hours after surgery (before intervention), 48, 72, 96, and 120 hours after surgery based on a checklist. It included straining during stool, feeling hard stool, feeling of incomplete defecation, feeling of blockage in the bowel, feeling of needing to perform a manual maneuver for defecation, feeling of bloating, and consistency of stool. The researcher completed the checklist of patients' symptoms within 24 hours after surgery (before intervention), 48, 72, 96, and 120 hours after surgery. After completing the tools above, the intervention for the acupressure group was carried out as follows:

Acupressure was performed 48 hours after surgery twice daily (10 am and 6 pm) and for three sequential days (20). The ST 25 AND LI4 were used (31) (Figure 1). The ST25 point is two thumbs away from the navel. The LI4 point is located in the depth of the muscular ridge, resulting in the thumb and forefinger being close together. Acupressure was applied to each point for two minutes. One minute was applied as pressure with the thumb vertically, then 5 seconds rest and one-minute circular movement; Since the interventions were performed simultaneously and with a two-handed technique, in total, each time, a maximum of 3 minutes of intervention was applied to the patient (20); Nutrition training and routine nursing care were also provided. It should be noted that interventions were performed 48 hours after surgery.

Nutrition education and routine heart disease care were given to the control group. The demographic and medical information questionnaire, symptom registration checklist, Rome IV, and Bristol stool scale were completed. There was no intervention in this group. Intestinal function indices were completed 24 hours after surgery (before intervention), 48, 72, 96, and 120 hours after surgery.

For the sham group, nutrition education and routine nursing care were provided. The working method was exactly the same as the intervention group, with the difference that the pressure was applied at a 1.5 cm distance from the acupressure points according to acupuncture and acupressure specialists in the valid books of this field, that this point is not located on a specific meridian. The order of pressure, the method of pressure, the patient's position, the time, and the

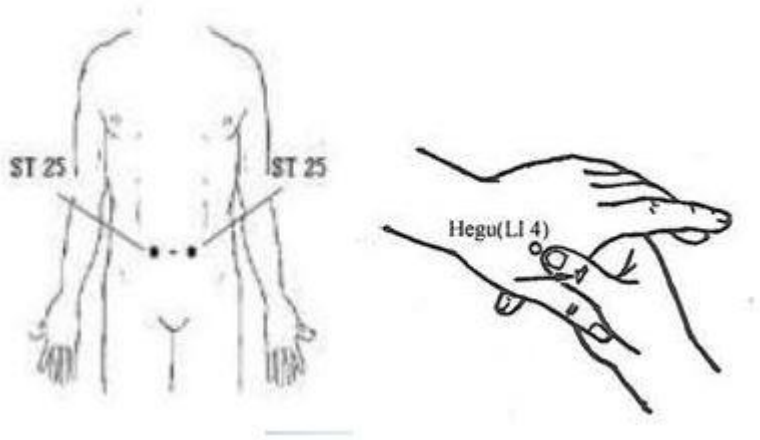

Figure 1. ST 25 and LI4 acupressure points

amount of pressure were the same in the intervention and sham groups. It should be noted that the pressure procedure was done by one person (first author) in both groups. Then intestinal function and checklists were completed 24 hours after surgery (before intervention), 48, 72, 96, and 120 hours after surgery.

All groups received routine care, including training on proper food consumption and magnesium hydroxide 15 cc every twelve hours (11 in the morning and 11 at night) (20). It should be noted that magnesium hydroxide was started 48 hours after surgery for all three groups. In this study, magnesium hydroxide syrup, owned by Alborz Daru Company, holder of the ISO 9001 certificate and GMP certificate, was used. Also, all patients were taught to consume only portioned food. The patients' daily excretion status (intestinal function) was recorded; the type of food received was the same in all patients.

In this study, 125 patients were examined upon arrival. Ten patients went back to the operating room due to coronavirus, ten patients due to going on a balloon pump, five patients due to thyroid problems, five patients due to extensive drainage, and five patients to They were excluded from the study because they were intubated for more than 24 hours (Figure 1).

The present study was approved by the Ethics Committee of Mazandaran University of Medical Sciences (IR.MAZUMS.REC.1400.301). All the

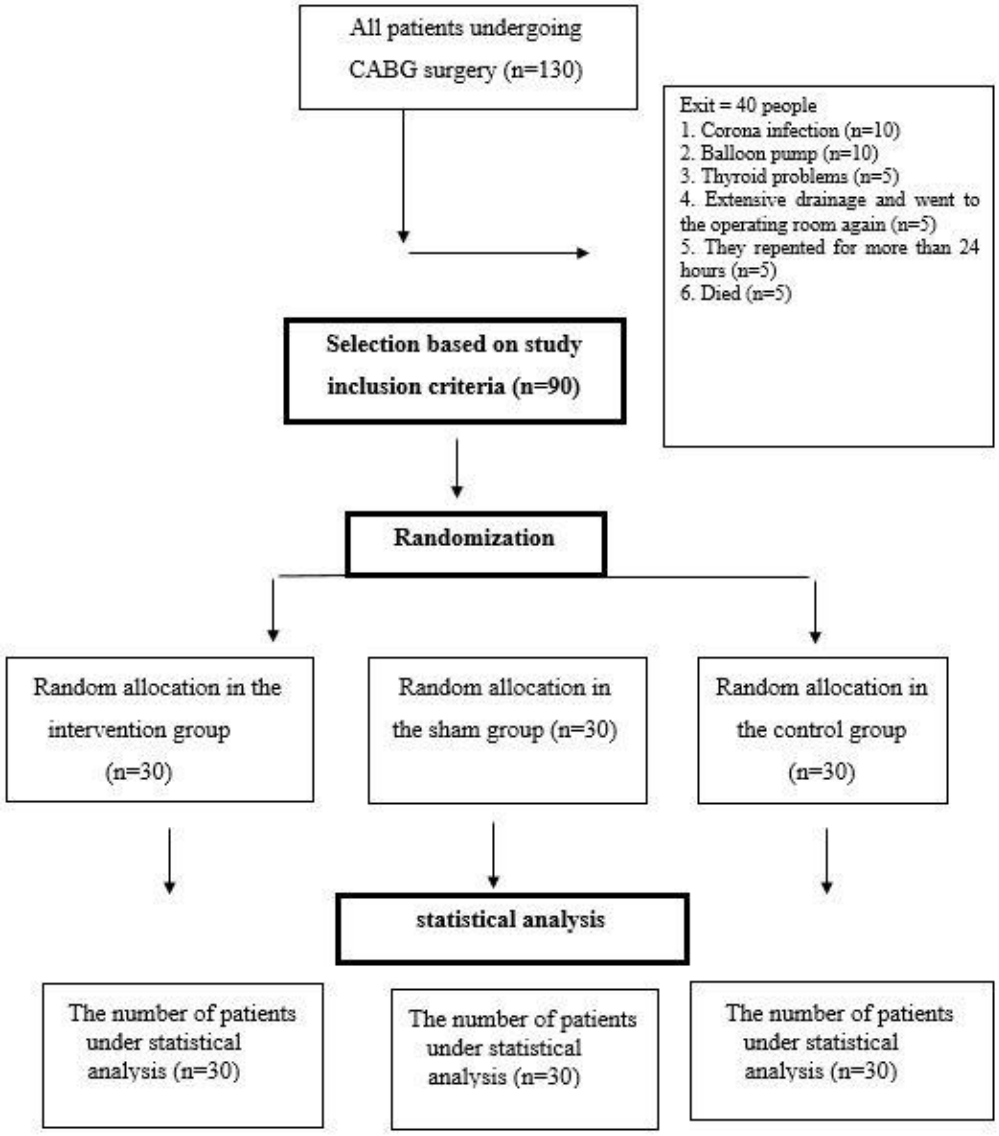

Figure 1. Consort diagram

procedure was explained to the patients, and written informed consent was obtained.

Data analysis

After recording the data in SPSS software version 24 and checking the normality of the data using the Shapiro-Wilk and Kolmogorov-Smirnov tests, the data were analyzed with descriptive statistics tests such as frequency and statistical tests such as ANOVA, survival analysis, and chi-square analysis were analyzed. Significance was considered at the 0.05 level.

Results

The average age of the participants in the intervention, sham, and control groups was 61.17±5.23, 58.77±10.23, and 60.50±8.85 years, respectively. The three groups were compared in age, gender, body mass index, underlying diseases, history of smoking, movement status, daily use of fruits and vegetables, and type of diet. There was no statistically significant difference between them (Table 1).

According to Table 2, none of the participants had bowel movements 24 hours after surgery (before intervention) and 48 hours after surgery (after intervention). However, 100%, 70%, and 73.3% reported the first bowel movement within 72 hours after surgery in the intervention, sham, and control groups, respectively.

The stool consistency of the patients is shown in Table 3. In 72 hours, the incidence of constipation in the intervention, sham, and control groups was 0, 9.5, and 9.5 percent, respectively. After 96 hours, 80% in the intervention, 96.7% in the sham group, and 96.7%

Table 1. Comparison of the sociodemographic and medical characteristics of AMI patients among three groups

Variables		Groups			Statistical test & *p*-value
		Intervention N (%)	Sham N (%)	Control N (%)	
Gender	Male	20 (66.7)	22 (73.3)	23 (67.7)	0.679*
	Female	10 (33.3)	8 (26.7)	7 (23.3)	
Smoking	Yes	2 (6.7)	3 (10)	3 (10)	0.872*
	No	28 (93.3)	27 (90)	27 (90)	
Underlying diseases	Yes	30 (100)	30 (100)	30 (100)	-
Physical activity	Alone	4 (13.3)	9 (30)	7 (23.3)	0.451*
	With cane	9 (30)	7 (23.3)	10 (33.3)	
	Cane	4 (13.3)	3 (10)	7 (23.3)	0.689*
	Walker	8 (26.7)	8 (26.7)	5 (16.7)	
	Wheelchair	5 (16.7)	3 (10)	1 (3.3)	
Daily use of fruits and vegetables	Yes	9 (30)	9 (30)	10 (33.3)	
	No	21 (70)	21 (70)	20 (66.7)	
Diet	Cardiac	18 (60)	21 (70)	20 (66.7)	
	Cardiac-diabetic	12 (40)	9 (30)	10 (33.3)	
Mean (SD)					
Age (years)		61.17 (5.23)	58.77 (10.23)	60.5 (8.85)	0.496**
BMI (kg/m2)		27.93 (3.11)	26.94 (2.93)	27.5 (2.18)	0.390 **

* Chi-square **ANOVA

Table 2. Comparison of the frequency of defecation of AMI patients among three groups during the study

Variable	Hours		Groups			Inter-group comparison, *p*-value *
			Intervention N (%)	Sham N (%)	Control N (%)	
Defecation frequency	24 h	None	30 (100)	30 (100)	30 (100)	----------
		One	0 (0.0)	0 (0.0)	0 (0.0)	
	48 h	None	30 (100)	30 (100)	30 (100)	----------
		One	0 (0.0)	0 (0.0)	0 (0.0)	
	72 h	None	0 (0.0)	9 (30)	8 (26.7)	0.005
		One	30 (100)	21 (70)	22 (73.3)	
	96 h	One	14 (46.7)	30 (100)	30 (100)	<0.001
		two and more	16 (53.3)	0 (0.0)	0 (0.0)	
	120 h	One	7 (23.3)	20 (66.7)	19 (63.3)	0.001
		two and more	23 (76.6)	10 (33.3)	11 (36.7)	

* Chi-square

in the control group had regular bowel movements based on the Bristol stool scale. The statistical test showed a significant difference in stool consistency at 96 and 120 study hours ($p<0.001$).

The Kaplan-Meier chart compares the start of defecation time in the three intervention, sham, and control groups. The results showed that the average estimated time of defecation start for the intervention, sham, and control groups were 67±3.25 and 45.45, respectively. It was 70±0 and 72±0.17 hours. The comparison of these three groups with the log-color test showed a statistically significant difference (2x=55.08, 2df=2, and $p<0.001$).

Discussion

The findings of the present study showed that after the intervention, there was a statistically significant difference in the frequency of bowel movements between the three groups within 72 hours, 96 hours, and 120 hours. All patients in the intervention group had defecation in 72 hours, while 30% and 26.7% did not defecate in the sham and control groups, respectively.

Stool consistency in patients who had defecation in the intervention, sham, and control groups was normal after 72 hours of defecation (type 3); It should be noted that in both the sham and control groups, two patients reported mild constipation, no statistically significant difference was observed between the groups. After 96 hours and 120 hours, a statistically significant difference in stool consistency was observed between the three groups, and in the intervention group, most patients reported normal excretion (type 4). The present study's findings showed that acupressure could increase the number of bowel movements and stool consistency in patients undergoing CABG.

A study titled the effect of Acupressure on intestinal excretion of patients undergoing bone stretching with Constipation acupressure was applied on LI4, SJ6, and ST25 points for 2 minutes, 2 times a day, and 3 days. After the intervention, there was a statistically significant difference between the control and acupressure groups in terms of the average state of intestinal excretion and intestinal excretion in most of the people in the intervention group, and it was relatively easy. There was a statistically significant difference between the two groups after the intervention regarding the time of the first bowel movement, and the intervention group had bowel movements sooner (20). In the present study, the intervention group was performed on points LI4-ST25 twice daily for three days. In terms of acupressure points, the two studies are similar.

In another study, the findings showed that after the implementation of acupressure intervention at Zhongwan (CV12), Guanyuan (CV4), and Tianshu (ST25) points for three days and 8 minutes every day in patients with advanced cancer with acute constipation, it led to Convenience during elimination (17). In this study, one of the acupressure points was ST25, and the duration of the intervention was short and similar to the present study. The reason is that in patients with acute constipation, the duration of acupressure is considered shorter, and the reason for choosing the ST25 point in both studies is easy to access this point.

Table 3. Comparison of the frequency of stool consistency based on the Bristol stool scale one day after the intervention among three groups

Variable	Days of intervention		Groups			Inter-group comparison, *P*-value *
			Intervention	Sham	Control	
Stool consistency	72 h	Constipation	0 (0.0)	2 (9.5)	2 (9.5)	0.228
		Normal defecation	30 (100)	19 (90.5)	20 (90.9)	
		Low diet fiber	0 (0.0)	0 (0.0)	0 (0.0)	
	96 h	Constipation	0 (0.0)	0 (0.0)	0 (0.0)	0.032
		Normal defecation	24 (80)	29 (96.7)	29 (96.7)	
		Low diet fiber	6 (20)	1 (3.3)	0 (0.0)	
	120 h	Constipation	0 (0.0)	0 (0.0)	0 (0.0)	<0.001
		Normal defecation	0 (0.0)	28 (93.3)	27 (90)	
		Low diet fiber	30 (100)	2 (6.7)	3 (10)	
			p <0.001	p <0.001	p <0.001	

* Chi-square

A study investigated the effect of acupressure on li4, liv3, ST 36, SP15, and cv6 points on chronic constipation in patients undergoing hemodialysis treatment. Patients in the intervention group received acupressure during hemodialysis three times a week for four weeks. The findings showed that the number of bowel movements after the intervention in the acupressure group compared to the placebo group significantly increased in hemodialysis patients (19). Although the results are consistent with the present study, the two studies have differences in cognitive methodology; In the present study, the effect of acupressure on constipation in acute conditions has been investigated, and patients with chronic constipation were excluded from the study, and for this reason, acupressure was performed for three days; Also, LI4-ST25 points were chosen because of the patient's movement limitation and the surgery location so that patients can have a suitable position to receive acupressure after surgery and the points can be easily accessed.

Also, in a study that investigated the effect of ear acupressure on the points of the intestine, rectum, San Jiao, spleen, lung, sympathetic, and sub-cortex on the relief of chronic constipation in patients with breast cancer who underwent chemotherapy; For the intervention group, ear acupressure was applied for 6 weeks using Vaccaria seeds on seven ear points, and it was observed that acupressure improves constipation (32). The results of this study are consistent with the present study, despite the differences in the selection of research cases that had chronic constipation and performed acupressure on seven ear points for 6 weeks.

The result of a study showed that in patients undergoing hemodialysis who had chronic constipation, in the intervention group, where one-minute acupressure was applied three times a week for four weeks on points sp15, li4, liv3, and st36, they had more normal stools (33). The cognitive methodology of the study above differed from the current study due to the intervention on chronic constipation patients, the intervention's duration, and the patient's position after surgery. The selection of acupressure points was different; however, the study's findings are consistent with the results of the present study.

Another blinded clinical trial study showed that acupressure on the TH-6 point for 15 minutes twice a day, morning and evening, for one week (40-45 seconds of heating and massage, then 2.5 minutes pressure and 30 seconds of rest) leads to the reduction of chronic constipation in the first, second and third

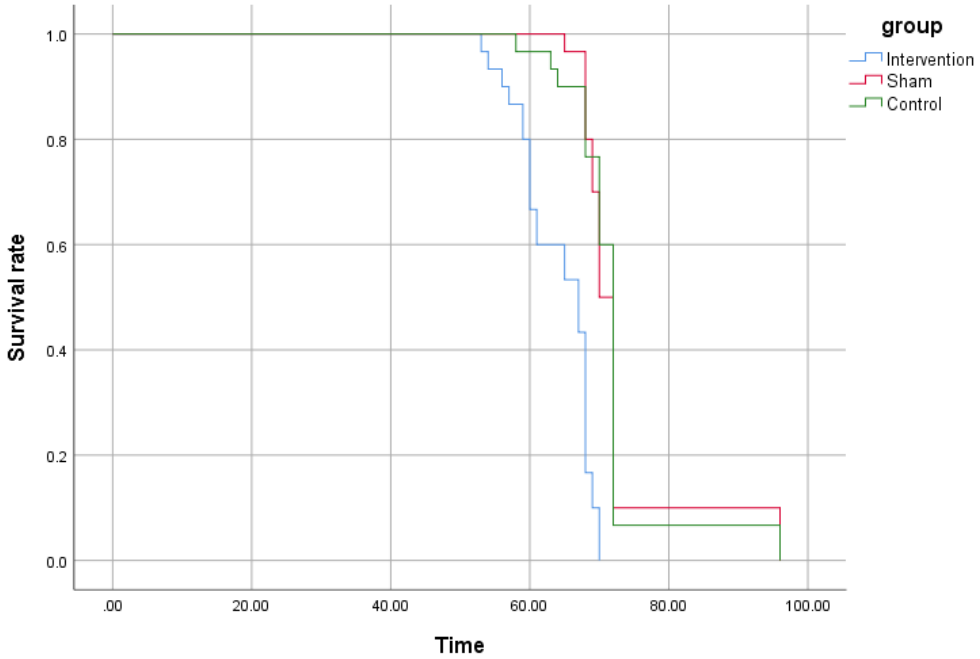

Figure 2. Probability of survival of constipation according to the hours of defecation according to the intervention, sham and control groups

trimesters of pregnancy (18). Therefore, the results of these studies are consistent with the present study despite having methodological differences; Therefore, based on the results of the above studies and the present study, it can be said that acupressure is effective on the intestinal function of patients.

During the investigations conducted, two similar studies (17, 20) that investigated acupressure on acute constipation were similar in the duration of the study and the selection of the ST25 point.

According to figure 2, the survival rate of constipation in the intervention group was between 62.24-65.95 hours, in the sham group, 69.61-75.68 hours, and in the control group, 69.06-74.33 hours; this means that in the intervention group, the survival of constipation was 65.95 hours and in the other two groups it was 75.68 and 74.33 hours. The three groups had statistically significant differences. Based on the present study's results, acupressure is recommended to increase the frequency of defecation and stool consistency. Studies with a larger sample size are recommended to confirm the current evidence.

Conclusion

In the present study, the number of daily bowel movements of patients undergoing CABG within 72, 96, and 120 hours after the start of the intervention was higher in the acupressure group compared to the sham and control groups, and this difference was statistically significant.

In this study, the stool consistency was checked 72, 96, and 120 hours after the start of the intervention, and according to the results obtained in the acupressure group, after 72 hours, all the patients who had stools had normal bowel movements.

In the control and control groups, the number of daily bowel movements and stool consistency during 72, 96, and 120 hours after the intervention was not significant.

Based on the present study's results, using the acupressure point LI4 and ST25 is recommended due to the positive effects on the frequency of bowel movements and stool consistency in patients undergoing CABG as a nursing intervention.

The current study had a limitation, considering that the sampling was done during the COVID-19 pandemic; the stress of COVID-19 and surgery might affect the study results because stress can increase constipation in patients.

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Conflict of interests

The authors declare no conflict of interest.

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