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Original Article

Association of gum chewing with early gastrointestinal recovery in single-port laparoscopic gynecologic surgery

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Abstract: Objective: To examine the impact of gum chewing on the recovery of gastrointestinal function following single-port laparoscopic surgery for gynecologic conditions. Methods: In this prospective, randomized, controlled trial, patients who underwent single-port laparoscopic surgery were randomly assigned to either a gum-chewing group or a control group. Participants in the gum-chewing group were instructed to chew gum for 15 minutes every 6 hours while awake until they passed gas for the first time, while those in the control group received standard postoperative care. The primary outcome measure was the time to the first passage of flatus, and secondary outcome measures included the time to first bowel movement sounds, time to first defecation, and length of hospital stay. Results: The study included 100 patients who were randomly assigned to either the gum-chewing group (n=52) or the routine care group (n=48). Patients in the gum-chewing group had a significantly shorter time to the passage of the first flatus compared to those in the control group (20.7±13.1 vs. 26.8±15.8 h; $P<0.05$). There were no significant differences between the two groups in terms of time to first bowel movement sounds, time to first defecation, or length of hospitalization. Conclusion: Postoperative gum chewing is associated with an earlier recovery of gastrointestinal function in patients undergoing single-port laparoscopic gynecologic surgery. Additionally, gum chewing is considered safe and is well-tolerated and should be recommended as an adjunct treatment in postoperative care.

Keywords: Gastrointestinal function, gum chewing, gynecologic surgery, single-port laparoscopy

Introduction

Gynecologic single-port laparoscopic surgery is a cutting-edge treatment option for women with benign conditions. This type of surgery is considered minimally invasive and utilizes only one incision, in contrast to traditional laparoscopy which requires three or more incisions. This innovative surgical technique has gained popularity among patients due to its cosmetic advantages, as the single incision results in less visible scarring. The use of single-port laparoscopic surgery has been increasing in recent years as patients become more concerned about their post-surgery appearance [1, 2].

After abdominal surgery, the normal recovery time for gastrointestinal function is around 3 days. This includes several hours for the small intestine, 24-48 hours for the gastric cavity, and 48-72 hours for the colon [3]. Dysfunction in the gastrointestinal tract can lead to postoperative symptoms such as abdominal distension, nausea, vomiting, pain, and delayed defecation which can prolong hospital stay, as well as decrease patient satisfaction and comfort levels [4].

The management of bowel function after gynecologic surgery has evolved over the last 20 years [5]. In the past, the traditional protocol after gynecological surgery included nasogastric decompression, which has been reevaluated due to its cost and lack of alignment with early discharge goals. An alternative method that has been recommended is early oral intake, but many practitioners are hesitant to use it due to safety concerns and potential

complications. Another method that has been investigated is sham feeding to enhance the recovery of bowel function after surgery, which does not have the same complications as other methods.

Gum chewing is an alternative method of sham feeding that has been shown to enhance the return of gastrointestinal function without complications [6]. The underlying mechanism is thought to be the activation of the vagus nerve axis in the head, which increases hormone secretion and accelerates the recovery of gastrointestinal function [7]. Additionally, gum chewing has been shown to have a positive effect on intestinal motility by reducing inflammation after surgery [8]. However, previous studies and meta-analyses have yielded inconclusive results regarding the efficacy of chewing gum after colorectal and abdominal surgery [9-11]. There are currently no guidelines that support the use of gum chewing for gastrointestinal functional recovery after gynecological surgery [12].

Our study aimed to determine the impact of gum chewing on gastrointestinal function in patients who underwent gynecologic single-port laparoscopic surgery.

Methods and materials

Study design and settings

This prospective randomized controlled trial was carried out between January 2021 and January 2022 at the Department of Gynecology, West China Second University Hospital of Sichuan University, Chengdu, China. This study was approved by the West China Second University Hospital Ethics Committee (No. 2020-018) and all participants received comprehensive information about the study and provided written informed consent before recruitment. On the day of admission, eligible patients were invited to participate in the study by a member of the research team, who thoroughly explained the study protocol.

The study was randomized by an independent investigator using a computer-generated, network-based randomization process utilizing the block-of-four method. The randomization numbers were placed in opaque envelopes, which were sealed and kept separate from the study envelopes. Once the participant consented to participate, the study envelope was opened to reveal the participant's assigned group. The participants were randomly divided into two groups in a 1:1 ratio. Group A received postoperative care along with gum chewing, while Group B only received routine postoperative care. Because of the nature of the study, the patients and nursing staff were aware of the assigned treatment, but were instructed to keep it confidential. Only the individuals assessing the outcomes were unaware of the group assignments.

Participants

The study recruited female patients who had been diagnosed with benign gynecologic conditions such as uterine fibroids and ovarian cysts and were scheduled for single-port laparoscopic surgery. The inclusion criteria were: being of good consciousness, aged between 18 and 50 years, and willing to participate in the study. Patients were excluded if they required emergency surgery, had been diagnosed with cancer, were unable to chew gum, had a risk of choking, were allergic to xylitol, had a known history of gastrointestinal disease, had thyroid disease, had poor cognitive function, experienced severe postoperative complications such as excessive intraoperative blood loss, needed postoperative intensive care, or had bowel injury during the surgery.

Intervention

The nursing staff were trained to administer the intervention. Patients in the intervention group were instructed to chew gum for 15 minutes, starting 2 hours after surgery and continuing every 6 hours while they were awake, until they had their first passage of flatus. They were advised not to chew gum at night or while lying flat in bed. A commercial sugar-free gum (containing xylitol) was used in our study.

Study procedures

The baseline demographic and clinical characteristics of the patients were recorded after obtaining written informed consent. All patients received the same standard of preoperative, perioperative, and postoperative care adhered to the same standards. On the day before surgery, all patients received oral sodium phos-

phate as a bowel preparation. Patients who had difficulty sleeping were given Valium. The anesthesiologists adopted the same anesthetic techniques throughout the surgery, which included a combination of inhalation anesthesia and general anesthesia. None of the patients received epidural anesthesia at the same time. All patients underwent single-port laparoscopic surgery at the umbilicus, which was performed by the same surgical team from the Gynecology Department. All patients followed the same feeding regimen after surgery. They were allowed to drink low-fat liquid 6 hours after surgery and were instructed to follow a light and soft diet after their first bowel movement. Following the first passage of feces, patients were advised to return to a regular diet. If the patient was unable to consume an oral diet, intravenous fluids were administered until the patient's symptoms were resolved.

All patients were asked to inform nursing staff when they first passed flatus or defecated. An outcome assessor, who was unaware of the patient's study allocation, assessed the patient's bowel sounds using a standard stethoscope every 4 hours, starting 2 hours after surgery and continuing until bowel sounds were detected.

Analgesic pumps were used to manage pain as needed. A mixture of physiological saline (180 ml), tramadol (800 mg), metoclopramide hydrochloride (20 mg), and sufentanil (100 μg) was administered intravenously via the pump for 72 hours at a rate of 2 ml/h. Pain was assessed using a numeric rating scale (NRS). If the patient's pain score was 1-3, pain was reassessed every 6 hours, if the pain score was 4-6, pain was reassessed every 3 hours, and if the pain score was 7 or higher, pain was reassessed every hour and dezocine (5 mg) was given intramuscularly as needed. Patients were encouraged to begin mobilization 6 hours post-surgery.

Other surgical complications such as deep vein thrombosis, reoperation, fever (temperature >38.5°C), and readmission were monitored throughout the hospital stay. All participants were held to the same discharge criteria which included the ability to walk without assistance, no fever for at least 24 hours, no postoperative complications, and normal urination and defecation.

Outcome measurement

The primary outcome measure of the trial was the time to passage of the first flatus, with the completion of surgery being defined as zero (0) hours. Secondary outcome indicators were the time to first bowel movement sounds, time to first defecation, and length of hospital stay.

The time of first bowel movement sounds was defined as the time from the surgery to the first detection of bowel sounds. The time of first mobilization was defined as the time from the surgery to when the patient first walked without assistance. Nausea symptoms were classified as "asymptomatic" if the patient did not feel sick, "mild" if the patient felt a little nauseous but it did not affect the ability to eat, "moderate" if the patient had obvious symptoms of nausea that affected the ability to eat, and "severe" if the patient felt continuously nauseous and unable to get out of bed. Abdominal distension was categorized as "asymptomatic" if the patient did not feel distension at all, "mild" if the patient felt a little abdominal distension with mild tenderness, "moderate" if the patient had obvious symptoms of abdominal distension with reduced abdominal breathing, and "severe" if the patient had obvious symptoms of abdominal tenderness with no abdominal breathing.

The collected data included patient characteristics, history of constipation, comorbid diseases, diagnosis, previous abdominal surgery, type of surgical procedures, operative time, anesthesia time, blood loss, time to first passage of flatus, time to first bowel movement sounds, time to first defecation, time to first mobilization, length of hospital stay, blood potassium level, postoperative pain score (measure using the NRS) at 6, 12, and 24 hours, postoperative abdominal distension at 6 hours, use of analgesia pump, occurrence of ileus and total hospital cost.

Sample size calculation

The sample size was calculated using a power formula and the two ratios were compared. Based on a previous study performed on patients who underwent laparotomy for benign gynecologic surgery [13], it was predicted that

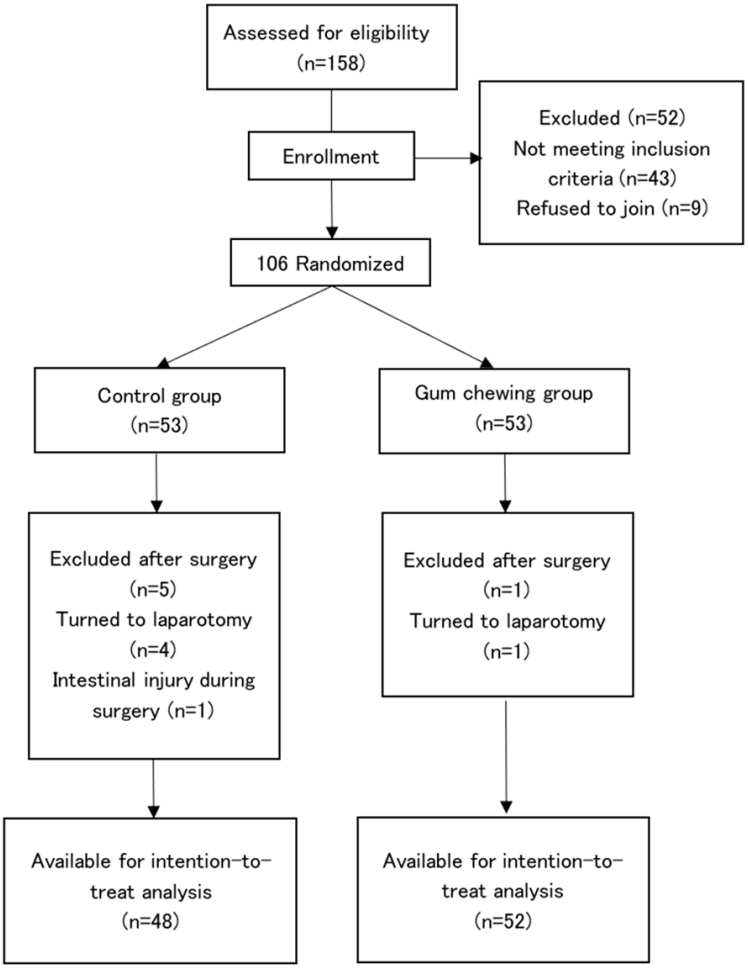

Figure 1. Flow diagram of trial recruitment and follow-up.

the mean time to first flatus would be 30.8±17.7 hours in the gum chewing group and 42.2±17.1 hours in the routine postoperative care group. With an α level of 0.05 and a power of 90%, the required sample size in each group was 49, assuming a 5% dropout rate, and the goal was to recruit 103 patients.

Statistical analysis

Statistical analysis was performed with SPSS 22.0 for Windows. Descriptive statistics are provided for continuous and categorical variables. Categorical variables were analyzed using chi-square test or Fisher Precision Probability test, normally distributed continuous variables were assessed using Student's *t* test, and the Mann-Whitney *U test* was used for variables that were not normally distributed. A *P value* of less than 0.05 was considered statistically significant.

Results

Trial recruitment and follow-up

A total of 158 patients with benign gynecological conditions who were scheduled for single-port laparoscopic surgery at West China Second University Hospital were assessed for eligibility. Out of these, 52 were excluded for not meeting the inclusion criteria or for refusing to participate, resulting in 106 patients being randomly assigned to the control group (n=53) and gum-chewing group (n=53). Six patients were later excluded from the study after randomization because they no longer met the inclusion criteria (five in the control group and one in the gum chewing group). Therefore, a total of 48 patients in the control group and 52 in the gum-chewing group were included in the intention-to-treat analysis. The flow diagram and reasons for pre- and post-randomization are shown in **Figure 1**.

Clinical and operative characteristics

The clinical characteristics and baseline demographics of the included patients are presented in **Table 1**. The patients' age, body mass index (BMI), history of constipation, comorbid diseases and diagnosis were similar between the control group and the gum chewing group. Uterine fibroids were the most common indication for surgery (98.1% in the gum chewing group and 95.8% in the control group). The operative characteristics compared between the control and gum chewing groups are summarized in **Table 2**. Patients had similar operative characteristics between the two groups, including history of previous abdominal surgery, type of surgical procedures, operation time, anesthesia time,

Table 1. Clinical characteristics and baseline demographics of the control and gum chewing groups

Characteristics	Gum group (n=52)	Control group (n=48)	*P*
Age (years)	42.8±8.0	44.6±6.4	0.22
BMI (kg/m^2)	23.4±2.9	22.3±4.3	0.15
History of constipation	2 (3.8)	2 (4.2)	0.94
Comorbid disease	20 (38.5)	15 (31.3)	0.45
Hypertension	1 (1.9)	2 (4.2)	0.51
Diabetes mellitus	1 (1.9)	3 (6.3)	0.27
Anemic	18 (34.6)	9 (18.8)	0.07
Others	1 (1.9)	3 (6.3)	0.27
Diagnosis			
Uterine fibroids	51 (98.1)	46 (95.8)	0.51
Ovarian cyst	1 (1.9)	2 (4.2)	0.51

Data are presented as the mean ± standard deviation (SD) and number (percentage). BMI, body mass index; Others = ventricular premature beat, hepatitis.

Table 2. Operative characteristics compared between the control and gum chewing groups

Characteristics	Gum group (n=52)	Control group (n=48)	*P*
Previous abdominal surgery			
Cesarean section	19 (65.5)	21 (77.8)	
OCR	6 (20.7)	3 (11.1)	0.56
MM	4 (13.8)	3 (11.1)	
Type of surgical procedure			
MM	33 (63.5)	27 (56.3)	
TH+BS	10 (19.2)	14 (29.2)	0.55
TH+BS+BO	8 (15.4)	5 (10.4)	
OCR	1 (1.9)	2 (4.2)	
Operative time (h)	2.2±1.0	2.3±0.8	0.86
Anesthesia time (h)	3.5±1.1	3.5±0.9	0.92
Blood loss (ml)	144.2±233.5	100.1±148.8	0.27

Values are given as the mean ± standard deviation (SD) and number (percentage). TH: total hysterectomy; MM: myomectomy; OCR: ovarian cyst removal; BS: bilateral salpingectomy; BO: bilateral oophorectomy.

and blood loss. The most common type of surgical procedure was myomectomy. All gum-chewing patients completed their course of chewing gum until the passage of the first flatus, and no adverse events were observed during the study.

Postoperative clinical outcomes

Table 3 shows the postoperative clinical outcomes compared between the control group and the gum chewing group. The first passage of flatus time was significantly shorter in the gum chewing group. The mean time to the first passage of flatus was 20.7±13.1 hours in the gum chewing group and 26.8±15.8 hours in the control group ($P<0.05$). The time to first bowel movement sounds, time to first defecation, and length of hospital stay were also shorter in the gum chewing group than in the control group; however, there were no statistically significant differences between the two groups ($P>0.05$). Postoperative blood potassium levels were similar in both groups. The classification of postoperative nausea and abdominal distension at 6 hours was not significantly different between the groups ($P=0.89$ and $P=0.81$). No ileus, deep vein thrombosis, reoperation, fever or readmission were observed in either group.

Discussion

In this randomized controlled trial, it was found that chewing gum can enhance gastrointestinal function after gynecological single-port laparoscopic surgery. Compared to the control group, patients in the gum chewing group had a significantly shorter time to passage of the first flatus. However, there were no statistically significant differences between the two groups in the time to first bowel movement sounds, time to first defecation, or length of hospital stay.

Postoperative ileus is a common complication that can occur after all types of surgery. The cause of postoperative ileus is not fully understood but it can be attributed to factors such as extensive dissection, intestinal manipulation, the effects of narcotic analgesia, and electrolyte imbalance [14, 15]. Postoperative ileus can result in significant economic burden and psychological distress for patients [16]. To reduce the incidence of postoperative ileus, gum chewing and early postoperative feeding are recommended as part of enhanced recovery after surgery (ERAS) protocol [17-19]. However, due to reports of adverse reactions,

Table 3. Postoperative clinical outcomes compared between the control group and the gum chewing group

Characteristics	Gum group (n=52)	Control group (n=48)	*P*
Time to first passage of flatus (h)	20.7±13.1	26.8±15.8	0.04
Time to first bowel movement sound (h)	13.2±11.0	17.4±11.6	0.07
Time to first defecation (h)	57.7±27.5	61.2±22.3	0.49
Time to first mobilization (h)	19.4±12.2	20.1±11.7	0.80
Length of hospitalization (d)	5.1±1.2	5.3±1.5	0.37
Blood potassium (mmol/L)	3.7±0.2	3.7±0.3	0.82
Postoperative 6-hour NRS score	2.5±1.2	2.7±1.5	0.44
Postoperative 12-hour NRS score	2.0±0.9	2.2±1.4	0.33
Postoperative 24-hour NRS score	1.5±0.9	1.6±1.0	0.40
Postoperative 6-hour nausea			
Asymptomatic	30 (57.7)	25 (52.1)	
Mild	17 (32.7)	17 (35.4)	0.89
Moderate	4 (7.7)	4 (8.3)	
Severe	1 (1.9)	2 (4.2)	
Postoperative 6-hour abdominal distension			
Asymptomatic	33 (63.5)	33 (68.8)	
Mild	16 (30.8)	12 (25.0)	0.81
Moderate	3 (5.8)	3 (6.3)	
Severe	0	0	
Analgesia pump	26 (54.2)	31 (59.6)	0.69
Ileus	0	0	Not estimated
Total hospital cost (US dollar)	2575.8±609.6	2592.2±494.2	0.87

Values are given as the mean ± standard deviation (SD) and number (percentage).

some physicians are hesitant to implement early oral intake [20-22].

Several studies have shown that chewing gum can accelerate the recovery of gastrointestinal function without causing side effects [23-25]. As a form of sham feeding, gum chewing does not add extra strain on the gastrointestinal tract. Chewing gum activates the cephalic-vagal reflex in a similar way to consuming food, which can promote the secretion of digestion juices and increase gastrointestinal tract motility [26]. In addition, chewing gum also stimulates the salivary glands and it prevents the mouth from drying [27], and it can also be used as an oral hygiene measure to prevent bad breath. For these reasons, we chose to use chewing gum as an intervention in our study.

The gum-chewing group and control group were similar in terms of known and potential confounding factors, resulting in comparable results such as previous abdominal surgery, type of surgical procedure, operative time, anesthesia time and history of constipation. All patients underwent single-port laparoscopic surgery at the umbilicus, which has been implemented as standard care for total hysterectomy and myomectomy in our hospital. Single-port laparoscopic surgery is less invasive, which leads to a faster recovery and less impact on the patient's quality of life [28]. An increasing number of patients are choosing single-port laparoscopy due to its cosmetic benefits [29].

Passage of flatus is an important indicator of the recovery of gastrointestinal function after abdominal surgery. Compared to patients who underwent conventional laparotomy surgery for gynecological conditions [13], the mean time to the first flatus in our study was significantly shorter. In gynecological laparotomy surgeries, the bowel undergoes more surgical manipulation and there is a progressive decline in gastrointestinal function. On the other hand, laparoscopic surgery has been proven to quickly

restore bowel motility with minimal intestinal manipulation [24]. Therefore, patients undergoing laparotomy surgeries are inherently at a higher risk of gastrointestinal dysfunction than those undergoing laparoscopic surgeries.

Ertas *et al.* [30] investigated bowel activity after gynecologic laparotomy surgery and concluded that the time interval between surgery and the first flatus was significantly shorter in the gum-chewing group, and the reduced mean time to first flatus was longer than in our study (9 hours vs. 6 hours). Therefore, patients who undergo laparotomy surgery may benefit more from chewing gum than those who undergo laparoscopic surgery. Husslein *et al.* [31] conducted a randomized controlled trial to assess the effects of chewing gum on gastrointestinal function after gynecologic laparoscopic surgery. The results showed that the gum-chewing group had a significantly shorter time to pass the first flatus than the control group, which is consistent with our findings. However, the median time to the first flatus in our study was much longer than that in Husslein's study. One possible explanation is that in Husslein's study, an operation time of more than 3 hours was excluded and in some cases, the procedure took as little as 10 minutes. In our study, we had operative times ranging from 1.4 hours to 3.5 hours. Longer surgeries may lead to more peri-operative complications. Another reason may be the time to first mobilization time after surgery. In our study, the mean time to first mobilization was over 19 hours but it was only 3 hours in Husslein's study, and early mobilization after surgery may have a positive effect on bowel motility.

There was no significant difference in the time to first bowel movement sounds, first defecation, or length of hospital stay between the two groups in our study. A meta-analysis involving 1077 women reported that the time to first bowel movement sounds in the gum-chewing group was significantly reduced compared to that in the control group. The reason for this difference may be that the measurement of time to the first bowel movement sound is subjective, so we trained the outcome assessors to perform the auscultation in the same way to increase the validity of our outcomes. Roslan *et al.* [11] performed a meta-analysis on patients who underwent colorectal surgery and showed no significant reduction in the length of hospitalization in patients treated with gum chewing compared to controls. This consistent finding may be because the length of hospital stay is influenced by a variety of nonclinical factors [32, 33], so it may not be an accurate endpoint for evaluating the effectiveness of chewing gum.

No adverse effects have been reported in relation to post-surgery patients who chew gum [34, 35]. These findings align with the results of our study; where all patients were able to tolerate gum without experiencing dry mouth, jaw pain, airway obstruction, or choking.

Our study had several strengths. First, effective randomization helped to minimize selection bias and ensure that the demographic and surgical characteristics of both groups of patients were similar. Additionally, all surgical procedures were performed by the same surgical team at the same hospital, reducing variability between the two groups. Furthermore, to the best of our knowledge, this is the first randomized controlled trial to examine the effects of gum chewing on gastrointestinal recovery after single-port laparoscopic surgery in gynecology.

This study also had several potential limitations. One limitation is that the sample size was determined based on a study of patients who had undergone laparotomy surgery, and no previous studies on the effects of gum chewing on gastrointestinal recovery after laparoscopic surgery were available at the time of study conception. Another limitation is that the nature of the study did not allow for patient or nurse staff to be blinded, which could introduce bias. Furthermore, a placebo comparison group was not established, and the placebo effect may have an impact on the investigation of interventions for gastrointestinal recovery.

Conclusion

The study suggests that postoperative gum chewing is linked with an early recovery of gastrointestinal function in patients undergoing gynecologic single-port laparoscopic surgery. This safe and well-tolerated intervention led to early passage of the first flatus after surgery. Therefore, gum chewing should be considered as an additional treatment in the postoperative

care of patients undergoing gynecologic single-port laparoscopic surgery.

Disclosure of conflict of interest

None.

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