Influence of gum-chewing on postoperative bowel activity after laparoscopic surgery for gastric cancer

A randomized controlled trial

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Abstract

**Background:** In some studies, gum-chewing was demonstrated to have a beneficial effect on resumption of bowel function; however, other contradictory findings in other studies refute the effects of gum-chewing on peristaltic movements and digestive system stimulation. In addition, previous studies were after colorectal or gynecology surgery, whereas few reports focused on the effect of gum-chewing after gastrectomy. The aim of this randomized controlled trial was to assess the effectiveness of gum-chewing on postoperative bowel function in patients who had undergone laparoscopic gastrectomy.

**Methods:** From March 2014 to March 2016, 75 patients with gastric cancer received elective laparoscopic surgery in Shanghai Tongji hospital and were postoperatively randomly divided into 2 groups: 38 in a gum-chewing (Gum) group and 37 in a control (No gum) group. The patients in the Gum group chewed sugarless gum 3 times daily, each time for at least 15 minutes, until the day of postoperative exhaust defecation.

**Results:** The mean time to first flatus (83.4±35.6 vs. 79.2±24.2 hours; P=0.554) and the mean time to first defecation (125.7±41.2 vs. 115.4±34.2 hours; P=0.192) were no different between the no gum and Gum groups. There was also no significant difference in the incidence of postoperative ileus (P=0.896) and postoperative hospital stay (P=0.109) between the 2 groups. The postoperative pain score at 48 hours (P=0.032) in the Gum group was significantly higher than in the no gum group. There was no significant difference between the 2 groups in regards to patient demographics, comorbidities, duration of surgery, complications, and nausea/vomiting score.

**Conclusion:** Gum-chewing after laparoscopic gastrectomy did not hasten the return of gastrointestinal function. In addition, gum-chewing may increase patient pain on the second postoperative day.

**Abbreviations:** ASA = American Society of Anesthesiologists, CD = Clavien–Dindo classification, ERAS = enhanced recovery after surgery, PCA = patient-controlled analgesia, POD = postoperative day, POI = postoperative ileus.

**Keywords:** gastric cancer, gum-chewing, laparoscopic, Sham feeding

1. Introduction

For the past few decades, promoting the recovery of postoperative gastrointestinal function has been an issue needing urgent improvement. Patients undergoing abdominal surgery experience reduced gastrointestinal peristalsis owing to extensive dissection, postoperative exhaust, and long duration of anesthesia. Postoperative ileus (POI) is referred to as delayed defecation, lasting for 3 to 5 days, prolonging the resumption of regular bowel movements following abdominal surgery. Extended hospital stays increase the risk of hospital-acquired infections, deep vein thrombosis, pulmonary compromise, and total hospital costs.[1] Traditional interventions to prevent POI or restore bowel function after surgery include decompression of the stomach with a nasogastric tube, adequate pain control,[1] early mobilization of the patient to stimulate bowel function, epidural anesthesia,[2] and drugs such as metoclopramide, erythromycin, neostigmine, alvimopan, among others.

Recent studies aimed at shortening the period of POI have revealed that chewing gum can stimulate gastrointestinal motility, thereby reducing POI.[3,4,5] However, contradictory findings in other studies[6,7] refute the effects of gum-chewing on peristaltic movements and digestive system stimulation. In
addition, most previous studies were after colorectal or gynecology surgery, whereas few reports focused on the effect of gum-chewing after gastrectomy[8,9].

The aim of this randomized controlled trial was to assess the effectiveness of gum-chewing on restoring postoperative bowel function in patients who received laparoscopic gastrectomy.

2. Methods

2.1. Patients and study design

This study was a prospective, single-center, randomized, and controlled clinical trial. The aim of the study was to evaluate the effectiveness of gum-chewing on postoperative bowel function and included consecutive adult patients with gastric cancer receiving elective laparoscopic surgery in Shanghai Tongji hospital from March 2014 to March 2016. The study was reviewed and approved by the Shanghai Tongji Hospital Review Board and the Ethics Committee of Shanghai Tongji Hospital. It was registered with the Chinese Clinical Trial Registry (Protocol ChiCTR-TRC-14004287).

For identification of cases, patient inclusion criteria were as follows: age ≥18 years; satisfactory consciousness (i.e., alertness) and cooperativeness toward chewing; underwent laparoscopic radical gastrectomy (including conversion to open surgery); any gender; any BMI; and informed consent.

Exclusion criteria for the study participation included the following: age < 18 years; unconsciousness after surgery; no teeth or defective or incomplete chewing movement; patient of long-term fasting and having received total parenteral nutrition; pyloric obstruction; remnant of gastric cancer; recurrence of gastric cancer; palliative surgery for advanced gastric cancer; refusal to participate in the trial; muscular and neurological disorders; history of drug addiction, especially opioids; and severe water and electrolyte disturbances.

The participants were given a thorough description of the research approach before entering the study. After eligibility had been established and patients provided written informed consent, patients were randomly allocated by a 1:1 ratio to the gum-chewing (Gum) or control (No gum) groups using a computer-generated (www.random.org) randomization sequence in our coordinating office. The sequence was then provided to the participating nurses by telephone after the operation. The same surgical group, to ensure technical replication, performed all the operations. All patients remained enrolled until the end of the study.

2.2. Sample size calculation

The required sample size in each group was calculated using G*Power software (University of Kiel, Germany). The time to first bowel movement was used for power analysis because it was more accurate than the time to flatus. For this purpose, the medical records of patients who had undergone laparoscopic gastrectomy between January 2012 and January 2013 were reviewed. The mean time to first bowel movement was estimated to be 122 ± 40 hours. The few previous studies on the effect of gum-chewing after gastric surgery showed conflicting results.[8,9]

Therefore, we assumed a 20% reduction of time to bowel movement for the gum-chewing group, according to a previous meta-analysis,[10] whose results were mostly from colectomy studies predicting a 98-hour mean time to bowel movement for the gum-chewing group, with a clinically relevant difference of 40 hours. A minimum sample size of 36 patients per randomization arm was estimated to obtain a power of 80% for detecting a difference at the 5% level.

3. Interventions and data collection

The protocol was carried out as follows: patients in the Gum group chewed sugarless gum for at least 15 minutes at 7:00, 12:00, and 18:00 from the first postoperative day (POD)-1 and continued until the day of exhaust defecation (up to 7 days). The patients in the No gum group received medical interventions with standardized ward care, thus minimizing confounding variables, to permit comparison for a placebo-like control for gum-chewing (i.e., sham feeding) alone. Although the patients, ward nurses, and the research assistant could not be blinded, all other investigators were blinded. Patients or their relatives completed their own confidential questionnaires to prevent bias and subjectivity.

Specific elements of the traditional enhanced recovery after surgery (ERAS) were incorporated, including preoperative and intraoperative warming. Other ERAS elements included use of patient-controlled analgesia, early removal of urinary catheters for most cases, and early ambulation, beginning on POD 1. We followed the strategy for removing the nasogastric tube within 24 hours after surgery.[11] Patients were subsequently allowed to receive a clear-liquid diet. The drain was removed when the aspirate was minimal or nonpurulent, usually within 3 to 4 days. Using 24-hour durations as time points after operation, we recorded the occurrence of first flatus and defecation, the incidence of POI, pain scores, nausea, and vomiting scores (Table 1), analgesic drug use, and complication data. Adynamic or paralytic ileus that persisted for >3 days following surgery was termed POI.[12] Complications were graded and reported using the Clavien–Dindo (CD) classification.[13] Complications of grades I and II were defined as minor complications, and grades III and higher were defined as major complications. The data-collecting instruments included the interview form, questionnaires, and the examination of subjects. In addition, age, sex, comorbidity, American Society of Anesthesiologists (ASA) grade, duration of the operation, need for postoperative analgesics, morbidity, mortality and postoperative hospital stay were also recorded. At our hospital, discharge from the department was performed when 3 conditions were fulfilled: normal body temperature for at least 24 hours, normal leukocyte count, and no apparent surgical site infection.

4. End points

The primary end points were time to flatus, time to defecation, and the incidence of POI. The secondary end points were length of postoperative hospital stay, pain score, and nausea/vomiting scores.

4.1. Statistical analysis

Summarized data were analyzed using SPSS (version 19.0; SPSS Inc, Chicago, IL). Continuous variables, such as age, duration of surgery, analgesic drug consumption, time to first flatus, and defecation, were presented as the mean ± standard deviation. Categorical variables, such as sex, ASA grade, comorbidities, postoperative complications, pain scores, and nausea and vomiting scores were expressed as frequencies. Student t tests were used to compare the means of continuous variables with
normal distribution, whereas Mann-Whitney U tests were used for those with nonparametric distribution. Categorical variables were compared using the \( \chi^2 \) test. For small samples, we used Yate correction for continuity, as appropriate. A probability value \( \leq 0.05 \) (\( P \leq 0.05 \)) was considered significant.

## 5. Results

Between March 2014 and March 2016, 85 patients participated in this trial. After 10 patients were excluded before randomization (see flowchart), a total of 75 patients were randomly assigned to either the Gum (n = 38) or No gum (n = 37) group.

Baseline characteristics were similar between the 2 groups (Table 2). There were no differences in sex, age, comorbidities, and ASA grade. Twenty-one patients in the No gum group had comorbidities before their operations, as did 21 patients in the Gum group. The most common comorbidities included primary hypertension, type 2 diabetes mellitus, post-stroke syndrome, and coronary artery disease.

### Table 2

| Baseline characteristics          | No gum group (n=37) | Gum group (n=38) | \( P \)  |
|----------------------------------|--------------------|-----------------|---------|
| Sex (male/female)                | 20/17              | 25/13           | 0.300   |
| Age, y                           | 64.2±14.1          | 61.9±10.2       | 0.437   |
| Comorbidities                    | 21 (56.76%)        | 21 (55.26%)     | 0.896   |
| Primary hypertension             | 16                 | 14              |         |
| Type 2 diabetes                  | 4                  | 5               |         |
| Post-stroke syndrome             | 2                  | 3               |         |
| Coronary artery disease          | 1                  | 1               |         |
| Atrial fibrillation              | 1                  | 1               |         |
| Livedoarhythm function           | 1                  | 0               |         |
| Renal dysfunction                | 1                  | 1               |         |
| Cardiac dysfunction              | 0                  | 1               |         |
| Asthma                           | 0                  | 1               |         |
| Severe anemia                    | 1                  | 0               |         |
| ASA score                        | 0.939              |                 |         |
| I                                | 18                 | 17              |         |
| II                               | 17                 | 19              |         |
| III                              | 2                  | 2               |         |

ASA = American Society of Anesthesiologists.

The operation outcomes for both groups are shown in Table 2. Two cases in the No gum group and 4 cases in the Gum group were converted to open surgery. There was no significant difference in the duration of operation between the 2 groups. The rates of POI of the 2 groups did not significantly differ. In the No gum group, 1 patient developed CD grade I complications: wound infection requiring dressing change. One patient developed a grade III complication: pleural effusion requiring thoracocentesis under local anesthesia. In the Gum group, 1 patient developed CD grade I complications: wound infection requiring dressing change. Grade II complications occurred in 2 patients: pneumonia requiring antibiotics. One patient developed a grade III complication: pleural effusion and atelectasis requiring thoracocentesis under local anesthesia.

Patient-controlled analgesia (PCA) with fentanyl was administered to all the patients. There was no significant difference in fentanyl consumption between the 2 groups (\( P = 0.969 \)).

As shown in Table 3, there was no significant difference in the mean time to the onset of gas passage (\( P = 0.554 \)) or defecation (\( P = 0.192 \)) between the 2 groups. There was also no significant difference in the incidence of POI (\( P = 0.896 \)) and postoperative hospital stay (\( P = 0.109 \)) between the 2 groups.

Pain scores after operation are listed in Table 4. We found that the 48-hour postoperative pain scores in the Gum group were significantly higher (\( P = 0.032 \)). However, the 24-, 72-, and 72-hour-after pain scores were not significantly different between the 2 groups. We evaluated nausea and vomiting scores 24, 48, 72, and after 72 hours in the patients (Table 5). Between the 2 groups, 24 hours, 48 hours, 72 hours, and 72 hours after nausea and vomiting scores were not significantly different.

### Table 3

| Operative outcomes | No gum group (n = 37) | Gum group (n = 38) | \( P \) |
|--------------------|-----------------------|-------------------|--------|
| Operation          |                       |                   | 0.964  |
| Distal gastrectomy | 32 (1)*               | 33 (3)            |        |
| Total gastrectomy  | 5 (1)                 | 5 (1)             |        |
| Fentanyl consumption, mg | 1.00±0.37             | 1.01±0.29         | 0.969  |
| Complication       |                       |                   | 0.352  |
| Clavien-Dindo ≤2   | 3                     | 5                 |        |
| Clavien-Dindo ≥3   | 1                     | 2                 |        |
| Mortality          | 0                     | 0                 | 1.000† |
| Time to flatus, h  | 83.4±35.6             | 79.2±24.2         | 0.554  |
| Time to defecation, h | 125.7±41.2           | 115.4±34.2        | 0.192  |
| POI                | 21                    | 21                | 0.896  |
| Postoperative hospital stay, days | 10.7±4.2          | 12.4±5.0          | 0.109  |

POI = postoperative ileus.

* The number inside parenthesis represents the laparoscopic surgery converted to open.

† Yate correction for continuity.

### 6. Discussion

Paralytic ileus is the most common postoperative complication after abdominal surgery. POI can result in pain, vomiting, and abdominal distension; this can delay the speed of a patient’s recovery after major gastrointestinal surgery. In recent years,
Nausea and vomiting score after operation.

|                 | No gum group (n = 37) | Gum group (n = 38) | P     |
|-----------------|-----------------------|--------------------|-------|
| Nausea and vomiting score (0/1/2/3) |                       |                    |       |
| 24 h            | 10/15/10/2            | 7/11/19/1          | 0.142 |
| 48 h            | 14/15/6/2             | 7/14/17/0          | 0.032 |
| 72 h            | 15/18/2/2             | 8/24/6/0           | 0.103 |
| After 72 h      | 21/14/2/0             | 22/15/1/0          | 0.845 |

Table 4

Pain score after operation.

|                 | No gum group (n = 37) | Gum group (n = 38) | P     |
|-----------------|-----------------------|--------------------|-------|
| Pain score (0/1/2/3) |                       |                    |       |
| 24 h            | 10/15/10/2            | 7/11/19/1          | 0.142 |
| 48 h            | 14/15/6/2             | 7/14/17/0          | 0.032 |
| 72 h            | 15/18/2/2             | 8/24/6/0           | 0.103 |
| After 72 h      | 21/14/2/0             | 22/15/1/0          | 0.845 |

Table 5

Nausea and vomiting score after operation.

|                 | No gum group (n = 37) | Gum group (n = 38) | P     |
|-----------------|-----------------------|--------------------|-------|
| Nausea and vomiting score (0/1/2/3) |                       |                    |       |
| 24 h            | 29/4/4/0              | 28/10/0/0          | 0.853 |
| 48 h            | 33/4/0/0              | 28/10/0/0          | 0.087 |
| 72 h            | 31/6/0/0              | 33/5/0/0           | 0.710 |
| After 72 h      | 35/2/0/0              | 38/0/0/0           | 0.149 |

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