



Chewing gum promotes bowel function recovery in elderly patients after lumbar spinal surgery: a retrospective single-center cohort study

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Background: Postoperative paralytic ileus is not a rare complication after lumbar spinal surgery especially in elderly patients. Chewing is a kind of sham feeding that has been reported to stimulate bowel motility, but so far there was no study showed these positive results may or may not be extrapolated to the spinal surgery population. We sought to determine whether chewing gum facilitates bowel function recovery in elderly patients undergoing lumbar spine surgery.

Methods: Sixty consecutive elderly patients (over 60 years old) with lumbar degenerative diseases undergoing posterior lumbar fusion surgery between September 2017 and April 2019 were respectively included and divided into two groups. The chewing gum group (30 patients) started chewing gum after they were awakened from anesthesia until the first defecation occurred, while the control group (30 patients) chewed nothing. The time to first flatus, first bowel sounds heard and first defecation, the length of hospital stay and postoperative complications were all recorded and analyzed.

Results: Compared with control group, the chewing gum group had less time to the first flatus (12.4 ± 2.9 vs. 17.8 ± 2.2 h; $P < 0.001$), first bowel sounds heard (17.3 ± 2.8 vs. 25.0 ± 2.5 h; $P < 0.001$) and first defecation (51.9 ± 5.2 vs. 76.1 ± 3.8 h; $P < 0.001$), but no significant differences were found in the length of hospital stay (11.7 ± 2.1 vs. 11.9 ± 2.5 d; $P = 0.697$) and the postoperative complications ($P = 0.501$).

Conclusions: This study demonstrated that chewing gum can promote bowel function recovery in elderly patients after lumbar spinal surgery.

Keywords: Elderly; chewing gum; postoperative bowel function recovery; lumbar spinal surgery

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Introduction

Postoperative paralytic ileus is defined as temporary gastrointestinal motility dysfunction after surgery, which is characterized by abdominal pain/distention, belching, nausea, vomiting and constipation (1). It may lead to increased postoperative pain, patients' discomfort, delayed enteral nutrition, poor wound healing, delayed mobilization and increased health care costs (2). Although most of

postoperative paralytic ileus occurred in patients after abdominal surgery, it is not rarely reported in orthopedic surgery (3,4). Postoperative paralytic ileus is reported as a frequent complication after lumbar spinal surgery, occurring in 2.6% to 12% depending on the invasiveness and approach of the surgery (5). Moreover, China is facing a rapid aging population (6), and lumbar spinal surgery in the aging population is also reported being on

the rise (7). Elderly patients were often complicated with chronic constipation (8), and thus may suffer higher risk of postoperative ileus after orthopedic surgery than the younger (9). Therefore, it is of great significance to find effective measures to prevent postoperative paralytic ileus in the elderly after lumbar spinal surgery.

To prevent postoperative paralytic ileus, many therapies including early enteral nutrition, early removal of nasogastric tube, gastrointestinal motility drugs and physical therapy have been put forward and applied in clinical work (10-12). However, they can not be routinely or widely used because of the low compliance of the former two and limited clinical efficacy of the latter two (13,14). It has been reported that chewing gum can promote gastrointestinal motility after abdominal surgery such as caesarean section and colorectal resection (15-17), but so far there was no study showed these positive results may or may not be extrapolated to the orthopedic surgery population.

Therefore, we conducted this retrospective single-center cohort study to investigate the influence of chewing gum on gastrointestinal motility function recovery in elderly patients after lumbar spinal surgery. We present the following article in accordance with the STROBE reporting checklist (18). Available at <http://dx.doi.org/10.21037/apm-20-1077>.

Methods

This retrospective single-center cohort study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by Ethics Committee of the First Affiliated Hospital of Chongqing Medical University (No.: 2018-089) and all of the participants provided their written informed consent before their data were recorded and stored.

Patients selection

Consecutive patients undergoing posterior lumbar fusion surgery for degenerative lumbar diseases under general anesthesia at our department between September 2017 and April 2019 were respectively selected.

The inclusion criteria: (I) patients who were diagnosed with degenerative lumbar diseases, such as lumbar disc herniation (LDH), lumbar spinal stenosis (LSS) or lumbar spondylolisthesis (LS), based on clinical symptoms (e.g., low back pain, lower limb pain or numbness) and radiological imaging; (II) patients who were over 60 years old; (III)

patients undergoing conservative therapy for at least 3 months without improvement; (IV) patients who received open posterior lumbar fusion surgery, such as posterior lumbar interbody fusion (PLIF) or transforaminal lumbar interbody fusion (TLIF), under general anesthesia.

The exclusion criteria: (I) patients with a history of spinal or gastrointestinal surgery; (II) patients who can not understand the experiment content or unable to cooperate (e.g., neural mental diseases, poor education level); (III) patients with high risk of esophageal obstruction (e.g., dentures, loose teeth); (IV) patients with spinal fractures, tumor, infection, or spinal deformity; (V) patients with diabetes mellitus, gastrointestinal dysfunction, or severe cerebrovascular diseases.

Postoperative management

All the surgical procedures (PLIF or TLIF) were performed by a senior spinal surgeon according to the standard operation method. The surgery was done in the prone position under general anesthesia. A midline skin incision was made to expose the spinous processes, lamina, facets, and transverse processes of the involved lumbar levels. The pedicle screws were implanted with the C-arm radiography confirmation. Total laminectomy or hemilaminectomy was performed to decompress the nerve root or spinal canal. Then, discectomy was done and a cage filled with the autograft was implanted for interbody fusion. Finally, the operation field was flushed by normal saline and the incision was closed layer by layer after placing a drainage tube. After operation, the chewing gum group started chewing gum 4 hours after they were totally awoken of anesthesia. They chewed gum every 4 hours, 4 grain every time and at least for 15 minutes. When first passage of flatus occurred, the gum chewing frequency was decreased to every 8 hours until first defecation. A commercially available sugarless gum (Extra, Wm Wrigley Jr Company, China agent) was used. The control group did not chew gum. Standard postoperative care interventions (e.g., prophylactic antibiotics, dehydrating agents) were provided for all patients. Patient-controlled analgesia (PCA) was only used in the patients who signed the consent for use preoperatively. When first bowel sounds were heard, patients were allowed to start oral intake of liquid, semi-fluid or soft foods, and then gradually transition to a normal diet.

Measurement

Preoperative demographic data [e.g., age, gender, body mass

index (BMI), diagnosis, comorbidities] and surgery related variables (e.g., ASA grade, type of operation, operative level, operative duration and blood loss, the use of postoperative PCA) were all recorded. We defined severe constipation as follows: (I) onset of constipation symptoms at least 6 months prior to spinal surgery; (II) previous treatment with at least 2 laxatives from different classes for at least 6 months; (III) no evidence of organic diseases causing constipation. Patients who meet the above three points are considered to be serious constipation. Preoperative opioid medication of the patients was also collected and compared. The time of the first gum chewing was defined as the 0 hour. Postoperative bowel sounds of each patient was checked by two research members every half an hour using a standard stethoscope. All patients were asked to notify the nurse or medical staff when first passage of flatus and the first defecation occurred. The length of hospital stay was defined as the period from patient's admission to discharge. The postoperative complications included esophageal obstruction caused by gum, vomiting, abdominal distension, intestinal obstruction, urinary retention, pulmonary infection and wound infection. Clavien-Dindo classification was used to evaluate the postoperative complications (19).

Statistical analysis

Quantitative data was represented as mean \pm standard deviation and compared by *t*-test. Qualitative data was recorded as number (percentages). Disordered qualitative data (e.g., gender) was compared by Chi square test or Fisher's exact test and ordered qualitative data (e.g., ASA grade and Clavien-Dindo classification) was compared by Mann-Whitney U test. SPSS 22.0 software was used for statistical analysis and $P < 0.05$ was considered to be the significant difference.

Results

A total of 60 patients were finally included in this study, involving 30 cases in the chewing gum group and 30 cases in the control group. There was no significant difference in age, gender, BMI, preoperative diagnosis, comorbidities and serious constipation between the two groups (Table 1).

No significant differences were found in the ASA grade, type of operation, operative level and postoperative PCA use. The operative duration and operative blood loss in the two groups were 139.5 ± 27.0 , 138.7 ± 34.5 min and 156.7 ± 76.3 , 182.3 ± 154.9 mL, respectively ($P > 0.05$). The

comparisons of surgery related variables between the two groups were shown in Table 2.

We found a significant shorter time to first flatus in chewing gum group compared with control group (12.4 ± 2.9 vs. 17.8 ± 2.2 h; $P < 0.001$). The time to first bowel sounds heard (17.3 ± 2.8 vs. 25.0 ± 2.5 h; $P < 0.001$) and first defecation (51.9 ± 5.2 vs. 76.1 ± 3.8 h; $P < 0.001$) were both significantly reduced in chewing gum group compared with control group. However, no significant difference was found in length of hospital stay (11.7 ± 2.1 vs. 11.9 ± 2.5 d; $P = 0.697$). The comparisons of postoperative clinical outcomes between the two groups were shown in Table 3.

According to the Clavien-Dindo classification, there were 7 case of complications in the chewing gum group, including 2 cases of grade I (1 case of vomiting, 1 case of abdominal distension), 5 cases of grade II (1 case of vomiting, 1 case of abdominal distension, 2 cases of urinary retention and 1 case of pulmonary infection). In the control group, there were 10 cases of complications, including 2 cases of grade I (1 case of vomiting, 1 case of abdominal distension), 7 cases of grade II (2 cases of vomiting, 1 case of abdominal distension, 1 case of non-symptomatic intestinal obstruction, 2 cases of urinary retention and 1 case of pulmonary infection), and 1 case of grade III (1 case of wound infection). No significant difference was found in postoperative complications between the two groups ($P = 0.501$). The comparison of postoperative complications between the two groups was shown in Table 4. All the complications were recovered after active treatment.

Discussion

It is reported that the mean incidence of postoperative ileus after lumbar surgery is about 3.5% (20,21), and it varies with the surgical approach. Fineberg *et al.* conducted a retrospective study involving more than 200,000 patients and found that a posterior lumbar spinal fusion surgery had a mean postoperative ileus rate of 2.6% compared with 7.5% for an anterior approach and the incidence can be as high as 12% for a combined anterior and posterior approach (5). Moreover, an increasing trend for lumbar spinal surgery in Chinese elderly patients was also widely reported because of the aging of the population (6,7). As most of the elderly suffer chronic constipation (8), the risk of postoperative ileus in elderly patients may be higher than that previously reported in the younger (9,22). Thus, although paralytic ileus is considered a mild complication of spinal surgery in previous study (23), it occurs more frequently than we

Table 1 Comparison of preoperative demographic data between the two groups

Preoperative demographic data	Control group (n=30)	Chewing gum group (n=30)	P value
Age (yr), mean \pm SD	67.1 \pm 4.3	66.4 \pm 3.4	0.509
Gender			0.602
Male	18	16	
Female	12	14	
BMI (kg/m ²), mean \pm SD	22.6 \pm 2.8	22.5 \pm 2.1	0.821
Serious constipation (n)	3	5	0.706
Spinal disease (n)			0.690
LDH	9	10	
LSS	17	14	
LS	4	6	
Comorbidities (n)			0.691
Hypertension	3	5	
Diabetes	4	3	
Cardiovascular diseases	3	2	
Lung diseases	1	2	
Preoperative opioid medication (n)	5	7	0.519

LDH, lumbar disc herniation; LSS, lumbar spinal stenosis; LS, lumbar spondylolisthesis; BMI, body mass index.

Table 2 Comparison of surgery related variables between the two groups

Surgery related variables	Control group (n=30)	Chewing gum group (n=30)	P value
ASA grade (n)			0.632
I	19	17	
II	9	11	
III	2	2	
Type of operation (n)			0.573
PLIF	8	10	
TLIF	22	20	
Operative levels (n), mean \pm SD			0.432
1	19	16	
2	11	14	
Operative duration (min), mean \pm SD	139.5 \pm 27.0	138.7 \pm 34.5	0.917
Blood loss (mL), mean \pm SD	156.7 \pm 76.3	182.3 \pm 154.9	0.419
Postoperative PCA	22	26	0.197

PLIF, posterior lumbar interbody fusion; TLIF, transforaminal lumbar interbody fusion; PCA, patient-controlled analgesia.

Table 3 Comparison of postoperative clinical outcomes between the two groups

Clinical outcomes	Control group (n=30)	Chewing gum group (n=30)	P value
Time to first flatus (h)	25.0±2.5	17.3±2.8	<0.001
Time to first bowel sounds (h)	17.8±2.2	12.4±2.9	<0.001
Time to first defecation (h)	76.1±3.8	51.9±5.2	<0.001
Length of hospital stay (d)	11.9±2.5	11.7±2.1	0.697

Table 4 Comparison of postoperative complications between the two groups

Complications (Clavien-Dindo classification)	Control group (n=30)	Chewing gum group (n=30)
II	2	2
II	7	5
III	1	0
In total	10	7 [#]

[#], Mann-Whitney U test was performed, P=0.501, compared with the control group.

ever thought, especially in elderly patients. Therefore, it is of importance to find out proper management to promote bowel function recovery in elderly patients after spinal surgery.

At present, treatment of postoperative ileus mainly includes perioperative prevention, traditional treatment, pharmacologic interventions and surgical treatment (24). Traditional treatment such as nasogastric decompression, electrolyte replacement and early ambulation have been reported with limited clinical efficacy and poor patient compliance (25). Pharmacologic interventions are commonly used following abdominal surgery to prevent ileus, such as prokinetic motility drugs, antiemetics, neostigmine and μ -receptor antagonist, but they had been found of little or even no benefit (26,27). Surgery is only indicated for the serious complications due to intestinal obstruction, such as bowel perforation or ischemia. So, the postoperative prevention plays an important role in the management of postoperative ileus.

Chewing is a kind of sham feeding that has been reported to stimulate bowel motility in humans (28). The possible physiological mechanisms are as follows: (I) chewing gum can stimulate the chemical and mechanical receptors of oropharynx, activate the cephalic-vagal nerve pathway, and increase the secretion of gastrointestinal hormones such as gastric acid, pepsinogen, gastrin and motilin, thus promoting the motility of gastrointestinal tract (29,30); (II)

masticatory action itself can also stimulate the vagus nerve pathway, increase the release of acetylcholine transmitters; the acetylcholine transmitters bind to nicotine receptors on inflammatory cells, thus reducing the release of pro-inflammatory factors and promoting the recovery of gastrointestinal motility (31); (III) some studies have shown that xylitol contained in sugar-free gum had the effect of affecting gastrointestinal motility and mild permeable diarrhea, which may also be the reason why chewing gum promotes the recovery of intestinal paralysis (32). Therefore, chewing gum can promote gastrointestinal motility mainly by directly activating cephalic-vagal nerve pathway and indirectly promoting the secretion of gastrointestinal hormones.

In our study, the results showed that chewing gum can promote bowel function recovery in elderly patients after posterior lumbar surgery. The time to first flatus, first bowel sounds heard and first defecation were all significantly accelerated. The bowel motility was significantly accelerated in both two groups compared with that reported in abdominal surgery (3 to 4 days). There are several potential explanations. Firstly, the operative duration of posterior lumbar fusion surgery was usually very short (less than 3 hours). Secondly, there is less intestinal inflammatory response during the posterior lumbar fusion surgery that reduce the risk of postoperative ileus after posterior lumbar surgery compared with abdominal surgery. Thirdly, in

posterior lumbar surgery, however, the bowel is hardly intervened.

A shorter hospitalization time in the chewing gum group was expected based on its promoting bowel motility recovery, but our data did not demonstrate a notable difference, this result was different with the previous meta-analyses (33,34). There may be the following reasons: (I) the sample size of this study is small with only 60 cases included; (II) the hospitalization time was related variable factors, such as the time of preoperative examination, the change of patient's health condition, or even the insurance system which covers most of the hospitalization fees; (III) surgeons may have different experiences in the indication of discharge. Moreover, no serious complications were found in the two groups indicating the tolerance and safety of chewing gum in elderly patients.

This study also had some limitations. Firstly, it was a single center retrospective study with small sample size. Secondly, research members may have different experiences in the auscultation of the bowel sounds and thus may cause some heterogeneity. Thirdly, the time to first passage of flatus and first defecation were provided by the patients or their family members, and there may be a lack of inaccuracy or timeliness.

Conclusions

Postoperative chewing gum enhances the bowel function recovery in elderly patient after lumbar spine surgery without serious complications, and thus it might be recommended in clinical work. However, since this was a small-sample retrospective study, prospective randomized control studies with large sample size are needed to validate our findings.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by Ethics Committee of the First Affiliated Hospital of Chongqing Medical University (No.: 2018-089) and individual consent for this retrospective analysis was also obtained from the patient.

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