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Feeding jejunostomy following esophagectomy may increase the occurrence of postoperative small bowel obstruction

Tomoki Nakai, MD[a], Junya Kitadani, MD, PhD[a], Toshiyasu Ojima, MD, PhD[a],* , Keiji Hayata, MD, PhD[a], Masahiro Katsuda, MD, PhD[a], Taro Goda, MD[a], Akihiro Takeuchi, MD, PhD[a], Shinta Tominaga, MD[a], Naoki Fukuda, MD[a], Shotaro Nagano, MD[a], and Hiroki Yamaue, MD, PhD[a]

Abstract

This study aimed to clarify the characteristics and treatment of bowel obstruction associated with feeding jejunostomy in patients who underwent esophagectomy for esophageal cancer. In this single-center retrospective study, 363 patients underwent esophagectomy with mediastinal lymph node dissection for esophageal cancer at the Wakayama Medical University Hospital between January 2014 and June 2021. All patients who underwent esophagectomy routinely underwent feeding jejunostomy or gastrostomy. Feeding jejunostomy was used in the cases of gastric tube reconstruction through the posterior mediastinal route or colon reconstruction, while feeding gastrostomy was used in cases of retrosternal route gastric tube reconstruction. Nasogastric feeding tubes and round ligament technique were not used. Postoperative small bowel obstruction occurred in 19 of 197 cases of posterior mediastinal route reconstruction (9.6%), but in no cases of retrosternal route reconstruction because of the feeding gastrostomy ($P < .0001$). Of the 19 patients who had bowel obstruction after feeding jejunostomy, 10 patients underwent reoperation (53%) and the remaining 9 patients had conservative treatment (47%). The cumulative incidence of bowel obstruction after feeding jejunostomy was 6.7% at 1 year and 8.7% at 2 years. Feeding jejunostomy following esophagectomy is a risk factor for small bowel obstruction. We recommend feeding gastrostomy inserted from the antrum to the jejunum in the cases of gastric tube reconstruction through the retrosternal route or nasogastric feeding tube in the cases of reconstruction through the posterior mediastinal route.

Abbreviations: BMI = body mass index, BOFJ = bowel obstruction associated with feeding jejunostomy, FERL = a feeding enterostomy technique using the round ligament of the liver, POD = postoperative day.

Keywords: bowel obstruction, esophageal cancer, feeding jejunostomy

1. Introduction

Treatment of esophageal cancer mainly comprises esophagectomy with radical lymphadenectomy. Esophagectomy is a highly invasive procedure, however, and postoperative complications (cardiovascular events, respiratory events, anastomotic leakage, etc) and mortality are more common than in other gastrointestinal surgeries.[1–3] Clinically, postoperative weight loss is common after esophagectomy, even in the absence of complications,[4] and severe weight loss is associated with poor prognosis.[5] In our previous randomized controlled trial on postoperative nutritional support for patients with esophageal cancer, there was 10.9% to 18.0% body weight loss at 1 year postoperatively.[6] Feeding jejunostomy is considered to be useful for postoperative nutritional management and for improving the general postoperative condition in such highly invasive surgeries for esophageal cancer, after which poor feeding in the long term is usually expected.[7–9] Meanwhile, early postoperative enteral nutrition was shown to reduce postoperative complications such as wound infection and anastomotic leakage, and hospital stays were shortener than by intravenous nutrition only.[10–12] Early enteral nutrition is recommended to minimize postoperative complications during highly invasive surgery. In our hospital, feeding jejunostomy is used in all surgical cases of esophageal cancer, and we perform early enteral feeding.

*Correspondence: Toshiyasu Ojima, Second Department of Surgery, School of Medicine, Wakayama Medical University, 811-1 Kimiidera, Wakayama 641-8510, Japan (e-mail: tojima@wakayama-med.ac.jp).

However, postoperative small bowel obstruction associated with feeding jejunostomy (BOFJ) is sometimes encountered.[13–15] This study aims to clarify the clinical characteristics and treatment of BOFJ.

2. Materials and Methods

2.1. Patients

This single-center retrospective cohort study was conducted at the Wakayama Medical University Hospital, Wakayama, Japan, with approval from the institutional ethics committee and in accordance with the Declaration of Helsinki. Informed consent to be included in the study, or the equivalent, was obtained from all patients. Thoracoscopic esophagectomy with mediastinal lymph node dissection was performed in all patients in prone position. Gastric mobilization was then performed in a supine position, with abdominal lymph node dissection by laparoscopy or laparotomy, and gastric tube reconstruction. Right-colon interposition was performed in patients with esophageal cancer who could not undergo gastric tube reconstruction. All patients who underwent esophagectomy systematically underwent feeding jejunostomy or gastrostomy. In our department, patients with advanced esophageal cancer who receive preoperative chemotherapy or preoperative chemoradiotherapy and patients who undergo reconstruction by right-colon interposition generally undergo reconstruction via the retrosternal route. In other patients, reconstruction is generally performed via the posterior mediastinal route. Nasogastric feeding tubes and round ligament technique were not used, and abdominal drains were not inserted in esophagectomy.

2.2. Surgical procedures

Feeding jejunostomy was performed in the cases of gastric tube reconstruction through the posterior mediastinal route and right-colon interposition, while feeding gastrostomy was performed in the cases of gastric tube reconstruction through the retrosternal route. Specifically, a 60 cm, 12 Fr, jejunostomy catheter (Needle Catheter Jejunostomy Kit, Fuji Systems, Tokyo, Japan) was inserted via a 5-cm middle incision after gastric mobilization and abdominal lymph node dissection into the jejunum, 20 cm distal from the Treitz ligament. The feeding jejunostomy was placed 3 to 4 cm to the left of the midline. Conversely, feeding gastrostomy was inserted from the antrum in the gastric tube to the jejunum, 20 cm distal from the Treitz ligament. Feeding jejunostomy and gastrostomy were created using the Stamm method in all cases. In addition, 3 or 4 fixed sutures using nonabsorbable silk thread were placed around the puncture site.

2.3. Postoperative nutritional management

Glucose was administered from postoperative day (POD) 2, elemental diet, (Elental, EA Pharma Co., Inc., Tokyo, Japan) was administered from POD 3, and liquid enteral nutritional formula, Racol NF (Otsuka Pharmaceutical Factory, Japan), was administered from POD 7. Food intake was usually started on POD 8 if there was no anastomotic leakage or severe dysphagia. Food intake is often reduced for some time after surgery and some patients may undergo adjuvant chemotherapy, so nutrition via feeding jejunostomy or feeding gastrostomy was routinely continued for an average of 3 months until sufficient food intake was achieved.

2.4. Definition of postoperative bowel obstruction following feeding jejunostomy

Postoperative bowel obstruction following feeding jejunostomy was defined as bowel obstruction caused by the jejunostomy site shown on computed tomography (Fig. 1A). In addition, if contrast from a nasogastric tube or ileus tube confirmed that the obstruction was at the fixed part of the feeding jejunostomy, we diagnosed BOFJ.

2.5. Statistical analyses

Data are recorded as the median (range) or numbers. The clinical features between patients with and without BOFJ were analyzed. All statistical analyses were by JMP Pro 14.1 (SAS Institute Inc., Cary, NC). Categorical variables were assessed using chi square method and continuous variables were evaluated using the Wilcoxon signed-rank test. The cumulative incidence of BOFJ was assessed by Kaplan–Meier method. Statistical significance was defined as a *P* value <.05.

3. Results

In total, 363 patients underwent surgery for esophageal cancer at Wakayama Medical University Hospital between January 2014 and June 2021. intrathoracic anastomosis was performed in 17 patients and cervical anastomosis was performed in 346 patients.
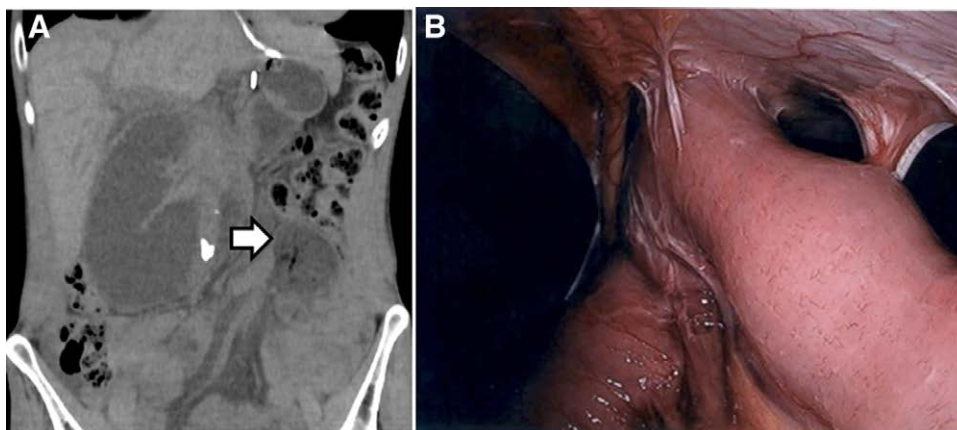

Figure 1. (A) Computed tomography image shows an obstruction of the jejunum at the site of the feeding jejunostomy (white arrow). (B) Laparoscopy shows adhesion and flexion of the small intestine at the site of the feeding jejunostomy. Bowel obstruction was improved by exfoliation of the adhesions.

3.1. Patient characteristics compared between patients with and without BOFJ

Comparison of the patient characteristics between patients with and without BOFJ is shown in Table 1. Approach of abdominal procedure, (laparoscopy or laparotomy) was not significantly different between the 2 groups. Moreover, there were no significant differences in the previous history of abdominal surgery between the 2 groups. BOFJ occurred in 19 of 197 cases of posterior mediastinal route reconstruction (9.6%) but in none of the cases of retrosternal route reconstruction because of the feeding gastrostomy ($P < .0001$). BOFJ should be divided into 2 groups, those who underwent posterior mediastinum feeding jejunostomy and those who underwent retrosternal feeding gastrostomy. However, the analysis in this study included 25 cases of colon interposition in the retrosternal route. In these cases, feeding jejunostomy was selected, making division into the posterior mediastinum feeding jejunostomy or retrosternal feeding gastrostomy groups difficult. Postoperative small bowel obstruction within the first 90 postoperative days occurred in 7 patients. Overall morbidity rate was 69% and mortality rate was 0%. Overall morbidity rate more than Clavien–Dindo grade III was 20%.

3.2. Clinical differences between reoperation and conservative groups

Comparison between patients who underwent reoperation and those who received conservative treatment is shown in Table 2. Of the 19 patients who had BOFJ, 10 underwent reoperation (53%) and 9 had conservative treatment (47%). The number of onset of BOFJ in the reoperation group was significantly higher than that of the conservative group (3 incidences vs 1 incidence, $P = .042$). Median rate of occurrence after primary operation was similar between the reoperation and conservative groups (6.5 vs 5 months; $P = .806$). The clinical features and surgical outcomes of the 10 patients that underwent reoperation are shown in Table 3. Three patients had laparotomy and 7 patients had laparoscopic surgery. Median time to reoperation from primary surgery was 15.5 months (range; 0–68 months). All patients had adhesion (Fig. 1B) and in addition, 3 patients had bending and 1 patient had torsion. No patients required bowel resection.

3.3. Accumulated occurrence rate of BOFJ

The cumulative incidence of BOFJ according to Kaplan–Meier estimates is shown in Figure 2. The median observation period in this study was 27 months (range: 0–94 months). In cases of feeding jejunostomy from the gastric tube, there was no observation of BOFJ. Among the cases of feeding jejunostomy in posterior mediastinal reconstruction, the cumulative incidence of BOFJ was 6.7% at 1 year, 8.7% at 2 years, and since then, the onset of BOFJ has rarely been observed.

4. Discussion

In this retrospective study, we analyzed 363 patients who underwent esophagectomy for esophageal cancer and clarified the occurrence of BOFJ. BOFJ occurred in 19 of 363 patients with esophageal cancer (5.2%), each of whom was a case of posterior mediastinal route reconstruction with feeding jejunostomy. There were no postoperative small bowel obstructions in patients with feeding gastrostomy inserted from the antrum in the gastric tube to the jejunum. Of the 19 patients who had BOFJ, 10 required reoperation (53%). In addition, the results of our study suggest that operative treatment of BOFJ should be considered when BOFJ has occurred twice or more. Length of hospital stay in BOFJ group was similar to that in patients in the group without BOFJ because most of the patients in the BOFJ group developed small bowel obstruction after discharge. According

Table 1

Patient characteristics between patients with and without BOFJ.

Categories	With BOFJ (n = 19)	Without BOFJ (n = 344)	P value
Age, median (range), yr	70 (45–80)	68.5 (28–89)	.56
Sex			.22
Male	18	281	
Female	1	63	
BMI, median (range), kg/m²	21.2 (17.2–25.9)	21.4 (12.7–34.2)	.57
Approach of abdominal procedure			.58
Laparoscopic	16	291	
Laparotomy	3	53	
Neoadjuvant chemotherapy	7	150	.56
Pathological stage			.14
0	2	63	
1	8	52	
2	4	106	
3	5	110	
4A	0	12	
4B	0	1	
Comorbidity			
Hypertension	8	170	.54
Diabetes mellitus	3	46	.73
Hyperlipidemia	4	42	.28
Coronary artery disease	0	16	.42
Previous history of abdominal surgery	8	111	.37
Route of reconstruction			<.001
Posterior mediastinal	19	178	
Retrosternal	0	166	
Organ for substitution			.63
Gastric tube	19	319	
Colon	0	25	
Location of tumor			.75
Ce	0	7	
Ut	4	41	
Mt	10	179	
Lt	4	97	
Ae	1	20	
Operative time, median (range), min	477 (308–606)	453.5 (232–1132)	.737
Blood loss, median (range), mL	55 (25–325)	75 (5–4335)	.194
Postoperative hospital stays, median (range), d	25 (16–102)	27 (15–249)	.846

Ae = abdominal esophagus, BMI = body mass index, BOFJ = bowel obstruction associated with a feeding jejunostomy, Ce = cervical esophagus, Lt = lower thoracic esophagus, Mt = middle thoracic esophagus, Ut = upper thoracic esophagus.

Table 2

Clinical differences between patients in reoperation and conservative treatment groups.

Categories	Reoperation group (n = 10)	Conservative treatment group (n = 9)	P value
Age, median (range), yr	72 (45–80)	69 (49–76)	.44
Sex			.47
Male	10	8	
Female	0	1	
BMI, median (range), kg/m²	21.65 (18.5–25.9)	21.2 (17.2–23.5)	.33
Approach of abdominal procedure			.58
Laparoscopic	9	7	
Laparotomy	1	2	
Previous history of abdominal surgery	5	3	.65
Number of onset	3 (1–5)	1 (1–3)	.042
Occurrence time after primary operation, median (range), mo	6.5 (0–67)	5 (1–28)	.81

BMI = body mass index.

Table 3

Clinical features and surgical outcomes of the patients requiring reoperation.

| Case	Age	Sex	Time to reoperation from primary surgery (mo)	Reoperation approach	Bowel resection	Outcomes	Pattern
1	62	M	56	Laparoscopy	No	Full recovery	Adhesion
2	68	M	5	Laparoscopy	No	Full recovery	Adhesion
3	79	M	1	Laparotomy	No	Full recovery	Adhesion + bending
4	71	M	15	Laparoscopy	No	Full recovery	Adhesion
5	51	M	68	Laparoscopy	No	Full recovery	Adhesion + bending
6	67	M	16	Laparotomy	No	Full recovery	Adhesion
7	80	M	33	Laparoscopy	No	Full recovery	Adhesion
8	79	M	57	Laparoscopy	No	Full recovery	Adhesion
9	78	M	8	Laparoscopy	No	Full recovery	Adhesion + bending
10	80	M	0	Laparotomy	No	Full recovery	Torsion

M = male.
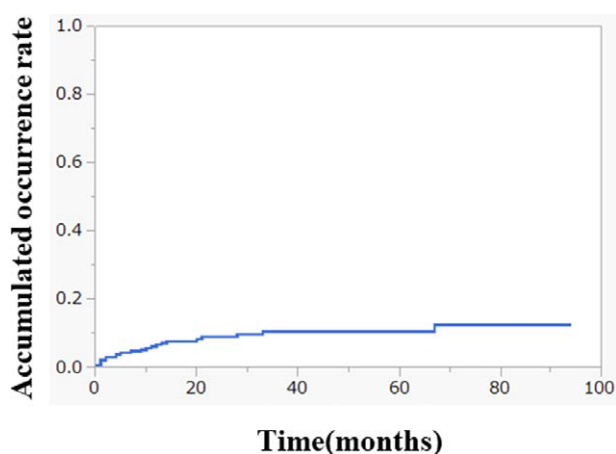
Figure 2. Kaplan–Meier curve shows accumulated occurrence rate of bowel obstruction associated with feeding jejunostomy and time (months) after the surgery for esophageal cancer only in posterior mediastinal reconstruction.

to the Japanese insurance system, the length of hospital stay for patients with esophageal cancer surgery is longer than the length of stay in most Western countries. All patients receive preoperative rehabilitation and nutritional support. Enteral nutrition was started on the second postoperative day and oral intake on the eighth postoperative day, and these protocols of enhanced recovery after surgery were indicated for all patients. Nasogastric feeding tubes are an option for enteral feedings. In comparison of the use of nasogastric feeding tube and jejunostomy, the time to reach target nutritional levels (3 days) and duration of nutritional support (3 days) have been reported to be similar in both groups.[11]

There have been reports on the importance of jejunostomy followed by esophagectomy for patients with esophageal cancer in the early postoperative period as compensation for postoperative weight loss due to inadequate oral intake.[16,17] Jejunostomy reportedly better maintained the structure and function of the intestine and prevented bacterial translocation compared with intravenous nutrition because it provided nutrition directly to the intestine.[18] However, the incidence of serious complications such as bowel obstruction, intractable jejunocutaneous fistula, infection at the site of jejunostomy, and tube obstruction associated with jejunostomy are estimated to be 2% to 15%.[13–15,19] Among these complications, postoperative bowel obstruction following feeding jejunostomy is a particularly serious problem because it occurs repeatedly and requires surgical intervention. Incidence of bowel obstruction has been recently reported to range between 0% and 11.5%.[14,18–24]

Regarding the mechanism of bowel obstruction, most cases occur due to bowel bending or torsion in addition to simple adhesion at the jejunostomy site. In recent years, laparoscopic abdominal procedures to mobilize the gastric tube have often been performed in high-volume institutions. Although an advantage of laparoscopic surgery is that there are fewer adhesions than open surgery, fewer adhesions around the fixation site of feeding jejunostomy can be the cause of bowel bending or torsion, which lead to small bowel obstruction.[25,26]

Indwelling nasogastric feeding tube is the other method of enteral nutrition after esophagectomy. The use of such tubes is associated with some complications, however, including aspiration pneumonia and atelectasis.[27] Nasogastric feeding tubes also increase patient discomfort.[28] Inadvertent removal of tubes and tube obstruction necessitate replacement of the tube.

To prevent BOFJ, feeding gastrostomy inserted from the antrum in the gastric tube to the jejunum should be selected with reconstruction through the retrosternal route. Gastrostomy has also been reported to have complications such as peritonitis, catheter site infection, and dermatitis, but is reported to have fewer complications of peritonitis and pneumonia and bowel obstruction than jejunostomy.[20] For these reasons, gastrostomy is performed instead of jejunostomy in the cases of gastric tube reconstruction through the retrosternal route in our department. In cases of posterior mediastinal route reconstruction, it may be better to insert a nasogastric feeding tube as an alternative to performing feeding jejunostomy, in spite of the associated limitations. If jejunostomy is used, the placement of the jejunostomy should also be considered because a short distance between the tube and midline may increase the incidence of BOFJ.[25] The usefulness of a feeding enterostomy technique using the round ligament of the liver (FERL) has been recently reported.[21] The cumulative incidences of postoperative small bowel obstruction associated with feeding enterostomy in the FERL group were reported to be significantly less frequent than those in the feeding jejunostomy group. When creating feeding jejunostomy, special informed consent should be received from the patient owing to the possibility of the need for emergency operation if small bowel obstruction occurs.

The current study also failed to examine whether the present conclusions are transferable to groups of Western patients, with an average body mass index (BMI) close to 30 kg/m². However, a comparison of the groups with a BMI ≥25 kg/m² and those with a BMI <25 kg/m² showed no significant difference in the development of BOFJ ($P = .33$), so it is likely that the present conclusions are transferable to Western groups of patients. Patients who underwent prehabilitation reportedly tended to have lower percentage of weight loss and lower number of patients requiring jejunostomy for nutritional support or hospitalization during neoadjuvant therapy.[29] Prehabilitation may contribute to reducing the need for postoperative artificial feeding.

There are several limitations to this study. It was a single-center retrospective study with a certain selection bias in terms of reconstruction route to perform feeding jejunostomy or feeding

gastrostomy inserted from the antrum in the gastric tube to the jejunum. In addition, the study only included patients who underwent the Stamm procedure, and it is unclear whether similar results can be obtained with the Witzel procedure. Future studies using data from large multicenter registries are needed to clarify the risk factors for small bowel obstruction.

5. Conclusion

Feeding jejunostomy following esophagectomy is a risk factor for small bowel obstruction. To prevent small bowel obstruction, feeding jejunostomy should be avoided. In cases of retrosternal route reconstruction, we recommend feeding gastrostomy inserted from the antrum in the gastric tube to the jejunum. Use of nasogastric feeding tube is recommended in the cases of posterior mediastinal route reconstruction.

Acknowledgments

Authors contributions

TN designed the study and wrote the initial draft of the manuscript. TN, JK, and TO contributed to data interpretation and critical revision of the manuscript. All the other authors (KH, MK, TG, AT, ST, NF, SN, and HY) contributed to data collection and interpretation and critical review of the manuscript. All authors have read and approved the final version of the manuscript and have agreed to be accountable for all aspects of the study, ensuring that any queries related to the accuracy or integrity of any part of the work are answerable.

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