ORIGINAL ARTICLE

Alternative method for jejunostomy in Ivor-Lewis esophagectomy

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Abstract

Background: To supplement nutrition, jejunostomy has been widely adopted as an adjunct surgical procedure for Ivor-Lewis esophagectomy. Most Chinese surgeons have a preference for parenteral nutrition even though it has some disadvantages compared with jejunostomy. In this report, we describe a new approach that allows the quick insertion of a feeding tube in Ivor-Lewis esophagectomy. We retrospectively analyze cases that have applied this approach and compare the advantages and disadvantages of jejunostomy.

Methods: Between January 2010 and December 2012, 131 patients underwent Ivor-Lewis esophagectomy in our hospital. These patients were divided into three groups: the total parenteral nutrition (PN) group, the jejunostomy (JT) group and the feeding tube (FT) group. The effect and safety of the procedure were compared.

Results: It took approximately 20 minutes longer to perform jejunostomy compared to placing a feeding tube ($P < 0.05$). The nutrition cost of the JT group was higher than the FT group ($P < 0.05$). There was no significant difference between the FT and JT groups ($P > 0.05$) in the ratio of body weight loss seven days post-surgery. The anal exsufflation time of the FT group was similar to the JT group ($P > 0.05$). The incidence of intestinal adhesion and obstruction in the JT group was 26.3%, which is much higher than in the FT and PN groups ($P < 0.05$).

Conclusion: Placing the feeding tube after Ivor-Lewis esophagectomy can decrease operative damage and bring sufficient nutrition. We believe it can be an alternative to jejunostomy in Ivor-Lewis esophagectomy.

Introduction

Esophageal cancer is one of the most common tumors in humans and its incidence has increased in recent years.[1–5] Ivor-Lewis esophagectomy with esophagogastric anastomosis has typically been applied to deal with middle and lower esophageal cancer. At the same time, jejunostomy has been widely adopted as an adjunct surgical procedure for esophageal cancer and as a route for postoperative nutrition administration.[6] However, the intestinal wall should be punctured and fixed to the abdominal wall during the jejunostomy, therefore, it is easier to cause intestinal adhesion and obstruction. In addition, skin corrosion and ulceration sometimes occurs around the jejunal tube, caused by intestinal juice reflux. As a consequence, most Chinese surgeons have a preference for parenteral nutrition even though it has some disadvantages compared with jejunostomy.

In this report, we describe a new approach that allows for the effective, safer, easier, and quicker insertion of a feeding tube, rather than performing jejunostomy during Ivor-Lewis esophagectomy. This procedure has been implemented for four years in our hospital. In this article we retrospectively analyze those cases and determine whether this method could be an alternative for nutrition supplement after Ivor-Lewis esophagectomy.

Methods

Patients

Between January 2010 and December 2012, 131 patients received Ivor-Lewis esophagectomy in our hospital. Exclusion criteria for our study were: anastomotic active bleeding within 24 hours after surgery; serious lung infection within

three days after surgery; cardiovascular events within 15 days after surgery; chylothorax within seven days after surgery; death within seven days post surgery; or lost to follow up one year post-surgery.

All patients underwent Ivor-Lewis esophagectomy, which is a two stage abdominal surgical procedure followed by a right thoracotomy and esophageal resection. The abdominal stages were performed by laparotomy. All patients underwent pyloroplasty, which was performed by sewing up the full thickness of the pylorus horizontally with an interrupted suture, using omentum to implant the incision. All patients received a gastric tube for gastrointestinal decompression after surgery.

The patients were divided in to three groups, according to the type of nutrition supplement used: total parenteral nutrition (PN), jejunostomy (JT), and feeding tube (FT) groups.

Enteral nutrition, including Supportan and Enteral Nutritional Suspension, was provided to the JT and FT groups on the second or third post-surgery day. The doses of enteral nutrition were calculated by body weight, gender, age, and height.

Method for placing a feeding tube

As detailed in our previous study,[7] the procedure was as follows (Fig 1):

1 With the patient in the supine position, mobilize the gastric body through an upper abdominal incision. Suture the pylorus with two stitches as stay stitches, and longitudinally cut the full thickness of the pylorus.
2 Enclose a candy ball using sterile gloves peel and fix it to the front end of the feeding tube (Tube A). Push the feeding tube until the front end and the candy ball lies in the duodenum; put the rest of the feeding tube into the gastral cavity.

The "candy" we use is a fruit drop. Soak it in povidone-iodine for 15 to 20 minutes, ensuring that it is not completely melted. Wrap the candy using sterile gloves peel and suture it to the tube. Then, cut a tiny hole in the front to prevent the melted candy causing an intestinal obstruction or rupture.

3 Pyloroplasty: Sew up the full thickness of the pylorus horizontally with an interrupted suture, and use omentum to cover the incision.
4 Extrude the candy with your finger until it reaches the jejunum and is 20 cm away from the ligament of Treitz. Then close the abdominal incision.
5 With the patient in the left lateral position, a posterolateral incision is made through the 5th intercostal space. The esophagus is mobilized and cut near the cardia, then the stomach is pulled to the thoracic cavity. Cut the esophagus up to five centimeters away from the tumor, and remove the specimen. A gastric conduit is then established and requires anastomosis to the stump of the thoracic oesophagus in the upper chest.
6 Pull the upper end of feeding tube A, and tie feeding tube A with another tube which was placed in the esophagus through the nose prior to surgery (Tube B). Enclose the joint with one finger to avoid mucosa damage. Remove the guide wire of feeding tube B, and then pull it out from the nose. Remove feeding tube B; Tube A remains in the nose for enteral nutrition.

Assessment

We compared the effectiveness and safety of the procedure between the three groups, including such factors as operation time, hospital stay, nutrition status, gastrointestinal function recovery, and post-operative complication. We recorded and compared the ratio of body weight loss of the patients seven days post-surgery. The time of anal exsufflation showed the gastric bowel function from a certain extent. We also recorded the time of anal exsufflation to compare the recovery time of the gastric bowel function. Post-operative complications, including anastomotic leakage, intestinal adhesion and obstruction, reflux esophagitis, functional delayed gastric emptying (FDGE), and skin corrosion and ulceration were recorded post-surgery. Intestinal adhesion and obstruction were diagnosed through clinical manifestations and laboratory examinations. Clinical manifestations included paroxysmal abdominal pain, bloating, and hyperactive bowel sounds; upright abdominal X-ray radiography showed bowel dilatation, excluding other related diseases.[8] Reflux esophagitis was diagnosed using clinical features and a gastroscope. Patients were followed for 12 months after the surgery to assess the status of intestinal adhesion or obstruction, reflux esophagitis, and functional delayed gastric emptying.

Statistical analysis

Statistical analysis was performed using SPSS PASW Statistics 18.0. Analysis of the categorical variables was performed with a chi-square test, and analysis of continuous variables was performed with an unpaired *t* test in order to investigate the differences among the groups. A Fisher's exact test was used to compare the complication rates among the groups. Continuous values were expressed as the mean ± standard deviation, and differences were considered significant statistically when $P < 0.05$.

Results

Patient characteristics

Between January 2010 and December 2012, 131 patients received Ivor-Lewis esophagectomy in our hospital. Seventeen

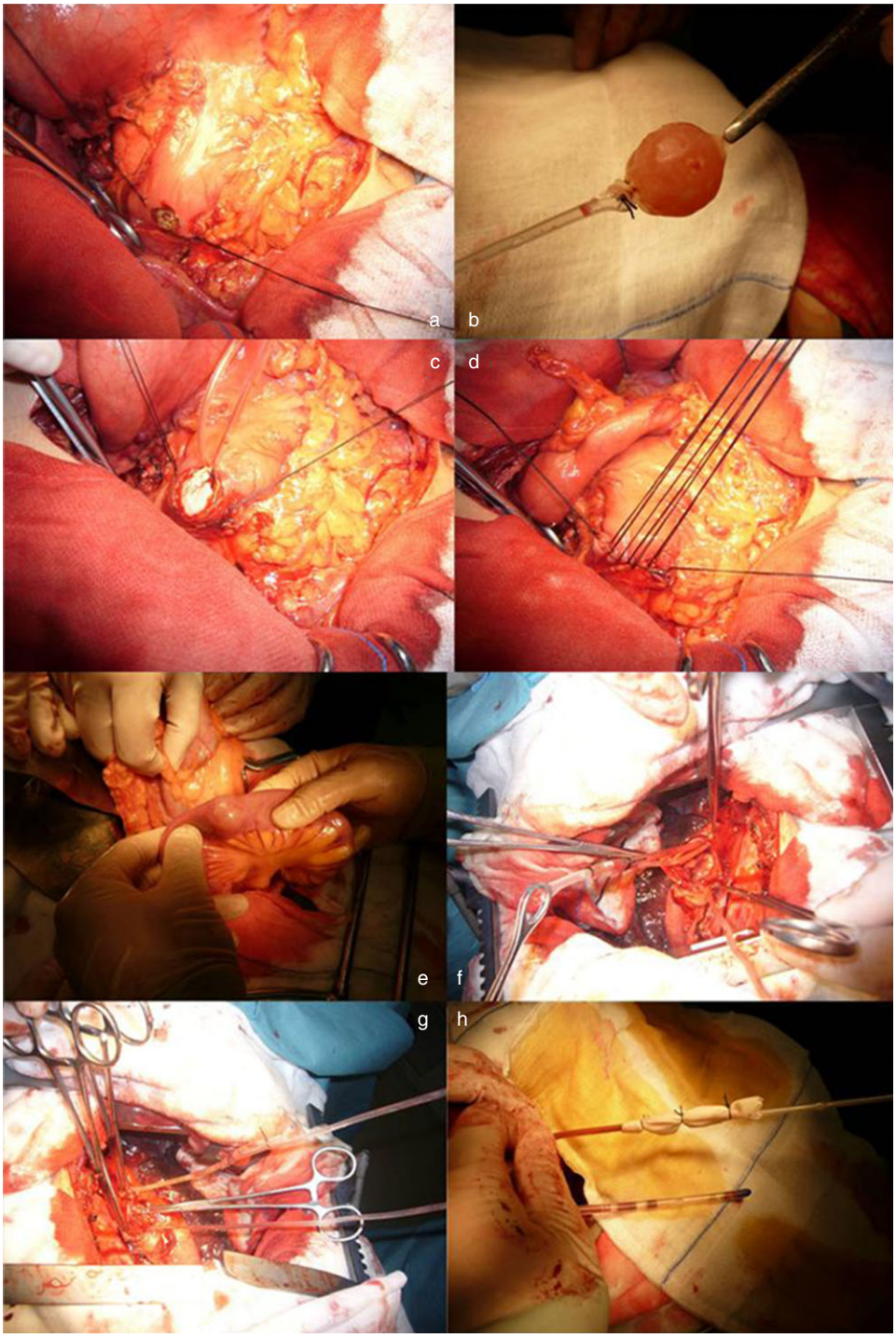

Figure 1 Surgical procedure of the new mode of feeding tube placement in Ivor-Lewis esophagectomy. (**a**) Suture the pylorus with two stitches as stay stitches, and longitudinally cut the full thickness of the pylorus. (**b**) Enclose a candy ball using one finger and fix it to the front end of feeding tube. (**c**) Push the feeding tube till the front end and the candy ball lies in the duodenum; then put the rest of the feeding tube into the gastral cavity. (**d**) Pyloroplasty: Sew up the full thickness of the pylorus horizontally with an interrupted suture and use omentum to cover the incision. (**e**) Extrude the candy with one finger until it reaches the jejunum and is 20 centimeters away from the ligament of Treitz. (**f**) Pull tube B, which is placed in the esophagus through the nose before surgery. (**g**) Pull the upper end of feeding tube A, and tie feeding tube A with B. (**h**) Enclose the joint with one finger to avoid mucosa damage.

Table 1 Demographic and clinical characteristics of the three groups

Variables	Groups			*P*-value
	JT group ($n = 38$)	FT group ($n = 37$)	PN group ($n = 39$)	
Gender				$P > 0.05$*
Male	22	22	25	$P > 0.05$**
Female	16	15	14	
Age (years)	61.92 ± 9.19	61.03 ± 9.61	60.79 ± 9.47	$P > 0.05$*
				$P > 0.05$**
Weight (Kg)	64.34 ± 10.79	62.76 ± 11.71	64.46 ± 9.07	$P > 0.05$*
				$P > 0.05$**
Height (cm)	166.58 ± 8.70	164.32 ± 8.64	166.18 ± 6.03	$P > 0.05$*
				$P > 0.05$**
Body mass index (kg/m^2)	23.07 ± 2.73	23.09 ± 3.11	23.27 ± 2.57	$P > 0.05$*
				$P > 0.05$**
Tumor length	3.83 ± 1.08	4.14 ± 1.07	4.08 ± 1.30	$P > 0.05$*
				$P > 0.05$**
Clinical stage				$P > 0.05$*
I	10	6	7	$P > 0.05$**
II	19	19	20	
III	9	12	12	
Tumor Location				$P > 0.05$*
Middle esophagus	26	23	27	$P > 0.05$**
Low esophagus	12	14	12	
Tumor Pathology				$P > 0.05$*
Squamous-cell carcinoma	33	33	34	$P > 0.05$**
Adenocarcinoma	5	3	4	

*Compared between the jejunostomy (JT) and feeding tube (FT) groups; **compared between the FT and parenteral nutrition (PN) groups.

patients were excluded because of anastomotic active bleeding, serious lung infection, cardiovascular events, chylothorax, post-surgery death, or when lost to follow up one year post-surgery. According to the grouping method, there were 39 patients in the PN group, 38 patients in the JT group, and 37 patients in the FT group. The median age was 61.25 years (range, 38–79); the gender ratio (female/male) was 69:45; and 71% of patients' body mass index (BMI) were less than 25, with 0.8% at more than 30. The majority of patients (81.5%) had squamous-cell carcinoma. There were no significant differences in demographic distribution, BMI, clinical stage, tumor size and tumor location among the three groups (Table 1).

Comparison of effectiveness and safety

Surgical time for the jejunostomy, placing the feeding tube, and hospital stay was compared Jejunostomy took approximately 20 minutes longer than placing the feeding tube ($P < 0.05$). The mean hospital stays were 10.8, 12.1 and 14.3 days in the FT, JT, and PN groups, respectively. There were significant differences among the three groups ($P < 0.05$) (Table 2).

Table 2 Comparison of effectiveness and admission cost

Variables	Groups			*P*-value
	JT group ($n = 38$)	FT group ($n = 37$)	PN group ($n = 39$)	
Operation time (minutes)†	23.16 ± 4.66	6.78 ± 2.49	0	$P < 0.05$*
				$P < 0.05$**
Hospital stay (days)	12.10 ± 2.86	10.78 ± 2.67	14.33 ± 2.79	$P < 0.05$*
				$P < 0.05$**
Anal exsufflation time (hours)	56.03 ± 7.71	58.87 ± 7.16	106.26 ± 17.52	$P > 0.05$*
				$P < 0.05$**
Admission cost (CNY)	1804.18 ± 169.45	1345.70 ± 233.70	4987.51 ± 260.03	$P < 0.05$*
				$P < 0.05$**

*Compared between the jejunostomy (JT) and feeding tube (FT) groups; **compared between the FT and parenteral nutrition (PN) groups; †operation time for jejunostomy or placing the feeding tube.

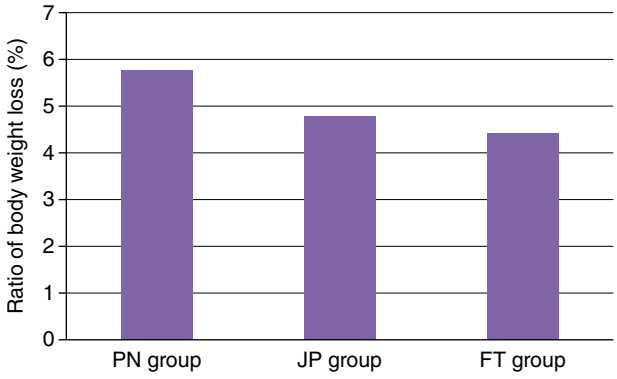

Figure 2 Body weight loss.

Admission cost

Admission for the PN group was a higher cost than for the FT and JT groups ($P < 0.05$). The admission cost of the JT group was more than FT group, and there was a significant difference ($P < 0.05$).

Body weight loss

The ratio of body weight loss of the patients was analysed seven days post-surgery (Fig 2). We found no significant difference between the FT and JT groups ($P > 0.05$); however there was a significant difference between the PN and FT groups, and the PN and JT groups ($P < 0.05$).

Gastric bowel function

The time of anal exsufflation was recorded and comparison was made between the three groups post-surgery (Table 2). The FT group had a shorter hospital stay than the JT and PN groups (58.87 ± 7.16 vs. 56.03 ± 7.71 and 106.26 ± 17.52). There was no significant difference between the JT and FT groups; however, there was a significant difference between the PN and JT groups, and the PN and FT groups.

Postoperative complications

Postoperative complications mainly included: incision pain, anastomotic leakage, intestinal obstruction, reflux esophagitis, functional delayed gastric emptying (FDGE), and skin corrosion and ulceration. The results show that FDGE and reflux esophagitis occurred less often in the FT than in the PN or JT groups, but there was no significant difference ($P > 0.05$). Skin corrosion and ulceration in the JT group was 13.2%, while the FT and PN groups had no such complications. The incidence of intestinal adhesion and obstruction in the JT group was 26.3%, which was much higher than in the FT and PN groups, and there was a significant difference between them ($P < 0.05$). There was no significant difference in the incidence of anastomotic leakage between the three groups (Table 3).

Discussion

An esophagectomy with a radical lymphadenectomy has been considered to be the most effective treatment for esophageal cancer.[9–11] Ivor-Lewis esophagectomy with esophagogastric anastomosis can provide more extensive lymph node dissection and contribute to a higher survival rate; therefore, it has typically been applied to deal with middle and lower esophageal cancer. In terms of supplementing nutrition, the enteral route is considered more physiologic; therefore jejunostomy has been widely adopted as an adjunct surgical procedure for esophageal cancer and as a route for postoperative nutrition administration.[6] However, this method increases the risk of causing intestinal adhesion and obstruction, skin corrosion, and ulceration around the jejunal tube. The feeding tube is soft and it is difficult to insert through the duodenum during Ivor-Lewis surgery. These are the main reasons why most

Table 3 The incidence of post-operative complication

	Groups			
Variables	JT group ($n = 38$)	FT group ($n = 37$)	PN group ($n = 39$)	*P*-value
Anastomotic leakage (%)	0 (0/38)	2.7 (1/37)	2.6 (1/39)	$P > 0.05$*
				$P > 0.05$**
Intestinal adhesion or obstruction (%)	26.3 (10/38)	8.1 (3/37)	5.1 (2/39)	$P < 0.05$*
				$P > 0.05$**
Reflux esophagitis (%)	7.9 (3/38)	5.3 (2/37)	7.7 (3/39)	$P > 0.05$*
				$P > 0.05$**
Functional delayed gastric emptying (%)	2.6 (1/38)	0 (0/37)	5.1 (2/39)	$P > 0.05$*
				$P > 0.05$**
Skin corrosion and ulceration	13.2 (5/38)	0 (0/37)	0 (0/39)	$P < 0.05$*
				$P > 0.05$**

*Compared between the jejunostomy (JT) and feeding tube (FT) groups; **compared between the FT and parenteral nutrition (PN) groups.

Chinese surgeons have a preference for parenteral nutrition even though it has some disadvantages in achieving nutritional goals and maintaining gastrointestinal mucosal integrity.

We have found an easier way to place a feeding tube during Ivor-Lewis surgery. Using this method, we can easily place the feeding tube into the jejunum and do not need to puncture and fix the intestinal wall to the abdominal wall. It can reduce surgical duration, decrease operative damage, provide sufficient nutrition, and lower the incidence of intestinal adhesion and obstruction.

In our study, we found that the FT group required less surgical time than the JT group. Generally, placing the feeding tube can save more than 20 minutes, which could shorten the anesthesia time and cause less damage to the patient during surgery. There were significant differences in mean hospital stay between the three groups (FT<JT<PN), which indicated that the FT group is at a lower risk of damage and required less recovery time than the JT or PN groups. Because of the shorter recovery time, the FT group had subsequently cheaper post-surgery nutrition supplement requirements, which could be advantageous in developing countries.

Enteral nutritional support is superior to total parenteral nutrition in achieving nutritional goals, improving outcomes, maintaining gastrointestinal mucosal integrity, promoting immuno secretory function, and avoiding infectious complications.[12–16] It is believed that early enteral feeding can reduce the morbidity and mortality of surgery.[17–20] It can promote mucosal growth and function recovery after surgery, decreased bacterial translocation, improved nutrient utilization, and cause less hepatobiliary complications. We analysed gastrointestinal function recovery after surgery and the nutrient status of the patients. The anal exsufflation time of the FT group is earlier than in the JT or PN groups. The ratio of body weight loss was analysed seven days post-surgery. There was no significant difference between the FT and JT groups, but their results were better than the PN group. During jejunostomy, puncturing the intestinal wall and fixing it to the abdominal wall is necessary, which may cause trauma to intestinal function. Placing a feeding tube has no such trauma and provides an advantage in gastrointestinal function recovery with the same or better nutrient support for patients.

The jejunostomy tube with the jejunostomy extension was reported to have complications for 53% of patients, with 11% leakage around the tube, 23% plugging of tubes, 4% fracture of tubes, and 15% retrograde migration of tubes.[21,22] Jejunostomy also can cause late post-operative complications, such as intestinal adhesion and obstruction. As previously reported, 34.6% of patients who underwent open abdominal or pelvic surgery were readmitted a mean of once to twice over 10 years for a disorder directly or possibly related to adhesions, or for abdominal or pelvic surgery that could potentially be complicated by adhesions; 22.1% of all outcome readmissions occurred in the first year after initial surgery.[8,23] Although serious intestinal adhesion or obstruction is rare, paroxysmal abdominal pain, bloating, hyperactive bowel sounds, and bowel dilatation are common post abdominal surgery. Our results show that the incidence of intestinal adhesion and obstruction in the JT group is 26.3%, which was much higher than in the FT and PN groups. We conclude that this is because the intestinal wall is punctured and fixed to the abdominal wall during jejunostomy, which can cause a large amount of serous fibrino and suppurative fibrino exudation, which, subsequently, might induce adhesion and obstruction. Our results show that the incidence of FDGE and reflux esophagitis in the FT group is lower than in the PN or JT groups, but with no significant differences. It is easier for patients to tolerate and accept the nasogastric tube after surgery; most patients keep the tube until a return to normal eating is permitted. Incidences of patients pulling out the nasogastric tube are very rare.

The leak rate for open thoracic anastomoses is between 5.5 and 13%,[24–26] and it is life threatening. Placing the feeding tube during Ivor-Lewis esophagectomy cannot reduce the incidence of anastomotic leakage; however, if an anastomotic leak happens, we believe that enteral nutrition is very important and can reduce the mortality rate. It is also an important reason for the recommendation of placing the feeding tube.

Conclusion

Placing the feeding tube after Ivor-Lewis esophagectomy can reduce surgical duration, decrease operative damage, provide sufficient nutrition, has shorter recovery times, and lowers the incidence of intestinal adhesion and obstruction. We believe it can be an alternative method for jejunostomy in Ivor-Lewis esophagectomy.

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Authors' contributions are as follows. Bo Yan is co-first author. Liqun Gong, Yulong Chen, Meng Wang, Qiang Zhang and Changli Wang contributed to study design, operation, data collection and analysis. Bo Yan and Hui Chen contributed to data analysis and the interpretation and writing of the manuscript.

Disclosure

No authors report any conflict of interest.

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