Bypass Operation for Unresectable Esophageal Cancer: Postoperative Complications After Thoracotomy Versus No Thoracotomy

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Abstract Patients with unresectable esophageal cancer suffer from dysphagia, causing severe malnutrition and reduced quality of life (QOL). We elect to perform bypass because patients can have greater long-term survival with chemoradiation following this operation. We sought to compare complications in cases of bypass without thoracotomy versus those with thoracotomy. Thirty-four locally advanced esophageal cancer patients between 2007 and 2014 were studied. Eighteen patients underwent thoracotomy, and 16 patients did not have a thoracotomy. CT was obtained to check the anastomosis and the oral stump of the esophagus and to measure the diameter of the intra-thoracic esophagus. In the thoracotomy group, the rate of postoperative pulmonary complications was high. On the other hand, in the non-thoracotomy group, the rates of anastomotic leak and recurrent nerve paralysis were high. The stump of the esophagus was 2 cm lower in the T group than in the nT group. As the esophagus shortens after division, the final difference in esophageal height between the groups was only around 1 cm. We concluded that a viable gastric tube with a good blood supply as well as a careful cervical operation are the most important aspects of the esophageal bypass operation.

Keywords Esophageal cancer · Anastomotic leak · Bypass operation · Thoracotomy

Introduction

In patients with unresectable esophageal cancer with severe stenosis of the esophagus or with fistulae to the airway, the bypass operation is a first-line treatment modality in patients that can tolerate surgery. The bypass operation is a palliative treatment for many patients, but this also may prolong life if chemoradiation can be given as an adjuvant. Because these patients have such advanced cancer, whether or not they are surgical candidates at all is controversial. In some institutions, the first-line treatment for unresectable esophageal cancer patients is stent placement. Stenting and surgical bypass both have risks and benefits, and understanding these is important in patient counseling [1, 2].

Because resumption of oral intake is the goal of the operation, anastomotic leak as a complication must be avoided. Four patients (11.8 %) in 34 had anastomotic leaks in our series. All of these patients were in the non-thoracotomy group.

There are two operative procedures for esophageal bypass. One involves a thoracotomy, which occurs in the situation of an aborted resection. The other is performed without a thoracotomy in cases of planned bypass. We sought to compare complications in cases of bypass without thoracotomy versus those with thoracotomy.

Patients and Methods

Thirty-four locally advanced esophageal cancer patients between 2007 and 2014 in Nagoya City University Hospital were studied. All patients had squamous cell carcinoma. Eighteen patients underwent thoracotomy (group T), and 16 patients did not have a thoracotomy (group nT). Eight patients were females. The mean ages in the T group versus the nT

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group were 70.2 versus 66.9, and this was not significant. The majority of tumors were located in the mid-esophagus. The most common organ into which the tumors invaded (T4) was the respiratory tree, followed by the aorta. Neoadjuvant therapy was performed for more than a half of the patients. Radiation therapy was performed in 50 % of the T group and 37.5 % of the nT group (Table 1).

Esophageal Bypass Surgery

An upper midline abdominal incision was made, and a Kocher maneuver was performed. At a safe distance from the right gastroepiploic artery and vein, the omentum was divided. As the spleen was approached, the left gastroepiploic vessels were carefully ligated and the short gastric vessels were divided.

We transfixed the entire wall of the stomach to the antrum 5 cm from the pylorus using a 21-mm intraluminal stapler, creating a ring surrounded with staples. Next, we created a tube which measured 3 cm in diameter using a linear stapler. Four to six staple applications were needed. The part corresponding to the lesser curvature serves to drain the distal esophagus in relation to the tumor, and the greater curvature makes up the tube.

Recently, the method of beginning the staple line at the cardia has improved the Postlethwait method. The GIA™ Radial Reload (Covidien Japan, Tokyo) is used for the first stapler load from cardia. A circular stapler is thus not necessary in this method.

A neck incision measuring 10 to 12 cm was made along the inner border of the sternocleidomastoid muscle. The platysma muscle was divided. After dissection and division of the cervical esophagus, the distal end was amputated using a linear stapler. Recently, a radial reload is used, because it is easy to achieve esophageal separation at the level of the sternum horizontally. A purse string was fashioned for positioning the head of a 25-mm intraluminal stapler in the stump of the proximal esophagus.

In the thoracotomy group, after aborting resection, we detach and divide the esophagus on the proximal side of the tumor.

After the subcutaneous tunnel was formed, the gastric tube end was brought into the neck. We then proceeded with the anastomosis of the proximal stump of the cervical esophagus to the proximal end of the terminolateral gastric tube using a 25-mm intraluminal stapler. The excess tubing was sectioned using a linear stapler.

Results

Surgical Outcomes of Esophageal Bypass Surgery

Mean operation time was 390 min in the T group and 248 min in the nT group. Mean blood loss in the T group (361 g) was greater than that in the nT group (255 g). Postoperative complications occurred in about half of the patients. In the T

Table 1 Clinical characteristics of patients

	Thoracotomy group (<i>n</i> = 18), <i>n</i> (%)	Non-thoracotomy group (<i>n</i> = 16), <i>n</i> (%)	<i>p</i> value
Gender			
Male	13 (72.2)	13 (81.3)	ns
Female	5 (27.8)	3 (18.8)	
Age, mean (range)	70.2 (56–90)	66.9 (53–78)	ns
Tumor location			
Upper thoracic	1 (5.9)	1 (6.3)	ns
Middle thoracic	17 (94.4)	10 (62.5)	
Lower thoracic	0 (0)	4 (25)	
Abdominal	0 (0)	1 (6.3)	
T4 organs			
Trachea/bronchus	8 (44.4)	4 (25)	ns
Aorta	4 (22.2)	2 (12.5)	
Lung	6 (33.3)	3 (18.8)	
Others	6 (33.3)	10 (62.5)	
Neoadjuvant therapy			
Chemotherapy	4 (22.2)	4 (25)	ns
Chemoradiotherapy	9 (50)	4 (25)	
Radiotherapy	0	2 (12.5)	
None	5 (27.8)	6 (43.8)	

ns not significant

group, respiratory complications occurred in eight patients. Anastomotic leak occurred in four patients, and they were all in the nT group. Recurrent nerve paralysis occurred in six patients, and the incidence was higher in the nT group. One patient died in the nT group due to progression of disease within 30 days of operation. Improvement in oral intake occurred in all but two patients whose cancer progressed rapidly. Postoperative chemoradiation was done for six patients (33.3 %) in the T group and for nine patients (56.2 %) in the nT group. In both groups, adjuvant therapy was started approximately 1 month after the operation (Table 2).

Computed Tomography

A postoperative computed tomography (CT) was performed in 27 of 34 patients. The mean length of the anastomotic region and suprasternal notch was 19.7 mm in the T group and 27 mm in the nT group. The mean lengths of the esophageal stump from the suprasternal notch and carina were 17.1 and 34.2 mm in the T group and 0.8 and 52.6 mm in the nT group. All these differences were statistically significant. There was no difference in height between the two groups. The maximum esophageal diameter was 24.7 mm in the T group and 22 mm in the nT group. In seven patients, CT was performed more than three times after the bypass operation (Table 3). Regarding diameter, only one patient had an increased luminal diameter; all other patients remained stable or had a decrease in diameter. There were no cases of esophageal stump blowout.

Survival

The 30-day mortality rate was 0 % in the T group and 6.3 % in the nT group. Mean survival was 7.39 months in the T group

and 5.63 months in the nT group. There were no differences in survival (Fig. 1).

Discussion

Management of unresectable esophageal cancer includes endoscopic stenting, radiation therapy, chemotherapy, endoscopic dilation, and bypass surgery. Dysphagia is the most common symptom that afflicts these patients and leads to severe malnutrition and a reduced quality of life. Many institutions employ endoscopic stenting as this modality is minimally invasive [3, 4]. Some hospitals, however, including our own institution, prefer the bypass operation in patients who can tolerate surgery [5–9]. We summarized the advantages and disadvantages of stent therapy and bypass operation (Table 4).

There are many reasons that we prefer the bypass operation. First of all, the operation is not as invasive as a resection. Secondly, long-term survival is possible with adjuvant therapy (radiation in particular). Oral intake can be increased in most cases, and improvement of respiratory symptoms is beneficial.

In four cases, we experienced anastomotic leak. The incidence of anastomotic leak after esophagectomy during the same period was 13.1 %. These rates were similar.

Patients undergoing bypass operation in this series are divided into two groups. The first group consists of cases that were converted from esophagectomy to a bypass operation, and the second group is cases for whom planned bypass operations were performed. Anastomotic leak occurred in the second group, so we herein compare and examine the postoperative course in the two groups.

There were no significant differences between the groups in terms of clinical characteristics. Operative time was longer,

Table 2 Surgical outcomes

	Thoracotomy group (<i>n</i> = 18), <i>n</i> (%)	Non-thoracotomy group (<i>n</i> = 16) <i>n</i> (%)	<i>p</i> value
Operation time, median (range)	390	248	<0.0001
Blood loss, median (range)	361	255	ns
Postoperative complications			
All	6 (33.3)	10 (62.5)	
Respiratory	8 (44.4)	4 (25)	ns
Anastomotic leakage	0 (0)	4 (25)	0.045
Recurrent nerve paralysis	2 (11.1)	4 (25)	ns
30-day mortality	0 (0)	1 (6.3)	ns
Adjuvant therapy			
Chemotherapy	1 (5.9)	1 (6.3)	ns
Chemoradiotherapy	5 (27.8)	5 (31.3)	
Radiotherapy	0 (0)	3 (18.8)	
None	12 (66.7)	7 (43.8)	

ns not significant

Table 3 Measured values by computed tomography

	Thoracotomy group (<i>n</i> = 18)	Non-thoracotomy group (<i>n</i> = 16)	<i>p</i> value
Anastomotic region-suprasternal notch (mm)	19.7	27	0.049
Suprasternal notch-esophageal stump (mm)	17.1	0.8	0.045
Esophageal stump-carina (mm)	34.2	52.6	0.024
Maximum esophagus diameter (mm)	24.7	22	ns
Height, mean (range) (cm)	160.2 (145–176)	161.3 (149–172)	ns

ns not significant

and blood loss was greater in the T group. However, the incidence of postoperative complications was higher in the nT group. There were more respiratory complications in the T group, but this was not significant. The incidence of anastomotic leak and recurrent nerve injury was higher in the nT group, and the leak rate difference was significant. One possible reason for this is the length of the proximal esophagus. In the T group, the proximal esophagus is long enough to anastomose to the gastric tube without tension. In the nT group, the cervical esophagus is divided from an intrathoracic approach. For this reason, nerve damage at the time of the esophageal division in the neck is avoided.

We divide the esophagus 3–5 cm proximal to the tumor in the thoracotomy group. The proximal esophagus is then divided if possible. The esophagus can be divided flush to the wall as no lymphadenectomy is necessary. In particular, we are careful not to damage the recurrent nerves on either side. In the non-thoracotomy group, we divide the esophagus

distally, mindful of the recurrent nerves. This maneuver may have led to the high rate of recurrent nerve paralysis in the nT group. It is difficult to secure sufficient length on the esophagus via a purely cervical approach. Recently, we have begun to use the radial-shaped stapler to divide the esophagus as low as possible.

Esophageal stump blowout is a dreaded complication. We use a staple with three rows of staples per side. Additionally, we do not drain the stump externally as this has been associated with rupture. In some hospitals, the stump of the cardiac portion of the divided stomach is placed in the hypochondrium as an external fistula (cardiostomy) [10]. However, while providing good drainage, this requires ostomy care and QOL subsequently decreases. Initially, there is little secretion from the esophagus and it is therefore unlikely to rupture when drainage into the stomach is adequate. In some cases, the oral side of the tumor expands and liquid retention occurs. With time, however, the esophagus eventually decompresses. For the drainage downstream of necrotic tumor debris and secretions, it is important that the lumen of the lesser curvature is secured.

In 27 of 34 cases, CT was obtained to check the anastomosis and the oral stump of the esophagus and to measure the diameter of the intrathoracic esophagus. We did not observe a difference in height between the groups. Because of the different approaches for the esophageal division between the two groups, the stump of the esophagus was 2 cm lower in the T group than in the nT group. As the esophagus shortens after division, the final difference in esophageal height between the groups was only around 1 cm. However, in regard to tension on the anastomosis, this difference may have been enough to create tension and increase the risk for leak.

There have, heretofore, been no reports on esophageal diameter as it changes over time after bypass surgery. Postoperative dilation was likely due to nerve injury and ileus and nearly always resolved. In addition to the securing of the lumen of the lesser curvature of the gastric tube, torsion of the tube with a fixation point at the pylorus is a risk. As such, the great curvature is crossed over the lesser curvature of the gastric tube and is lifted to the neck. The

Fig. 1 Survival curves after bypass operation

Table 4 Comparison between stent and bypass

	Advantage	Disadvantage
Stent	Minimally invasive	- Tracheal compression - Consequence of radiation therapy - Perforation of the esophagus - Bleeding - Stent migration - Tumor overgrowth
Bypass	- Allows for the use of subsequent therapeutic options - Completely separates the respiratory system from the gastrointestinal tract	Invasive

torsion may be aggravated by forcible lifting. This torsion greatly influences drainage from the esophagus and the passage of the food. We perform a Kocher mobilization in order that the gastric tube can be lifted smoothly. If the length of the gastric tube is short or the blood flow is poor, we alter our bypass technique. The great curvature side of the gastric tube is cut at the antrum and separated from the lesser curvature side. This gastric tube with a long vascular pedicle is lifted to the neck. While this increases the total number of anastomoses to 2, it is valuable in certain situations.

There are reports regarding radiation therapy before and after stent insertion [11–14]. Particularly, radiation therapy after stent insertion may have negative effects. Several investigators have indicated that patients who underwent radiation therapy after stent placement experienced severe complications more frequently than did patients who were treated with stents after radiation therapy. In our hospital, we do not radiate patients after stent insertion. These limitations do not exist, however, after bypass surgery, and we have experienced that many patients can have prolongation of life with postoperative radiation. We have demonstrated that we have good outcomes after esophageal bypass in cases of unresectable esophageal cancer.

Compliance with Ethical Standards All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1964 and its later revision.

Conflict of Interest The author declares that he has no competing interests.

Informed Consent Informed consent or substitute for it was obtained from all patients for being included in the study.

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