



Pyloroantrectomy and Pedunculated Short Gastric-Tube Interposition in Esophageal Carcinoma Patients Associated With Early Gastric Adenocarcinoma

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Gastric carcinoma is one of the most common secondary malignancies in esophageal cancer patients. We herein report our surgical procedure for esophageal reconstruction in esophageal cancer patients associated with synchronous or metachronous early gastric adenocarcinoma. Gastric adenocarcinoma was removed by pyloroantrectomy with preservation of the right gastroepiploic artery and vein, and a pedunculated short gastric tube was used as an esophageal substitute in a Roux-en-Y fashion. Surgical data of 6 esophageal cancer patients who underwent this type of surgery between 1993 and 2012 were analyzed. Three patients had synchronous early gastric carcinoma and the remaining 3 patients had metachronous early gastric adenocarcinoma. The gastric tube was easily pulled up to the neck and no problems occurred during this procedure. Postoperative complications, including leakage of esophagogastrostomy, acute respiratory failure, and diffuse peritonitis, were observed in 3 patients. No patients suffered from necrosis of the gastric tube. Although 3 patients died of other diseases, gastric

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cancer recurrence has not been observed to date. Despite the need for precaution to ensure technical safety, pyloroantrectomy and esophageal reconstruction using a pedunculated short gastric-tube are oncologically feasible as a potential curative surgery for esophageal cancer patients with early gastric adenocarcinoma.

Key words: Early gastric carcinoma – Esophageal carcinoma – Esophageal reconstruction – Interposition – Pyloroantrectomy

Esophageal cancer patients sometimes have a second malignancy, such as carcinoma of the head and neck, lung, or stomach.^{1,2} Gastric adenocarcinoma is a high-incidence second malignancy in esophageal cancer patients, and its incidence is highest in Japan and East Asia.^{3,4} This association with gastric carcinoma makes it more complicated and difficult to construct a strategy for the treatment of esophageal cancer patients. If the gastric tumor is small and localized to the mucosa, endoscopic submucosal dissection (ESD) can be performed as a potentially curative treatment prior to or after radical esophagectomy. However, if the tumor has invaded deeper than the mucosa, gastrectomy is indicated, making the stomach unavailable for esophageal substitution. In such cases, a colonic or jejunal conduit is used as an alternative. Multi-visceral resection of the esophagus and the stomach is much more surgically invasive than standard radical esophagectomy and markedly lowers the patient's quality of life.⁵

A similar problem can arise in gastric carcinomas that occur postoperatively in patients who have undergone radical esophagectomy (i.e., gastric tube cancer cases). There are no current treatment recommendations in cases where ESD is not absolutely indicated for the tumor. Only total resection of the gastric tube has the potential to cure the disease; however, unacceptably high risk for serious postoperative morbidity has been reported with this operation.^{6,7}

The management of esophagogastric cancers has changed during past 20 years. The Japanese gastric cancer treatment guidelines 2010 noted that en-bloc endoscopic resection of the following pathological T1b tumors was considered as curative resection of expanded indication; size ≤ 3 cm, histologically of differentiated-type, and <500 μ m from the muscularis mucosae (SM1).⁸ It is still unknown; however, whether this expanded indication could be applied to the treatment for esophageal cancer patients who have clinical T1b tumor of the distal stomach synchronously or metachronously.

Here we describe a surgical procedure that includes pyloroantrectomy and gastric interposition using a pedunculated short gastric tube in esophageal cancer patients with early synchronous or metachronous adenocarcinoma of the distal stomach. We also report the short- and long-term results for 6 patients who underwent this surgery.

Materials and Methods

Between 1993 and 2012, a total of 6 patients underwent pyloroantrectomy and esophageal reconstruction with pedunculated gastric tube interposition due to adenocarcinoma of the gastric antrum. Three patients had gastric adenocarcinoma synchronously with esophageal squamous cell carcinoma (SCC; synchronous cancer patients), and the remaining 3 had gastric adenocarcinoma after radical esophagectomy (metachronous cancer patients). The clinicopathologic profiles of the 6 patients are summarized in Table 1. All patients were preoperatively evaluated by computed tomography and considered to have no lymph node metastasis in the perigastric region, according to the preoperative CT scanning. The surgery was undertaken by 2 esophageal surgeons (TT, TK) at Niigata University Hospital and the affiliated hospital.

We evaluated the surgical results and prognosis of the 6 patients. The clinicopathologic characteristics, perioperative data (including operating time, blood loss, and postoperative morbidity), and follow-up data (including cancer recurrence) were obtained from our prospectively collected data files. The clinical and pathologic staging for the esophageal cancer were classified according to the International Union Against Cancer (UICC); primary tumor, regional lymph nodes, and distant metastasis (TNM) classification⁹; and staging of gastric cancer was determined according to the Japanese Classification of Gastric Cancer.¹⁰ Postoperative morbidities were defined as grade II or higher according to the Clavien–Dindo classification.¹¹

Table 1 Clinical characteristics of esophageal and gastric cancers in six patients

Patient	Age, y	Sex	Double cancer	Esophageal squamous cell carcinoma			Interval, ^a mo	Gastric adenocarcinoma		
				Stage	Surgery	Reconstruction route		Histology	Size, mm	Depth of tumor invasion
1	70	M	Synchronous	T3N3M1 Stage IV	THE	RS	-	Tub1	22	T1a
2	83	M	Synchronous	T3N0M0 Stage IIA	THE	PM	-	Tub1	15	T1b
3	57	M	Synchronous	T3N0M0 Stage IIA	TTE	RS	-	Tub2	15	T1b
4	65 ^b	M	Metachronous	T3N1M0 Stage IIIA	TTE	RS	91	Tub2	30	T1b
5	58 ^b	F	Metachronous	T1bN0M0 Stage IA	VATS-E	PM	109	Sig	37	T2
6	71 ^b	M	Metachronous	T3N1M0 Stage IIIA	TTE	RS	97	Tub1	15	T1b

PM, posterior mediastinal; RS, retrosternal; THE, transhiatal esophagectomy; TTE, transthoracic esophagectomy; VATS-E, video-assisted thoracic surgery for esophagectomy.

^aInterval between esophagectomy and gastrectomy. Clinicopathologic staging of esophageal and gastric cancers are classified according to the International Union Against Cancer TNM classification, 7th edition⁸ and the Japanese Classification, 14th edition,⁹ respectively.

^bAge at second surgery for gastric adenocarcinoma.

Surgery

Surgery for esophageal cancer patients with synchronous association of gastric carcinoma was conducted using the procedures described in our previous report.¹² Briefly, after resection of radical esophagectomy was completed, a conventional gastric tube was fashioned using linear staplers. The branches of the right gastroepiploic vessels were carefully cut along the gastric wall (Fig. 1a). This procedure was started near the resection line of the pyloroantrectomy and extended downward to the pyloric ring. The duodenum was divided immediately distal to the pylorus (Fig. 1b), and the duodenal stump was closed. The distal part of the gastric tube was resected along with the suprapyloric lymph nodes. The distal stump of the gastric tube was anastomosed to the upper jejunum for a Roux-en-Y reconstruction (Fig. 1c). The gastric tube was pulled up through the retrosternal or mediastinal route (Fig. 1d) and anastomosed to the cervical esophagus. The cervical anastomosis was easily accomplished as separation from the duodenum greatly increased mobility of the pedunculated short gastric tube.

The surgical procedures applied for patients with gastric tube carcinoma were essentially the same as those previously reported by Motoyama *et al.*¹³ After laparotomy, the distal part of the gastric tube was carefully mobilized (Fig. 2a). Branches from the right gastroepiploic vessels were dissected along the gastric tube wall while preserving the vascular

pedicle of the gastric tube. We omitted lymph node dissection of the stations along the right gastroepiploic artery. The gastric tube was divided from the duodenum, and the distal part of the gastric tube was segmentally resected (Fig. 2b). The gastric remnant was anastomosed with the jejunum in a Roux-en-Y fashion (Fig. 2c).

Results

All 6 patients underwent macroscopic and microscopic complete resections (R0-resection) for gastric adenocarcinoma, although the esophagectomy in 1 synchronous cancer patient resulted in a palliative resection based on newly discovered lung metastases during the surgery.

Three of the six patients experienced postoperative complications. One of the synchronous cancer patients needed tracheal reintubation on postoperative day 4 as a result of respiratory failure triggered by a massive pleural effusion. The other synchronous cancer patient suffered from leakage of the anastomosis between the cervical esophagus and gastric tube. One metachronous cancer patient required reoperation due to the occurrence of diffuse peritonitis caused by leakage from the duodenal stump on postoperative day 7. This patient had tight peritoneal adhesions in the right upper abdominal cavity because of a previous right hemicolectomy, such that the duodenal dissection to preserve the right gastro-

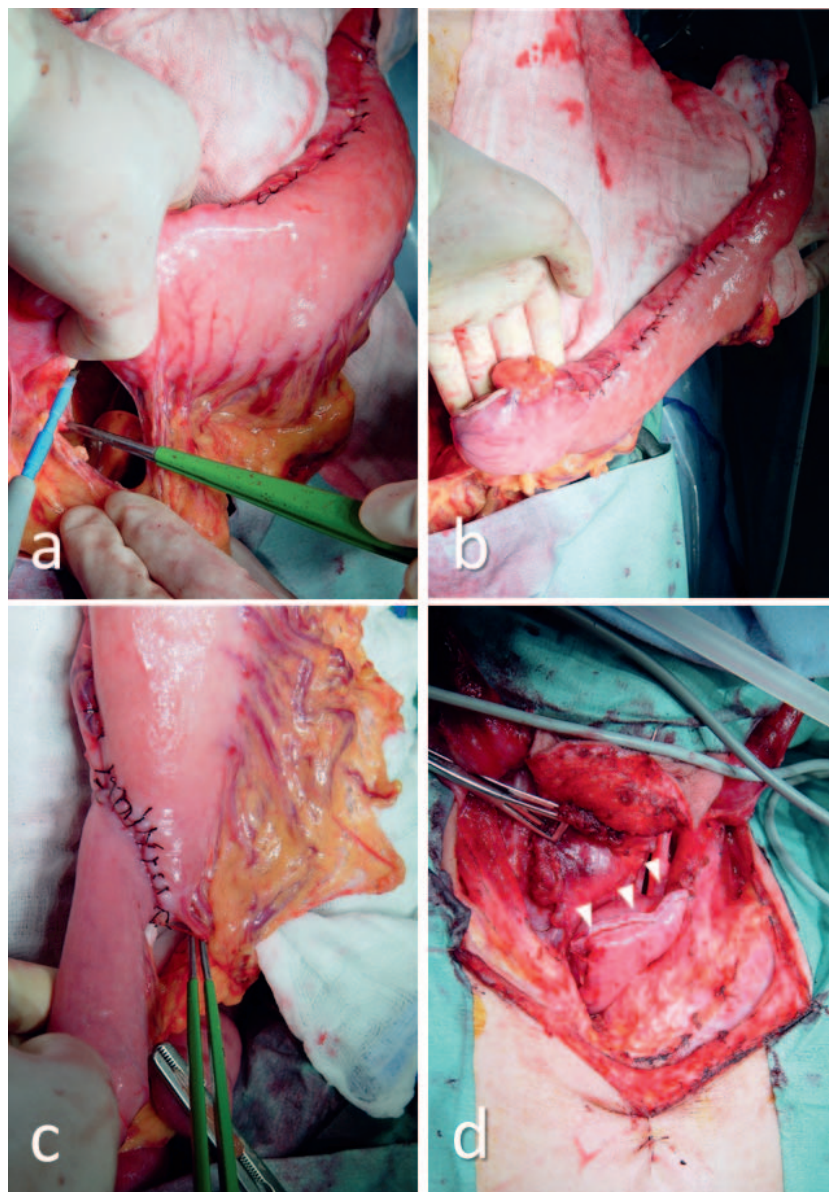


Fig. 1 Operative findings in patients with a synchronous association of gastric carcinoma. (a) Branches of the right gastroepiploic vessels supplying the pyloroantral region were dissected along the greater curvature. (b) The duodenum was divided distal to the pyloric ring, and the duodenal stump was closed. The distal part of the gastric tube including the early gastric adenocarcinoma and suprapyloric lymph nodes were resected. (c) The distal stump of the gastric tube was anastomosed to the jejunum in a Roux-en-Y fashion. (d) The gastric tube was pulled up through the retrosternal or mediastinal route and anastomosed to the cervical esophagus. Arrowheads indicate the oral stump of the gastric tube that was retrosternally pulled up.

epiploic vessels and closure of the stump were complicated. These technical limitations may have led to the failure of the duodenal stump closure. There was no postoperative mortality. Of the 6 patients, 3 have survived to date, 1 died of esophageal SCC, and 2 died of pneumonia. None showed gastric cancer recurrence during the follow-up period. The surgical results and prognosis for the 6 patients are summarized in Table 2.

Discussion

In this case series, we presented our techniques for patients with esophageal carcinoma concurrent with

early gastric cancer of the antrum. This technique is composed of sleeve resection of the affected antrum with the preservation of the right gastroepiploic vessels and utilization of the gastric remnant for a short gastric tube with the application of a Roux-en-Y gastrojejunostomy.

We introduced this reconstructive procedure expecting comparatively lesser invasiveness than colonic or jejunal conduit; however, we found postoperative complications, including leakage and respiratory failure, suggesting that operative morbidity may not be infrequent with our procedure. This may be explained by the small sample size of this series and the fact that radical esophagectomy is

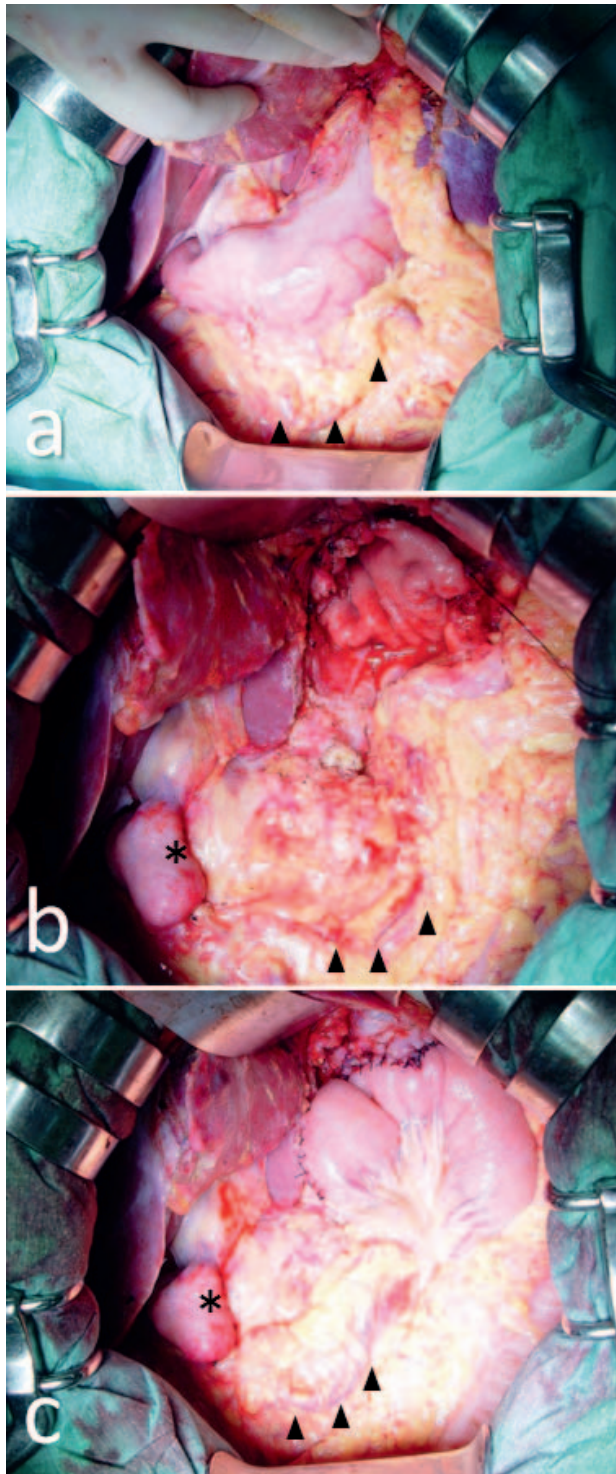


Fig. 2 Operative findings in a patient with gastric tube carcinoma. (a) The distal part of the gastric tube was carefully mobilized and the vascular pedicle was identified. (b) Branches from the right gastroepiploic vessels were carefully cut along the gastric tube wall, and the distal part of the gastric tube was segmentally resected. (c) The distal stump of the remnant gastric

per se a highly invasive procedure with a high complication rate. Although the overall incidence of postoperative complications was not low, graft necrosis did not occur in any of the patients in this series. Increasing numbers of esophageal surgeons have expressed a preference for adding microvascular surgery to prevent graft necrosis when using colonic or jejunal conduit.^{14,15} However, the blood flow in the short gastric tube is maintained when the vascular pedicle composed of the right gastroepiploic vessels is well preserved. A decreased risk for graft necrosis and the lack of a need for microvascular surgery may be regarded as one of the advantages of our procedure.

On the other hand, the greatest disadvantage associated with the present procedure was an increased risk for microscopically incomplete resection of potentially curable gastric carcinoma. In early adenocarcinomas of the lower third of the stomach, which characterized the subjects in the present series, the areas along the right gastroepiploic artery are known to be one of the most common sites for lymph node metastases. The present procedure featured a pedunculated gastric tube that preserved the right gastroepiploic vessels. Thus, dissection of the lymph nodes along the right gastroepiploic artery was omitted. According to the previous study of Han and colleagues,¹⁶ the selection of the present procedure may be associated with a theoretical risk of metastasis of approximately 10% or more for T1b tumors. The rationale for the selection of this procedure was that esophageal SCC was a poor prognostic disease and likely to relapse even if complete resection was achieved. Considering the poor prognosis of esophageal SCC, the impact of lymph node metastasis from gastric adenocarcinoma on survival is substantially reduced. Surgery in the present series was only indicated for patients diagnosed on imaging or intraoperatively as negative for lymph node metastases, which may have also lowered the risk for recurrence from gastric adenocarcinoma.

In addition, total resection of gastric tube is often avoided in patients with metachronous gastric cancer after radical esophagectomy, considering its high invasiveness and patients' general status.⁶ Therefore, the present procedure may be acceptable even for a T2 or deeper tumor in the antrum with

← tube was anastomosed to the jejunum in a Roux-en-Y fashion. Asterisks and arrowheads show the duodenal stump and right gastroepiploic artery, respectively.

Table 2 Surgical outcomes and prognosis in six patients

Patient	Operating time, min	Blood loss, mL	Postoperative hospital stay, d	Postoperative morbidity, ^a (grade)	Prognosis (cause of death)	Survival, mo
1	323	689	31	None	Dead (esophageal SCC)	6
2	285	200	44	Respiratory failure (IVa)	Dead (pneumonia)	13
3	630	635	40	Anastomotic leakage (IIIa)	Alive	70
4	200	102	20	None	Dead (pneumonia)	95 ^b
5	340	310	18	None	Alive	60 ^b
6	406	580	37	Duodenal stump leakage (IIIb)	Alive	46 ^b

^a Postoperative morbidities are graded according to Clavien-Dindo classification.¹⁰

^b Survival after second surgery for gastric adenocarcinoma.

clinically node-negative disease in such conditions. Yagi *et al*¹⁷ reported a successful case of a gastric tube cancer that was treated with distal resection of the gastric tube with sentinel node biopsy, preserving the right gastroepiploic artery and vein. Sentinel node navigation surgery might be able to select patients who need lymphadenectomy along the right gastroepiploic vessels or not, which could provide an appropriate treatment for these patients.

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