

Total Esophago-Gastrectomy Followed by Composite Reconstruction with Retrosternal Pedicled Jejunum and Antethoracic-Free Jejunal Autograft: A Case Report

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The patient was a 72-year-old man. He received a detailed gastrointestinal examination because of severe anemia. Early multiple esophageal cancers (affecting 3 sites of the esophagus) and advanced gastric cancer were detected. The patient was scheduled to undergo surgical treatment (esophagectomy and total gastrectomy). This operation would be followed by reconstruction with a pedicled jejunum via the antethoracic route. During the operation, however, the mesentery was found to be thick and short, and the anteroposterior dimension of the patient's body was longer than normal. For these reasons, reconstruction with a pedicled jejunum alone via the antethoracic route was judged to be impossible. We then tried composite reconstruction with a pedicled jejunum and free jejunal autograft via the antethoracic route. With this method, the pedicled jejunum was not long enough to allow safe anastomosis of both ends of the intestine. To resolve this difficulty, we raised the pedicled jejunum via the retrosternal route to reduce the needed distance for raising, and the free jejunal autograft before the chest wall was guided to a location behind the sternum at the 3rd intercostal level, followed by anastomosis. In this way, we achieved reconstruction while avoiding tension to the reconstructed intestine. Composite reconstruction using the pedicled jejunum and free jejunal autograft is useful as a means of reconstruction of the esophagus when the stomach affected by disease cannot be used for reconstruction, since this method is expected to reduce the tension to the anastomosed area and ensure good blood supply. Our technique is useful when the intestine to be raised is not long enough for composite reconstruction via the antethoracic route. (*Ann Thorac Cardiovasc Surg* 2009; 15: 31–37)

Key words: esophageal cancer, composite reconstruction, jejunum, reconstruction route, total gastrectomy

Introduction

When treating cases of esophageal cancer accompanied by gastric lesions (e.g., cancer and ulcers), surgeons are

often forced to use the intestine for esophageal reconstruction. In such cases, we make it a rule to use the jejunum with an antethoracic route for reconstruction of the esophagus. We recently encountered a case of early

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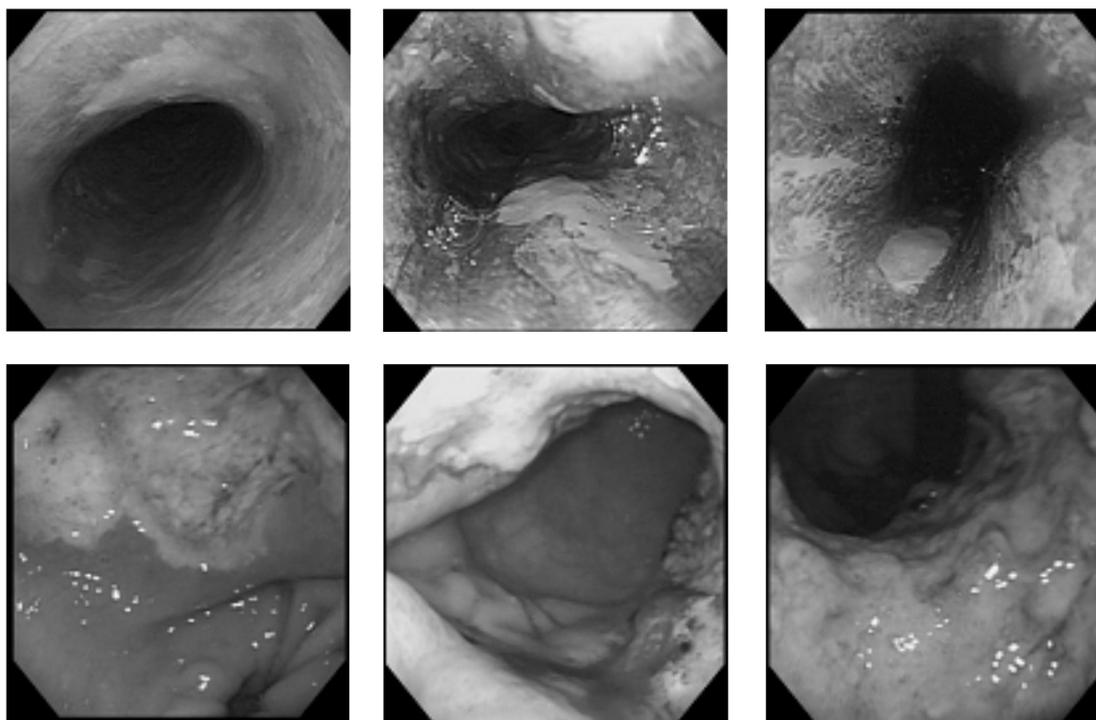


Fig. 1. Findings from upper gastrointestinal endoscopy.

A–C: Esophageal cancers, showing no chromatic response to Lugol staining, are visible at 3 sites of the esophagus (27.5, 30, and 32.5 cm from the anterior teeth).

D–F: Borrmann type 3 gastric cancer, occupying most parts of the lesser curvature, is visible.

A	B	C
D	E	F

multiple esophageal cancers with advanced gastric cancer. We performed esophagectomy and total gastrectomy and attempted to reconstruct the esophagus during the single operation using a pedicled jejunum alone via an antethoracic route. However, it was difficult to raise the jejunum to the level of cervical esophagus, and we finally reconstructed the esophagus using a composition of pedicled jejunum (retrosternal route) and free jejunal autograft (antethoracic route). The postoperative course was uneventful. Composite reconstruction with an antethoracic route provides a safe means of reconstruction, which avoids tension in the anastomosed area. When this technique does not allow safe anastomosis, the method we employed for reconstruction in the present case seems useful. This case will be therefore presented in this paper, with references to the literature.

Case Report

In March 2005, a 72-year-old man was referred to our hospital because of the detection, during a detailed gastrointestinal examination for severe anemia, of early multiple esophageal cancer (affecting 3 sites on the

esophagus) and advanced gastric cancer. He was thus admitted to our department to undergo surgery.

When blood cell counts were taken on admission, a sign of intense iron deficiency anemia was noted (red blood cell [RBC]: $244 \times 10^4/\text{mm}^3$; hemoglobin [Hb]: 5.6 g/dL; hematocrit [Ht]: 19.8%; ferrum [Fe]: 11 $\mu\text{g}/\text{dL}$). Biochemically, the total protein level was slightly low (6.2 g/dL), and signs of slightly compromised renal function were noted (blood urea nitrogen [BUN]: 35 mg/dL; creatinine [Cr]: 1.61 mg/dL), but no other abnormality was observed. All tumor markers tested were within the normal range (CEA: 0.9 ng/mL; CA19-9: 12 U/mL; SCC: 1.0 ng/mL).

Upper gastrointestinal endoscopy revealed 3 lesions with irregular mucosa and no chromatic response to Lugol staining at 3 sites of the esophagus (27.5, 30, and 32.5 cm from the anterior teeth), with the maximum diameter being 14, 20, and 8 mm, respectively (Figs. 1A–1C). A biopsy of these lesions allowed a diagnosis of squamous cell carcinoma. Furthermore, a Borrmann type 3 gastric cancer was detected in a wide area of the stomach, primarily along the lesser curvature, extending from the upper gastric body to the pylorus (Figs.

1D–1F). This cancer seemed to be responsible for anemia in this case. A biopsy of the gastric cancer allowed a diagnosis of moderately differentiated adenocarcinoma. The results of such things as CT scans, MRI, and a nuclear medicine study revealed tumor metastases to lymph nodes around the stomach, but no distant metastases. Gastric cancer was rated as cT3N1H0P0M0, cStage IIIA. We therefore planned surgical treatment and reconstruction during a single operation. According to the plan, a resection of the thoracic esophagus and total gastrectomy were to be followed by reconstruction of the esophagus using a pedicled jejunum alone via an antethoracic route. If raising the jejunum to the neck level were impossible, a free jejunal autograft would be interposed between the pedicled jejunum (raised via the antethoracic route) and the cervical esophagus.

The abdomen was explored through an extended midline incision. The tumor was found exposed on the serosa of most parts of the stomach, and it was rated as an advanced gastric cancer with numerous macroscopic lymph node metastases. Small amounts of ascites were noted, but intraoperative cytology of them revealed no cancer cells (CY0). Total gastrectomy with regional lymph node dissection was carried out as planned. Gastric cancer was rated as sT3N1H0P0CY0M0, sStage IIIA, radicality level B, at surgery. This was followed by the thoracic esophagectomy. That is, the esophagus was adequately freed manually from the esophageal hiatus of the diaphragm, and a wide collar incision was followed by a dissection of the cervical esophagus and the tying of a stripper to the distal (anal) stump of the cervical esophagus. The esophagus was then removed in the direction of the esophageal hiatus.

For subsequent reconstruction, we ligated and cut the first and second jejunal artery and vein and prepared a pedicled jejunum. We attempted to raise the pedicled jejunum to the neck level for anastomosis to the cervical esophagus. However, we found it impossible to do this because the mesentery of the jejunum was thick and short. For this reason, we switched the reconstruction method to composite reconstruction, by which a free jejunal autograft (antethoracic route) would be interposed between the pedicled jejunum (raised via the antethoracic route) and the cervical esophagus (Fig. 2). A free jejunal autograft approximately 30 cm long was donated from the segment 200 cm distant from the Treitz ligament. This was immediately anastomosed to the cervical esophagus. Vascular anastomosis was

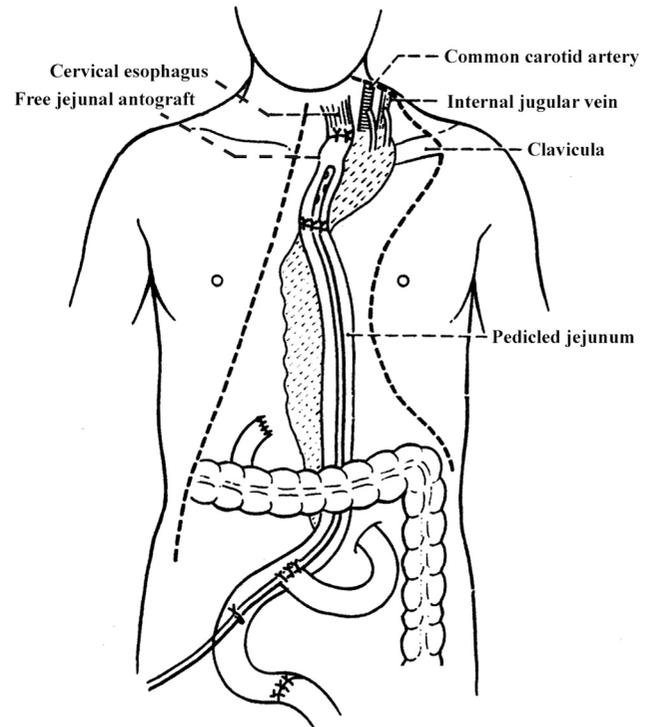


Fig. 2. Schematic representation of composite reconstruction.

completed by end-to-side anastomosis of the veins of the free jejunal autograft to the right internal jugular vein and end-to-side anastomosis of the arteries of the free jejunal autograft to the right common carotid artery. This was followed by end-to-side anastomosis of the cervical esophagus to the proximal end of the free jejunal autograft with the stapling device. The pedicled jejunum was then raised via the antethoracic route, and its anastomosis to the free jejunum was attempted. However, since the patient's body had a large antero-posterior dimension, it was not possible for the pedicled jejunum to reach the distal (anal) end of the free jejunal autograft. To overcome this difficulty, we resected the third costal cartilage on the left side and linked the antethoracic space to the retrosternal space and guided the pedicled jejunum upward from the abdomen along the retrosternal route. In this way, side-to-end anastomosis of the free jejunal autograft to the pedicled jejunum was possible by reducing the distance of travel needed (through raising the pedicled jejunum via the retrosternal route). Reconstruction of the esophagus was thus completed (Fig. 3).

One day after surgery, the patient was weaned from intubation and resumed spontaneous respiration. Esophagography on the 10th postoperative day revealed

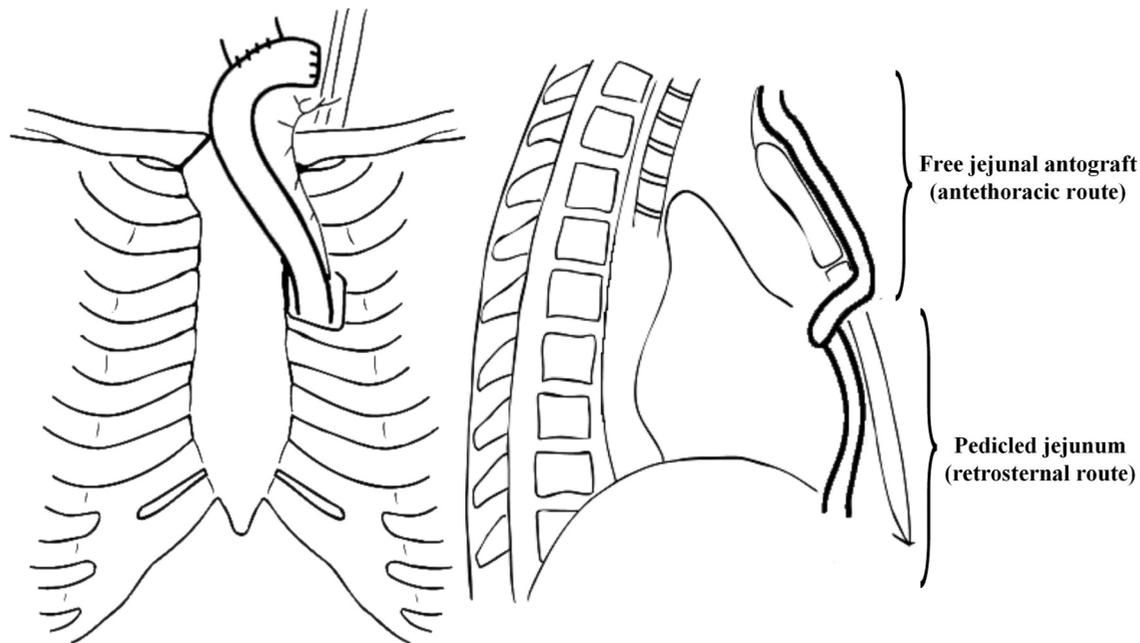


Fig. 3. Schematic representation of the technique of esophageal reconstruction employed for the present case.

no leak from the intestine used for reconstruction and good passage through it (Fig. 4), allowing the patient to resume oral ingestion. From the 21st postoperative day, 2 courses of chemotherapy with cisplatin (CDDP) + S-1 were administered. The patient was discharged from the hospital 70 days after surgery and thereafter was followed as an outpatient. One year and 6 months after surgery, ascites resulting from peritonitis carcinomatosa began to be noted, and the patient died of cancer 3 months later.

Pathological findings

The esophagus had three foci of early cancers: Type 0-IIc, 14 × 12 mm, at the point of OW 4 cm; type 0-IIc, 20 × 17 mm, at OW 7.5 cm; and type 0-IIb, 8 × 6 mm, at OW 10.5 cm (Fig. 5A). Each type of 0-IIc cancer consisted of moderately differentiated squamous cell carcinoma that had primarily proliferated in the mucosa and focally invaded into the muscularis mucosa. Focal lymphatic permeation was seen, but no lymph node metastasis was noted. The type 0-IIb cancer comprised squamous cell carcinoma in situ. The gastric tumor was a large Borrmann type 3 cancer, 12 × 11.5 cm, centered in the body along the lesser curvature (Fig. 5B). Histologically, the tumor was composed of a mixture of tubular, papillary, and poorly differentiated solid adenocarcinomas, of which moderately differentiated



Fig. 4. A postoperative esophageal roentgenography using contrast medium revealed no anastomotic leakage or stenosis.

tubular adenocarcinoma was predominant. The tumor penetrated the gastric serosa with a moderate degree of lymphatic and vascular invasion. Nodal involvement of moderately to poorly differentiated adenocarcinoma was noted. The gastric tumor was pathologically rated as advanced cancer, MUL, LessAntPost, type 3, 12 × 11.5 cm, tub2 > por1, INF β , int, pT3 (SE), ly2, v2, PM (-), DM (-), n1 (14/36). Its stage was pT3N1H0P0M0, pStage IIIA (overall radicality level B).

Discussion

When reconstructing the esophagus after surgical treatment of esophageal cancer, organs such as stomach, jejunum, and colon have been employed. These organs used for esophageal reconstruction have their unique advantages and disadvantages. When selecting an organ for use in esophageal reconstruction, the situation faced by each individual patient needs to be taken into account, and it is difficult to specify a certain organ applicable to all cases requiring esophageal reconstruction.

For esophageal reconstruction after esophagectomy in patients with esophageal cancer complicated by gastric cancer, the jejunum or colon is usually used because the stomach often needs a total gastrectomy. If the accompanying gastric cancer is confined to the cardia and in the early stages, it is possible to use the residual stomach after cardia resection for esophageal reconstruction. However, even in such cases, total gastrectomy is often selected from the viewpoint of radicality (including adequate regional lymph node dissection). At many medical institutions, the colon is often used¹⁾ for esophageal reconstruction after esophagectomy and total gastrectomy for the following reasons: (1) a pedicled intestine long enough to be raised to the neck level is easier to obtain from the colon; (2) the colon of Japanese people tends to be excessively long and is unlikely to show symptoms of defect even after esophageal reconstruction using a pedicled colon; (3) the use of colon for esophageal reconstruction allows better oral ingestion by the patient.²⁾ Disadvantages involved in the use of the colon for reconstruction include (1) higher operative stress and longer operation time because of the necessity of anastomosis at 3 points; (2) risk for intestinal necrosis because of thrombus formation in the arteries and veins involved; (3) a difference in diameter between the colon and the cervical esophagus.³⁾

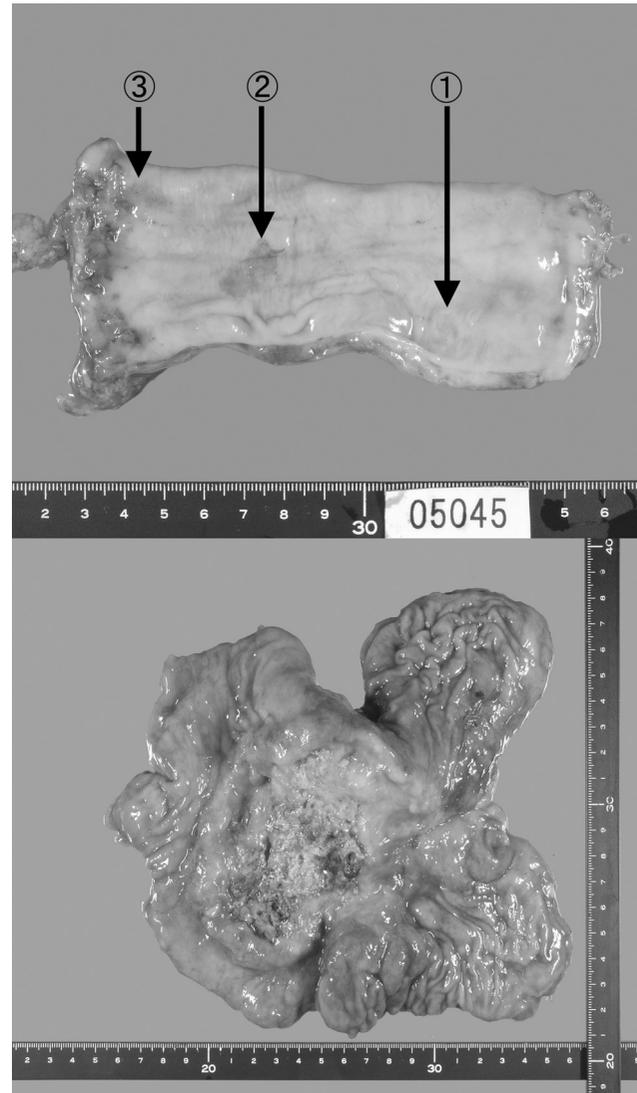


Fig. 5. Surgical specimens (macroscopic observation).

A: Esophagus.

- ① 0-IIc, 14 × 12 mm, p-T1a (MM)
- ② 0-IIc, 20 × 17 mm, p-T1a (MM)
- ③ 0-IIb, 8 × 6 mm, p-Tis (EP)

B: Stomach.

Total gastrectomy; Adv. Ca. MUL, LessAntPost, type 3, 12 × 11.5 cm, tub2 > por1, INF β , int, pT3 (SE), ly2, v2, PM (-), DM (-), n1 (14/36)

At our department, the jejunum is often used for esophageal reconstruction. This practice is for several reasons, including (1) safe raising to the neck level is possible to achieve unless the vascular system is injured, because the jejunum is rich in blood vessels and malformation of its marginal arcade is rare; (2) the diameter does not differ between the jejunum and the esophagus; (3) from the viewpoint of function, the

Table 1. Comparison between colon and jejunum used as the donor site for esophageal reconstruction

	Colon	Jejunum
Operative stress	High	Moderate to low
Length	No problem	No problem
Blood supply	Slightly inadequate	Inadequate
Blood supply after supercharging or in combination with free jejunal autograft	No problem	No problem
Contamination within the intestine	High	Low
Curving	Mild	Intense
Oral ingestion	Good	Good
Regurgitation	Unlikely	Unlikely
Risk of carcinogenesis	Moderate	Low

jejunum is favorable since peristalsis allows smooth food passage and regurgitation seldom occurs; (4) a pedicled jejunum can be prepared almost aseptically.⁴⁾ However, reconstruction with jejunum involves several disadvantages, such as (1) relative difficulty in raising, (2) a need for anastomosis at many points, (3) unsuitability for postoperative radiotherapy.³⁾

Table 1 lists the advantages and disadvantages of using a colonic or jejunal pedicle for reconstruction of the esophagus in cases where the stomach cannot be used for reconstruction. The greatest problem of utilizing either the colon or the jejunum as a source of material for esophageal reconstruction is how to retain blood supply to the reconstructed organ. It is expected that this may be ensured if vascular anastomosis is also performed for the purpose of supercharging, or if a free jejunal autograft is also used as needed. It is difficult to say whether the colon or the jejunum is superior as a source of material for esophageal reconstruction; it seems best for the surgeon to select the organ with which he has had more experience. In the present case, we selected the jejunum.

Regarding the criteria for selection of a reconstruction route, it has been reported that safety upon the onset of anastomotic leakage is high in the order of antethoracic route > retrosternal route > posterior mediastinal route; that the risk for the onset of anastomotic leakage is high in the order of antethoracic route > retrosternal route > posterior mediastinal route; and that from the viewpoint of physiological food passage, the posterior mediastinal route is most favorable, followed by the retrosternal route and then the antethoracic route.⁵⁾ Moreover, the risk of an onset of arrhythmias because of cardiac compression also needs to be taken into account when the retrosternal route is selected.⁶⁾ An organ used for reconstruction and

its route need to be selected based on a general assessment of various factors in each individual patient, including general condition, disease stage, feasibility of radical treatment, condition of the organ to be used for reconstruction, and the quality of life (QOL) target related to resumption of the patient's social activities.

In the present case, a pedicled jejunum was selected in accordance with the strategy at our department (if the jejunum to be raised is not long enough, the composition of a pedicled jejunum and a free jejunal autograft is considered).^{7,8)} Regarding the reconstruction route, we initially attempted reconstruction with a pedicled jejunum alone via the retrosternal route. However, since a pedicled jejunum proved to be too short for the retrosternal reconstruction because of the thick and short mesentery of the jejunum, we judged this route to be difficult and switched the method to composite reconstruction with an antethoracic route. Composite reconstruction, which involves interposing the free jejunal autograft between the pedicled jejunum and the cervical esophagus, is a useful and safer technique of reconstruction causing less stress, since it can avoid tensioning of the anastomosed area. Because this technique requires very high skill related to anastomosis of small blood vessels, it took much time to be adopted extensively. However, following advances in microsurgery, the outcome of surgery with this technique has improved markedly in recent years,⁹⁻¹¹⁾ and the technique has become a standard procedure for indicated cases. In the present case, we judged it impossible to safely achieve anastomosis of the pedicled jejunum to the free jejunal autograft by means of composite reconstruction with an antethoracic route alone, considering the unfavorable features of this case (thickened and shortened mesentery and large antero-posterior dimensions of the body). For this reason, only

the pedicled jejunum was raised via the retrosternal route, and it could be anastomosed to the antethoracic-free jejunal autograft through the artificial orifice of the third costal cartilage on the left side.

According to Ngan and Wong,¹²⁾ the retrosternal route is 1.8 cm shorter than the antethoracic route. When esophageal reconstruction is attempted, cutting the distance of the route by about only 2 cm makes it much easier to raise the intestine, possibly leading to safer anastomosis. From this point of view, we reduced the distance by adopting the retrosternal route for the pedicled jejunum and guided the antethoracic-free jejunal autograft to the retrosternal route at the third intercostal level to anastomose it to the pedicled jejunum. In this way, we succeeded in achieving safe reconstruction of the esophagus while avoiding a tensioning of the intestine used for reconstruction.

Lastly, therapeutic strategies for cases of early esophageal cancer accompanied by advanced gastric cancer are discussed. The first strategy is endoscopic dissection (ESD) for the early (multiple) esophageal cancer and multidisciplinary treatment composed of total gastrectomy and the appropriate chemotherapy for the advanced gastric cancer. The second strategy is multidisciplinary treatment (also including total gastrectomy) for the advanced gastric cancer followed by a second operation (the timing of which is determined on the basis of the postoperative course of the gastric cancer) to deal with the early (multiple) esophageal cancer. The third strategy is resection of the early (multiple) esophageal cancer and the advanced gastric cancer and reconstruction of the esophagus during a single operation, the strategy that was adopted in the present case. Considering that in this case the advanced gastric cancer was clearly more closely related to the prognosis than the esophageal cancer was, although surgical treatment of the advanced gastric cancer had an overall radicality level of B, the author now believes, after review, that in this case the first strategy rather than the third one would have been the better choice.

In conclusion, in cases where the intestine to be raised for esophageal reconstruction is not long enough for various reasons, the composite reconstruction of the esophagus is an excellent procedure expected to reduce the tension of the anastomosed area and to provide adequate blood flow to this area. We emphasize the usefulness of our technique of reconstruction in cases

where the intestine to be raised is not long enough for composite reconstruction via the antethoracic route.

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