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Colonic interposition and supercharge for esophageal reconstruction

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Abstract *Aims:* We evaluated the techniques of colonic interposition and supercharge for esophageal reconstruction and discussed the main considerations related to these procedures. *Patients and methods:* In this study, we performed 51 esophageal reconstructions using colonic interposition. Twenty-eight of the 51 patients had synchronous or allochronic gastric malignancy. We selected colonic interposition for high anastomosis in 11 patients and also for esophageal bypass in 3 patients. This procedure was also selected to preserve gastric function in 5 patients. We recently performed the supercharge technique for colonic interposition in 41 patients. *Results:* Despite the long duration and multi-step nature of the operation procedure, no perioperative complications were noted. The patients returned to a good quality of life. The incidence of postoperative weight loss did not differ significantly between the colonic reconstruction group and the gastric reconstruction group. In terms of heartburn and dumping syndrome, the outcome was markedly better in the colonic reconstruction group (no cases of heartburn or dumping syndrome) than that in the gastric reconstruction group. *Conclusion:* For reconstruction of the esophagus, the colonic interposition and supercharge technique is advantageous and contributes to the patient's quality of life.

Keywords Esophageal cancer ·
Colonic interposition · Supercharge

Introduction

Colonic interposition has historically been performed for reconstruction after esophagectomy and esophageal bypass for very advanced esophageal cancer. However, at present, the stomach is widely used for reconstruction after esophagectomy, and colonic reconstruction is performed only in patients whose stomach cannot be used for reconstruction because of postgastrectomy status or simultaneous gastric cancer. This is because use of the stomach is superior to that of the colon, as it is less invasive, safer, and surgery is easier to perform. However, it has been reported that colonic interposition with preservation of not only the stomach but also the vagus is desirable as it enhances

Table 1 Reconstruction with colonic interposition (January 1998–December 2004)

Disease	Cases
Postgastrectomy	22 (43.1%)
High-level anastomosis	11 (21.6%)
Synchronous gastric cancer	6 (11.8%)
Bypass	3 (5.9%)
Gastric function preserving	5 (9.8%)
Others	4 (7.8%)
Total	51

postoperative weight gain and results in fewer postoperative complications, including heartburn, dumping syndrome, etc. [1–5]. Some investigators have reported that even in cases in which preservation of the vagus nerve was not possible, reconstruction with the colon while preserving the stomach allowed higher caloric intake and better weight gain after surgery [6]. However, it has been reported that the incidence of anastomotic leakage after reconstruction with the colon is 15–51%, and that inadequate blood flow through the tip of the intestine used for reconstruction is responsible for many cases of such leakage [7]. We therefore adopted the supercharge technique in many cases to improve blood flow through the intestine used for reconstruction of the esophagus. Despite the multistep nature of this operation procedure, we incurred no perioperative complications and have the safety postoperative course as reported by the past studies [8–11]. We performed colonic reconstruction with preservation of the stomach and vagus in 3 patients, each of whom had a good postoperative recovery. In this paper, we present our experience with colonic interposition and supercharge and discuss the main aspects of these procedures.

Patients and methods

We performed esophageal reconstruction in 347 patients from January 1998 to December 2004 and performed colonic reconstruction on 51 patients (14.7%), aged from

Table 2 Colonic interposition cases

TNM classification	Numbers
Stage 0	0/51 (0%)
Stage I	4/51 (7.8%)
Stage IIa	5/51 (9.8%)
Stage IIb	6/51 (11.8%)
Stage III	31/51 (60.8%)
Stage IVa	4/51 (7.8%)
Stage IVb	1/51 (2.0%)

TNM tumor-node metastasis
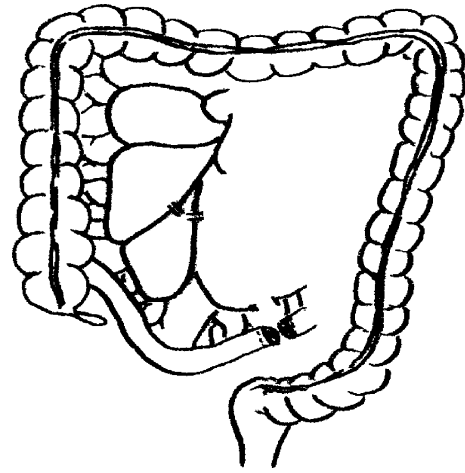
Fig. 1 Vessel ligation and intestinal resection for right-sided colonic interposition

41 to 85 years (mean±SD, 64.2±11.6; 46 men, 8 women). Twenty-eight of the 51 patients had synchronous or allochronic gastric malignancy. We selected colonic interposition for high anastomosis in 11 patients and also for esophageal bypass in 3 patients. This procedure was also selected to preserve gastric function in 5 patients (Table 1). Clinical typing of tumors was performed according to the tumor-node-metastasis (TNM) classification system of the International Union Against Cancer [12] (Table 2). We usually selected the right side of the colon for esophageal reconstruction (90.2%) with clipping of the terminal ileac and ileocolic vessels because adjustment to the length of the ileum permitted high anastomosis. (Figs. 1 and 2a,b; Table 3). Furthermore, we recently performed so-called supercharge vascular anastomosis in 41 patients. First,
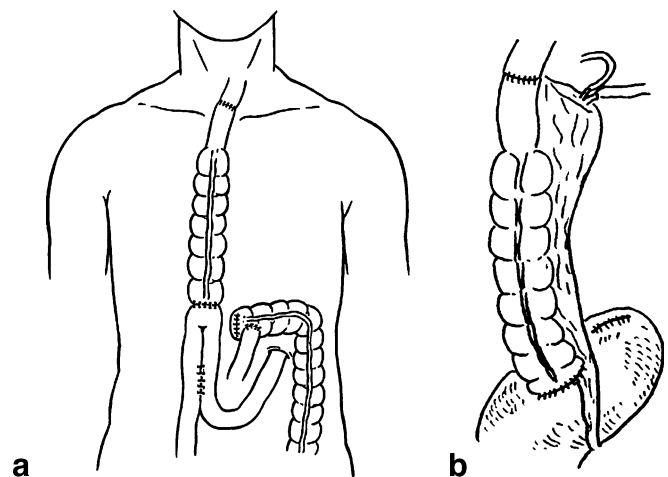

Fig. 2 Operative procedure. **a** Reconstruction after total gastrectomy. **b** Reconstruction for preservation of gastric function

Table 3 Colonic interposition

Right-side colon	46/51 (90.2%)
Left-side colon	5/51 (9.8%)

Table 4 Vessels for supercharge

Recipient A	Transverse cervical A	36/41 (86.7%)
	Internal thoracic A	3/41 (13.3%)
	Common carotid A	1/41 (2.4%)
Donor A	Terminal iliac A	34/41 (83.0%)
	Ileocolic A	7/41 (17.0%)
Recipient V	External jugular V	33/41 (80.5%)
	Internal jugular V	5/41 (12.2%)
	Internal thoracic V	2/41 (4.9%)
	Superficial cervical V	1/41 (2.4%)
Donor V	Terminal iliac V	34/41 (83.0%)
	Ileocolic V	7/41 (17.0%)

during resection of the primary tumor or neck dissection, potential donor vessels were identified. Taking location, vessel diameter, and blood flow into consideration, branches of the internal carotid artery such as the transverse cervical, superior thyroid, lingual, facial, the ascending pharyngeal artery, and the common carotid artery itself are commonly used. We tended to use the transverse cervical artery more frequently than others because this artery was outside the field of resection. In some cases of colonic interposition, the internal thoracic artery was used. The internal jugular vein was used in most of our patients. In almost all cases, we selected the terminal ileal vessels for the recipient (Table 4). We selected the subcutaneous route for colonic interposition. Although this has cosmetic disadvantages, safety is increased even in elderly patients and those with poor surgical risk. Compared to the stomach, the subcutaneous route for using the colon in reconstruction does not cause serious esthetic problems. Moreover, for this route, various vessels can be selected for supercharge in all cases. Even if the interposed intestine becomes necrotic, this is not life-threatening. Prior to gastrointestinal reconstruction, we perform supercharge vessel anastomosis microscopically (Fig. 3). Technically, all operations were successfully performed without peri-

operative complications. With the latest technique, vascular anastomosis requires only about 10–15 min each for the artery and vein. Therefore, the time lost for vascular anastomosis is only about 30 min in total, and there is little operative stress in this technique. In Japan, vagus-preserving gastrectomy is becoming a standard procedure for treatment of early gastric cancer to improve postoperative digestive and absorptive function for better quality of life (QOL). In 3 cases in which tumor remained within the mucosa, vagus nerve arrangement was relatively simple, and the likelihood of tumor metastasis to lymph nodes in the lower thorax and the abdominal segment of the esophagus was very low, we used esophagectomy and reconstruction with the colon while preserving the stomach

Fig. 3 Vessels selected for supercharge. **a, b** Transverse cervical artery and external jugular vein. **c** Internal thoracic artery and external jugular vein. **d** Internal thoracic artery and internal thoracic vein
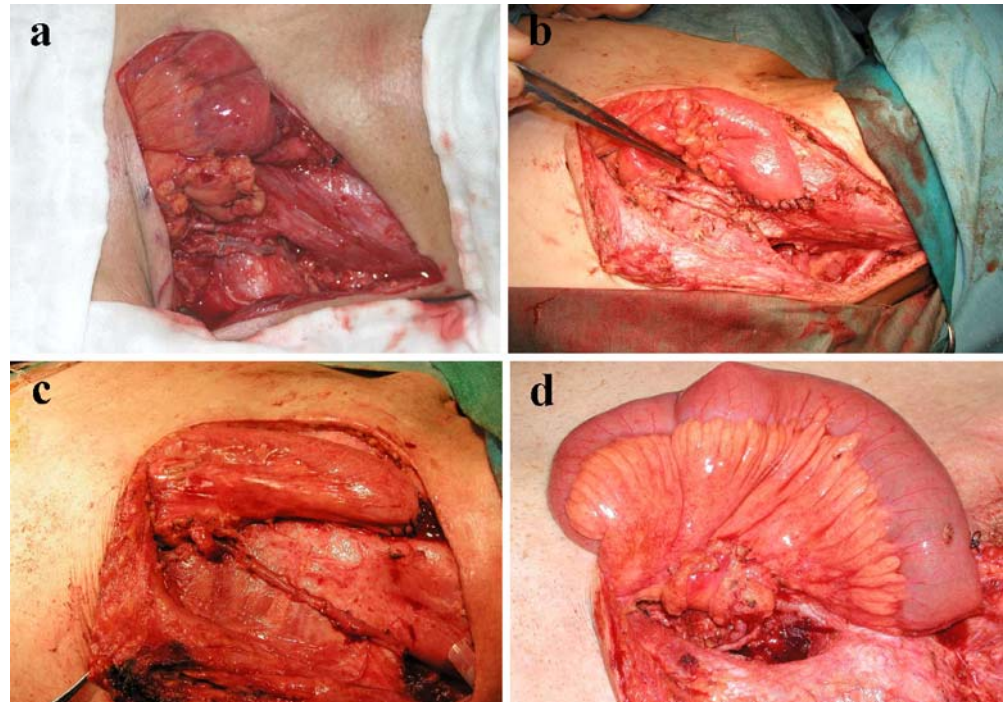
Table 5 Complication

Bleeding	1/51 (2.0%)
Minor leakage	4/51 (7.8%)
Anastomotic stenosis	7/51 (13.7%)
Heart burn	0/51 (0%)
Damping syndrome	0/51 (0%)

and the vagus nerve. This procedure yielded favorable results.

Results

One patient (2.0%) had hemorrhage from the site of arterial anastomosis immediately after the operation. Exploration, ligation of the bleeding point, and re-anastomosis were required. Another 4 (7.8%) patients had minor leakage from the esophago-ileostomy (Table 5). In these complicated cases, recovery was attained uneventfully with an overall postoperative mortality of zero. As another complication, postoperative stenosis of the anastomosed site was observed in 13.7% of all patients, but the incidence of this was lower than following esophagogastric anastomosis (23.9%). When operative time and length of postoperative hospital stay were compared between patients undergoing reconstruction with the colon (the colonic reconstruction group) and those undergoing reconstruction with the stomach (the gastric reconstruction group; $n=280$), operative time was found to be 110 min longer and length of postoperative hospital stay 7 days longer in the colonic reconstruction group. In terms of QOL, we compared results between the colonic reconstruction group and the gastric reconstruction group, with particular emphasis on the incidences of weight loss, heartburn, and dumping syndrome after surgery. There was no significant difference between the two groups in postoperative weight loss. However, there were striking intergroup differences in the incidence of heartburn (23% in the gastric reconstruction group vs 0% in the colonic reconstruction group) and dumping syndrome (13% vs 0%; Table 5).

Discussion

In recent years, the frequency of colonic reconstruction has increased. In 2002, colonic reconstruction was performed on 18 patients (33.3%) from a total of 54 esophageal reconstructions. The reasons for the increase in colonic reconstruction are that the prognosis of patients with gastric cancer has been improving and the incidence of secondary cancer of the esophagus has been increasing. Colonic interposition is a very useful technique that has gained wide acceptance in esophageal reconstruction for postgastrectomy patients [1–6]. The improvement in microsurgical techniques and availability of high-quality equipment has improved the safety of this technique [8–11]. It has certain advantages over previously used techniques, including its being a single-stage operation, with subsequent low morbidity and mortality and shorter length of hospitalization [13–21]. Technically, the ileum has a large and adequate vasculature and its diameter is almost the same as that of the esophagus. For these reasons, we used this technique in 51 patients. Technically, in all cases, the procedure was implemented without complication. Despite the fact that some patients were treated with radiotherapy, use of irradiated tissues and/or vessels did not increase the risk of complications. The evidence indicates that such use is safe and does not increase organ failure. The colonic interposition technique is also a valuable method for preservation of QOL after esophagectomy, with preservation not only of the stomach but also of the vagus. We have performed colonic reconstruction with stomach and vagus preservation on 3 patients, each of whom had a good postoperative course. In earlier cases of reconstruction with the colon, the supercharge technique was used only when poor circulation or venous congestion was noted at the tip of the intestinal graft during surgery. However, since anastomotic leakage or partial graft necrosis due to problems with postoperative blood supply was often noted following reconstruction with the colon, without the supercharge technique, we now make it a rule to use the supercharge technique when reconstructing the esophagus with the colon. Furthermore, We believe that the need for use of the supercharge technique is particularly high in patients with cancers in the very proximal part of the esophagus (11 such cases were noted among all cases encountered at our facility). The rate of postoperative complications in our patients was 23.5% (12 patients). Compared with other reports of up to 51% [7], this is quite low. Low failure rate (3–10%), low mortality, and short time of hospitalization time have also been reported in previous studies [1–4] and have convinced us that this is a good method for reconstruction of the esophagus, not only after gastrectomy but also for preservation of gastric function. Colonic interposition has been performed when it is not possible to use the stomach for reconstruction organ, e.g., postgastrectomy status. However, because of the need to preserve gastric function, we believe that active esophageal reconstruction using the colon will increase in the future. Thus, we consider colonic interposition a promising reconstruction procedure for esophageal surgery.

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