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ORIGINAL ARTICLE

Efficacy of preserving the residual stomach in esophageal cancer patients with previous gastrectomy

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Abstract

Objective There is no consensus concerning whether the residual stomach should be preserved after esophagectomy for thoracic esophageal cancer patients with previous distal or segmental gastrectomy. The purpose of this retrospective study was to assess the efficacy of preserving the residual stomach after esophagectomy in patients with previous gastrectomy.

Methods Between 2000 and 2015, 45 consecutive thoracic esophageal cancer patients with previous distal or segmental gastrectomy underwent esophagectomy followed by colon reconstruction. Patients were assigned to two groups according to how the residual stomach was treated (preservation group, $n=11$; resection group, $n=34$). We compared surgical outcomes and alterations of nutrition status, including the skeletal muscle area, between the two groups. In addition, we investigated the distribution of abdominal lymph node metastases in the resection group.

Results Operative time and blood loss tended to be lower in the preservation group compared to the resection group. However, the difference did not reach statistical significance. The rate of patients decreasing skeletal muscle area after surgery was significantly higher in the resection group (88% vs 50%, $P=0.03$). There were no patients with metastatic abdominal lymph nodes when the previous gastrectomy had been performed for gastric cancer and the esophageal cancer was located at the upper or middle esophagus in the resection group.

Conclusions Preservation of the residual stomach after esophagectomy in esophageal cancer patients with previous gastrectomy may influence the postoperative nutrition status and can be selectively approved.

Keywords Esophageal cancer · Esophagectomy · Gastrectomy · Residual stomach · Nutrition

Introduction

When the stomach cannot be used for reconstruction after esophagectomy because of previous gastrectomy in esophageal cancer patients, the colon or jejunum is used for reconstruction instead of the stomach. In such cases, surgical procedures may be more complicated when compared to reconstruction using the stomach because colonic or jejunal mobilization and additional anastomosis are required. Furthermore, previous reports described that the use of the colonic or jejunal conduit is associated with higher incidences of operative morbidity and mortality [1–3]. Despite these disadvantages, surgical cases of esophageal cancer patients with previous gastrectomy are increasing because of improving the survival after gastrectomy [3, 4].

Surgeons must consider how to deal with the residual stomach after esophagectomy when distal or segmental gastrectomy has been performed previously. In general, both

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oncological and nutritional aspects must be considered to decide whether to resect or preserve the residual stomach. We previously reported similar survival curves for thoracic esophageal carcinoma between in patients with and without a history of gastrectomy [5]. Noguchi and colleagues [6] reported the alteration of lymphatic flow after gastrectomy, limiting to the flow from mediastinum to perigastric lesions. A recent systematic review to examine the effect of postoperative complications on oncological outcome concluded that complications after radical surgery for esophageal cancer were associated with patient prognosis, and minimizing surgical invasiveness might reduce such complications and improve oncological outcomes [7]. However, there have been few additional reports according to surgical and oncological assessment in patients with preservation of the residual stomach after esophagectomy.

Sarcopenia, which is characterized by loss of the skeletal muscle area (SMA), has recently received great attention in the oncology field and is recognized as an important factor in predicting long-term prognosis in patients undergoing surgery for esophageal cancer [8]. Tanaka and colleagues [9] reported that the necessity for nutritional management of sarcopenia as well as weight loss from early postoperative days. However, there were few reports compared postoperative nutrition status between the patients whose residual stomach was preserved and those whose residual stomach was resected after esophagectomy in esophageal cancer patients with previous gastrectomy. Accordingly, there is no consensus concerning the decision making to preserve or resect the residual stomach in esophageal cancer patients with previous gastrectomy.

We hypothesized that the residual stomach could be preserved to reduce the surgical invasiveness and maintain the postoperative nutrition status in esophageal cancer patients with previous gastrectomy. Therefore, we retrospectively investigated and compared the surgical outcomes and alteration of the nutrition status between the patients who preserved and resected residual stomach after esophagectomy to evaluate the efficacy and adequacy of preserving residual stomach.

Methods

Patients

This retrospective study was approved by our Institutional Review Board of clinical research (No. 2017-061). A total of 2304 patients underwent surgery for esophageal cancer in our department between January 2000 and December 2015. Among them, 45 consecutive thoracic esophageal cancer patients with a history of distal or segmental gastrectomy who had undergone reconstruction by colon interposition after esophagectomy were enrolled. Patients who underwent reconstruction using the jejunum were excluded. The indication of preservation of the residual stomach was mainly determined by individual surgeons. However, this procedure generally has been adopted to the patients with prior chemoradiation therapy, early-stage tumor, and relatively poor condition. In the study, the residual stomach was preserved in 11 patients (preservation group) and resected in 34 patients (resection group). Tumor histology was described according to the seventh edition of the Union for International Cancer Control classification published in 2009 [10].

Surgical procedures

The approach for the thoracic field was right thoracotomy in all patients, except for two recent patients who were treated using thoracoscopic esophagectomy. The approach for the abdominal field was laparotomy with upper midline incision in all patients. When the residual stomach was preserved, reconstruction using colon interposition between the cervical esophagus and residual stomach was performed (Fig. 1 a). In contrast, when the residual stomach was resected, reconstruction using colon interposition between the cervical esophagus and duodenum or jejunum was performed (Fig. 1b, c). Three-field lymph node dissection was usually performed. However, two- or one-field lymph node dissection was applied for patients who were in a generally poor condition or underwent definitive chemoradiotherapy prior esophagectomy. Lymph node dissection in the abdominal field could not be performed if we preserved the residual stomach. We chose the type of colon graft based on vessel findings of the mesocolon during surgery. We preferred left colon grafts because of the advantages of more reliable blood supply and adequate length for reconstruction (left colon graft: $n=41$, right colon graft: $n=4$) [11]. The anastomosis between the esophagus and pedicled colon for all patients was completed in the neck.

Surveillance of surgical outcomes

To measure surgical outcomes, we reviewed operative time, blood loss, postoperative complications, reoperation rate, hospital stay, mortality rate, tumor recurrence rate, location of recurrence, overall survival rate, and disease-free survival rate after esophagectomy. The proximal esophagocolonic anastomosis was checked routinely by esophagography on postoperative day 7. Pulmonary complications included pneumonia, air leakage, and chylothorax. The clinical course after discharge was followed every month for 6 months. We surveyed tumor recurrence every 3 months by a physical examination and serum tumor markers. We basically performed computed tomography every 6 months and, endoscopy once per year. Tumor recurrence was divided into three

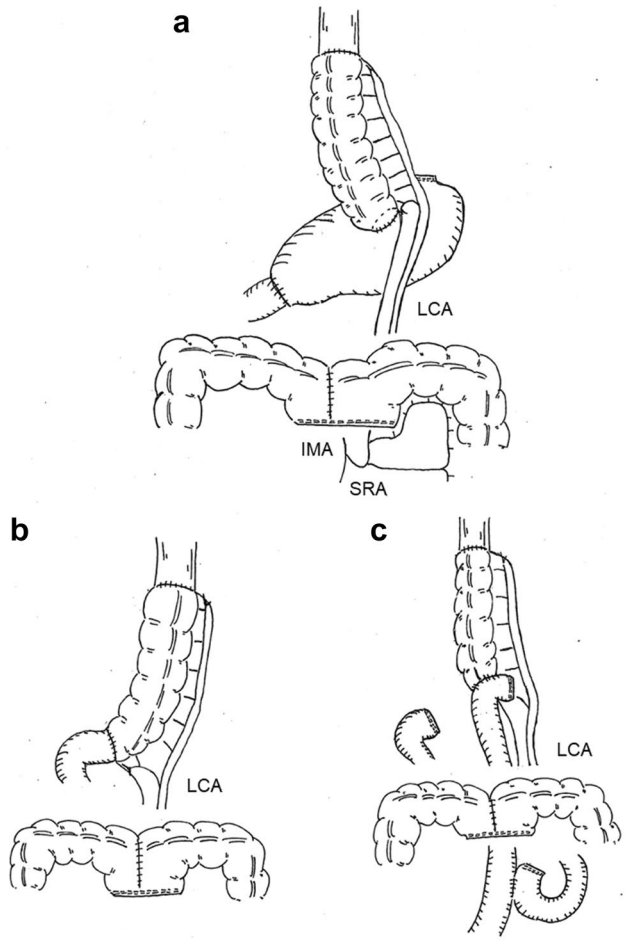

Fig. 1 Schemas of different types of reconstruction. Reconstruction using left colon graft interposition between the cervical esophagus and residual stomach after esophagectomy in patients with preservation of the residual stomach (**a**). Reconstruction using left colon graft interposition between the cervical esophagus and duodenum (**b**) or jejunum (**c**) after esophagectomy in patients with resection of the residual stomach. *LCA* left colic artery, *IMA* inferior mesenteric artery, *SRA* superior rectal artery

categories according to the site of the initial relapse: lymph node, locoregional, and distant. Long-term results were investigated in all patients. Overall survival was calculated from the data of esophagectomy to the most recent follow-up, and disease-free survival was calculated from the data of esophagectomy to that of identifying a recurrence or death for any cause, respectively.

Assessment of nutrition status

The changes of total serum protein and albumin levels, and skeletal muscle before surgery and 6 months after surgery were compared between the two groups. Due to the loss of data, we could only compare these values between 10 patients with preservation of the residual stomach and 25 patients without preservation of the residual stomach. The details about the loss of data (10 patients) were as follow: two patients who died within 6 months, one patient who required long hospital stays over 6 months due to the post-operative complication (anastomotic leakage), and seven patients who were not allowed to receive computed tomography examination at 6 month after surgery. To assess skeletal muscle, we calculated the SMA following previously published methods [12]. Using transverse computed tomography images of the third lumbar vertebra (L3) from each scan, we retrospectively measured the cross-sectional area of the skeletal muscle at the caudal end of L3 (cm^2) which was directly correlated with whole-body skeletal muscle in cancer patients [8, 12]. We investigated the changes in the value and percentage of SMA. Moreover, we checked the number and rate of patients who gained and lost SMA individually after esophagectomy.

Distribution of abdominal lymph node metastases in the resection group

In the resection group, we investigated the distribution of abdominal lymph node metastases to clarify the significance of perigastric lymph node dissection with resection of the residual stomach. We reviewed the medical records and pathological reports of 34 patients in the resection group and investigated the frequency of abdominal lymph node metastasis, especially in these five lymph node stations (#1, right pericardiac lymph node; #2, left pericardiac lymph node; #3a, perigastric lymph node of the lesser curvature; #4sa, perigastric lymph node of the greater curvature; #7, lymph node around the left gastric artery). These lymph node stations were described according to the Japanese classification published in 2009 [13]. Moreover, we categorized the patients into two groups according to the reason for previous gastrectomy (gastric cancer or peptic ulcer) and compared the number of retrieved lymph nodes and the number of the lymph nodes with metastasis between the groups.

Statistical analysis

Comparisons between groups were performed using Student's *t* test for continuous variables and the Chi-square test or Fisher's exact test for categorical variables. Survival curves were estimated by the Kaplan–Meier method and differences were assessed by the log-rank test. For all analyses, P values < 0.05 were considered statistically significant. All statistical analyses were performed using SPSS Statistics 23 (IBM Corporation, Chicago, IL).

Results

Clinicopathological characteristics

The clinicopathological characteristics of the patient population are summarized in Table 1. The esophageal tumor was located at the upper thoracic esophagus significantly more frequently in the preservation group than in the resection group (55% vs. 9%, $P=0.005$). Patients in the preservation group had earlier clinical stages than patients in the resection group (Stage I: 55% vs. 12%). There was a significant difference in the reasons for previous gastrectomy between the preservation group and the resection group (gastric cancer: 73% vs. 27%, $P=0.009$).

Surgical procedures and outcomes

The features of surgical procedures in the two groups are summarized in Table 2. No differences between the two groups according to surgical procedures were observed, except for the extent of lymphadenectomy. Perioperative outcomes are shown in Table 3. In the preservation group, operative time was shorter and blood loss was less than in the resection group. However, these differences were not statistically significant. There were no significant differences in the rates of postoperative complications between the two groups. In the resection group, conduit necrosis was observed in only one patient (3%) and reoperation was performed in the form of resection of the whole necrotic colonic conduit and reconstruction using the pedicled jejunum with additional microvascular anastomosis. In the resection group, the in-hospital death rate was 3%, with one patient death caused by recurrence and progression of the tumor

Table 1 Clinicopathological characteristics

Characteristics, $n=45$	Residual stomach		*P* value
	Preservation group	Resection group	
	$n=11$ (%)	$n=34$ (%)	
Age			0.76
Mean ± SD (years)	63.9 ± 8.9	64.7 ± 7.1	
Gender			0.58
Male	10 (91)	32 (94)	
Female	1 (9)	2 (6)	
Location of tumor			0.005
Upper	6 (55)	3 (9)	
Middle	2 (18)	18 (53)	
Lower	3 (27)	13 (38)	
Histology			0.22
Squamous	8 (73)	30 (88)	
Other	3 (27)	4 (12)	
Clinical stage (UICC 7th[a])			0.04
I	6 (55)	4 (12)	
II	0 (0)	11 (32)	
III	4 (36)	17 (50)	
IV	1 (9)	2 (6)	
Neoadjuvant therapy			0.27
Yes	3 (27)	15 (44)	
No	8 (73)	19 (56)	
Reason for gastrectomy			0.009
Gastric cancer	8 (73)	9 (27)	
Peptic ulcer	3 (27)	25 (73)	
Procedure of gastrectomy			0.11
DG + B-I/+ B-II/+ R-Y	6 (55)/2 (18)/1 (9)	22 (65)/11 (32)/1 (3)	
SG	2 (18)	0 (0)	

SD standard deviation, *DG* distal gastrectomy, *SG* segmental gastrectomy, *B-I* Billroth-I reconstruction, *B* Billroth-II reconstruction, *R-Y* Roux-en Y reconstruction

[a]The seventh edition of the Union for International Cancer Control classification

Table 2 Surgical procedures

Type of procedure, $n=45$	Residual stomach		*P* value
	Preservation group $n=11$ (%)	Resection group $n=34$ (%)	
Extent of lymphadenectomy			< 0.001
One field	3 (27)	1 (3)	
Two field	8 (73)	4 (12)	
Three field	0 (0)	29 (85)	
Section of colon interposition			0.56
Left colon	11 (100)	30 (88)	
Right colon	0 (0)	4 (12)	
Route of reconstruction			0.42
Retrosternal	7 (64)	27 (79)	
Posterior mediastinal	0 (0)	1 (3)	
Subcutaneous	4 (36)	6 (18)	
Anastomosis in the neck			0.19
Hand sewing	7 (64)	29 (85)	
Using stapler devices	4 (36)	5 (15)	
Microvascular anastomosis			1
Yes	4 (36)	5 (3)	
No	7 (100)	29 (97)	
Two-staged operation			1
Yes	0 (0)	2 (6)	
No	11 (100)	32 (94)	
Salvage surgery	3 (27)	5 (15)	0.3
Curative operation			0.14
Yes (R0)	9 (82)	33 (97)	
No (R1–2)	2 (18)	1 (3)	

Table 3 Perioperative outcomes

Variables, $n=45$	Residual stomach		*P* value
	Preservation group $n=11$ (%)	Resection group $n=34$ (%)	
Operative time, mean ± SD (min)	543 ± 383	731 ± 423	0.2
Blood loss, mean ± SD (mL)	510 ± 87	572 ± 127	0.14
Postoperative complications			
Overall morbidity	9 (82)	27 (80)	1
Anastomotic leakage	2 (18)	9 (27)	0.71
Conduit necrosis	0 (0)	1 (3)	1
Pulmonary	1 (9)	7 (21)	0.66
Vocal cord paralysis	4 (36)	11 (32)	1
Reoperation	2 (18)	6 (18)	1
Hospital stay, mean ± SD (days)	48 ± 36	40 ± 35	0.51
Hospital death	0 (0)	1 (3)	0.76
Tumor recurrence	5 (46)	11 (32)	0.33
Location of the tumor recurrence			0.55
Lymph node	1	3	
Locoregional	1	0	
Distant	3	8	

SD standard deviation

during treatment for a postoperative complication (conduit necrosis). Tumor recurrence occurred in five patients (46%) in the preservation group and 11 patients (32%) in the resection group. One of five patients with recurrence in the preservation group had locoregional recurrence associated with R2 surgery (residual tumor due to of invasion of the trachea). Lymph node recurrence occurred in four cases. However, lymph node recurrence was not seen in the abdominal region but in the cervical or mediastinal region. The overall survival and disease-free survival curves for all 45 patients are shown in Fig. 2. The median follow-up period was 45.8 months. The 5-year overall survival rates were 36% in the preservation group and 38% in the resection group, respectively. The 5-year disease-free survival rates were 27% in the preservation group and 32% in the resection group, respectively. In terms of overall survival and disease-free survival rates, there were no significant differences between the two groups.

Changes in nutritional status

Changes in nutritional status between the groups, including serum total protein and albumin levels and SMA, are shown in Table 4. In terms of total protein and albumin levels, there were no differences between the two groups at the time of surgery and 6 months after surgery. Although the percent of SMA loss was lower in the preservation group than in the resection group, the difference did not reach statistical significance (− 8% vs. − 12%, $P = 0.37$). The rate of patients decreasing SMA after esophagectomy was significantly higher in the resection group than in the preservation group (88% vs. 50%, $P = 0.03$).

Frequency of abdominal lymph node metastasis in the resection group

Among 34 patients in the resection group, there were four patients with abdominal lymph node metastases (12%). We detected abdominal lymph node metastases at the #1 lymph node station in two patients (6%), #2 lymph node station in three patients (9%), and #7 lymph node station in two patients (6%), respectively. The numbers of abdominal lymph node metastases and dissected lymph nodes according to subgroup analysis based on the reason for previous gastrectomy are shown in Table 5. In total, we detected the numbers of lymph node metastases at the #1 lymph node station (4/89), #2 lymph node station (5/75), and #7 lymph node station (2/61), respectively. We identified that there were more numbers of dissected lymph nodes and metastatic lymph nodes in the peptic ulcer group than in the gastric cancer group. The tumor location of esophageal cancer in four patients with abdominal lymph node metastases was the lower esophagus. In this study, no patients presented with abdominal lymph node metastasis when the previous gastrectomy was performed for gastric cancer and the esophageal cancer was located at the upper or middle esophagus. Furthermore, lymph node recurrence was not seen in the abdominal region in both resection group and preservation group. Therefore, overall abdominal lymph node metastasis including pathological metastasis and recurrence occurred in 12% of resection group and 0% of preservation group, respectively.

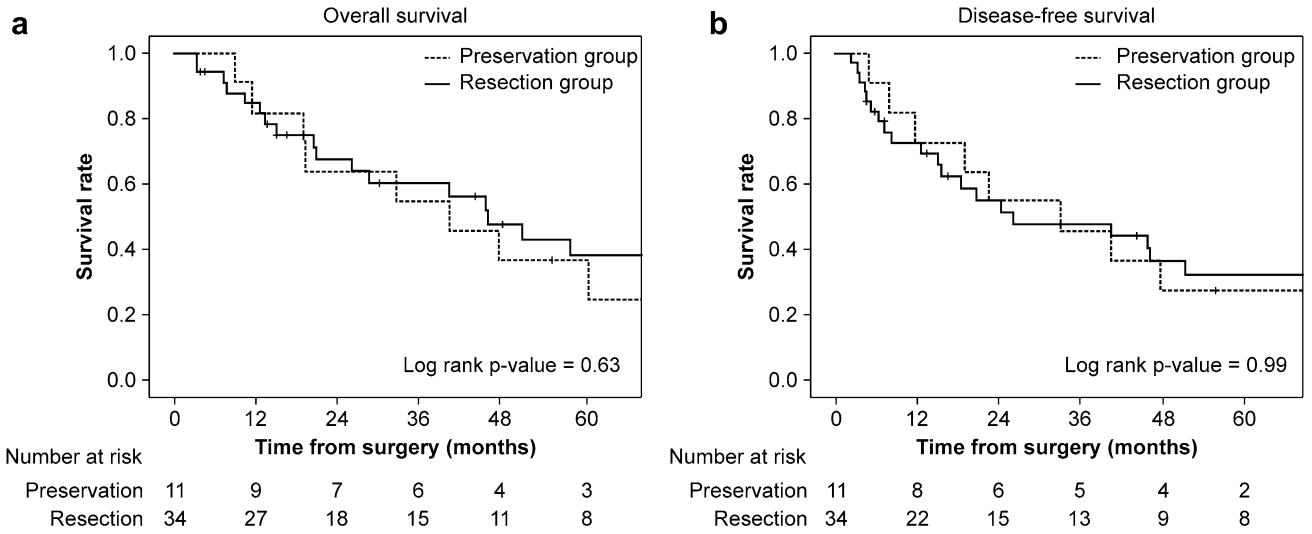

Fig. 2 Overall survival (**a**) and disease-free survival curves (**b**)

Table 4 Changes in nutritional status between the preservation group and resection group

Variables, $n=35$	Residual stomach		*P* value
	Preservation group	Resection group	
	$n=10$	$n=25$	
Total protein, mean ± SD (g/dL)			
Before surgery	6.7 ± 0.6	6.8 ± 0.6	
6 months after surgery	6.7 ± 0.6	6.9 ± 0.5	
Alteration of the volume	0.0 ± 0.5	0.1 ± 0.7	0.72
Albumin, mean ± SD (g/dL)			
Before surgery	4.0 ± 0.4	3.9 ± 0.4	
6 months after surgery	3.7 ± 0.6	3.7 ± 0.5	
Alteration of the volume	− 0.3 ± 0.4	− 0.2 ± 0.6	0.47
SMA, mean ± SD (cm^2)			
Before surgery	104.5 ± 13.8	109.7 ± 21.8	
6 months after surgery	95.3 ± 14.1	95.3 ± 16.6	
Alteration of the value	− 9.1 ± 16.5	− 14.4 ± 15.2	0.37
Alteration of the percentage (%)	− 8 ± 15	− 12 ± 12	0.37
Loss of SMA			0.03
Yes	5 (50)	22 (88)	
No	5 (50)	3 (12)	

SD standard deviation, *SMA* skeletal muscle area

Table 5 Numbers of abdominal lymph node metastases and dissected lymph nodes according to subgroup analysis based on the reason for previous gastrectomy

Abdominal lymph node station	Number of pN positive[a]/number of lymph nodes dissected		
	Total	Reason for previous gastrectomy	
		Gastric cancer	Peptic ulcer
#1	4/89	0/14	4/75
#2	5/75	1/11	4/64
#3a	0/119	0/14	0/105
#4sa	0/24	0/1	0/23
#7	2/61	0/1	2/60

[a]pN positive = lymph node metastasis confirmed by pathological reports

Discussion

In this study, we demonstrated that the rate of patients who lost SMA was significantly higher in the resection group than in the preservation group. Previously, it has been reported that reconstruction using the colon with preservation of the stomach is desirable as it enhances nutritional status, including postoperative weight gain, compared to the patients underwent reconstruction using gastric tube [14–16]. However, few reports have compared nutritional status using bodyweight loss between the residual stomach preservation and resection groups in esophageal cancer patients with a history of previous gastrectomy. Doki and colleagues [2] reported that there was no significant difference in bodyweight loss between 15 patients with preservation of the residual stomach and seven patients with resection of the residual stomach in esophageal cancer patients who had undergone prior distal gastrectomy. Although we could not obtain bodyweight loss data in this retrospective study, we investigated SMA which became the focus of the assessment of sarcopenia. To the best of our knowledge, this was the first report to compare SMA between the preservation group and the resection group after esophagectomy. We considered that preservation of the residual stomach enhanced postoperative nutritional status because the reservoir function of the stomach had favorable effects on oral intake. A previous study mentioned that preservation of the residual stomach can aid in food storage and extend the retention of food in the upper digestive tract, facilitating sufficient digestion and absorption [17]. Another possible factor causing the difference was that preservation of the residual stomach aided in the absorption of vitamin B12 and Fe and the secretion of gastric hormones, such as ghrelin [18].

There were no significant differences in surgical outcomes between the two groups. Previous reports described that longer operative time and more blood loss were caused by more complicated reconstruction and the need to resolve adhesions in patients with esophagectomy after gastrectomy compared with those without a history of gastrectomy [3,

19]. Wang and colleagues [17] reported that esophagectomy combined with reconstruction of the residual stomach has several advantages over reconstruction with the jejunum or colon, such as shorter operative time and less bleeding. Indeed, a reduction in the number of surgical maneuvers (for instance, resolving strict adhesions and fewer bowel anastomoses) represents the real advantage of preservation of the residual stomach, with a concomitant decrease in surgical invasiveness and incidence of postoperative complications [20, 21]. As in previous reports, we considered that preservation of the residual stomach had advantages related to the reduction of surgical invasiveness. In terms of long-term outcomes, there were no significant differences between the two groups and these results indicated that the surgical outcomes in the preservation group were not inferior to those in the resection group.

From clinicopathological findings, the preservation procedure and omission of dissection of the abdominal lymph nodes were selected for patients with early-stage tumors located at the upper esophagus and with a history of previous gastrectomy for gastric cancer. Wada and colleagues [3] reported that the residual stomach was preserved in 25 patients without cancer involvement and that none of them experienced tumor recurrence in the residual stomach. However, the authors did not mention metastases of the perigastric lymph nodes and there were few reports assessing the significance of dissection of the perigastric lymph nodes. In the present study, when the esophageal cancer was located at the lower esophagus, there were a few patients who had metastatic abdominal lymph nodes, especially at the #2 lymph node station. Although almost all previous gastrectomies for gastric cancer were performed in other institutes, most abdominal lymph nodes, except for the #2 lymph node station, were assumed to be dissected in the previous gastrectomy. When the previous gastrectomy was performed for gastric ulcers, we assumed that systematic lymph node dissection had not been performed. We considered that this fact led to our results revealing more numbers of retrieved lymph nodes and metastatic lymph nodes when the previous gastrectomy was performed for peptic ulcers. We previously reported that the frequency of abdominal lymph node metastasis in esophageal cancer patients with previous gastrectomy for both gastric cancer and ulcers was the highest in the left pericardiac nodes (#2 lymph node station) [5]. Furthermore, we demonstrated that the rate of abdominal lymph node metastasis was lower in esophageal cancer patients with previous gastrectomy than in patients without. The limitation of metastasis to the abdominal lymph nodes because of alteration of lymphatic flow after gastrectomy was a possible reason for this [6]. Because of low risk of abdominal lymph node metastasis, the preservation procedure may be indicated for patients with early-stage tumors located at the upper or middle esophagus and with a history of previous gastrectomy for gastric cancer. On the other hand, residual stomach should be resected in patients with a history of previous gastrectomy for peptic ulcer.

There are several limitations to this study that should be discussed. First, this study represents a retrospective single-institution experience. Therefore, the lack of some data and external validity are potential problems. Second, the small sample size makes our analyses underpowered to detect differences in several values. Finally, there was selection bias in the present study. In the future, a large-scale prospective trial with many institutions is necessary to prove the true benefit, superiority and indication of preservation of the residual stomach.

Conclusions

In conclusion, the results of this study suggest that preservation of the residual stomach is associated with improved postoperative nutritional status. Furthermore, surgical outcomes are not inferior to those in the resection group. These results mean that preservation of the residual stomach for esophageal cancer with previous gastrectomy can be selectively approved.

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Compliance with ethical standards

Conflict of interest All authors have no financial or other relations that could lead to a conflict of interest.

Ethical statement This work followed the guidelines set forth in the Helsinki Declaration of 1975, as revised in 2000, concerning Human and Animal Rights. This article does not contain human or animal subjects performed by any authors. This was a retrospective study approved by the institutional review board of the National Cancer Center Hospital.

References

1. Zeng F, He B, Wang Y, Xue Y, Cong W. Combined thoracoscopic and laparoscopic minimally invasive esophagectomy. J Thorac Dis. 2014;6:152–5.
2. Doki Y, Okada K, Miyata H, Yamasaki M, Fujiwara Y, Takiguchi S, et al. Long-term and short-term evaluation of esophageal reconstruction using the colon or the jejunum in esophageal cancer patients after gastrectomy. Dis Esophagus. 2008;21:132–8.
3. Wada H, Doki Y, Nishioka K, Ishikawa O, Kabuto T, Yano M, et al. Clinical outcome of esophageal cancer patients with history of gastrectomy. J Surg Oncol. 2005;89:67–74.
4. Bartels H, Thorban S, Siewert JR. Anterior versus posterior reconstruction after transhiatal oesophagectomy: A randomized controlled trial. Br J Surg. 1993;80:1141–4.

5. Kato H, Tachimori Y, Watanabe H. Surgical treatment for thoracic esophageal carcinoma in patients after gastrectomy. J Surg Oncol. 1992;51:94–9.
6. Noguchi Y, Imada T, Abe S, Tamura S, Ymamoto Y, Amano T, et al. Lymphatic flow of the remnant stomach. Nihon Geka Gakkai zasshi. 1988;89:852–62.
7. Shimada H, Fukagawa T, Haga Y, Oba K. Does postoperative morbidity worsen the oncological outcome after radical surgery for gastrointestinal cancers? A systematic review of the literature. Ann Gastroenterol Surg. 2017;1:11–23.
8. Nakashima Y, Saeki H, Nakanishi R, Sugiyama M, Kurashige J, Oki E, et al. Assessment of sarcopenia as a predictor of poor outcomes after esophagectomy in elderly patients with esophageal cancer. Ann Surg. 2018;267:1100–4.
9. Tanaka Y, Yoshida K, Suetsugu T, Imai T, Matsuhashi N, Yamaguchi K. Recent advancements in esophageal cancer treatment in Japan. Ann Gastroenterol Surg. 2018;2:253–65.
10. Sobin LH, Gospodarowicz MK, Wittekind C. UICC international Union Against Cancer. TNM classification of malignant tumors. 7th ed. New York: Wiley-Blackwell; 2009.
11. Watanabe M, Mine S, Nishida K, Kurogochi T, Okamura A, Imamura Y. Reconstruction after esophagectomy for esophageal cancer patients with a history of gastrectomy. Gen Thorac Cardiovasc Surg. 2016;64:457–63.
12. Yoshizumi T, Shirabe K, Nakagawara H, Harimoto N, Toshima T, Yamashita Y, et al. Skeletal muscle area correlates with body surface area in healthy adults. Hepatol Res. 2014;44:313–8.
13. Takubo K, Makuuchi H, Fujita H, et al. Japanese classification of esophageal cancer, tenth edition: Part I. Esophagus-Tokyo. 2009;6:1–25.
14. Roka S, Rath T, Jakesz R, Wenzl E. Treatment and reconstruction after disconnection of the failed cervical esophagogastric anastomosis. Dis Esophagus. 2003;16:130–4.
15. Davis PA, Law S, Wong J. Colonic interposition after esophagectomy for cancer. Arch Surg. 2003;138:303–8.
16. Cense HA, Visser MR, van Sandick JW, de Boer AG, Lamme B, Obertop H, et al. Quality of life after colon interposition by necessity for esophageal cancer replacement. J Surg Oncol. 2004;88:32–8.
17. Jun W, Wei W, Weibing W, Jing X, Fuxi Z, Xiaoxiang X, et al. Clinical outcome of using gastric remnant or jejunum or colon conduit in surgery for esophageal carcinoma with previous gastrectomy. J Surg Oncol. 2017;115:729–37.
18. Cummings DE, Weigle DS, Frayo RS, Breen PA, Ma MK, Dellinger EP, et al. Plasma ghrelin levels after diet-induced weight loss or gastric bypass surgery. N Eng J Med. 2002;346:1623–30.
19. Li HH, Zhang QZ, Xu L, Hu JW. Clinical outcome of esophageal cancer after distal gastrectomy: a prospective study. Int J Surg. 2008;6:129–35.
20. Dionigi G, Dionigi R, Rovera F, Boni L, Carcano G. Reconstruction after esophagectomy in patients with [partial] gastric resection. Case report and review of the literature of the use of remnant stomach. Int Semin Surg Oncol. 2006;3:10.
21. Xie SP, Fan GH, Kang GJ, Geng Q, Huang J, Cheng BC. Esophageal reconstruction with remnant stomach: A case report and review of literature. World J Gastroenterol. 2013;19:3169–72.