Principles of Surgical Treatment for Carcinoma of the Esophagus

Analysis of Lymph Node Involvement

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Extensive lymph node dissections in the posterior mediastinum and abdomen were performed during resections of esophageal carcinomas. Analysis of lymph nodes demonstrated a widespread distribution of positive lymph nodes regardless of the location of the tumor. The distribution of positive lymph nodes was noticed in the area between the superior mediastinum and the celiac region. The studies were also made on the distribution of positive lymph nodes in the superior gastric region, particularly in the region of the lesser curvature of the stomach. The following principles should be followed when carcinoma of the esophagus is surgically treated. 1) Lymph node dissection of the whole length of the posterior mediastinum, superior gastric region, and celiac region must be performed. 2) Total thoracic and abdominal esophagectomy with resection of the proximal lesser curvature and cardia, including the first to fourth branches, and preferably the fifth branch of the left gastric artery, is mandatory in order to remove possible lymphatic and intramural spread of tumors. 3) Satisfactory esophageal replacement in one stage must follow. Of the 354 patients with carcinoma of the esophagus admitted to the Toranomon Hospital, 210 underwent resections and reconstructions, for a resectability rate of 59.3%. The operative mortality rate was 1.4% and the overall five-year survival rate was 34.6%.

SURGICAL TREATMENT OF CARCINOMA of the esophagus consists of resectional and reconstructive surgery, yet both must be considered in close relationship. An incomplete resection negates the most important and primary purpose of the operation—cure of the malignancy. On the other hand, unnecessary and excessive resection of organs may result in the failure of consecutive reconstruction. Yet, possible spread of the tumor must be predicted from the data obtained by analysis of the hospital records of patients who had been treated for esophageal carcinoma, and the extent to which surgical resection can be safely accomplished must be assured.

This paper describes the principles of surgery for resectable carcinoma of the esophagus, and its relation to tumor spread and successful esophageal replacement.

Materials

During the last eight years and five months (from October 1972 to February 1981), 600 patients with carcinoma of the hypopharynx and cervical esophagus, thoracic esophagus and esophagogastric junction were admitted to the Department of Surgery, Toranomon Hospital. The 600 patients were assigned to groups according to three locations, as described above, to avoid statistical confusion (Table 1). Those grossly divided three groups show individually different modes of tumor extension, both anatomically and oncologically.

Carcinoma of the hypopharynx and cervical esophagus (Table 1) consists of tumors which are located above the jugular notch. The most common operative procedure for patients in this group is radical neck dissection and reconstruction. Carcinoma of the esophagogastric junction (Table 1) manifests itself as a group of tumors pathologically known to originate in the stomach. To resect tumors of this group, the left thoracoabdominal approach was chosen. These two groups of carcinomas should be considered separately,[2,4] and are excluded from the data presented in this paper.

Carcinoma of the esophagus (Table 1) presents as

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TABLE 1. *Number and Resectability Rate of Carcinoma of the Hypopharynx, Esophagus and Esophagogastric Junction*

Location	Cases without Resections	Resections and (Resectability Rate)	Total
Hypopharynx and Cevical esophagus	14	57 (80.3%)	71
Esophagus	144*	210* (59.3%)	354*
Esophagogastric junction	41	134 (76.6%)	175
Total	199	401 (66.8%)	600

* Materials of this paper.

tumors of the thoracic esophagus and part of the abdominal esophagus. All of the patients with esophageal carcinoma in this study had squamous cell carcinomas. Adenocarcinomas were excluded from this group. Squamous cell carcinomas were differentiated from adenocarcinomas by examination of resected specimens or biopsy specimens. A total of 354 patients in this group, including 210 patients who underwent resections and reconstructions, were analyzed.

Of the 354 patients included in the study, there were 312 men and 42 women. The ratio of men to women was 7.4:1.

The age distribution of the 354 patients with carcinoma of the esophagus is shown in Figure 1. The percentages of patients in their 50s, 60s and 70s were 29.1%, 37.3% and 24.0%, respectively. Patients between the ages of 60–69 were most frequently seen. The youngest patient was a 35-year-old man who underwent resection and reconstruction. The oldest patient was a 90-year-old man. This patient had carcinoma of the middle thoracic esophagus and underwent a one-stage resection and reconstruction by the principles described. He had his ninety-first birthday during his satisfactory postoperative period.

Methods

For statistical analysis, the esophagus was divided into three parts (Fig. 2). The esophagus between the levels of the jugular notch and carina was called the upper esophagus. The esophagus between the levels of the carina and esophagogastric junction was equally divided into two portions, the middle and lower esophagus; the lower esophagus included the lower thoracic esophagus and abdominal esophagus. The locations of the tumors in the 354 patients are shown in Figure 2. The middle esophagus was the most frequent site of carcinoma (61.7%). Adenocarcinomas that developed in the lower esophagus and cardia were included in the group of tumors of the esophagogastric junction (Table 1). Analysis of the lymph nodes dis-

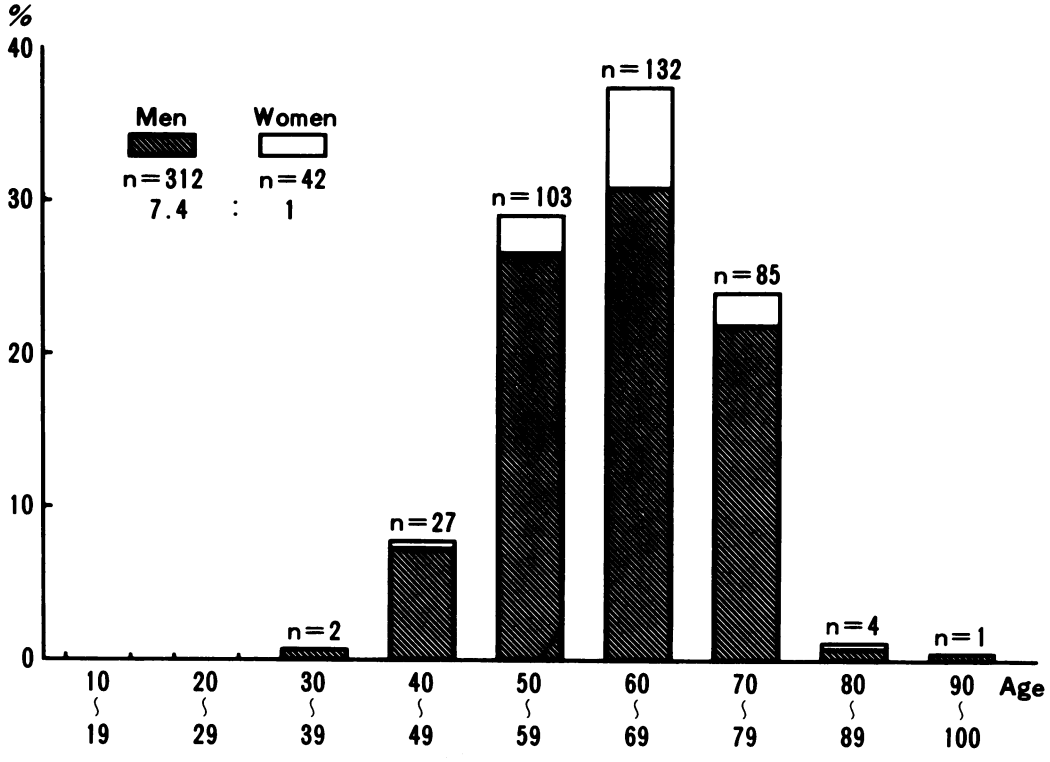

FIG. 1. Age distribution of 354 patients with carcinoma of the esophagus.

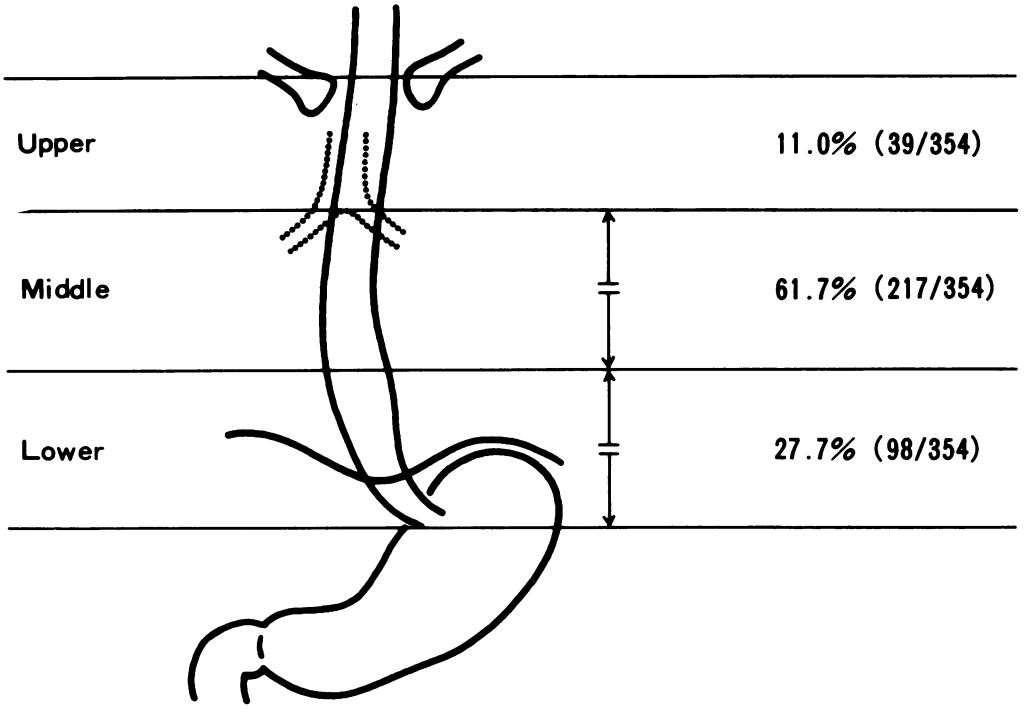

FIG. 2. Incidence of tumor in each region of the esophagus.

sected was done according to the locations of the tumors (Fig. 2).

There are many names for the groups of lymph nodes in the mediastinum and abdomen to be dissected for carcinoma of the esophagus.[8] Lymph nodes that are routinely dissected are shown in Figure 3. Superior mediastinal lymph nodes include nodes on the innominate artery, paraesophageal nodes, paratracheal nodes and nodes around the ligamentum arteriosum (Botallo). Nodes on the innominate artery are located at the highest nodes of the posterior mediastinum. They are regarded also as cervico-

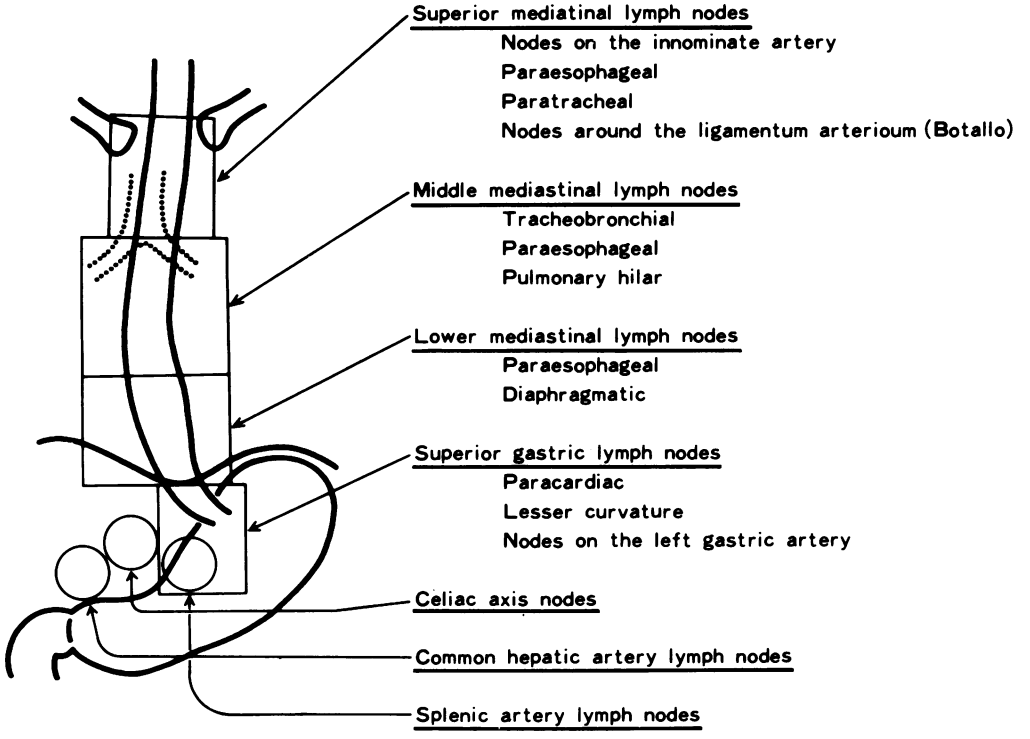

FIG. 3. Lymph nodes that may be involved in metastases.

thoracic nodes. Care must be taken not to traumatize the right recurrent laryngeal nerve during dissection. The left recurrent laryngeal nerve can also be tramatized, if attention is not paid, while the left paratracheal nodes are dissected. Nodes around the ligamentum arteriosum (Botallo) are also dissected because they are occasionally found to be positive for carcinoma. Middle mediastinal lymph nodes consist of tracheobroncheal, paraesophageal, and pulmonary hilar nodes. Even with the right thoracotomy, the left pulmonary hilar nodes are also dissected. Lower mediastinal lymph nodes include the paraesophageal and diaphragmatic nodes. Para-aortic nodes are also dissected, but it is not easy to differentiate the paraesophageal nodes from the para-aortic nodes. After dissection of those nodes, the crus of the diaphragm is exposed. Paracardiac, lesser curvature nodes, and nodes on the left gastric artery are considered superior gastric lymph nodes. Celiac axis nodes are removed and the left gastric artery is severed at its root. It is rather rare to find positive lymph nodes at the hepatoduodenal ligament or at the hilum of the spleen. Therefore, dissection does not have to extend to the nodes at the hepatoduodenal ligament or at the hilum of the spleen. Retropancreatic or para-aortic lymph nodes are considered to be distant lymph nodes, and they are not routinely dissected.

Results

The lymph nodes obtained from 205 patients who underwent systemic node dissections were pathologically examined, and the percentage of positive lymph nodes was determined. The rate of positive lymph nodes per number of cases was 59.0% (121/205 patients). A total of 6,258 lymph nodes were examined, and 398 nodes were found to be positive. Therefore, the rate of positive lymph nodes per number of nodes examined was 6.4%. No marked differences were noticed among the positive node rates in the upper, middle, and lower esophageal carcinoma (Table 2).

The percentage of positive lymph nodes according to location of the tumor is shown in Table 3. It is interesting that there is little difference between the number of positive lymph nodes in the thoracic and abdominal regions. Dissection or removal of distant lymph nodes, such as those in the neck or para-aorta, was occasionally performed. However, the rates of positive nodes in those areas were not determined because this was done only for selected cases. Figure 4 demonstrates the rate of positive lymph nodes according to the locations of the tumors. It is clear that there is a relation between the anatomic location of the tumor and the frequency of positive lymph nodes in each group. In carcinomas of the middle esophagus, it is thought to be natural to find node metastases in the mediastinum as well as in the abdomen. However, even when the tumor is located in the upper esophagus, there are possible node metastases in the superior gastric area in as many as 31.8% of the patients. When the tumor is located in the lower esophagus, there are still positive nodes in the superior mediastinum in 9.8% of the patients. Consequently, it should be emphasized that wherever the tumor is, total thoracic and abdominal esophagectomy is necessary, and complete node dissections in the posterior mediastinum and in the abdomen are mandatory. However, positive nodes in squamous cell carcinomas, are rarely found in the hepatoduodenal ligament, along the greater curvature of the stomach, or at the hilum of the spleen. Subsequently, node dissection in the hepatoduodenal ligament or combined resection of the tail of the pancreas and spleen is not required.

It is important to remove the lymph nodes of the

TABLE 2. *Rate of Positive Lymph Nodes*

Location of Tumor	Rate of Positive Lymph Nodes	
	Per No. of Cases	Per No. of Lymph Nodes Examined
Upper Esophagus	66.7% (16/24)	4.9% (38/779)
Middle Esophagus	50.9% (59/116)	5.2% (176/3419)
Lower Esophagus	70.8% (46/65)	8.9% (184/2060)
Total	59.0% (121/205)	6.4% (398/6258)

TABLE 3. *Rate of Positive Lymph Nodes*

Group of Lymph Nodes	Location of Tumor			Total
	Upper Esophagus	Middle Esophagus	Lower Esophagus	
Thoracic				
superior mediastinal	29.4 (8.3)	11.4 (4.6)	9.8 (2.7)	
middle mediastinal	27.3 (7.7)	20.7 (4.7)	14.3 (2.4)	18.7 (5.2)
lower mediastinal	28.6 (7.8)	18.0 (4.9)	27.4 (9.5)	
Abdominal				
superior gastric	31.8 (3.0)	32.8 (6.6)	61.5 (14.1)	
celiac axis nodes	0 (0)	4.4 (2.9)	21.2 (11.6)	
common hepatic artery lymph nodes	0 (0)	2.0 (1.1)	9.8 (6.0)	18.9 (7.5)
splenic artery lymph nodes	0 (0)	6.3 (5.6)	15.0 (7.1)	

Percentage of positive lymph nodes per number of patients (per number of lymph nodes examined).

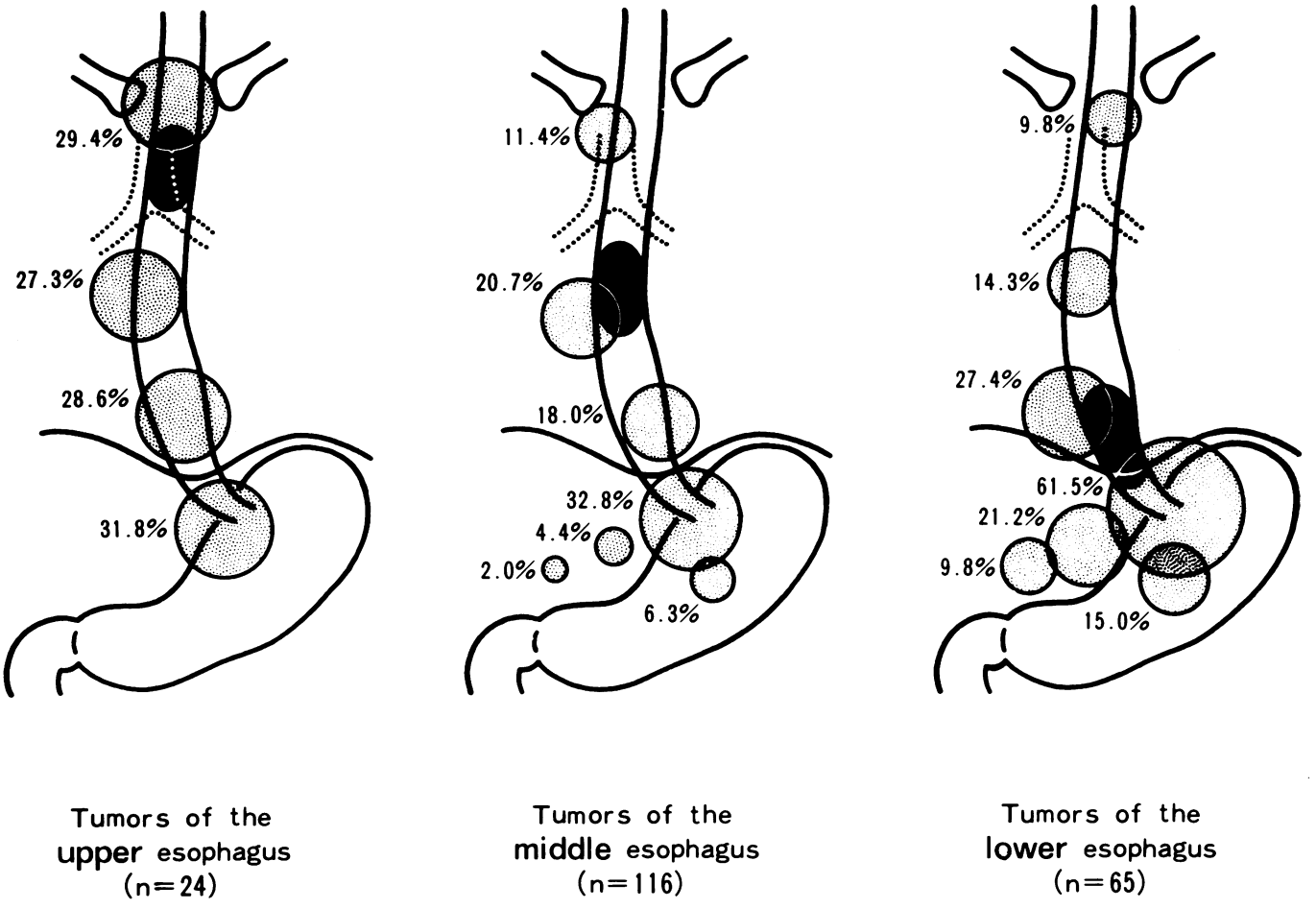

FIG. 4. Rate of positive lymph nodes per number of cases resected.

superior gastric group, and also the lymph nodes on the common hepatic and splenic arteries. The rate of positive nodes for lesions in the superior gastric region is illustrated in Figure 5. Positive nodes at the root and stem of the left gastric artery accounted for 9.3% and 23.0% of the nodes, respectively. Particular attention was paid to the incidence of positive nodes along the first, second, third, fourth and fifth gastric branches of the left gastric artery. The positive node rates were 25.1%, 14.1%, 8.5%, 6.0%, and 0%, respectively. The rate decreases in frequency as the location changes distally, along the lesser curvature of the stomach, and no positive nodes were found along the fifth branch. The nodes along the first branch are called the right paracardiac nodes. The rate of positive nodes at the left paracardia was 14.4%. The left paracardiac nodes belong to the group of nodes along the lesser curvature rather than the greater curvature of the stomach. In fact, macroscopically, no lymph node involvement was noticed along the greater curvature of the stomach. It was also noticed that there was no macroscopic lymph node involvement distal to the fifth branch of the left gastric artery.

The resectional line of the lesser curvature of the stomach is shown in Figure 5. The lesser curvature proximal to the fourth and preferably the fifth branch of the left gastric artery should be removed. This line of resection also connects the points where the vessels of the lesser curvature enter the gastric wall so that all lymph nodes along the vessels can be removed and, simultaneously, the intramural vascular network is preserved, in order to prepare the stomach as an esophageal substitute with satisfactory blood circulation.[3] Pyloroplasty is performed.

The operative approaches and routine method of esophageal replacement are illustrated in Figure 6. The patient is placed in the left lateral position. After exploratory laparotomy, the abdomen is temporarily closed. The right chest is opened through the fifth intercostal space. Mediastinal dissection is completed, and then the chest is closed. The patient is moved from the left lateral to the supine position. After lymph

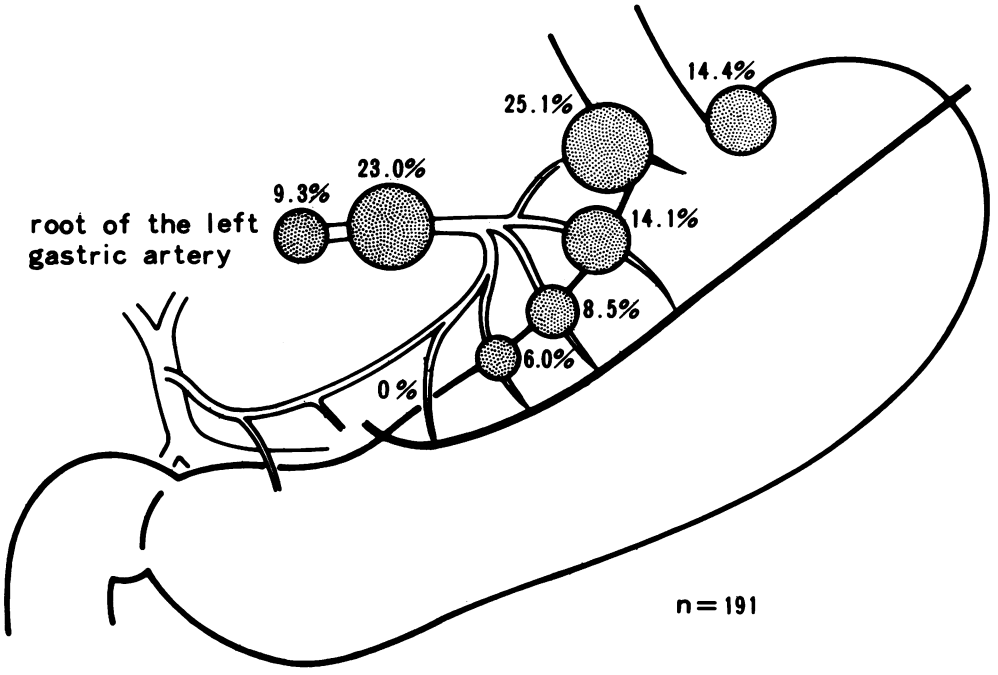

FIG. 5. Rate of positive lymph nodes in the superior gastric region (per number of cases).

node dissection in the abdomen is performed, the stomach is cut (Fig. 5). The esophagus is always severed at the level of the neck. The stomach is brought up to the neck via a retrosteral tunnel and a cervical esophagogastrostomy is performed. When the stomach cannot be used, the colon is used as an esophageal substitute.

The postoperative complications encountered after 210 resections are listed in Table 4. Pulmonary complications were the most frequently noticed complication (13.3%). The next most frequent complication was hoarseness (11.4%), which was probably caused by extensive lymph node dissection along the innominate artery and recurrent laryngeal nerve. Hoarseness is often temporary, and functional difficulty in swallowing will improve or disappear in the majority of patients. Anastomotic leakage occurred in 5.2% of the patients. However, the leaks were all minor and soon healed spontaneously in most of the patients. There were three deaths within 30 days after operation, due to pulmonary complication, acute hepatic failure, and superior mesenteric thrombosis. The operative mortality rate was 1.4% (3/210 patients).

The survical curves according to the pathologic examinations of the lymph nodes are shown in Figure 7. The long-term results shown in Figure 7 are for 52 patients who underwent curative and palliative resections and had a minimum five-year follow-up period. The 52 patients were divided into two groups, 26 patients with negative lymph nodes and 26 cases with positive lymph nodes, and survival curves of each group are shown (Fig. 7). The five-year survival rate in patients with negative nodes was 53.8%, and in patients with positive nodes it was 15.3%. Eighteen of the 52 patients survived five years. Therefore, overall five-year survival rate was 34.6%.

Discussion

The primary aim of surgical treatment for carcinoma of the esophagus is cure of the disease or prolongation of survival time, and the ability to ingest food normally. A balanced combination of resection and reconstruction with minimal surgical risks is im-

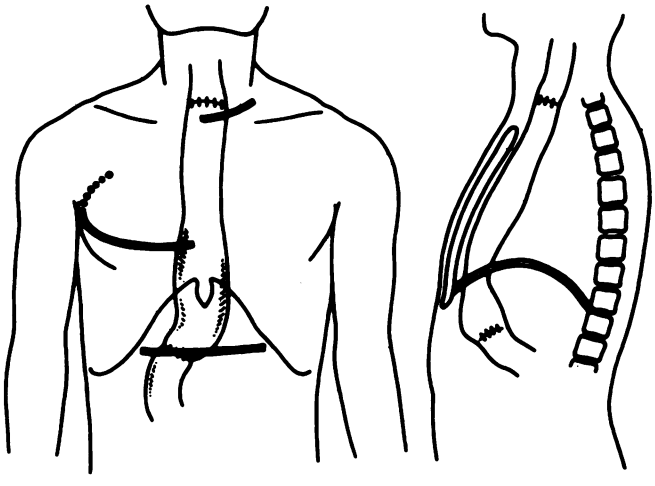

FIG. 6. Approaches and routine method of esophageal replacement.

TABLE 4. *Postoperative Complications after 210 Resections*

Complications	Number	Per Cent
Pulmonary complications	28 (1)	13.3
Hoarseness	24 (0)	11.4
Anastomotic leakage	11 (0)	5.2
Cardiac complications	9 (0)	4.3
Hepatic failure	1 (1)	0.5
Superior mesenteric thrombosis	1 (1)	0.5

Operative mortality rate: 1.4% (3/210 patients).
Numbers in parentheses indicate the number of operative deaths.

portant. The mode of lymphatic spread of tumors was studied to determine if the resection was adequate and if subsequent satisfactory reconstructive surgery was possible.

It has been demonstrated that complete lymph node dissection is necessary in the mediastinum as well as in the abdomen, regardless of the anatomic location of the tumor. However, resection is not indicated for patients with extensive tumor involvement in the cervical, para-aortic, retroperitoneal, and or other distant lymph nodes. The positive nodes in those regions were removed in a small number of patients, but those were only clinical trials or challenges. The extent to which we resect positive nodes of the esophagus and the stomach was described previously. It is important to remember that the superior gastric lymph nodes should be resected, even when the stomach is not used as an esophageal substitute, such as when the colon has been used for a patient who underwent a previous gastrectomy. Investigations proving that the major intramural lymphatics are in the submucosa with mainly longitudinal drainage, were done many years ago by Sakata.[13] The drainage of the lymph is not segmental. Therefore, it is understood that carcinomas of the esophagus metastasize rather longitudinally. Postlethwait[12] catalogued lymph node metastases of esophageal carcinoma based on the findings at autopsy examination. However, it would be difficult to conclude the adequate extent of lymph node dissection and resection from autopsy reports because of the various names assigned to the lymph nodes and the different anatomic locations of the tumor.[12] Lymphatic drainage of the esophagus was studied by McCort[10] by dividing the lymph nodes into eight groups. McCort noticed that the nodes along the lesser curvature of the stomach are not usually in the main drainage course from the esophagus but are frequently involved by metastases, possibly because of blockade of the normal drainage route. According to our study, it seems that the nodes of the lesser curvature are a normal direct pathway from the primary lesion to the celiac nodes.

Total thoracic and abdominal esophagectomy with resection of the cardia, particularly the proximal portion of the lesser curvature of the stomach, is thought to be a reasonable procedure because of the possibility of lymph node involvement, intramural vascular spread, satellite nodules, and multiple cancers. McKeown[11] also recommended total esophagectomy. For better exposure of the whole posterior mediastinum, a right thoracotomy should be chosen.[5,6,11,14] In order to have a safe surgical margin, care must be taken, particularly for lesions of the upper esophagus. Esophagotomy[1] in the neck is useful in order to avoid a cancer-positive surgical margin. To reduce the opera-

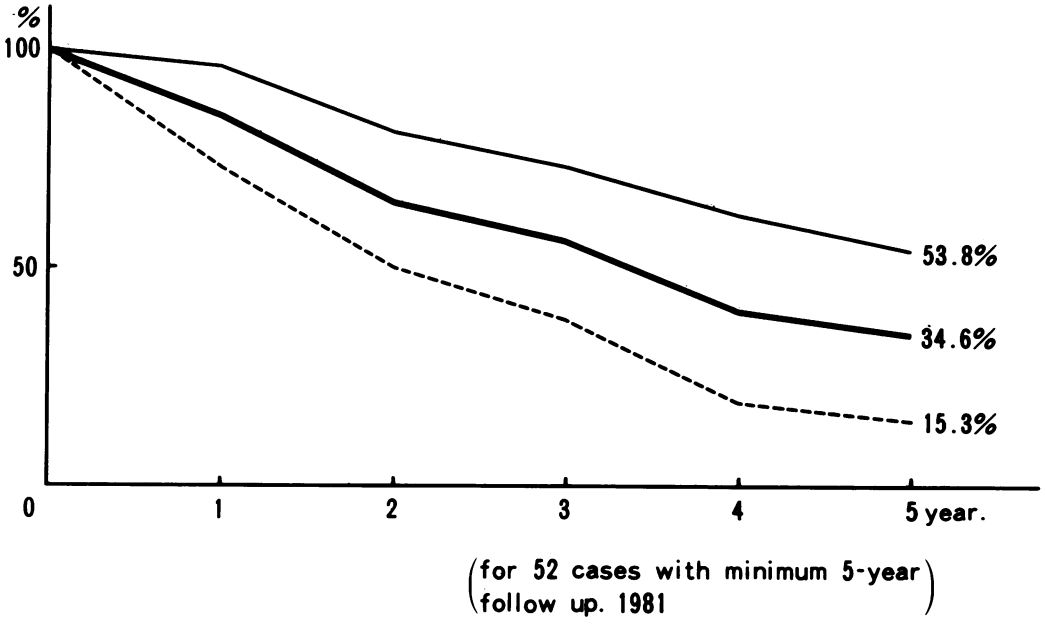

FIG. 7. Survival curve according to the findings of lymph nodes. Thin solid line: patients with negative lymph nodes. Bold solid line: overall survival rate. Broken line: patients with positive lymph nodes.

tive risk, a staged operation is recommended. However, in our series, satisfactory results were obtained with a one-stage operation.

Anastomosis is routinely performed in the neck. Cervical anastomosis has the advantages of postoperative safety and excellent exposure, which makes the anastomosis accurate.[5]

The retrosternal space is routinely used as the route of esophageal replacement in order to avoid the possibility of local tumor recurrence in the posterior mediastinum. However, for early-stage carcinoma, a posterior mediastinal route can be chosen. The presternal route is rarely used, because of length and cosmetic reasons. An intrathoracic anastomosis is not recommended, because of the possibility of incomplete mediastinal node dissection and prolongation of the time of thoracotomy.

Preoperative[7,9] and postoperative irradiation or other adjuvant therapies by chemotherapy or immunotherapy are also important means of treatment. They have been used for selected patients. However, studies have to be performed of the effects on patients with carcinoma of the esophagus.

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Discussion

MR. RONALD BELSEY (Bristol, England): The problem with carcinoma of the esophagus and its surgical treatment is the operative mortality. The published results vary between 40% and 1.6%, and this is the message that we all hope Professor Akiyama is going to give us today. You can cheat, if you like, by reducing your resection rate, but with a 60% resection rate there is more to it.

Careful preoperative preparation plays a part, but I have had the pleasure of watching Professor Akiyama operate, and one of the factors that impresses me most is his shear technical artistry.

There is still a place for art in surgery. At this meeting, we have been blinded by science, but the ancient Egyptians had a few slants on this. In the fourth and fifth dynasty, that is, about 3000 B.C., —they had a god of science, called Thoth, and they always portrayed this god of science as a baboon.

I had the pleasure, before the war, of spending a year with Professor Edward Churchill in Boston. The greatest lesson I learned from Churchill was the value of gentleness in surgery, respect for the friability and vulnerability of human tissue; it is a lesson I shall never forget.

I have seen no better exponent of that philosophy than Professor Akiyama.

Dr. Akiyama, how do you achieve an operative mortality rate of 1.6% in the surgical treatment of carcinoma of the esophagus?

DR. DAVID B. SKINNER (Chicago, Illinois): Like Mr. Belsey, several years ago I had the pleasure to visit Tokyo and watch Dr. Akiyama do an esophagectomy and review his patients. I can assure you that he is a careful, painstaking, and thorough surgeon, who has earned these results for his patients by much hard work and the observance of sound surgical principles. I do not believe that the disease is biologically different in the Orient, so what can we learn from this experience?

Dr. Akiyama's good results argue persuasively for near-total esophagectomy and an extensive and systematic node dissection for squamous cell carcinoma, an approach I advocate. Some patients with positive nodes do survive long-term in both Japan and the United States, and the staging of lymph node spread is a major determinant of prognosis and the need for adjuvant treatment, so full node dissection is important.

Our results in early patients with negative nodes also show a greater than 50% chance for five-year survival. So the most important message is early detection. In this field of early detection, the Japanese and Chinese are ahead of us, and this accounts for the overall better survival rates that they are able to report. Current investigative effort should be focused on the screening for early detection in highrisk groups and thorough preoperative staging. This is the emphasis of our own program at present and offers the best prospect for appropriate selection and improved results of extensive resection.

Dr. Akiyama's mortality rate is admirable, but I would like to know how he defines operative mortality.

Were all of these squamous carcinomas? Does adenocarcinoma of the lower third of the esophagus have a different pattern of nodal involvement than does squamous carcinoma at the same level, and does he do the same operation for adenocarcinoma of the esophagus?

Is there a relationship between the number of positive nodes and survival? He had four patients of 26 with positive nodes who survived five years. I would like to know how many nodes were