A NEW OPERATIVE TECHNIQUE FOR ESOPHAGEAL RECONSTRUCTION USING A LONG GASTRIC TUBE OF 3 CM DIAMETER

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Summary : The anthors have successfully prepared a 3 cm diameter gastric tube with a more favorable blood supply than the conventional one by performing interrupted suture each of the mucosal layers and seromuscular layers of the stomach separately with pyloromyotomy as a drainage procedure. This gastric tube caused no clavicular pressure on the anastomotic portion through a retrosternal route, so that we could perform end-to-end anastomosis between the cervical esophagus and the gastric tube in a region higher than the clavicle. We report in this paper the clinical findings of our procedure : it was effective in preventing postoperative complications such as suture insufficiency and passage disturbance other than postoperative complaints due to dumping and reflux esophagitis, etc.

Index Terms

thoracic esophageal carcinoma, long gastric tube, postoperative complication

INTRODUCTION

Although efforts have been made to improve the operative methods for reconstruction of thoracic esophageal carcinoma, safe and reliable methods not causing postoperative complications or complaints such as passage disturbance due to anastomotic leakage or stenosis, reflux esophagitis and dumping syndrome, have not been established.

We have developed a method of using a long gastric tube of 3 cm in diameter of the greater curvature because a narrow gastric tube may be more advantageous in blood flow per unit tissue compared with a wide gastric tube, and prevent anastomotic leakage or stenosis. Using a 3 cm diameter gastric tube, the proximal side of a gastric tube with favorable blood supply was stured with the cervical esophagus in as high a region from the clavicle as possible by Gambee's method (1) of end-to-end anastomosis through retrosternal route. We also added pyloromyotomy in the drainage procedure instead of pyloroplasty, because pyloromyotomy prevents passage disturbances in the pyloric portion. In this paper we report the procedure and usefulness of our new operative method.

SUBJECTS

The subjects were 16 patients (10 males and 6 females) ranging in age from 39 to 80 with a mean age of 65.6, who underwent esophageal reconstruction using a gastric tube following

resection of thoracic esophageal carcinoma at our department during the period from February 1987 to October 1989.

The chief complaints of these patients when they first visited our hospital were dysphagia in 10 patients, epigastric discomfort in 5, and heartburn in one. The locations of the lesions according to the Guide Line for the Clinical Pathologic Studies on Carcinoma of the Esophagus (2) was Im in 11 patients, the largest number of all, followed by Iu in 3, Ei in one, Ce in one whose macroscopic classifications were the superficial type in 2 patients, tumorous type in 10, serrated in 3 and spiral type in one. The histopathological diagnosis was squamous cell carcinoma in all cases. When classified by stage, 6 patients were in Stage IV, the most of all, followed by 4 each in Stages I and III, and 2 in Stage II.

OPERATIVE PROCEDURES

Operative technique for forming a long and narrow gastric tube

As for intrathoracic procedure, the right chest is opened in a left side position, and esophageal dissection and cleaning of lymph nodes are performed. After the chest is closed, the abdomen is opened by median incision as the posture is changed to a supine position. At first the evidence of metastasis to intra-abdominal organs and lymph nodes is investigated. The greater omentum is dissected at a site at a distance of 3 cm from the right gastroepiploic vessels on the greater curvature, not causing damage on the right gastroepiploic vessels and their branches. However, vessels communicating with the left gastroepiploic vessels are retained. The left gastroepiploic vessels are dissected in the neighborhood of the splenic hilus, and so are the short gastric vessels together with the gastrosplenic ligament. In the lesser curvature, the branches of the right gastric vessels are dissected at the proximal side at a distance of about 4 cm from the pyloric ring, and a gastrohepatic ligament is dissected as much in the neighborhood of a region to the liver as possible, and the left gastric artery is dissected at its root. The abdominal esophagus is then isolated, and the intrathoracic esophagus is dislocated from an esophageal hiatus into the abdominal cavity before the hiatus is closed, and the reconstruction of a gastric tube in started.

A line of 4 cm apart from the pyloric ring on the lesser curvature and 3 cm from the greater curvature is then decided. Lesser curvature of stomach is clamped by intestinal forceps in order to prevent bleeding or the exudate of stomach contents before the seromuscular layers of the anterior and posterior walls of lesser curvature are dissected by an electric scalpel and the mucosal layer is further dissected by Cooper's scissors.

As shown in Fig.1-a, interrupted suture of the mucosal layers is performed by 3-0 Coated VICRYL (ETHICON, INC.) at an interval of about 3 mm, and the intestinal forceps are removed when the suture is over. The stomach is then allowed to extend as much as possible and the interrupted suture of the seromuscular layers is performed by 3-0 silk with atraumatic needle in a similar fashion as shown in Fig.1-b. A gastric tube of 3 cm in width is made on the greater curvature by repeating this procedure as shown in Fig.1-c. The final form of the gastric tube is shown in Fig. 2. As a drainage procedure, we have been performing pyloromyotomy that reaches the proximal side at a distance of 4 cm from the pyloric ring.

After efforts were made to prepare a gastric tube in our 16 cases, a region from the pyloric

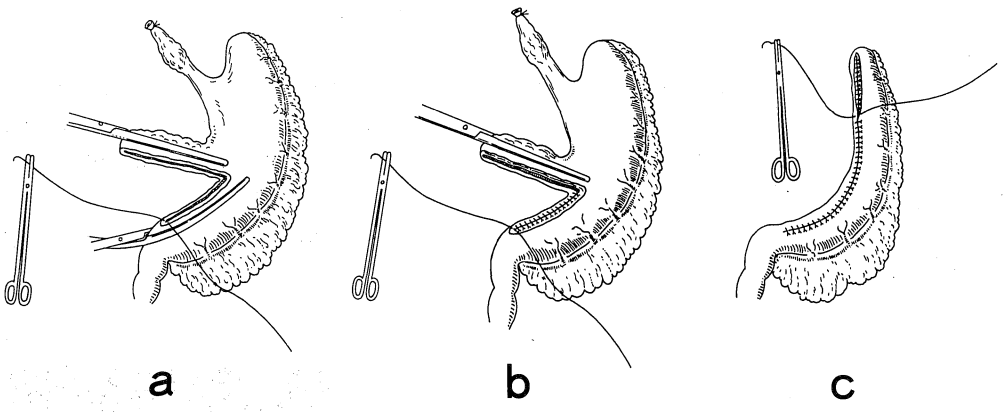

Fig. 1. Preparation of a 3 cm wide gastric tube.
a. For mucosal suture, the stomach is dissected in a width of 3 cm from the greater curvature in a distance of 4 cm of a pyloric ring.
b. A seromuscular layer is further sutured.
c. A gastric tube is prepared by repeating the suture each of mucosal and seromuscular layers separately.

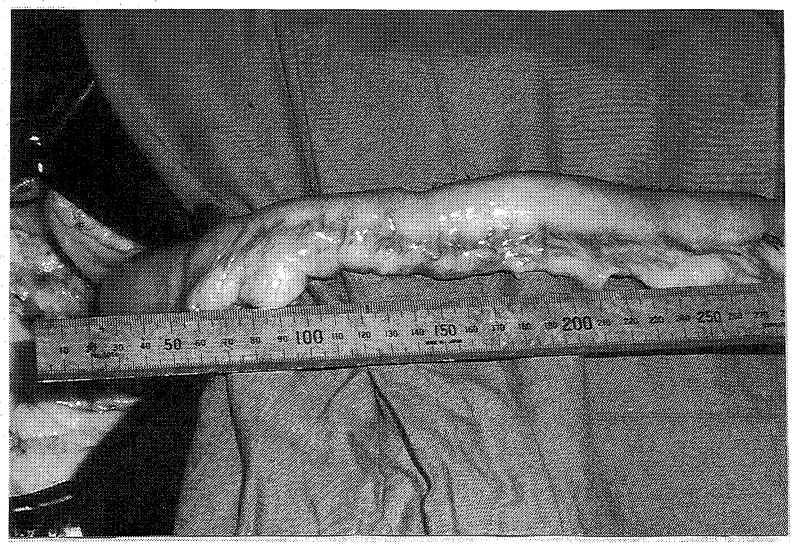

Fig. 2. Final form of a long gastric tube with a width of 3 cm.
Good blood supply in a end of this gastric tube (right side) is 3 cm wide and 34 cm long.

ring with an average length of 25.6 cm before the preparation of a gastric tube was successfully extended to 34.5 cm on the average by about 35% after surgery.

End-to-end anastomosis between cervical esophagus and gastric tube

An oblique incision of about 7 cm reaching the sternal upper edge is made along a frontal line of the left sternocleidomastoid muscle before the stump of the cervical esophagus is

allowed to be dislocated to the outside of the incision by ablating the cervical esophagus from the surrounding tissue.

After the gastric tube is raised to the cervical region through the retrosternal route, end-to-end anastomosis is performed by Gambee's method between the cervical esophagus and the region of gastric tube without tension and favorable blood supply at a region about 4 cm from the clavicle.

Fig. 3 shows the final form of the reconstructed esophagus with our long and narrow gastric tube of 3 cm diameter.

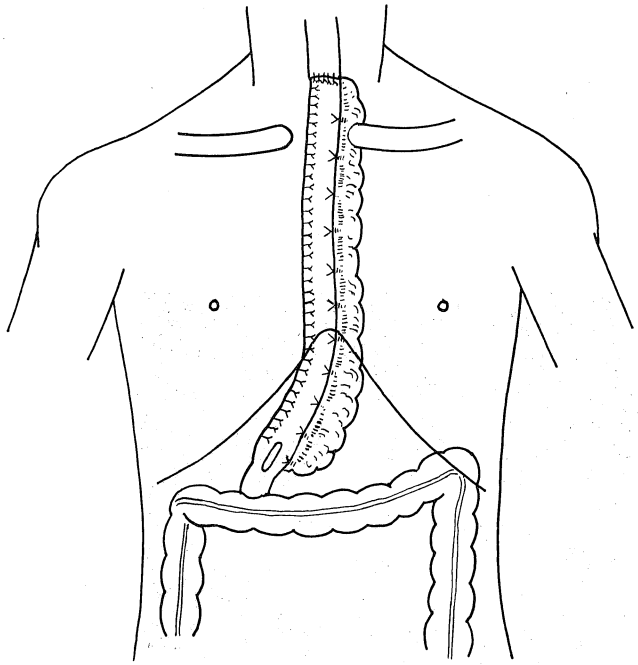

Fig. 3. The final form of esophageal reconstruction with a long gastric tube of 3 cm in width.
Gastric tube being raised up through retrosternal route is made so that clavicular pressure can be avoided and end to end anastomosis between the cervical esophagus and a gastric tube with pylor-omyotomy for drainage procedure at a proximal side of about 4 cm from the clavicle.

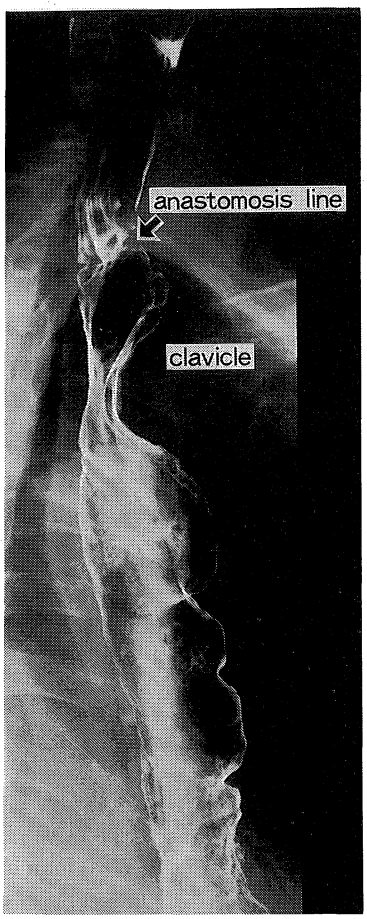

Fig. 4. Postoperative X-ray picture (anastomotic portion).
The passage of barium is seen favorable as an anastomotic line is located at a proximal side of about 4 cm from the upper clavicular line.

Fig. 5. Postoperative X-ray picture (pyloric portion).
No excretion of barium is seen in contraction phase of pyloric portion.

Fig. 6. Postoperative X-ray picture (pyloric portion).
Excretion of barium is seen in a dilatation phase of pyloric portion.

POSTOPERATIVE RESULTS

We have studied the postoperative results obtained from 16 cases who underwent our reconstruction procedures following resection of thoracic esophageal cancer. By about the 10 th postoperative day, no anastomic complication by suture insufficiency had been found. No passage disturbances after the start of feeding, reflux esophagitis or complaints such as dumping, etc. were observed.

Fig. 4 shows typical postoperative X-ray pictures obtained with barium as a contrast medium. The anastomotic portion shown in the picture is located at the proximal side, about 4 cm from the clavicular upper edge, and the passage of barium is seemingly favorable, but the gastric tube is being pressured by the clavicle.

As shown in Fig. 5, a radiographic picture in the neighborhood of the antrum, barium is not excreted to the duodenum in the contraction phase of antrum. However, as shown in Fig. 6, the fact that barium is more smoothly excreted to the duodenum in the dilatation phase may indicate the effective results of pyloromyotomy as sphincteric action of the pyloric portion is retained as well. In view of the postoperative angiography of the right gastroepiploic artery shown in Fig. 7, the blood supply in the gastric tube was acceptably favorable.

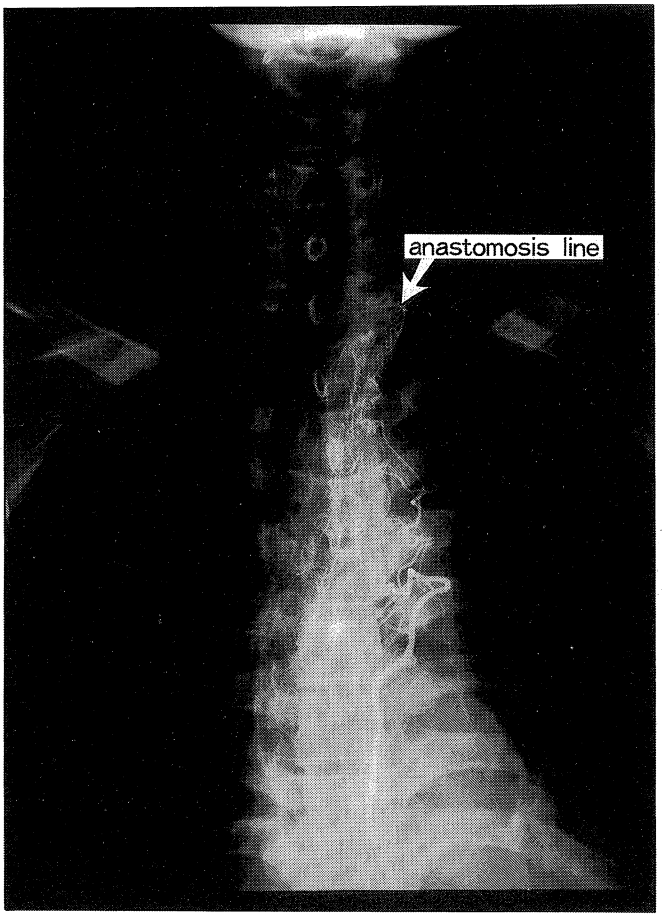

Fig. 7. Postoperative angiography of right gastroepiploic artery.
Blood supply in the right gastroepiploic artery up to an anastomotic portion can be seen.

DISCUSSION

Although various factors are conceivably responsible for major post-operative complications such as suture insufficiency and passage disturbance, blood flow disturbance in the proximal side of the gastric tube and tension of the anastomotic portion are particularly important. Efforts have been made to eliminate such factors (3)～(7) ever since a gastric tube on the greater curvature was introduced by Mes (8) in 1948, but the results are not completely satisfactory. Nonetheless, we have currently obtained favorable results from our procedure using a long gastric tube with a diameter of 3 cm. This narrow gastric tube may be advantageous in that it allows more blood flow per unit tissue, compared with a wide gastric tube, and anastomosis is available in a region with less blood flow disturbance, thereby enabling us to produce a long gastric tube with less tension on the anastomotic portion.

Ikeda et al. (9), who used 4 kinds of gastric tubes (whole stomach, 6, 3, and 1.5 cm in width) in an experimental study on blood flow in dogs, reported that the blood flow in a gastric tube with a diameter of 3 cm was significantly favorable when the blood flow was measured by the hydrogen clearance method (10). They mentioned that a 3 cm diameter gastric tube supplied by a single vessel of the right gastroepiploic artery allows more blood flow than whole stomach supplied by two vessels of the right gastroepiploic artery and the right gastric artery, and that this can be explained by the fact that the main supplied vessel is the left gastric artery in lesser curvature, and no improvement can be expected, even when the narrow right gastric artery is retained, as only supplement regions of blood flow are increased.

Sugimachi et al. (11), who also prepared a 3 cm diameter gastric tube, considered that there was a relative increase in the blood flow, since the supplement region of blood flow in the occupied area of the right gastroepiploic artery decreased. On the other hand, Yonezawa et al. (11) mentioned that more blood flow was observed in the mucosal and submucosal layers in the proximal side of a gastric tube, and that these layers are important in accretion of the tissue in the anastomosis of the digestive tract. Since it is important to employ a suture method that causes less damage to these layers, we have been using Gambee's method for anastomosis between the cervical esophagus and the gastric tube.

Upon preparing a 3 cm diameter gastric tube, we paid attention to the difference of extension between the mucosal layer and the seromuscular layer, which eventually made it possible to make a longer gastric tube. Thus, we dissected these layers separately in the first place, and performed interruted suture of the seromusuular layers after the mocosal layers were sutured. As a result, we successfully extended the gastric tube by about 35% more than those previously in use. The anastomotic side of a gastric tube with poor blood supply is resected and anastomosis in a region with favorable blood supply is available in a sufficiently long gastric tube. This conceivably alleviates the tension in the anastomatic portion as well.

In terms of distance, our procedure for reconstruction through retrosternal route is more advantageous than through an ante-thoracic route, since it makes it possible to perform anastomosis in a considerably higher cervical region than the clavicle, thereby avoiding disturbance due to pressure in the anastomotic portion. Thus, it is presumably easier to improve eventual suture insufficiency as it occurs in the cervical region.

Opinions differ as to whether the pyloric drainage procedure should be added to the esophageal reconstruction using a gastric tube on the greater curvature (13)～(16). Kuwabara in our department, who studied electromyograms of the gastric tube, inner pressure of the pyloric portion, and excretory dynamics of the gastric tube in dogs, mentioned that antral excitation was observed in the electromyographical changes of the antrum and the manometric changes of the pyloric portion in the gastric tube on the greater curvature before and after expansive stimulation, and that this excitation was improved after pyloromyotomy that accelerated the excretion of the contents of the gastric tube. (17)

For the above reason, pyloromyotomy instead of pyloroplasty is clinically employed for the prevention of passage disturbances in the pyloric portion. The advantages are rhythmical excretion of the contents of the gastric tube to the duodenum in the dilatation phase of the pyloric portion, and pyloric sphincteric action in addition to the prevention of rapid excretion

or reflux from the duodenum. Pyloromyotomy is also useful for eliminating postoperative complaints such as dumping syndrome and reflux esophagitis, etc., and conceivably prevents the shortening of the gastric tube due to vertical incision and horizontal suture by Heineke-Mikulicz's method.

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