A New Technique for Shaping the Gastric Tube, Using Both Radial and Linear Staplers

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One factor influencing surgery for esophageal cancer is the reconstruction technique, which may involve constructing a tube from the stomach or the intestines. Good blood flow and adequate length are necessary. Gastric tube formation became easier with the availability of improved surgical staplers, but gastric tube necrosis and leakage may still occur. Therefore, a simple technique providing good blood flow to the end of the gastric tube is needed. One method is called the whole stomach technique: the surgeon excises the small part of the gastric wall supplied by the left gastric artery. Another is called the gastric tube technique: the surgeon divides the stomach from the lesser curvature along the axis of the greater curvature. But the gastric tube method is so difficult that different devices are used in each institution.

We use the gastric tube method, except in patients with gastric cancer or patients with a history of gastrectomy. One reason for choosing this method is that it provides sufficient length. Length is never a problem, even in the case of laryngo-esophagotomy. With a linear cutting stapler, shaping the gastric tube is comparatively easy and time-saving. Since 2012, we have used the Endo-GIA60 with Tri-Staple (Covidien Japan). To shape a long, slender tube, we usually use 6 or 7 linear staplers.

The first problem is an irregular section of a knot, which causes no trouble if the serial stapling is in the same direction (Fig. 1). But once the direction shifts, inserting a linear stapler becomes difficult, and the knot becomes more notched. To shape a long tube, the first 2 staplers must be at a nearly right angle. If the area below is the remaining side, the section is more notched. These sides are vulnerable, with limited blood flow. Therefore, we developed a new technique using 2 types of staplers.

TECHNIQUE

We describe 2 methods: method A and our new procedure, method B. In both methods, the stapler was fired as often as needed to divide the stomach from the lesser curvature along the axis of the greater curvature, creating a 3- to 5-cm wide tube. The distance between the incision and the pylorus was approximately 5 cm, where the third branch of the right gastric artery was preserved.

Method A

As shown in Figure 2, the first incision with the linear stapler was toward the direction of the greater curvature, near the right angle of the lesser curvature. About 3 cm of the gastric wall was separated by this firing, and an area 3 to 5 cm from the greater curvature was preserved. The next staplers were set parallel to the greater curvature and fired to the cardia, so the angle of the first 2 staplers became nearly 90 degrees. We always use 6 or 7 staplers, 60 mm long, reinforcing the intersections with Albert and Lembert sutures, being especially careful at point b (Fig. 2).

There are problems with method A. First, once the first stapler is set perpendicularly, it is difficult to insert the second stapler parallel to the greater curvature. The staplers overlap at the intersection. Second, because of the difficulty in inserting the second stapler, we must twist the gastric wall, so the section becomes uneven. Third, frequently we cannot use the stapler’s full length. Finally, we must reinforce the intersections. Because of low blood flow, we always bury this intersection.

Method B (Fig. 2, dotted line)

We use the GIA Radial Reload (Covidien) for the first stapler, which places 3 curved rows of staples, 60 mm in length, on each side of a cut line and simultaneously divides the tissue between the third and fourth lines. With this stapler, we cut the gastric wall to the estimated gastric tube width. Then, a linear stapler can be set tangential to the arc of the separated line. After the second stapling, we always use 3 or 4 staplers 60 mm long. To perform this method more easily and certainly, we developed a special ruler to determine 3 points. First, we mark the initial point about 5 cm from the pylorus (Fig. 3, point a). Point a is placed on a line, at the

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The beginning of one-quarter of a circle (Fig. 4, X-Y), and the line Y-Z is parallel to and a distance of 3 to 5 cm from the greater curvature. The intersection of the end of the quarter-circle and the line Y-Z is marked (Fig. 3, point b). Point c is marked on the line Y-Z (Fig. 3), 6 cm from point b. The ruler is removed, and stapling is started. The GIA Radial Reload is set on the gastric wall. The stapler tip is at point b, and point a is on the stapler line. Then, we grip the stomach with no slack and shape the gastric tube, as in method A. We do not extend the gastric wall at the time of stapling. Expansion of the gastric wall causes the transformation post-stapling. Depending on the staple size, the length of the separated wall is often shorter than planned, mainly due to stretching caused by the stapler pressure.

With method B, all of the previous problems were solved. Insertion of the second stapler became easier, and overlap of the staples decreased. We do not twist the gastric wall at the time of stapler insertion, and the section becomes linear. We can use the stapler’s full length. We use 2 linear staplers to cut from points a to c in method A, but only 1 with method B. The intersection of the 2 staplers is similar to the intersection of 2 linear staplers with the same direction, so we omit the Lembert suture.

Although the staple line length with method A is longer than with method B, reinforcement sutures shorten the staple line. Due to the staplers’ overlap, the staple line of method A will not become straight; additionally, the staple line (b to c) often becomes irregular because of twisting of the gastric wall, and it will be shortened.
With method B, the best direction of the second stapler is Y to Z, but we sometimes must select the direction toward the lesser curvature. Correction takes place on the third stapling or later. A correction of direction less than 20 degrees is desirable. In cases involving a correction of more than 20 degrees, the modification of the staple line and the crush of the intersection become notable. To avoid these problems, we often use the GIA Radial Reload again.

**DISCUSSION**

Owing to the development and improvement of surgical staplers, suturing and anastomosis of the digestive organs, such as those during gastric tube reconstruction and esophagectomy, have become easier and safer. Many reports about the methods and experiments for esophageal reconstruction have been published. Important conditions required for reconstruction are good blood flow and sufficient length. The gastric tube’s blood supply is from the right gastric artery and gastroepiploic artery, and the blood flow of the gastric wall is decreased to the cardia. Blood flow within the stomach wall is also important. To preserve the blood flow within a wall, the whole stomach method is used. It is very easy to shape the whole stomach using 1 or 2 linear staplers.

Linear staplers are also used to shape the gastric tube. We use the Endo GIA Tri-Stapler because of its good operating characteristics and good arrest of hemorrhage. We usually use a vascular/medium cartridge with 2-mm, 2.5-mm, and 3-mm staples. With this cartridge, no bleeding is found at the staple line’s surface. With a narrow width, continuous stapling becomes easy, but the problem of the intersection remains. Rapidly turning the stapler must be avoided. Combinations of linear staplers cannot address this problem. The Radial-Reload can cut deeply with a curved line to the planned width. Then, linear staplers can cut the gastric wall parallel to the greater curvature. In order to make a series of staplings more simply and smoothly, unification of the first and second stapler is necessary. Our specialized ruler made it possible to unify the 2 staplers. After 3 points are determined, stapling is performed. The ruler’s slit facilitates selecting the second stapler’s direction.

![Figure 3. Surgical view. (A) The ruler and the 3 selected points. (B) Curved stapler is set. (C) Curved stapler is fired. (D) Linear stapler is fired next to the curved stapler.](image)

![Figure 4. Ruler for the gastric tube.](image)
We have experienced an angle of 20 degree or less with continuous stapling. When the angle becomes greater than 20 degrees, cutoff stump modification is required, and the intersection becomes large. With careful stapler insertion, we cannot discover the intersection easily. Moreover, the Radial-Reload is used not only for the first stapling but for closing the top of the gastric tube, for the esophagus and gastric anastomosis. We developed a special ruler to assist with a new method of gastric tube formation. Creating a long gastric tube parallel to the greater curvature, an arc about the stomach, is difficult, and it is very difficult to correct the tube’s shape before separating the stomach. With our ruler, we can make a simple and smooth gastric tube using a radial stapler along with a linear stapler.

REFERENCES