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ORIGINAL ARTICLE

Internal hernia after laparoscopic gastrectomy with Roux-en-Y reconstruction for gastric cancer

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Summary *Background/objective:* Laparoscopic gastrectomy (LG) is increasingly used to treat gastric cancer. Simultaneously, internal hernia (IH) has been reported after LG with Roux-en-Y reconstruction (RY). The aim of this study was to investigate IH after LG with RY for gastric cancer.
Methods: This study included 15 patients with IH from a database of 355 consecutive patients who underwent LG with RY for gastric cancers. We retrospectively analyzed IH incidence and clinical characteristics by operative procedures.
Results: The total incidence of IH was 4.2%. The incidence of IH at Petersen's defect tended to decrease with modifications to the reconstruction methods, but not significantly so. The incidence of IH at jejunojejunostomy mesenteric defect significantly decreased with closure of this defect ($p = 0.01$). The incidence of IH at transverse mesocolic defect was 1.3% in patients who underwent retrocolic RY; emergent small-bowel resection was only required in two cases of herniation through this defect after laparoscopic total gastrectomy.
Conclusion: Retrocolic RY with appropriate closure of defects can reduce IH incidence at Petersen's defect and at jejunojejunostomy mesenteric defect. Although the IH incidence

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at the transverse mesocolic defect is not particularly high, the possibility of herniation through this defect should be kept in mind.

1. Introduction

In Japan, gastric cancer is the second most common cause of cancer death.[1] Laparoscopic gastrectomy (LG) has been widely adopted as a treatment option, not only because it is less invasive and offers better cosmetic outcomes, but also because it enables the rapid recovery of intestinal movement and facilitates accurate lymph-node dissection through magnified viewing.[2] Simultaneously, internal hernia (IH) has been reported as a cause of postoperative small-bowel obstruction after LG, particularly after Roux-en-Y reconstruction (RY); in contrast, more adhesions are observed after open gastrectomies.[3–7] IH is a well-known postoperative complication of laparoscopic Roux-en-Y gastric bypass (LRYGB). The use of the antecolic antegastric route or closure of mesenteric defects is widely reported to reduce IH after LRYGB,[8–14] as is the use of proper techniques, such as avoiding mesenteric division and ensuring appropriate orientation of the alimentary limb.[15] Excess weight loss has been reported as a cause of IH.[16]

Unfortunately, IH is difficult to diagnose because its associated symptoms are rather nonspecific, and the imaging modalities used in its diagnosis are inadequately sensitive; however, it can be life threatening.[16–18] Whereas LRYGB and LG with RY have some differences (such as postoperative construction of the supracolic component and preoperative obesity with LRYGB), few reports have addressed IH after LG with RY. This study aimed to clarify the characteristics of IH after LG for gastric cancer.

2. Methods

2.1. Patients

This was an observational, historical cohort study. We analyzed patients from a database of 355 consecutive patients who underwent LG with RY for gastric cancers at the Department of Surgery, Japan Community Health care Organization, Kyushu Hospital between April 2006 and April 2012. Laparoscopic gastrectomies were indicated for all patients regardless of the clinical stages of their cancers, when an informed consent was obtained. These patients consisted of 257 who underwent laparoscopic distal gastrectomy (LDG) and 98 who underwent laparoscopic total gastrectomy (LTG). Postoperative staging was performed according to the tumor–node–metastasis staging system.[19] Early gastric cancer was defined as cancer invading the mucosa or submucosa, with or without lymph-node metastasis.[20]

2.2. Operative procedures for RY

Table 1 shows the changes in RY procedures over time at our institution. We performed antecolic RY without closure of Petersen's defect, which is found at the back side of the Roux limb or of the jejunojejunostomy mesenteric defect until March 2009 (first period). In April 2009, because of increasing IH occurrence, we changed our standard technique to retrocolic RY with closure of the jejunojejunostomy mesenteric defect (second period). Since April 2011, we have also closed Petersen's defect (third period). The transverse mesocolic defect was also closed by fixing the gastrojejunostomy site (LDG) or jejunum (LTG) to it in all patients who underwent retrocolic RY. All defects were closed with 4-0 absorbable intermittent sutures. To bring up the Roux limb, approximately 5 cm of the small bowel was sacrificed in LDG, and 20 cm in LTG, instead of dividing the mesentery. Both gastrojejunostomy (LDG) and esophagojejunostomy (LTG) were performed using linear staplers under pneumoperitoneum; the jejunojejunostomy was fashioned using hand sutures through the minilaparotomy or linear staplers under pneumoperitoneum in all cases.

2.3. Clinicopathological variables

We collected the following clinicopathological data for patients who developed IH: age, sex, cancer stage, degree

Table 1 Changes in Roux-en-Y reconstruction by period.

Period	Number of patients	Route of Roux limb	Closure of Petersen	Closure of JJ	Closure of T-colon
First period	119	Antecolic	No	No	—
	30	Retrocolic	No	No	Yes
Second period	3	Antecolic	No	Yes	—
	98	Retrocolic	No	Yes	Yes
Third period	105	Retrocolic	Yes	Yes	Yes

First period: April 2006–March 2009; second period: April 2009–March 2011; third period: April 2011–April 2012.
JJ = jejunojejunostomy mesenteric defect; Petersen = Petersen's defect; T-colon = transverse mesocolic defect.