Robotic distal gastrectomy for advanced gastric cancer after coronary artery bypass grafting using the right gastroepiploic artery

Introduction: The right gastroepiploic artery (RGEA) is used in coronary artery bypass grafting (CABG). However, the treatment of gastric cancer after CABG using the RGEA is complex, as stopping coronary blood flow from the RGEA may cause lethal myocardial ischemia. Adequate treatment must strike a balance between the curability and safety.

Case presentation: The patient was a 79-year-old man with advanced gastric cancer who had previously undergone CABG with the RGEA. It was impossible to perform curative gastrectomy with preservation of the RGEA. Thus, percutaneous coronary intervention was performed to revascularize the native right coronary artery. The patient then started chemotherapy using oxaliplatin and S-1. After four courses of chemotherapy, the patient underwent robotic distal gastrectomy with D2 lymphadenectomy, including regional lymph node dissection around the RGEA. The RGEA was cut after a clamp test confirmed that there was no ST change.

Conclusion: In patients who develop gastric cancer after CABG using the RGEA, percutaneous coronary intervention of the native coronary artery is useful when resection of the RGEA is required to dissect the no. 6 lymph node. Robotic gastrectomy is a surgical option in such cases.
Case Report

Robotic distal gastrectomy for advanced gastric cancer after coronary artery bypass grafting using the right gastroepiploic artery

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Robotic distal gastrectomy after CABG using the RGEA
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Robotic distal gastrectomy after CABG using the RGEA
Abstract

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Keywords: coronary artery bypass grafting, robotic surgical procedures, gastrectomy, gastroepiploic arteries, gastric cancer

Robotic distal gastrectomy after CABG using the RGEA
Introduction

Coronary artery bypass grafting (CABG) surgery is performed using the right gastroepiploic artery (RGEA). As the RGEA is a conduit with long-term patency, some patients may develop gastric cancer after CABG. In such patients, the stoppage of coronary blood flow from the RGEA may cause lethal myocardial ischemia. However, dissection of the no. 6 lymph node (LN) is indispensable, especially in advanced gastric cancer. Adequate gastrectomy after CABG using the RGEA requires a good balance between curability and safety. Therefore, the appropriate treatment must reduce the risk while maintaining the curability of the operation.

This is the first report of robotic distal gastrectomy in a patient who had previously undergone CABG using the RGEA and thus required preoperative percutaneous coronary intervention (PCI) therapy.

Case Report

The patient was a 79-year-old man. In 2003, he had been treated at another hospital for acute myocardial infarction with three-vessel CABG, involving a bypass between the right coronary artery (RCA) and the RGEA, between the left anterior descending branch and the left internal thoracic artery, and between the left circumflex coronary artery and the right internal thoracic artery.

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In March 2020, he presented at a local hospital because of appetite loss and vomiting. Gastric endoscopy revealed advanced gastric cancer in the lower-third (L) region (Fig. 1A). The patient was then referred to our hospital for gastrectomy. Upper gastrointestinal radiography showed a deep and irregular open ulcer in the L region (Fig. 1B). Abdominal computed tomography (CT) showed advanced gastric cancer with no LN metastasis (Fig. 2A). Distant metastasis was not detected. As there was a possibility of peritoneal metastasis, staging laparoscopy was performed. However, there was no metastasis and cytology was negative.

Curative gastrectomy was planned. As the advanced gastric cancer was located in the L region, it was essential to perform no. 6 LN dissection and resection of the RGEA. Angiographic therapy was performed to try to reopen the native RCA. The patient underwent coronary angiography preoperatively. After confirming that the RGEA was patent, the stenosed native coronary artery was revascularized using drug-eluting stents to avoid cardiac ischemia after resection of the RGEA (Fig. 3).

After angiographic treatment, the patient was started on dual antiplatelet drug therapy. To minimize the risk of intraoperative bleeding, the antiplatelet drug therapy was then gradually reduced. During the waiting period, the patient was administered chemotherapy comprising an injection of oxaliplatin (160 mg) on day 1 and oral administration of S1 (80 mg/day) for 14 days (SOX therapy); the patient received four 21-day Robotic distal gastrectomy after CABG using the RGEA.
courses of chemotherapy. After 3 months, one antiplatelet drug was ceased, and the operation was planned. The other antiplatelet drug was continued throughout the surgery.

After four courses of chemotherapy, there was no evidence of tumor progression on CT (Fig. 2B). Furthermore, the level of carcinoembryonic antigen decreased from 104.7 ng/ml to 19.4 ng/ml, suggesting that the chemotherapy effectively reduced the tumor. The effectiveness was judged as 'stable disease' in accordance with the Response Evaluation Criteria in Solid Tumors guidelines. Preoperative three-dimensional CT showed that the RGEA graft was clearly depicted, and was distinguishable on the upper surface of the left lateral liver segment (Fig. 4).

Surgery was performed 5 months after the first angiographic treatment, and distal gastrectomy with cutting of the RGEA was planned. Cardiovascular surgeons and cardiologists were on standby in case of unexpected myocardial infarction during the gastrectomy.

Robotic distal gastrectomy was performed using five ports. The RGEA graft was recognized on the left lobe of the liver (Fig. 5A). Before cutting the RGEA graft, it was clamped with forceps for 30 min (Fig. 5B). After confirmation from the anesthesiologist that there was no ST change or other changes during clamping, the RGEA graft was clipped and cut (Fig. 5C). Robotic distal gastrectomy with D2 lymphadenectomy was then performed.

The Billroth-I procedure was used for reconstruction (Fig. 6).

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The postoperative course was uneventful, and the patient was discharged on postoperative day 10. The pathology showed adenocarcinoma (por) and T3 (SS). There were no LN metastases. The final stage was classified as IIA based on the Japanese Classification of Gastric Carcinoma (14th edition).

Discussion

The RGEA is frequently used in CABG, and is the arterial graft of choice for RCA bypass surgery requiring long-term patency. However, gastric cancer after CABG with the RGEA is a potential problem. Curative gastrectomy for gastric cancer requires dissection of the LN around the stomach, and standard D2 lymphadenectomy includes dissection of the no. 6 LN. Such LN dissection requires resection of the RGEA, as the no. 6 LN is located at the root of the RGEA.

There are two strategies for gastrectomy in patients with a RGEA graft. First, when it is possible to preserve the RGEA graft, gastrectomy is performed without dissection of the no. 6 LN or with no. 6 LN dissection while preserving the RGEA during careful skeletonization. However, it is unclear whether this procedure achieves complete resection of the no. 6 LN, and it is hard to perform repeat resection for recurrence around the no. 6 LN because of the presence of the pancreatic parenchyma. In such cases, there is a possibility of incomplete no. 6 LN dissection. Second, when it is impossible to preserve the Robotic distal gastrectomy after CABG using the RGEA
Robotic distal gastrectomy after CABG using the RGEA, preoperative coronary revascularization is attained via either redo CABG or PCI or via intraoperative simultaneous CABG or additional alternative grafting. Preoperative coronary revascularization attained via either redo CABG or PCI reportedly enables successful gastrectomy, while performing simultaneous gastrectomy with CABG increases the operative difficulty and prolongs the procedure. In the present case, the patient had advanced gastric cancer located in the L region and required complete no. 6 LN dissection. Preoperative PCI was selected for revascularization, and we cut the RGEA graft after confirming the maintenance of adequate blood flow. Resection of the RGEA graft enabled dissection of the no. 6 LN, as reported in a similar previous case.

The two methods used to harvest the RGEA for grafting are the skeletonization method and the pedicle method. Skeletonization is the preferred method of harvesting the RGEA for CABG, as the skeletonized RGEA is easily identified as an intraperitoneal artery graft during gastrectomy because it does not adhere to the surrounding tissue. The major disadvantage of the pedicle method is that the RGEA may adhere to the greater omentum or to the anterior abdominal wall, and it may be hard to distinguish the REGA pedicle from the surrounding fat. When the vessels are covered with a large amount of fat, it is difficult to discriminate between the falciform ligament and the RGEA graft, which might lead to inadvertent injury of the RGEA graft during dissection. In the present case, CABG had been performed in another prefecture 17 years previously, so we were unable to obtain the

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operative record. However, by doing the staging laparoscopy, we confirmed that the RGEA graft had been harvested using the pedicle method. In such cases, it is very important to gather this information before surgery. Preoperative three-dimensional angiography is essential for the identification of the RGEA graft.

Because LN metastasis does not occur where the lymph flow has been disconnected from the stomach, we did not dissect the LN around the harvested RGEA. If the RGEA graft had been harvested by the skeletonization method and freed up to its base with resections of the pyloric branches during the first CABG operation, metastasis to the no. 6 LN would have been very unlikely and thus it would not have been considered necessary to dissect the no. 6 LN. Alternatively, if the RGEA graft had been harvested by the skeletonization method and freed to the point of the bifurcation of the gastroduodenal artery with resections of the pyloric branches during the first CABG, no. 6 LN metastasis would also have been extremely unlikely, as direct lymph flow to the no. 6 LN from the greater curvature of the stomach would have been eliminated. However, as the RGEA had been harvested by the pedicle method in the present case, we had to remove the no. 6 LN.

There are many reports of patients who have previously undergone CABG with the RGEA who have subsequently undergone gastrectomy performed via laparotomy, while there are only two reports of such patients undergoing laparoscopic gastrectomy. Furthermore, the present case is the first report of gastrectomy performed robotically. In performing

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repeat laparotomy, an epigastric median incision should be avoided to minimize the risk of injuring the graft.\textsuperscript{12} Laparoscopic surgery reduces the risk of injury to the RGEA due to either the laparotomy incision or a liver retractor.\textsuperscript{9} Furthermore, it is easy to identify the falciform ligament and RGEA pedicle under laparoscopic view. As the plan in the present case was to cut the RGEA graft, it was decided in the preoperative conference that a clamp test was essential to confirm that there were no cardiac changes before cutting the graft. Therefore, it was particularly important to avoid accidentally cutting the RGEA.

**Conclusions**

Preoperative PCI is useful for attaining revascularization when resection of the RGEA is needed to remove the no. 6 LN in patients who have undergone CABG with the RGEA. Furthermore, robotic gastrectomy is a viable surgical option in such cases.

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**Figure legends**

Fig. 1 Images of the gastric cancer at the time of presentation at our hospital. (A) Gastrointestinal endoscopic image showing advanced gastric cancer located in the lower-third region. (B) Upper gastrointestinal radiography showing a deep and irregular open ulcer in the lower-third region.

Fig. 2 Abdominal computed tomographic images showing the thickness of the stomach wall (A) before chemotherapy and (B) after chemotherapy.

Fig. 3 Angiographic images. (A) Angiogram of the celiac artery showing a patent right gastroepiploic artery (RGEA; arrow). (B) Coronary angiogram showing severe stenosis of the native right coronary artery (RCA) (arrow #1: 75%, #2: 99%, #3: 99%). (C) Three drug-eluting stents are implanted in the native RCA. Subsequently, the restricted blood flow improves and there is retrograde flow of contrast medium to the patent RGEA.

Fig. 4 Preoperative three-dimensional computed tomographic images showing (A) the right gastroepiploic artery (RGEA) graft is clearly depicted (arrows), and (B) the RGEA graft on the upper surface of the left lateral segment of the liver.

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Fig. 5 Intraoperative photographs of the right gastroepiploic artery (RGEA) graft. (A) The RGEA graft is easily identified on the left lobe of the liver. (B) Bulldog forceps are used to clamp the RGEA graft for 30 minutes before (C) the RGEA graft is clipped and cut.

Fig. 6 The resected gastric cancer specimen.

Robotic distal gastrectomy after CABG using the RGEA
Figure 3
Figure 5

A  Falciform ligament
B  Pedicle of RGEA
C  Graft
Figure 6
