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**Makoto Takahashi, Jun Aoki, Yu Okazawa, Yukihiro Yaginuma,
Yutaka Kojima, Kazuhiro Sakamoto**

ABSTRACT

Introduction: The right gastroepiploic artery (RGEA) is sometimes used for coronary artery bypass grafting (CABG) due to the high patency rate of the graft. Cases of laparoscopy-assisted colectomy (LAC) after CABG using the RGEA are extremely rare.

Case Report: The patient was a 70-year-old male with ascending colon cancer. His history included myocardial infarction at the age of sixty-two, for which he underwent CABG using the RGEA. The patency of the bypass vessels was good in preoperative coronary angiography and celiac angiography. Laparoscopy-assisted colectomy was conducted with standby of a cardiovascular surgeon. Pneumoperitoneum was performed at lower pressure than usual and a beating RGEA was confirmed. We were careful to avoid stress and damage to the RGEA. Laparoscopic right hemicolectomy was conducted without arrhythmia or ST change in an intraoperative electrocardiogram.

Conclusion: The important thing in LAC after CABG using the RGEA seemed to be a lower pneumoperitoneum pressure, a patient position, sophisticated surgical technique, and understanding surgical anatomy to conserve the RGEA.

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CASE REPORT

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Keywords: Laparoscopy assisted colectomy, Coronary artery bypass graft, Right gastroepiploic artery (RGEA), Colorectal cancer

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INTRODUCTION

Upper abdominal surgery is usually performed as open surgery in patients who have undergone coronary artery bypass grafting (CABG) using the right gastroepiploic artery (RGEA) as a graft because it is necessary to conserve the RGEA. However, several recent case reports have described laparoscopic surgery for gallstones and gastric cancer after CABG with the RGEA [1, 2]. Herein, we describe laparoscopic right hemicolectomy conducted safely in a patient with ascending colon cancer after CABG using the RGEA.

CASE REPORT

A 70-year-old male underwent colonoscopy due to positive results on a fecal occult blood test and was

diagnosed with ascending colon cancer. He had myocardial infarction at the age of 62 years and underwent CABG (left internal thoracic artery (LITA)—left anterior descending artery, RGEA—right posterior descending coronary artery). Symptoms on admission were operative scars on the midline of the chest and epigastric area. The abdomen was flat and soft, and no tumor was palpable. Blood tests showed no abnormal findings. Tumor markers were normal, with CEA of 1.6 ng/mL and CA19-9 of 11 ng/mL. Colonoscopy showed an ulcerated lesion of size 20 mm in the ascending colon and a laterally spreading tumor of size 30 mm in the cecum, both of which were found to be well-differentiated adenocarcinoma by biopsy. Computed tomography (CT) scan showed a slight wall thickness in the ascending colon, which was considered to be due to the primary lesion. No lymphadenopathy, ascites or distant metastasis was found. The RGEA was well enhanced, was inserted into the thoracic cavity via the antegastric route, and bypassed the right coronary artery (Figure 1). The computed tomography colonography showed a tumor of size 20 mm in the ascending colon, but a lesion in the cecum was not detected (Figure 2). Coronary angiography from the celiac artery showed the common hepatic artery, gastroduodenalis and right gastroepiploic artery in order, and finally the right coronary artery (Figure 3). The bypass from the LITA to the left anterior descending artery was also clearly apparent. A metal stent was inserted because stenosis in the left circumflex coronary artery was 90%.

The patient was diagnosed with ascending colon cancer (T3N0Mo, Stage IIA) and cecal cancer (TisN0Mo, Stage 0) after CABG using the REGA, and surgery was performed, with a cardiovascular surgeon on standby for an emergency. Surgery was performed under general anesthesia with the patient in the lithotomy position. Surgery started with establishment of 5 ports: a 12-mm port in the umbilicus, an 11-mm port in the left upper abdomen, and 5-mm ports in the left lower abdomen and the right upper and lower abdomen. Pneumoperitoneum pressure was set 5 mmHg, which was lower than usual. A beating RGEA toward the mediastinal direction via the antegastric route was found in the right side of the round ligament of the liver (Figure 4). Pneumoperitoneum pressure was gradually increased to 8 mmHg with careful attention not to strain the RGEA. The cecum and ascending colon were mobilized from the retroperitoneum by the retroperitoneal approach and the surgical trunk was exposed. The ileocolic artery and vein, the right branch of the middle colic artery and the accessory right colic vein were high ligated and resected. We could not detect vessels directed towards the greater omentum, so we could not confirm the gastrocolic trunk. The omental bursa was opened and severe postoperative adhesion due to the previous surgery was found between the greater omentum and transverse colon (Figure 5). The RGEA in the greater omentum could not be confirmed due to large amounts of fat. Consequently, we conserved the greater omentum itself and resected from the transverse colon

to prevent vascular injury in the greater omentum, and the hepatic flexure was mobilized (Figure 6). The port wound in the umbilicus was extended to 4 cm and the right side colon was moved to outside the body. After functional end-to-end anastomosis, right hemicolectomy were performed. Postural changes including head-up and head-down positions were kept to a minimum during surgery, and the RGEA was observed frequently when the surgical area was changed during the procedure. Consequently, there was no injury or excessive stress in the RGEA and no electrocardiogram (ECG) change or arrhythmia suggesting myocardial ischemia. The operative time was 4 h and 59 min and the blood loss was 20 mL.

The cancer was T3N1Mo and stage IIIB. Histopathological findings showed that the lesion in the ascending colon was moderately differentiated adenocarcinoma, 14×11 mm, T3, N1 (1/44), lymphatic and venous invasion: positive, and finally stage IIIB; and that the lesion in the cecum was well-differentiated adenocarcinoma, 26×24 mm (cancer component: 9×3 mm), Tis, No, lymphatic and venous invasion: negative, and finally stage 0. No symptom indicating cardiovascular events such as chest pain or palpitation occurred after the operation and no abnormality indicating myocardial ischemia appeared on the ECG monitor. The patient resumed eating on postoperative day (POD) 4 and therapy with an antiplatelet agent was started on POD 5. However, the antiplatelet agent was discontinued due to melena on POD 9. However, melena continued and colonoscopy showed bleeding at the anastomosis, which was clipped endoscopically to stop the bleeding. The subsequent course was good and no bleeding occurred after resuming the antiplatelet agent and ingestion. The patient was discharged on POD 36 and is currently receiving adjuvant chemotherapy without ECG changes, melena or recurrent cancer.

Figure 1: Computed tomography scan of the abdominal showing RGEA (arrow) bypass to the right coronary artery in front of the liver.

Figure 2: Computed tomography colonography showing a tumor of size 20 mm in the ascending colon (arrow).

Figure 3: Coronary angiography from the celiac artery showing that the RGEA (black arrowhead) from the gastroduodenalis artery (GDA, black arrow) is patent to the right coronary artery (RCA, white arrowhead).

DISCUSSION

About 800,000 people have ischemic heart disease in Japan and the healthcare costs of this disease are increasing yearly. Ischemic heart disease is treated using endovascular therapy or by surgery. Use of a drug eluting stent (DES) has slightly reduced performance of CABG surgery, but CABG is still recommended for total occlusions, calcified lesions, and cases with diabetic complications [3]. Arterial grafts are frequently used as bypass grafts for CABG due to their high patency rate,

Figure 4: Intraoperative view showing the RGEA (arrow) from the distal side of the stomach to the mediastinal direction.

Figure 5: Intraoperative view showing the stomach, transverse colon, greater omentum, and middle colic artery (MCA, arrowhead). Severe adhesion was present between the greater omentum and transverse colon (*).

Figure 6: Intraoperative view after mobilized of right side colon showing the greater omentum, pancreas, duodenum, Gerota's fascia, and clips of ARCV (accessory right colic vein) and MCA (Right) (right branch of middle colic artery).

and the internal thoracic artery is most often used and sometimes radial and gastroepiploic arteries are used [4]. Surgery in elderly patients with colon cancer is likely to become more common due to aging of the population and increased morbidity of colon cancer. Therefore, surgery for colon cancer after CABG may also increase. In upper abdominal surgery after CABG using the RGEA, considerable care is needed because serious complications may occur due to RGEA injury [5]. Therefore, open surgery is usually performed. However, laparoscopic surgery has recently been applied as upper abdominal surgery for gallstones and gastric cancer after CABG and laparoscopy-assisted colectomy (LAC) is widely used in patients with colon cancer and has been shown to be safe in elderly patients [1, 2, 6].

In our case, we successfully performed LAC in a patient with ascending colon cancer who had previously undergone CABG using the RGEA. Several key aspects of the procedure differed from usual LAC. These included the need to minimize postural changes, including the head-up and head-down positions, and to start pneumoperitoneum at lower pressure than usual and gradually increase the pressure to prevent excessive stress on the RGEA [1]. Preoperative CT scan was required for understanding the locations of vessels in the right side colon, including the middle colic artery, gastroduodenal trunk and accessory right colic vein, since there is considerable variation of these vessels among individuals. After CABG, the anatomical orientation is also particularly important for the RGEA [1]. Adhesion is likely due to previous operative procedures and it is important to remove adhesions carefully and confirm the entire RGEA with attention to the antegastric or retrogastric route. If the RGEA in the greater omentum cannot be confirmed by laparoscopy, as in our case, it is also important to conserve the greater omentum around the RGEA for prevention of RGEA injury. Preventive omentectomy is also recommended due to the concern of ischemia in the right side of the greater omentum because the blood flow in the greater omentum after CABG using the RGEA depends on the colon [7]. Therefore, conservation/resection of the greater omentum should be considered on a case-by-case basis. Myocardial ischemia may also occur due to traction and excessive stress during surgery, in addition to RGEA injury [1]. Thus, the RGEA should be frequently monitored and confirmed because the limited surgical area can only be observed by laparoscope. An intraoperative search for the cystic artery can be performed using a Doppler rheometer inserted from a 5-mm port in laparoscopic cholecystectomy and this approach may be applicable for detection of the RGEA and confirmation of blood flow in the RGEA [8].

A study of open surgery in six patients with gastric cancer and nine patients with colon cancer showed no difference in operative time in patients with and without myocardial ischemia ($p=0.95$) and indicated that patients with high intraoperative blood loss were more likely to develop myocardial ischemia ($p=0.03$) [5]. Laparoscopy-

assisted colectomy has a significantly longer operative time and lower blood loss in comparison with open surgery, which suggests that LAC after CABG may be an effective procedure if care is taken to avoid RGEA injury and stress [6]. Reported cases of LAC after CABG using the RGEA are extremely rare. However, there is likely to be an increase in the number of surgeries for colon cancer after CABG using the RGEA. Laparoscopic surgery should be safe in patients with colon cancer after CABG with clear understanding of the vessel anatomy in laparoscopic wide monitoring like using microscope.

CONCLUSION

We conducted laparoscopic right hemicolectomy safely in a patient with ascending colon cancer after coronary artery bypass grafting using the right gastroepiploic artery. The important thing seemed to be a lower pneumoperitoneum pressure, a patient position, sophisticated surgical technique, and understanding surgical anatomy to conserve the right gastroepiploic artery in laparoscopy-assisted colectomy.

Author Contributions

Makoto Takahashi – Conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Critical revision of the article, Final approval of the version to be published

Jun Aoki – Conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Critical revision of the article, Final approval of the version to be published

Yu Okazawa – Conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Critical revision of the article, Final approval of the version to be published

Yukihiro Yaginuma – Conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Critical revision of the article, Final approval of the version to be published

Yutaka Kojima – Conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Critical revision of the article, Final approval of the version to be published

Kazuhiro Sakamoto – Conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Critical revision of the article, Final approval of the version to be published

Guarantor

The corresponding author is the guarantor of submission.

Conflict of Interest

Authors declare no conflict of interest.

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