Case Report

Successful Robot-Assisted Surgery for Advanced Metachronous Cancer in a Gastric Conduit after Esophagectomy: A Case Report

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The incidence of gastric tube cancers has increased due to improved survival rates in patients after esophagectomy. However, the optimal surgical approach for gastric tube cancer remains controversial. Here, we report the case of a 70-year-old man with advanced gastric cancer arising from a retrosternally placed gastric conduit, 12 years after thoracic esophagectomy for esophageal cancer. Total resection of the gastric conduit was performed with robotic assistance. Although the working space was limited, secure resection was possible. Continuous en bloc mobilization was achieved with neck dissection, and reconstruction was performed via the same retrosternal route using the ileocolon. The patient was discharged on the 14th postoperative day without any adverse events. Robot-assisted surgery can overcome the technical limitations of laparoscopic mediastinal surgery and has advantages such as improved ergonomics, comfort, and elimination of hand tremors, and therefore may be an option for future minimally invasive surgeries.

Keywords: robotic surgery, gastric tube cancer, esophagectomy, metachronous gastric carcinoma

Introduction

The incidence of gastric tube cancer (metachronous cancer in the gastric conduit after esophagectomy) has increased owing to the improved survival rate of patients with esophageal cancer treated with esophagectomy.[1–4] In recent years, endoscopic treatments for early stage metachronous gastric carcinoma arising from the gastric conduit, such as endoscopic mucosal and submucosal dissections, have been successfully performed as minimally invasive treatments.[5] However, the indications for endoscopic treatment are limited to less-advanced tumors. Surgical resection with lymph node dissection is indicated in cases of advanced cancer; however, the surgical approach for gastric tube resection depends on the route of reconstruction at the time of esophagectomy. Although median sternotomy has traditionally been used for the resection and reconstruction of the gastric conduit in the retrosternal space,[6] minimally invasive surgical treatment using a thoracoscope or laparoscope has been attempted in recent years.[7–11] Herein, we report a case of robot-assisted surgery for advanced metachronous cancer in the gastric conduit after esophagectomy.

Case Report

A 70-year-old asymptomatic man visited our hospital for postoperative follow-up examination after esophagectomy for esophageal cancer. At 58 years

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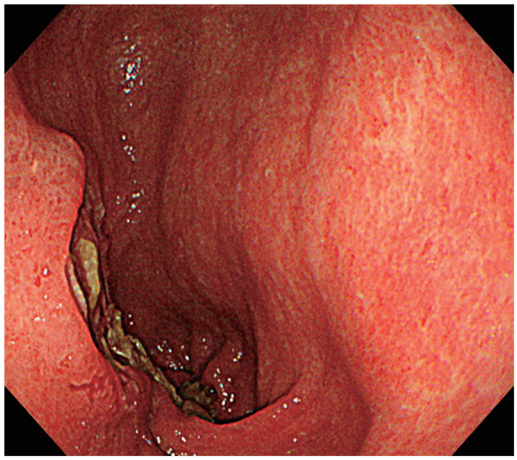

Fig. 1 Endocopic finding. Endoscopy shows Borrmann type 2 advanced cancer in the antrum.

Fig. 2 CT image. Enhanced CT shows swelling of three lymph nodes at the right gastroepiploic (no. 4d), suprapyloric (no. 5), and infrapyloric (no. 6) stations. CT: computed tomography

of age, he underwent thoracoscopic esophagectomy through the right thoracic cavity, with three-field lymphadenectomy and gastric conduit reconstruction via the retrosternal route. Follow-up gastrointestinal endoscopy showed a lesion 20 mm in length in the antrum of the gastric conduit (**Fig. 1**), and biopsy specimens revealed adenocarcinoma. The primary lesion could not be detected on computed tomography (CT); however, three lymph node metastases were noted at the right gastroepiploic (no. 4d), suprapyloric (no. 5), and infrapyloric (no. 6) stations (**Fig. 2**). Fluorodeoxyglucose (FDG) positron emission tomography-CT revealed FDG accumulation in the lymph nodes and main lesion of the stomach (**Fig. 3**). Based on these results, the patient was diagnosed with advanced gastric carcinoma arising from

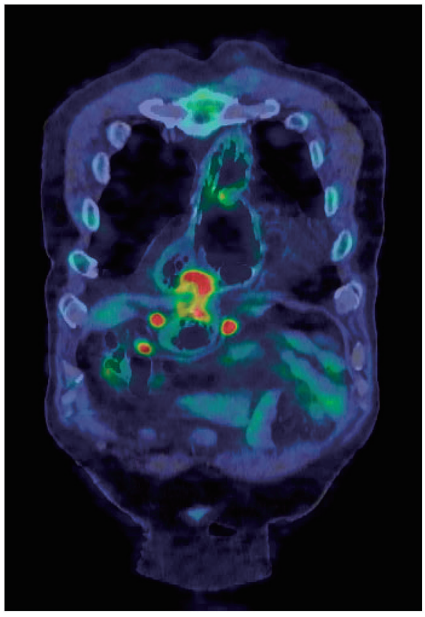

Fig. 3 FDG PET-CT image. FDG PET-CT shows FDG accumulation in the tumor at the antrum and lymph nodes (right gastroepiploic and supra- and infrapyloric lymph nodes). FDG PET-CT: fluorodeoxyglucose positron emission tomography-computed tomography

the gastric conduit (tumor, node, metastasis [TNM] stage T2N2M0: IIA).[12] We planned total resection of the gastric conduit with lymph node dissection.

Robotic surgery was performed using da Vinci Xi (Intuitive Surgical Inc, Sunnyvale, California, USA). Under general anesthesia, the patient was placed in the supine position. The robot-scope (30-degree) was inserted into the abdominal cavity through an 8-mm port at the umbilicus, and four additional trocars and a liver retractor were inserted (**Fig. 4**). The intra-abdominal pressure was maintained at 10 mmHg using the AirSeal system (CONMED Corporation, Largo, FL, USA).

Dissection of the gastric conduit was performed from the ventral side using the xiphoid process and sternum as landmarks (**Fig. 5A**). Since the right gastroepiploic artery was running on the left side, we proceeded with dissection of the gastric conduit while partially resecting the left pleura (**Fig. 5B**), while being careful to avoid damaging it. Consequently, the left thoracic cavity was widely opened. On the right side, the gastric conduit was dissected from the adhesions of the right pleura (**Fig. 5C**). After taping and elevating the pyloric region dorsally, we attempted to remove the gastric conduit from the pericardial surface (**Figs. 5D** and **5E**). Dissection of the gastric conduit was continued circumferentially up to the suprasternal border as high as possible (**Fig. 6**).

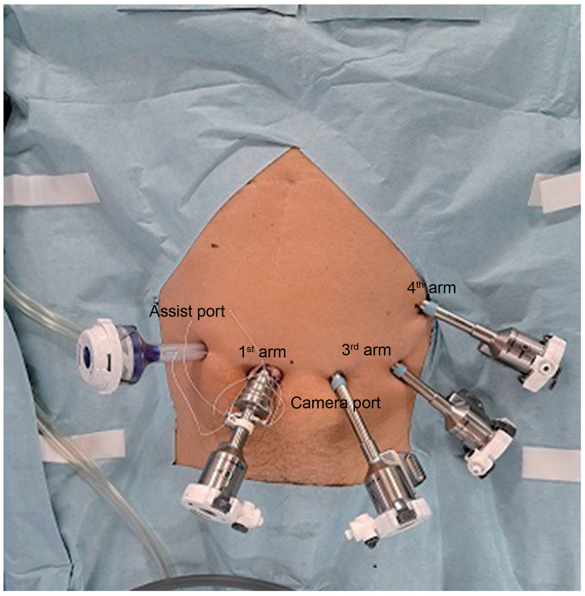

Fig. 4 Placement of the trocars and robotic arms.

Robotic manipulation was terminated when the position of the esophagogastric anastomosis was exceeded and the suprasternal margin was reached.

A mini-laparotomy was performed in the midline of the epigastrium, the lymph nodes along the right gastroepiploic vessels and supra- and infrapyloric lymph nodes were resected, and the duodenum was divided. Adhesions around the right popliteal artery were severe, causing some bleeding and requiring more time for vascular dissection. Subsequently, this approach was applied to the cervical region. The wound was opened using the left half of the skin incision obtained during a previous surgery. To preserve the left recurrent nerve, the periesophageal area was dissected while confirming the course of the recurrent nerve using a nerve monitoring device. Dissection was completed by completely freeing the cervical esophageal remnant prior to esophagogastric anastomosis. Consequently, complete en bloc dissection of the gastric conduit and esophagogastric anastomosis was performed in conjunction with dissection from the abdominal side. For ileocolic reconstruction, we adequately mobilized the region from the terminal ileum to the ascending colon from the retroperitoneum using hand-assisted laparoscopic surgery and then checked the vessels using transillumination and indocyanine green fluorography. A cervical esophago-ileo anastomosis was performed in an end-to-side (hand-sawn) fashion. We then performed a functional end-to-end anastomosis of the ileum and transverse colon using a linear stapler and Billroth II fashion reconstruction for the distal end of the colon graft to the jejunum with manual suturing. Jejunostomy was placed. The total operative time was 620 min (console time, 283 min), and the estimated blood loss was 560 mL (50 mL of blood loss during robotic gastrectomy). A drainage tube was placed in the left thoracic cavity. No postoperative complications were observed. The patient began oral intake on the seventh postoperative day and was discharged on the 14th postoperative day. Pathological examination revealed a poorly differentiated ulcerative tumor invading the subserosa with lymph node metastases (8/27). No exposure of the tumor to the surface of the specimen was observed. The final stage was pT3N3aM0, pStage IIIB, according to the TNM classification.[12] The patient is currently receiving postoperative adjuvant chemotherapy with docetaxel plus S-1.

Discussion

Herein, we report a successful case of robot-assisted gastrectomy for metachronous cancer with lymph node metastasis in the gastric conduit after esophagectomy. Although video-assisted thoracoscopic surgery and laparoscopic surgery for gastric conduit resection have been reported,[10,11,13] this is the first report of robotic surgery for a gastric conduit resection.

Patients with gastric tube cancer who are not eligible for endoscopic resection are candidates for surgical resection.[5] Depending on the patient's clinical condition and tolerance of invasive surgery, partial or subtotal resection may be performed.[6,14,15] However, total gastrectomy with regional lymph node dissection is recommended for tumors that have invaded beyond the submucosal layer or for cancers with lymph node metastasis. In this case, metachronous cancer in the gastric conduit was detected 12 years after esophageal cancer surgery. Although CT was performed every year for more than 5 years after surgery and annual endoscopic examinations had been repeated for the past 11 years, the cancer was found to be in an advanced state with lymph node metastasis. Because the patient had no history of any serious comorbidity other than esophageal cancer and maintained an acceptable performance status for surgery, the decision was made to resect the gastric conduit with lymph node dissection.

In the case of retrosternal reconstruction, the traditional mainstream approach involving median sternotomy is highly invasive and poses a high risk of unintentional injury to the gastric conduit, resulting in contamination

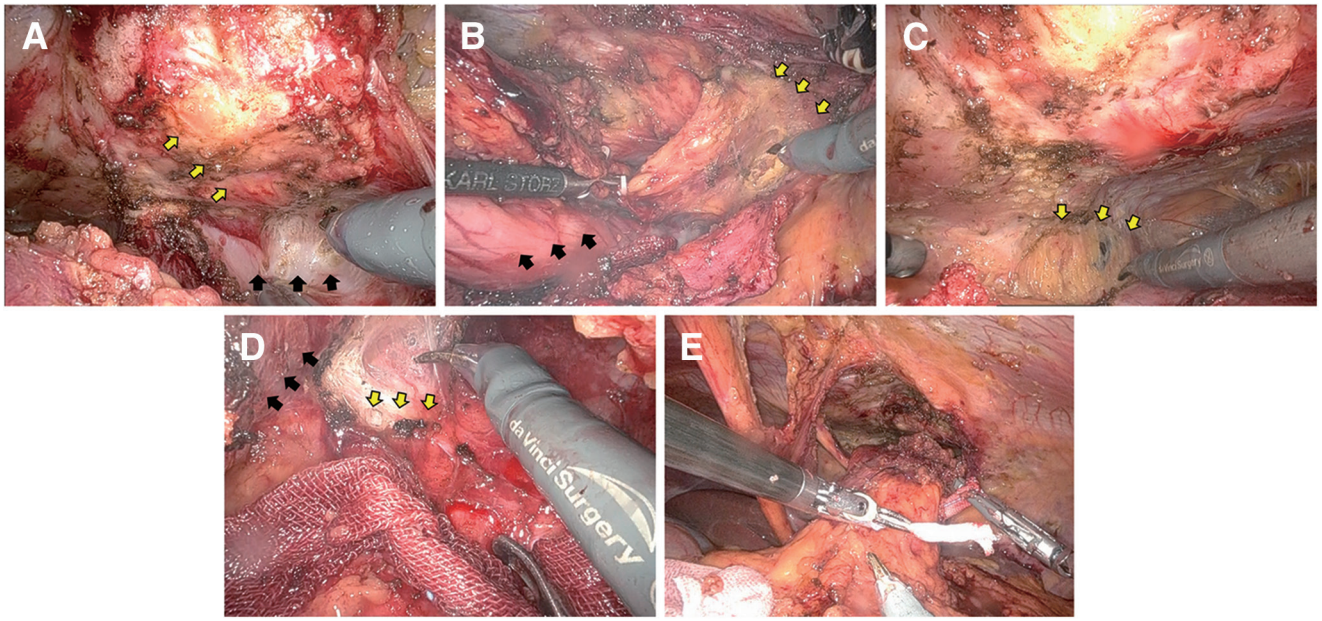

Fig. 5 Intraoperative videoscopic view. (**A**) Dissection of the anterior adhesions: adhesions are dissected along the xiphoid process and sternum. Yellow arrows: sternum and black arrows: gastric conduit. (**B**) The gastric conduit is dissected while partially resecting the left pleura, carefully avoiding damage to the right gastroepiploic vessels. Yellow arrows: left pleura and black arrows: gastric conduit. (**C**) Gastric conduit is dissected from the right pleura. Yellow arrows: right pleura. (**D**) Dissection of the posterior adhesions: the posterior adhesions are bluntly dissected. Yellow arrows: pericardium and black arrows: gastric conduit. (**E**) Taping of the gastric tube in the abdominal cavity.

of the operative field with dirty gastric content and malignant cells. Several studies have reported surgical techniques that do not require sternotomy to reduce surgical stress. The left or right thoracoscopic approach or a cervical and abdominal approach using laparoscopy has been reported previously.[5,8–11,13] In surgery for gastric conduit cancer reconstructed through the retrosternal root, a midsternal incision and right thoracotomy approach are commonly used. Recently, there have been reports of gastric conduit cancer resection using a specular approach. The laparoscopic approach is considered to have a lower risk of injury to the lung or vital vessels because it is not affected by adhesions in the thoracic cavity. If injury to vital vessels should occur, there is no need for repositioning, and rapid sternotomy is possible.[7,11,14,16] In addition, if the surgery is completed using the laparoscopic approach, it is expected to have less of an impact on postoperative respiratory function because the thorax is not injured. However, one difficulty with the laparoscopic approach is that the working space is limited in the cephalic region, and various methods have been used to overcome this problem. In addition, there have been no reports on using robotic surgery as a method to overcome this difficulty.

Robotic surgery has several distinct advantages that overcome the technical limitations of laparoscopic surgery, such as improved ergonomics, comfort, and the elimination of hand tremors. The development of more sophisticated articulated wrist instruments and three-dimensional (3D) images from a stable camera facilitates dissection in the narrow pelvis, especially in cases of low rectal tumors and anatomically complex cases.[17–19] In gastric tube cancer surgery, similar to pelvic manipulation for low rectal tumors, the working space becomes narrower as it moves up to the superior mediastinum. The difficulty in securing this working space is a problem with the laparoscopic approach; however, this may be possible with robotic surgeries. In the present case, we reached the superior border of the sternum through the abdominal cavity. In addition, as in this case, there was no need for differential pulmonary ventilation through the cervical and abdominal approaches alone, and the effect on respiratory complications was less than that of thoracoscopic gastric tube resection.

The appropriate extent of lymph node dissection for metachronous cancer of the gastric conduit after esophagectomy remains controversial. We believe that during surgery for gastric cancer, the regional lymph

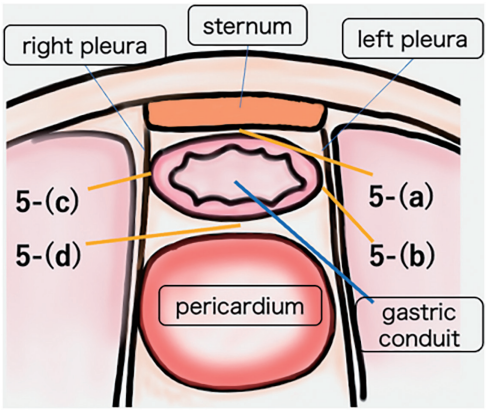

Fig. 6 Schematic diagram of the perigastric conduit in the retrosternum.
5-(a)-(d) match the images in **Figs. 5**(**A**)–**5**(**D**).

nodes defined by the Japanese Classification of Gastric Carcinoma should be dissected with the highest priority. In the present case, the lymph nodes along the right gastric and gastroepiploic arteries were resected because other regional lymph nodes had been dissected during the previous surgery for esophageal cancer. Although cephalad lymphatic spread through the previous esophagogastric anastomosis might exist, no such evident case has been reported, and the location of the gastric cancer in this case seemed sufficiently low. Dissection of the greater omentum of the gastric tube, including the lymph nodes along the right gastroepiploic vessels, is important. Another important aspect of the operation was not leaving the tumor cells on the patient's side or exposing the tumor during dissection, which was successfully achieved in our case. 3D images from a stable camera and advanced articulated wrist devices allowed us to recognize the appropriate cut line and dissect the appropriate layer. In terms of both completeness of lymph node dissection and precision of the dissection plane, our robot-assisted surgery suggests that these can be accomplished safely.

Robot-assisted surgery for gastric tube cancers has some limitations. First, the operation time can be prolonged. As the robot is positioned on the patient's head side, simultaneous surgery from the neck and abdomen is difficult while the robot is in use. Second, the robotic approach is not suitable when the tumor is large because it does not provide sufficient working space or field of view, particularly beyond the tumor. In such cases, it is suggested that total gastrectomy with midline sternotomy ensures a margin between the tumor and dissection layer, which is difficult to achieve with an endoscopic approach.

Conclusion

Robot-assisted surgery for gastrointestinal tract cancer is technically feasible and may be a minimally invasive surgical option.

Declarations

Acknowledgments
None declared.

Informed consent:
We obtained comprehensive informed consent from the patient.

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None declared.

Conflicts of interest/Competing interests
None declared.

Data availability
Not applicable.

Authors' contributions
KF, HS, SH, YO, MU, and HU managed the patient. KO wrote the illustration in **Fig. 6**. KF wrote the manuscript and provided the original pictures. All the other authors reviewed the manuscript. All authors approved the content of the manuscript.

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