

## Advanced Esophageal Cancer with Situs Inversus Totalis Successfully Treated with Chemoradiotherapy Followed by Esophagectomy: Case Report

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### ABSTRACT

We report a case of advanced esophageal cancer successfully treated with neoadjuvant chemoradiotherapy followed by esophagectomy in a 53-year-old man with situs inversus totalis. Upper gastrointestinal endoscopy in a clinical examination revealed a tumor in the lower third of the esophagus, and moderately differentiated squamous cell carcinoma was diagnosed from the biopsy findings. He was referred to us and the disease was diagnosed as esophageal cancer (clinical T3N1M0, cStage III) after further evaluation. According to the therapeutic strategy of our department, neoadjuvant chemoradiotherapy was commenced. The regimen was composed of radiotherapy (2 Gy/day, 5 days/week, 4weeks, total 40Gy) with cisplatin (70 mg/m<sup>2</sup>/day, day 1) and 5-FU (700 mg/m<sup>2</sup>/day, day 1-4). We performed a subtotal esophagectomy with radical lymph node dissection through a left thoracotomy because of the existence of situs inversus totalis. The thoracic operation could be performed with relatively safety because the organs were arranged in a mirror image of their normal positions. On the other hand, it was relatively difficult to construct a gastric tube. In particular, ligation of the gastrosplenic ligaments was difficult and this led to increased blood loss compared with usual operation. Histopathological examination revealed no residual carcinoma at the site of the primary focus. The patient has been followed up periodically on an outpatient basis and has remained free of recurrence for longer than 2 years 5 months after surgery.

**Key words:** *Esophageal cancer, Neoadjuvant chemoradiotherapy, Situs inversus totalis*

Situs inversus totalis is an unusual disorder, in which the organs are arranged in a mirror image of their normal positions. According to the published data, the incidence rate of situs inversus totalis is about 0.01%<sup>8)</sup>. We recently treated a 53-year-old man with advanced thoracic esophageal cancer with situs inversus totalis undergoing neoadjuvant chemoradiotherapy followed by esophagectomy with radical lymph node dissection through a left thoracotomy. This case is reported because of its rarity, and the surgical procedures are discussed in relation to the relevant literature.

### CASE REPORT

The patient was a 53-year-old man who was diagnosed with situs inversus totalis in early childhood. Upper gastrointestinal endoscopy in a clinical examination revealed a tumor in the lower third of the esophagus, and moderately differentiated squamous cell carcinoma was diagnosed from

the biopsy findings. He consulted us and further examination was performed. Chest imaging by radiography showed dextrocardia (Fig. 1). Upper gastrointestinal radiography showed a semi-circumferential tumor 5 cm in length with a peripheral ridge and a central recess in the lower third of the esophagus (Fig. 2). Upper gastrointestinal endoscopy also revealed a semi-circumferential type 2 tumor located in the lower third of the thoracic esophagus (Fig. 3a). Computed tomography (CT) showed esophageal wall thickening (Fig. 4a) and no invasion of the primary tumor to the adjacent structures. CT also showed enlargement of the right cardiac lymph nodes and left gastric artery lymph nodes, suggesting lymph node metastases (Fig. 4b, 4c). Positron emission tomography (PET) showed abnormal uptake of [18F] fluoro-2-deoxyglucose by the primary tumor (standardized uptake value (SUV) max = 9.2) and abdominal lymph nodes (SUV max = 1.9). The disease was

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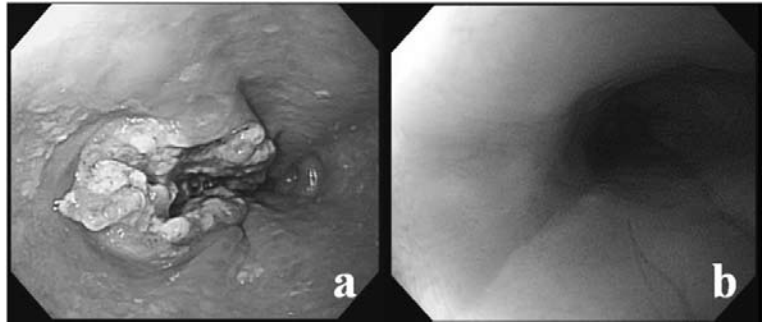
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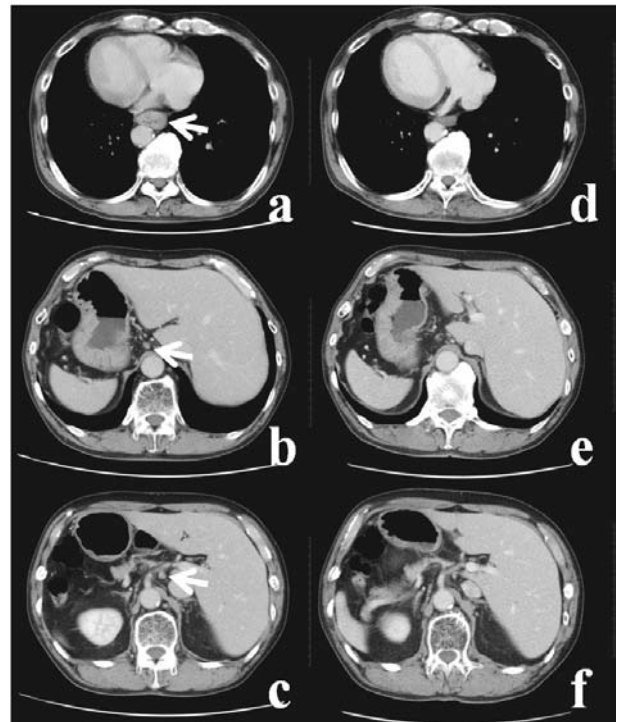
**Fig. 1.** Chest imaging by radiography showed dextrocardia.



**Fig. 2.** Upper gastrointestinal radiography showed a semi-circumferential tumor 5 cm in length with a peripheral ridge and a central recess in the lower third of the esophagus (arrow).

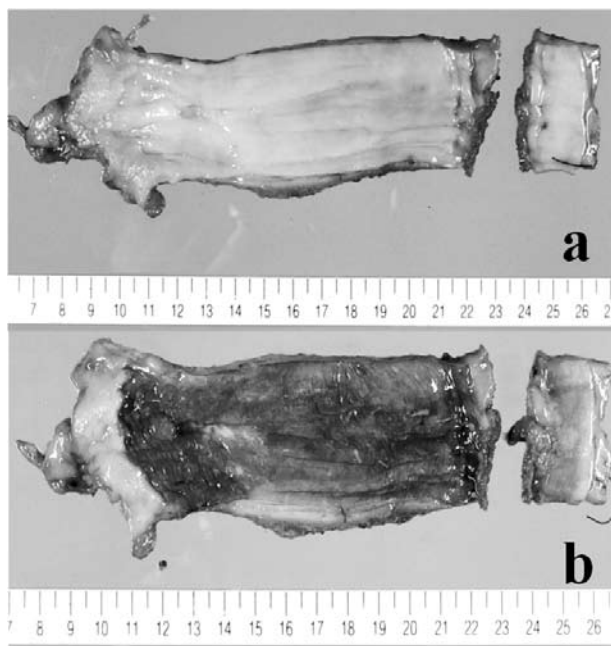


**Fig. 3.** Upper gastrointestinal endoscopy revealed a semi-circumferential type 2 tumor located in the lower third of the thoracic esophagus (Fig. 3a). After chemoradiotherapy, the tumor was markedly decreased (Fig. 3b)



**Fig. 4.** Computed tomography (CT) showed esophageal wall thickening (Fig. 4a, arrow) and enlargement of the right cardiac lymph nodes (Fig. 4b, arrow) and left gastric artery lymph nodes (Fig. 4c, arrow), suggesting lymph node metastases. After chemoradiotherapy, CT showed a decrease in the tumor (Fig. 4d) and lymph node size (Fig. 4e, 4f).

diagnosed as advanced thoracic esophageal cancer (clinical T3N1M0, cStage III<sup>10</sup>), and neoadjuvant chemoradiotherapy followed by esophagectomy was selected for treatment according to our protocol. The regimen was composed of radiotherapy (2 Gy/day, 5 days/week, 4 weeks, total 40Gy) with cisplatin (70 mg/m<sup>2</sup>/day, day 1) and 5-FU (700 mg/m<sup>2</sup>/day, day1-4). No grade 3 or 4 adverse events developed during chemoradiotherapy. After chemoradiotherapy, upper gastrointestinal endoscopy revealed marked shrinkage of the tumor (Fig. 3b) and CT showed a decrease of the tumor (Fig. 4d) and the lymph node size (Fig. 4e, 4f). PET showed

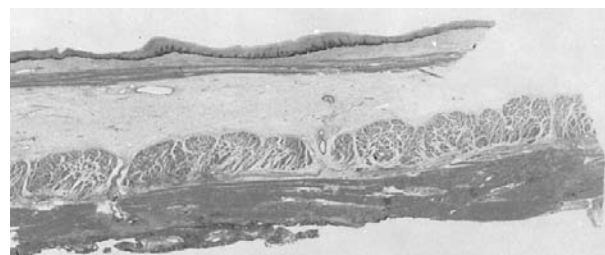


**Fig. 5.** On examination of the resected specimen, a tumor scar was noted in the lower third of the esophagus (Fig. 5a). A zone slightly stained by Lugol's iodine solution was noted at the same site (Fig. 5b).

decreased uptake of [18F] fluoro-2-deoxyglucose by the primary tumor (SUV max = 2.3) and abdominal lymph nodes (SUV max = 1.6); a complete response (CR) was achieved.

The general condition of the patient was good and we performed a subtotal esophagectomy with two-field lymph node dissection through a left thoracotomy, followed by esophageal reconstruction with a gastric tube via a posterior mediastinal route 4 weeks after completion of chemoradiotherapy.

The patient was placed in the right decubitus position, which is opposite to the standard position. The surgeon stood on the abdominal side of the patient. The fifth intercostal space was opened with one-lung ventilation. During thoracotomy, neither pleural effusion nor dissemination was noted. We cut the mediastinal pleura and divided the azygos arch. After identification of the left vagus nerve, we traced that nerve cephalad and identified the left recurrent laryngeal nerve passing behind the left subclavian artery and ascending posteriorly, and dissected the lymph nodes around the nerve. After breaking up adhesions between the posterior surface of the trachea and esophagus, we identified the right recurrent laryngeal nerve ascending along the posterolateral tracheal margin, and dissected the lymph nodes around the nerve. The thoracic esophagus with regional lymph nodes was separated from the surrounding tissues. The surgeon then stood on the left side of the patient and with the patient supine, an upper midline incision was made in the abdomen. A gastric tube was constructed and the feed-



**Fig. 6.** Histopathological examination revealed no residual squamous cell carcinoma at the site of the primary focus.

ing vessels corresponding to the right gastroepiploic vessels and right gastric vessels were preserved. A right neck incision, which was also contralateral to the normal position, was made and the gastric tube was brought up to the neck and esophago-gastric anastomosis was performed by hand sewing. The operating time was 7 hr 43 min and the estimated blood loss was 800 g. There were no postoperative complications and oral intake was possible 9 days after surgery and the patient was discharged 18 days postoperatively.

On examination of the resected specimen, a tumor scar was noted in the lower third of the esophagus (Fig. 5a). A zone slightly stained by Lugol's iodine solution was noted at the same site (Fig. 5b). Histopathological examination revealed no residual squamous cell carcinoma at the site of the primary focus (Fig. 6) and resected lymph nodes; therefore, we diagnosed a pathological complete response. The patient has been followed up periodically on an outpatient basis and has remained free of recurrence for longer than 2 years 5 months after surgery.

## DISCUSSION

Situs inversus totalis is an unusual disorder, in which the organs are arranged in a mirror image of their normal positions. According to the published data, the incidence rate of situs inversus totalis is about 0.01%<sup>9</sup>. Several abnormalities are associated with situs inversus totalis, including cardiac malformation, bronchiectasis, polysplenia, genitourinary anomalies, and so on<sup>8,11</sup>. However, there were no such abnormalities in our patient. To our knowledge, only three cases of situs inversus totalis in association with esophageal cancer, including the present case, have been reported in the global literature<sup>4,13</sup>. This may be the first report of advanced esophageal cancer with situs inversus totalis successfully treated by chemoradiotherapy followed by esophagectomy.

A right aortic arch (RAA) is an infrequent condition that can be part of situs inversus totalis or can be isolated<sup>2</sup>. For surgery on a patient with thoracic esophageal cancer, esophagectomy is usually performed via a right thoracotomy to avoid damage

to the aortic arch, which flanks the left side of the esophagus, although when RAA is present, a left thoracotomy may be the better approach<sup>6,12</sup>). However, it is very difficult to perform an esophagectomy with radical lymph node dissection for patients with RAA without situs inversus totalis through left thoracotomy alone because the left recurrent laryngeal nerve runs around the left ductus arteriosus and it is difficult to identify the right recurrent laryngeal nerve through a left thoracotomy<sup>9</sup>). It has been reported that left thoracotomy plus sternotomy is the best approach to allow visualization of the bilateral recurrent laryngeal nerves<sup>3</sup>, because lymph nodes around both recurrent laryngeal nerves have a high incidence of metastasis in thoracic esophageal carcinoma. However, it is easier to perform an esophagectomy through a left thoracotomy for patients with situs inversus totalis because the organs are arranged in a mirror image of the normal positions and curative surgery can be achieved through a left thoracotomy only.

A controversial point in the surgical treatment of esophageal cancer with situs inversus totalis is that surgeons can become confused because important organs, such as the recurrent laryngeal nerves and bronchus, are arranged in a mirror image of their normal positions and it is difficult to identify these organs at the beginning of the operation. In addition, there were some modifications, such as fibrosis and adhesion, because of irradiation in this case. However, thoracic surgery could be performed with relatively safety by understanding the normal positions of the anatomy, trying to imagine the mirror image of the anatomy at all times during surgery, and dissecting the lymph nodes very carefully so as not to injure the important organs. On the other hand, it was relatively difficult to construct a gastric tube. In particular, ligation of the gastrosplenic ligaments was difficult and this led to increased blood loss compared with the usual operation. Some surgeons recommend reversing the position of the surgeon and the assistant during surgery<sup>7</sup>), but this does not seem to be critical. Careful and cautious assessment of abnormalities by preoperative examination is very important before any surgical procedure is performed. It is reported that 3D-CT is very useful for imaging the structure of arteries and major organs preoperatively, especially in patients with situs inversus totalis<sup>5</sup>).

In conclusion, we report a case of advanced esophageal cancer with situs inversus totalis successfully treated with chemoradiotherapy followed by esophagectomy. This may be the first case of its kind reported to date. It is considered that careful and cautious assessment of abnormalities by pre-

operative examination is necessary and trying to imagine the mirror image of the anatomy at all times during surgery is very important.

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## REFERENCES

1. Akel, S., Hababi, J. and Shawis, R. 1998. Abdominal situs inversus with congenital duodenal stenosis: rare association. *Eur. J. Pediatr. Surg.* **8**: 55-57.
2. Edwards, J.E. 1977. Anomalies of the aortic arch system. *Birth. Defects.* **13**: 47-63.
3. Kinoshita, Y., Udagawa, H., Kajiyama, Y., Tsutsumi, K., Ueno, M., Nakamura, T., Akiyama, H. and Tsurumaru, M. 1999. Esophageal cancer and right aortic arch associated with a vascular ring. *Dis. Esophagus.* **12**: 216-218.
4. Mimae, T., Nozaki, I., Kurita, A. and Takashima, S. 2008. Esophagectomy via left thoracotomy for esophageal cancer with situs inversus totalis: report of a case. *Surg. Today* **38**: 1044-1047.
5. Murakami, S., Terakado, M., Misumi, M., Tsuji, Y., Okubo, K., Hirayama, R., Inoue, K. and Arai, E. 2003. Situs Inversus Totalis with Malignant Lymphoma of the Stomach: Report of a Case. *Surg. Today* **33**: 533-536.
6. Saito, R., Kitamura, M., Suzuki, H., Kamata, S. and Ogawa, J. 1999. Esophageal cancer associated with right aortic arch: report of two cases. *Surg. Today* **29**: 1164-1167.
7. Saito, T., Tebayashi, A., Hisai, H., Katahira, T., Kondo, H., Takahashi, Y., Gotoda, A. and Fujita, M. 1997. Diagnosis of gastric leiomyosarcoma with situs inversus totalis by endoscopic ultrasonography (in Japanese). *Endosc. Dig.* **9**: 1781-1785.
8. Schmutzer, P.V. 1958. Situs inversus totalis associated with complex cardiovascular anomalies. *Am. Heart J.* **56**: 761.
9. Shimakawa, T., Naritaka, Y., Wagatsuma, Y., Konno, S., Katsube, T. and Ogawa, K. 2006. Esophageal cancer associated with right aortic arch: a case study. *Anticancer Res.* **26**: 3733-3738.
10. UICC (the Union for International Cancer Control). 2002. TNM Classification of Malignant Tumours (6th Edition).
11. Varano, N.R. and Merklin, R.J. 1960. Situs inversus. *J. Int. Coll. Surg.* **33**: 131-148.
12. Yano, M., Shiozaki, H., Murata, A., Inoue, M., Tamura, S. and Monden, M. 1998. Successful resection of thoracic esophageal cancer associated with the right aortic arch. *Surg. Today* **28**: 76-78.
13. Yoshida, T., Usui, S., Inoue, H. and Kudo, S.E. 2004. The management of esophageal cancer with situs inversus totalis by simultaneous hand-assisted laparoscopic gastric mobilization and thoracoscopic esophagectomy. *J.Laparoendosc Adv. Surg. Tech. A.* **14**: 384-389.