Esophagus (2010) 7:169–172
DOI 10.1007/s10388-010-0244-6
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CASE REPORT

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Diaphragmatic herniation after esophagectomy for carcinoma of the esophagus: a report of two cases

Received: April 28, 2010 / Accepted: August 6, 2010

Abstract Diaphragmatic herniation after esophagectomy for carcinoma of the esophagus is a rare but preventable postoperative complication. For patients with symptoms, surgical repair of the hernia is recommended to prevent the potentially disastrous complications. In patients with asymptomatic hernias, a watchful waiting approach is reasonable. To prevent diaphragmatic herniation, we emphasize the importance of routine narrowing of the hiatus so that the surgeon can introduce three or four fingers and recommend awareness of the possibility of diaphragmatic herniation in patients with symptoms of intestinal obstruction. We report two cases of diaphragmatic herniation after esophagectomy for carcinoma of the esophagus, and estimate the incidence of herniation and assess surgical results on the basis of reported cases in the English-language literature.

Key words Diaphragmatic herniation · Esophagectomy · Esophageal carcinoma

Introduction

For carcinoma of the esophagus, surgical resection with preoperative chemoradiotherapy or chemotherapy has become the standard initial therapy worldwide. Reconstruction is usually performed with a gastric tube through the mediastinal or posterior sternal route. Because of improvements in preoperative staging techniques and perioperative management, surgical resection for carcinoma of the esophagus has become a safe and reliable treatment method. However, rare complications can occur after surgery. One such complication is diaphragmatic herniation, which can occur as an early or late postoperative event following esophagectomy with gastric tube replacement, but only if the mediastinal route has been used. Diaphragmatic herniation is potentially life-threatening because strangulation and perforation of the herniated contents can occur when diagnosis is delayed [1]. When herniation is acute, emergency laparotomy must be performed to prevent bowel obstruction and strangulation. We report early and late cases of diaphragmatic herniation after esophagectomy for carcinoma of the esophagus, and estimate the incidence of herniation and assess surgical results on the basis of reports in the English-language literature.

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Case reports

Case 1

A 78-year-old man underwent transhiatal esophagectomy with a gastric tube through the posterior mediastinum as a salvage operation for recurrence after definitive chemoradiation to a cT3N0M0 stage IIA squamous cell carcinoma of the thoracic esophagus. At surgery, because of extraluminal growth of the tumor, the left diaphragmatic crus was partially resected to achieve complete resection. On the 4th postoperative day, the patient complained of nausea and abdominal pain. Physical examination revealed diffuse abdominal tenderness and decreased breath sounds over the left lung. An abdominal X-ray film demonstrated ileus with small-bowel obstruction, and a chest X-ray film showed bowel loops within the lower left hemithorax (Fig. 1A). An X-ray examination after the patient had swallowed a water-soluble contrast agent showed small-bowel obstruction. Computed tomography demonstrated a massive hiatal hernia with migration of bowel loops into the left hemithorax and compression of the left lung within the left anterior hemithorax (Fig. 1B). Emergency operative repair was performed through the reopened upper midline abdominal incision. At laparotomy, inspection of the abdominal contents revealed a 6–7-cm diameter dilated diaphragmatic hiatal defect, and incarcerated herniation of the jejunum and distal transverse colon. Reduction of the incarcerated

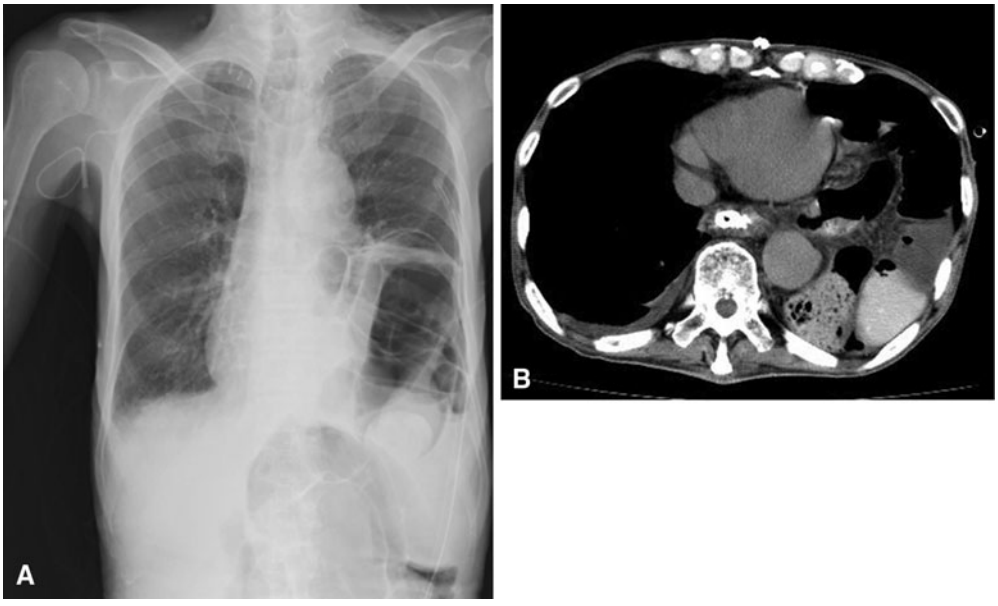

Fig. 1. **A** Chest X-ray film shows bowel loops within the lower half of the left hemithorax. **B** Computed tomography scan demonstrates a massive hiatal hernia with migration of bowel loops into the left hemithorax

herniation of the jejunum and colon was easily performed. There were no adhesions within the abdomen or left thoracic cavity. The congestion of the incarcerated parts of the digestive tract was gradually reduced. Thus, concomitant resection of the digestive tract was not necessary. The diaphragmatic defect was sutured and left crus closed, and a gastric tube was sutured to the reefed crus. The postoperative course was uneventful, and the patient was discharged on the 12th postoperative day.

Case 2

A 76-year-old woman underwent transthoracic esophagectomy with three-field lymphadenectomy and reconstruction of gastric tube in the posterior mediastinum for cT1N1M0 stage IIB adenocarcinoma of Barrett's esophagus metastatic to the upper and lower mediastinal lymph nodes. At surgery, the left diaphragmatic crus was partially divided 1 cm in diameter to allow easy passage of the gastric tube through the hiatus and to prevent gastric outlet obstruction. The postoperative course was uneventful, and the patient was discharged on the 12th postoperative day. However, 27 days after surgery the patient complained of severe abdominal pain and nausea. A chest X-ray film showed bowel loops within the lower half of the left hemithorax (Fig. 2A). Computed tomography demonstrated a massive hiatal hernia with migration of bowel loops into the left hemithorax and ipsilateral pulmonary collapse (Fig. 2B). Emergency repair was performed through a reopened upper midline abdominal incision. Laparotomy revealed a 5-cm diameter diaphragmatic defect through which the small bowel had herniated into the left hemithorax. The hernia was easily reduced, and the congestion of the incarcerated small bowel was reduced. The diaphragmatic defect was sutured and left crus closed, and a gastric tube was anchored to the reefed crus. The postoperative course was uneventful, and the patient was discharged on the 14th postoperative day.

Discussion

Transthoracic esophagectomy with extended lymphadenectomy for squamous cell carcinoma of the esophagus is a standard surgical procedure; in Japan, the retrosternal route is often used. Unlike in Japan, in many Western countries transhiatal esophagectomy is a standard surgical procedure for adenocarcinoma of the esophagus, and the mediastinal route is almost always used. When the retrosternal route is used, the hiatus is often closed tightly, and diaphragmatic herniation does not occur. Therefore, because diaphragmatic herniation occurs after esophagectomy only when the mediastinal route is used, it is a rare but preventable postoperative complication that occurs in 0.4% to 4% of cases [2,3]. In our institution, the mediastinal route is preferred after esophagectomy, and incidence of diaphragmatic herniation after esophagectomy was 1% (2/168). To date, 30 cases of diaphragmatic herniation after esophagectomy for carcinoma of the esophagus have been reported in the English-language literature (Table 1) [2–13]. Our reports of diaphragmatic herniation after esophagectomy are, to our knowledge, the first from Japan in the English-language literature.

Diaphragmatic herniation can occur either as an early postoperative event or as a late complication after several months. Including the present two cases, 32 cases have been reported, 11 of which occurred in the early postoperative period. However, 21 of 32 cases (66%) were late complications that occurred 1–44 months after esophagectomy. In 18 of the 22 cases (82%) in which the site of herniation was clearly described, abdominal organs had herniated into the

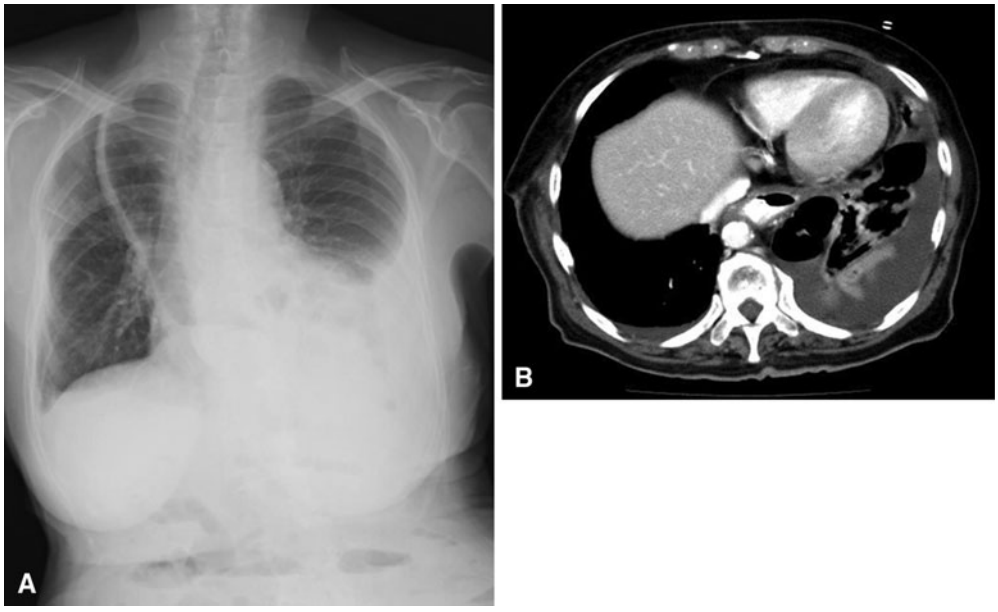

Fig. 2. **A** Chest X-ray film shows bowel loops within the lower half of the left hemithorax. **B** Computed tomography scan demonstrates a massive hiatal hernia with migration of bowel loops into the left hemithorax

Table 1. Reported cases of diaphragmatic herniation after esophagectomy for carcinoma of the esophagus

First author [Ref.]	No. of patients	Interval	Site of herniation	Herniated organs	Treatment
Terz [12]	1	7 days		Colon and small bowel	Laparotomy
Granke [8]	1	7 days	Mediastinum	Omentum	Laparotomy
Reich [11]	1	10 months	Right	Colon and small bowel	Laparotomy and thoracotomy
Heitmiller [3]	2	3 days, 6 days	1 right, 1 left	Colon	1 laparotomy, 1 nonsurgical treatment
van Sandick [2]	9	3 days to 44 months		Colon, small bowel, spleen	5 laparotomy, 1 thoracotomy, 3 nonsurgical treatment
Cordero [6]	1	6 days	Left	Colon	Laparotomy
Choi [5]	1	6 months	Left	Colon	Laparotomy
Hamaloglu [9]	1	28 days	Left	Colon and small bowel	Laparotomy
Fumagalli [7]	2	4 months, 8 months	1 left, 1 left and right	Colon and small bowel	2 laparotomy
Kaushik [10]	1	28 days	Right	Colon	Laparotomy
Aly [4]	1	20 months	Left	Small bowel	Laparotomy
Vallbohmer [13]	9	0.3–30 months	9 left	Colon, small bowel, spleen	7 laparotomy, 2 nonsurgical treatment
Present cases	2	4 days, 27 days	2 left	Colon and small bowel	2 laparotomy

left hemithorax. In all cases, herniated abdominal organs were the colon or the small bowel or both; surprisingly, herniation of the spleen has also been reported [2,13]. Diaphragmatic herniation can usually be detected with plain chest radiographs, which reveal air within herniated bowel loops above the level of the diaphragm. The diagnosis can be confirmed with computed tomography or X-ray examination after the patient has swallowed a water-soluble contrast agent.

Of the 32 patients, 26 (81%) underwent surgical repair of the herniation: a transabdominal approach, which may be preferable, was used in 25 of the 26 patients (96%). However, 6 (19%) of 32 patients did not undergo surgical repair of the hernia but were instead treated with a conservative waiting and watching approach. Three of these 6 patients had no symptoms [2,3,13]: 2 of them were eluded because of advanced tumor recurrence [2], and 1 refused to undergo surgical reduction of the hernia [13]. Surgical repair of the hernia is generally recommended to prevent the potentially disastrous complication of strangulation and perforation. However, untreated patients with asymptomatic herniation have been reported [2,3,13]. In patients with asymptomatic hernias, especially in those who have a limited life expectancy, a watchful waiting approach is reasonable.

Diaphragmatic herniation after esophagectomy is a rare iatrogenic complication that can be prevented. It occurs when the hiatus of the diaphragm is enlarged or the crus is divided to allow adequate mobilization of the esophagus and prevent gastric outlet obstruction. van Sandick et al. have reported that the risk of diaphragmatic herniation after esophagectomy is significantly higher with extended

enlargement of the hiatus than with routine hiatal opening [2]. Reich et al. have suggested that if enlargement of the hiatus is required for adequate mobilization of the esophagus, the risk of herniation is lower with an anterior incision of the diaphragm than with a lateral extension [11]. At the end of the procedure, the hiatal defect should always be inspected. The importance of routine narrowing of the hiatus has been emphasized [14]. If the hiatal defect is too wide, sutures should be placed to narrow the diaphragmatic crus, taking care not to injure the blood supply of the reconstructive organs [2,13]. In our 2 cases, the hiatal defect was too wide. Furthermore, we have never inspected the hiatal defect and have routinely sutured the graft along the crus. Because of these cases of diaphragmatic herniation after esophagectomy, to prevent gastric outlet obstruction we recommend narrowing of the hiatus so that the surgeon can introduce 3 or 4 fingers with or without an anterior incision of the hiatus.

In conclusion, diaphragmatic herniation after esophagectomy for carcinoma of the esophagus is a rare but preventable postoperative complication. It occurs either as an early or a late postoperative event, but occurs more often when the hiatus is overly extended. The herniation of the colon or small bowel, or both, most often occurs in the left hemithorax. For patients with symptoms of herniation of abdominal contents, surgical repair of the hernia is recommended to prevent the potentially disastrous complications of strangulation and perforation. In patients with asymptomatic hernias, especially in those who have a limited life expectancy, a watchful waiting approach is reasonable. To prevent diaphragmatic herniation, we emphasize the importance of routine narrowing of the hiatus so that the surgeon can introduce 3 or 4 fingers, and recommend awareness of the possibility of diaphragmatic herniation in patients with symptoms of intestinal obstruction.

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