"Post-operative imaging of esophagectomy complications"

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Learning objectives

To illustrate the changes of chest anatomy after esophagectomy and the role of imaging in detecting post-operative complications that may affect patients undergoing this kind of surgery.

In this poster, we present the most common complications after esophagectomy detected using chest radiograms, esophagus-stomach-duodenum follow-through radiograms and chest/abdomen computed tomography (CT) scans.

As imaging plays a crucial role in diagnosis and management of these complications, this poster is also aimed to distinguish the normal post-operative radiographic findings from complications that may arise after surgery.

Background

A variety of surgical procedures are used to treat esophageal cancer. Although meticulous surgical techniques and improved post-operative care have recently markedly reduced the occurrence of complications associated with esophagectomy, the rate of both intra-operative and post-operative complications remains high.

The main surgical techniques include three types of trans-thoracic and one type of trans-hiatal esophagectomy:

- Ivor-Lewis procedure, which involves an initial laparotomy followed by a posterolateral right thoracotomy; it is the most common technique used for surgical management of carcinoma in the middle and lower third of the esophagus.

- McKeown procedure, which permits an abdominal midline laparotomy, an anterolateral thoracotomy through the fourth-fifth right intercostal space, and a cervical incision on either the right or left side to be performed simultaneously.

- Left thoracoabdominal approach, which provides thoraco-abdominal exposure of both the superior abdominal compartment and the posterior mediastinum through a single incision; this approach is considered optimal for carcinoma of the lower esophagous and cardia.

- Transhiatal esophagectomy, which consists of an abdominal, a cervical and a mediastinal phase with the patient supine; it is used for the curative resection of tumors of the lower third of the esophagous or gastric cardia.
The most commonly used conduit in patients undergoing esophagectomy for malignancy is a gastric tube formed with either an intrathoracic or a cervical esophagogastronomy. The stomach is the optimal conduit to replace the resected esophagus, since it has a very reliable blood supply and can reach any level in the chest up to the hypopharynx. If the stomach is not available due to intrinsic disease or previous gastric surgery, the colon is an acceptable second choice. The right colon has the advantage that it may be used in an isoperistaltic position, whereas the left colon is most commonly used in an antiperistaltic position. The use of colon interposition reduces the prevalence of reflux esophagitis and stricture associated with esophagogastronomy. Finally, the jejunum can be used as a conduit, usually as a free jejunal graft with microvascular anastomosis to replace the cervical esophagus.

The incidence of post-operative complications is reported around 40%, depending on the type of esophagectomy: 45% in case of Ivor-Lewis approach, 62% in case of transhiatal esophagectomy, 44% in case of transthoracic esophagectomy through a left thoracotomy.

Post-esophagectomy complications may be local or systemic and may require medical or a surgical treatment.

Medical complications include:

- local infections: pneumonia, aspiration bronchiolitis, mediastinitis;
- systemic infections: meningitis, sepsis;
- cardiac problems: arrhythmia, myocardial infarction, pericardial tamponade;
- respiratory problems: atelectasis, adult respiratory distress syndrome, respiratory failure;
- metabolic diseases: Wernicke's encephalopathy.

Infections must be treated as early as possible with intravenous antibiotic therapy. In case of serious conditions, patients are moved to the intensive care unit, to be assisted at their respiratory and cardiovascular functions and to be treated in case of metabolic and systemic disorders.

One complication of esophagectomy is Wernicke's encephalopathy (WE). It is an acute neuropsychiatric disorder, which arises as the result of an inadequate supply of thiamine to the brain. Patients who undergo esophagectomy and have a gastric tube, may develop early or late WE as a result of a lack of absorption of thiamine. WE begins with a classic triad of signs and symptoms: oculomotor abnormalities, cerebellar dysfunction, and confusion. If untreated, WE leads to death in up to 20% of cases or, in 85% of the survivors, to the chronic form of the condition, the Korsakoff syndrome. This encephalopathy cannot be diagnosed by measuring the circulating thiamine level since
there is not one critical circulating level below which every individual will develop the Wernicke lesion. In WE, the blood-brain barrier is defective in the periventricular regions, in which there is a high rate of thiamine-related glucose and oxidative metabolism. MRI usually shows symmetric signal intensity alterations in the thalami, mamillary bodies, tectal plate, and periaqueductal area. Signal intensity alterations in the cerebellum, cerebellar vermis, cranial nerve nuclei, red nuclei, dentate nuclei, caudate nuclei, splenium, and cerebral cortex represent atypical MRI findings. Atypical MRI findings are always found in association with the classical neuroradiological presentation. In the acute setting of WE, the cytotoxic edema can appear on both CT and MR images as symmetric hypodensity and signal intensity alterations, respectively. However, in the acute setting of WE, the sensitivity of the brain CT is low compared with MRI. The prognosis depends on the time of thiamine supplementation onset (with 500 mg of thiamine hydrochloride IV three times a day for two-to three days, diluted in 50-100 mL of normal saline, and infused slowly over 30 minutes to reduce the chance of an anaphylactic reaction).

Surgical complications are almost limited to the anastomosis and include:

- fistula, that might be esophagous-cutaneus, esophago-bronchial, or esophago-mediastinal;

- anastomotic leak between surgical borders;

- ischemic suffering, due to a lack of anastomosis and conduit vascularization;

Other surgical complications include:

- functional complications of esophageal replacement such as: anastomotic stricture, redundancy and impaired emptying, obstruction at the upper thoracic inlet or diaphragmatic hiatus, reflux esophagitis, ulceration of the esophageal substitute;

- pneumothorax;

- pleural effusion;

- chylothorax;

- herniation of abdominal viscera through the hiatus;

- volvulus;

- peritonitis.

Frequently, patients need to undergo re-survery to be treated, if the "wait and see" approach does not work.

Complications that interest the anastomosis should be regarded with attention and must be treated rapidly. In case of a fistula/anastomotic leak, the treatment consists in
arranging a drainage or an esophageal prosthesis. If there is ischemic suffering of the gastric conduit, the patient has to be re-operated to replace it with a new colon/jejunum conduit. Drainages are also placed in case of pneumothorax, chylothorax and pleural effusion. In case of herniation of abdominal viscera through the hiatus or a volvulus, the patient has to be re-operated.

Major complications associated with Ivor-Lewis procedure include respiratory insufficiency (up to 38%) resulting from thoracotomy or prolonged mechanical ventilation and mediastinitis and sepsis resulting from an intrathoracic anastomotic leak, (whose rate is up to 14%). In case of McKeown procedure, the anastomosis created in the neck through a separate left-side cervicotomy mitigates the potential for sepsis resulting from an intrathoracic anastomotic leak and post-operative bile reflux. The transhiatal approach has the potential to minimize respiratory compromise (up to 54%), and anastomotic complications are usually managed easily (whose rate is up to 26%). Finally, in case of transthoracic esophagectomy through a left thoracotomy, incidence of anastomotic leak is up to 12%, that of respiratory complications up to 34%.

**Findings and procedure details**

Post-operative imaging (chest radiograms, esophagus-stomach-duodenum follow-through radiograms, CT scans) is crucial in confirming the clinical diagnosis and in monitoring the outcome of patients, especially after re-intervention.

In our center, we follow a standardized protocol, which involves:

- esophagus-stomach-duodenum follow-through radiogram using oral diluted contrast (Gastrographin), usually at sixth-eighth day post-esophagectomy;

- thoracic and abdominal CT after oral and/or intravenous iodate contrast administration, in case of complications.

Imaging findings include:

- anatomosis’ ischemia: shown with a CT scan after intravenous contrast;

- anastomotic leak or fistula: clinically suspected and confirmed with an esophagus-stomach-duodenum radiogram or/and a CT scan;

- hematomas, leakage, peri-anastomotic, pleural or pericardial effusions: clinically suspected and confirmed with a CT scan;

- pneumothorax: clinically suspected and confirmed with a chest radiogram.
Fig. 1: Esophago-cutaneous fistula in a 66-year-old woman with a neuroendocrine carcinoma of the lower thoracic esophagus. The patient underwent thoracoscopic esophagectomy. This axial-oblique CT scan (1.5-mm section thickness) obtained 8 days after surgery shows an esophagocutaneous fistula (yellow arrows). The oral contrast (G), once swallowed, exits from esophagus (*) through the fistula and fills a left laterocervical bag (red arrow). Surgeons placed a drainage (D) through the fistula.
**Fig. 2:** Two axial CT-scans (1.5 mm thickness) taken at different levels 8 days after esophagectomy of the same patient of Fig.1 show laterocervical bag (red arrow), esophagocutaneous fistula (yellow arrow), drainage (D) and new esophagus (*) filled with oral contrast (Gastrographin, G)
**Fig. 3:** Pneumothorax in a 78-year-old woman with an indiffereniate cancer of the middle thoracic esophagus, 8 days after a thoracoscopic esophagectomy. These CT scans (1.5-mm section thickness) lung (L) windowing show an anterior PNX of the right lung from the top to the basis (yellow arrows). The patient developed also bilateral pleural effusions and atelectasis (red arrows).
Fig. 4: Acute respiratory distress syndrome in a 76-year-old man who underwent Ivor-Lewis esophagectomy. The first sagittal CT-scan (1.5-mm section thickness) has been obtained 15 after esophagectomy and shows bilateral diffuse ground-glass attenuation (yellow arrows); 7 days later the patient developed right basal and intrascissural pleural effusions (red arrows).
Fig. 5: Mediastinal (M) and abdominal (A) abscesses in a 69-year-old woman with a spinocellular carcinoma of the upper esophagus. The patient had undergone a thoracoscopic esophagectomy. Sagittal and axial CT-scans (1.5 mm thickness) taken 9 days after surgery show an extended abscess, with a huge air bubble (*) from posterior mediastinum to upper abdomen (under left hepatic lobe, H). Yellow arrow shows nasogastric tube inside the esophagus.
**Fig. 6:** Basal and arterious CT scans (1.5-mm section thickness), taken after oral contrast administration (G) 20 days after surgery in the same patient, show mucosal flap (yellow arrows), extended for 9-10 cm, and ischemic suffering (*) of middle and upper esophagus. Red arrows show left basal pleural effusion.
Fig. 7: Esophago(*)cutaneous fistula in a 71-year-old man with an adenocarcinoma and Barrett esophagus. The patient had undergone a transhiatal esophagectomy. This axial CT scans (1.5-mm section thickness) obtained 18 days after surgery shows an esophagocutaneous fistula (yellow arrows). Red arrows show a left laterocervical bag.
Fig. 8: These axial and sagittal CT scans (1.5-mm section thickness) of the same patient of Fig. 7 show an herniation of mesenteric adipose tissue through the hiatus (F) and a mediastinal posterior abscess (A). The patient has a naso-gastric tube (yellow arrow) in new esophagus (*).
Fig. 9: These two axial CT-scans (1.5-mm section thickness) show mediastinal abscess (A) shown in Fig.8.
**Fig. 10:** These lateral and frontal esophagus-stomach-duodenum radiograms show a sort of diverticulum/ cul-de-sac in the cervical region, near the anastomosis, filled with oral contrast (red arrows). This 51-year-old patient underwent a thoracoscopic esophagectomy for a spinocellular cancer of the middle esophagus. The images were taken 53 days after surgery. Yellow arrows show the new esophagus.
**Fig. 11:** Axial CT-scan (1.5-mm section thickness) of the esophagous (*) cul-de-sac seen in Fig. 10 (red arrow) filled with oral contrast (G).
Fig. 12: These frontal esophagus-stomach-duodenum follow-through radiogram and axial CT-scan (1.5-mm section thickness) show drainages (D) filled with oral contrast caused by an esophagus (E)-jejunal (J) anastomotic dehiscence. This 78-year-old man underwent a total gastrectomy for an adenocarcinoma of cardia. The images were taken 24 and 31 days after surgery.
Fig. 13: This lateral esophagous-stomach-duodenum radiogram shows spillage (red arrows) of oral contrast and right bronchial opacification in a 57-year-old man who underwent a thoracoscopic esophagectomy for a spinocellular carcinoma of lower esophagus. The radiogram was taken 45 days after surgery. The patient had a double esophagous prothesis (P). Yellow arrow indicates assemblage of oral contrast outside, on the right of gastric conduit at thoraco-abdominal transition.
Fig. 14: These CT-scan (1.5-mm section thickness) and chest radiogram show pneumonia (yellow arrows) of middle left lung (L) in a 49-year-old woman who underwent an Ivor-Lewis esophagectomy for an adenocarcinoma of cardia. The CT-scan was taken 2 days after surgery; the radiogram 2 days later. Red arrows indicate pleural effusions. The patient had a naso-gastric tube (T) and a pleural right drainage (D).
Fig. 15: This coronal CT-scan (1.5-mm section thickness) shows a big hematoma behind the trachea (yellow arrow). This 47-year-old man underwent an Ivor-Lewis esophagectomy after having drunk caustics. The CT-scan was taken 3 days after surgery.
**Fig. 16:** This axial CT-scan (1.5-mm section thickness) shows a right idro (red arrow)-pneumothorax (yellow arrows) in a 64-year-old woman 7 days after a thoracoscopic esophagectomy for a spinocellular carcinoma of middle esophagus.
Fig. 17: This coronal CT-scan (1.5-mm section thickness) shows a big colon herniation (red arrow) through the hiatus in a 62-year-old man 7 days after surgery for an adenocarcinoma of distal esophagus and cardia. Colon is filled with oral contrast (G).
Fig. 18: T2-weighted and FLAIR sequences of the brain at the level of thalamus, which appears hyperintense (yellow arrows). This is a RMN sign of Wernicke encephalopathy. This 57-year-old man developed ocular signs and consciousness disorders 14 months after esophagectomy.
**Fig. 19:** T2-weighted and FLAIR sequences of the brain at the level of mesencephalon in the same patient of Fig. 18; the mesencephalon appears hyperintense (yellow arrows). This is another RMN sign of Wernicke encephalopathy.
**Fig. 20:** Axial CT-scans taken at three different levels (1.5-mm section thickness) show an extensive pneumothorax (yellow arrows) of the right lung, associated with subcutaneous emphysema (E), pneumo-mediastinum (PM) and contralateral shift of mediastinal structures (red arrow) in a 67-year-old the day after esophagectomy.
**Fig. 21:** The same patient of Fig. 20 developed, one month later, an esophagous-mediastinal fistula. The esophagus-stomach-duodenum radiogram was taken 38 days after esophagectomy and shows a filiform spilling of oral contrast in the mediastinal space (yellow arrows). The patient had an esophageal prothesis (P). The axial CT-scan (1.5-mm section thickness) was obtained the day after and shows a fistula (yellow arrow) filled with oral contrast (G).
Conclusion

In conclusion, post-operative imaging of patients who undergo esophagectomy is essential both in confirming the clinicians' suspect and in monitoring complications' evolution. A correct and prompt diagnosis allows more quick and appropriate treatment. The outcome of these patients depends both on the surgeon's and the radiologist's ability to detect and treat the complications.

Personal information

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References