Benign esophageal diseases - a review of the CT imaging findings

Poster No.: R-0148
Congress: RANZCR-AOCR 2012
Type: Educational Exhibit
Authors: P. Jagmohan, P. S. Goh
Keywords: Stomach (incl. Oesophagus), CT, Contrast agent-oral, Contrast agent-intravenous, Foreign bodies, Trauma, Congenital
DOI: 10.1594/ranzcraocr2012/R-0148

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.
Learning Objectives

1. Review the normal esophageal anatomy and examination technique on CT.
2. Describe the spectrum of CT findings of various benign conditions involving the esophagus.
3. Discuss the utility of multiplanar CT in evaluation of these diseases and its potential benefits and drawbacks compared to fluoroscopic esophagography and upper GI endoscopy (UGIE).
Background

The esophagus can be involved by a variety of benign conditions. The involvement may be primary, secondary or as a part of a systemic disease. Traditionally fluoroscopic esophagography and UGIE have been primary modalities for investigating the esophagus. Increasing use of cross sectional imaging means that often CT may be the first imaging study, especially in the setting of acute emergencies and postoperative states.

The aim of this exhibit is to look at the spectrum of benign esophageal conditions that can be seen on CT and to review their findings.
NORMAL ANATOMY:

The esophagus is a hollow tube, approximately 25 cm long that extends from the level of cricopharyngeus (C6) to the gastro-esophageal junction (usually T11). It is divided into three parts - cervical, thoracic and abdominal. The wall of the esophagus consists of mucosa, muscularis mucosa, submucosa, muscularis propria and adventitia.

The cervical part of the esophagus is related to the trachea anteriorly, thyroid and common carotid artery laterally and vertebral bodies posteriorly. The thoracic part is related to the trachea, left main bronchus and pericardium anteriorly; to the aorta along the left lateral aspect and pleura and azygos vein along the right lateral aspect. It passes through diaphragm at T10 level and its abdominal part is related to the left hepatic lobe and is attached to the phreno-esophageal ligament (fig 1).

On CT, the esophagus is usually seen as a collapsed tube with a small amount of air. The normal wall thickness measures 3 mm in the distended state and 5 mm in the non-distended state. The gastroesophageal (GE) junction and the gastric cardia may have a pseudomass appearance.

TECHNIQUE:

Esophageal evaluation on CT is often limited due to poor distensibility. Techniques to distend the esophagus with air or fluid include administration of a bolus of oral contrast on table, effervescent agents, buscopan and glucagon.

The use of contrast depends on the clinical situation. Most studies can be performed with oral and intravenous contrast (low osmolar iodinated contrast), however oral contrast is not used in studies for suspected foreign bodies. A suggested technique for suspected perforation advocated by some authors includes an initial non contrast study. This is followed by administration of 50 mL of an aqueous solution consisting of 10% IV LOCM, effervescent granules (sodium bicarbonate and tartaric acid), and water either by rapidly drinking the solution or by instillation through a nasogastric tube. A repeat helical CT is then performed post oral contrast and no intravenous contrast is used [4].

Other CT techniques to improve visualisation of the esophagus include thin collimation and use of multiplanar and 3D reformats.
IMAGING FINDINGS:

This review includes CT studies done at the National University Hospital and KK Women's and Children's Hospitals, Singapore and covers a wide spectrum of benign conditions involving the esophagus. The lesions were detected in three settings - 1) acute thoracic emergencies and post operative state, 2) CT done for further work up of an abnormality detected on other modalities eg. a mediastinal mass seen on a radiograph and 3) as an incidental finding on a CT study done for some other indication.

CONGENITAL:

Esophageal duplications are the 2nd most common GI duplication and arise from a nest of cells that are abnormally sequestered from the primitive foregut. Most patients are asymptomatic, though symptoms may be seen secondary to obstruction, bleeding and infections. Most cysts do not communicate with the esophagus. Associated vertebral anomalies may be seen, though these are more common with neurenteric cysts.

The lesion is usually seen as an incidental mediastinal mass on a plain radiograph. Esophagograms show an extrinsic mass effect on the esophagus and rarely, contrast within a communicating cyst.

CT shows a homogenous well defined thin walled cyst abutting the esophagus (Fig 2). The lower esophagus is the most common site of involvement. Complications such as bleeding and infections can result in hyperdense contents and mural thickening. Differentials include bronchogenic cyst and lymphangiomas [3].

FOREIGN BODIES:

Foreign bodies (FBs) are more common in children, aged, mentally handicapped patients and prisoners. Food bolus and coins are the most common FBs in the adult and pediatric population respectively. Other common FBs include fish and chicken bones, and dentures. The sites of impaction include the cervical esophagus, GE junction and at the site of a previous stricture.

Clinical features include a FB sensation, dysphagia, odynophagia, inability to swallow saliva and regurgitation. A range of complications can be seen including esophageal
erosion, hemorrhage, intramural hematoma, perforation, fistula, mediastinitis and mediastinal/lung abscess. Rarely a sharp FB may penetrate into adjacent vascular structures such as the aorta and can potentially cause a catastrophic bleed. While the majority of esophageal FBS are treated conservatively, 10 - 20% require endoscopic removal and 1% require surgery [1].

Initial imaging includes a plain radiographs of the neck, chest and abdomen for identification of a radio-opaque FB as well as its potential complications eg. retropharyngeal abscess, pneumomediastinum. An esophagogram with water soluble contrast has been the traditional investigation for a suspected FB and resultant perforation.

CT is useful in the emergent scenario and allows for more definitive localisation of FBs. It is especially useful for radiolucent FBs that may not be detected on radiographs and for evaluation of potential endoscopy blind spots in the hypopharynx and cervical esophagus. While an esophagogram or endoscopy allows for greater luminal details; CT provides a look beyond the lumen and can assess potential complications such as perforation and mediastinal complications (Fig 3, 4).

ESOPHAGEAL INJURY AND PERFORATION:

The spectrum of esophageal injuries includes mucosal laceration, partial thickness tear, intramural hematoma and full thickness perforation. Iatrogenic injury, foreign bodies, post traumatic, thermal injury, post vomiting (Boerhaave's syndrome) and esophagitis are the common causes.

Clinical features include chest pain, dysphagia and odynophagia. Presence of surgical emphysema is usually indicative of perforation. Complications of perforation include mediastinitis, mediastinal collections, lung consolidation, mediastinal/lung abscess, fistulous communication with adjoining structures and empyema.

Often these patients may undergo an initial chest radiograph and findings in perforation include pneumomediastinum and pleural effusions. Esophagography with water-soluble contrast material is the modality of choice for suspected injury. If the initial study is negative, the study can be repeated with barium to detect a small leak.

CT findings vary with the severity of the injury. Partial thickness tears may manifest as esophageal wall thickening or foci of hemorrhage and extraluminal air at the site
of mucosal injury in the case of laceration. An eccentric mural hyperdense collection is seen in a hematoma while an intramural dissection is seen as a mucosal flap with submucosal air or contrast. Findings in a full thickness perforation include contrast leak, an esophageal wall defect, periesophageal gas and fluid collections; and mediastinal emphysema [1]. Involvement of the mediastinum can be seen as fat stranding and inflammatory soft tissue, fluid collection and abscess. Pleuropulmonary involvement manifests as pleural effusion, empyema, pneumothorax, lung consolidation and abscess; and pleuropulmonary fistulas. (fig 5,6)

Esophagography is better for detecting the site of leak especially in cases of a small leak, however CT can detect a small amount of mediastinal gas which in the appropriate clinical context is indicative of an esophageal perforation. CT is the modality of choice for evaluation of complications. It has a role in very sick and uncooperative patients in whom an esophagogram may prove difficult. It can also be used in patients with penetrating injury to assess other mediastinal structures and lungs; and to rule out non esophageal causes of acute chest pain such as pulmonary embolism and aortic dissection.

Treatment options include nonsurgical management, esophagectomy, surgical exclusion and diversion. Mucosal lacerations, intramural perforations, some cervical & contained perforations are managed conservatively. Surgery is the mainstay for an uncontained perforation [1]. Prompt diagnosis and institution of therapy is critical as the prognosis worsens considerably with delay in diagnosis.

ESOPHAGEAL FISTULAS:

Fistulas can be congenital or acquired. Congenital fistulas usually manifest in the pediatric age group. In adults, esophageal fistulas are usually acquired and causes include trauma, neoplasms, infections or post esophagogastrectomy and radiation therapy. Complications depend on the fistulous communication and are similar to those seen with esophageal perforations.

CT findings of a fistula include air and contrast within the fistulous track. An esophagopleural fistula is characterised by contrast, air and water within the pleural cavity. CT is also useful for evaluating thoracic complications of fistulas. (fig 7)

INFLAMMATION AND INFECTIONS:
The most common causes of esophagitis are reflux esophagitis and infections. Esophageal infections are more frequent in immunosuppressed patients with Candida albicans, herpes simplex virus and cytomegalovirus being the most common causative organisms. Thoracic infections can also secondarily involve the esophagus.

Esophagograms and UGIE form the mainstay of the diagnosis, however occasionally these patients may undergo a CT. Findings on CT include circumferential wall thickening > 5 mm, target appearance of the wall (due to enhancing mucosa and hypodense submucosa), esophageal ulceration and fistula (fig. 8) [5]. The ability of CT to provide extraluminal information is especially useful in infections that secondarily involve the esophagus (fig. 9) as well as infections that can have multiple sites of involvement e.g. tuberculosis and candidiasis.

**BENIGN ESOPHAGEAL STRICTURES:**

Many benign diseases can cause esophageal stricture formation such as acid peptic reflux, autoimmune, infectious, caustic, congenital, iatrogenic, medication and radiation-induced disease processes.

CT findings include proximal esophageal dilatation, change in calibre at the site of the stricture and wall thickening (fig. 10,11,12). A CT grading has been proposed for determining esophageal injury and predicting the development of stricture formation in caustic injury.

**BENIGN TUMORS:**

Benign tumors compose about 20% of all esophageal neoplasms and include squamous papillomas, leiomyomas, fibrovascular polyps, other mesenchymal tumors such as fibromas, neurofibromas and hemangiomas.

Leiomyomas are the most common benign esophageal neoplasm. These are usually asymptomatic but may occasionally present with dysphagia, depending on the tumor size and luminal encroachment. The distal esophagus is the most common site of involvement with the size of the neoplasm varying from 2-8 cm. Esophageal leiomyomas rarely ulcerate and thus hematemesis is a rare presentation.

Plain radiographs may show an incidental mediastinal mass. Esophagograms depict a well defined submucosal mass. On CT leiomyomas are usually seen as an incidental
finding or detected in the setting of work-up for a mediastinal mass. CT shows a well defined sharply marginated soft tissue mass abutting the esophagus (fig. 13). Differentials include other mesenchymal tumors such as hemangiomas and neurofibromas [2].

**ACHALASIA:**

Achalasia is a motility disorder with degeneration of the myenteric plexus in the GE junction resulting in failure of the GE junction to relax. The clinical onset is insidious with progressive dysphagia, cough and recurrent aspiration pneumonitis.

Barium esophagogram is the imaging modality of choice and shows a characteristic smooth, tapered appearance of the lower esophagus near the GE junction, the so called "bird beak" or "rat tail" appearance.

Achalasia is usually seen as an incidental finding on CT studies done for an unrelated indication. Imaging findings include moderate to marked dilatation of the esophagus with normal wall thickness, air fluid levels, food debris and abrupt change in calibre at the GE junction (fig. 14,15). CT can demonstrate complications like esophageal carcinoma or postoperative complications.

Patients with achalasia are also prone to aspiration and CT is ideally suited to assess the lung parenchyma and airways. Bronchopneumonia involving the posterior segment of the upper lobe and apicobasal segment in a supine patient and posterobasal segment in an upright patient is the most common manifestation of aspiration pneumonia. Lobar pneumonia and lung abscess are less common. Repeated aspirations can result in bronchiolitis and this is seen on CT as centrilobular and tree in bud nodules, branching and tubular densities due to secretions within the bronchioles and acinar opacities.

**HIATAL HERNIA:**

Hiatal hernia occurs when part or whole of the stomach protrudes into the thoracic cavity through the esophageal hiatus of the diaphragm. Sliding and paraesophageal hernias are the two types of hiatal hernias with the former seen in 99% cases.
Hiatal hernias are often seen incidentally on plain radiographs as a retrocardiac mass with or without an air-fluid level. On esophagogram a sliding hernia is diagnosed based on the presence of a lower esophageal ring, or 5 or more mucosal folds 2 cm or more above the diaphragmatic hiatus. CT shows a retrocardiac mass with or without an air-fluid level and contiguous with the stomach. Other findings include herniation of omentum and separation of the diaphragmatic crura > 15 mm. (fig. 16)

SYSTEMIC DISEASES INVOLVING THE ESOPHAGUS - SCLERODERMA:

Scleroderma is a connective tissue disease characterized by smooth muscle atrophy and fibrosis in the esophageal wall. Patients have an incompetent lower esophageal sphincter and primary peristalsis is absent below the level of the aortic arch. This results in reflux esophagitis, peptic strictures and Barrett esophagus. On CT, esophageal dilatation is seen in the setting of other manifestations of the disease such as diffuse interstitial lung disease and mediastinal lymphadenopathy (fig. 17).

EXTRINSIC CAUSES OF ESOPHAGEAL COMPRESSION:

Owing to its close relations with adjacent thoracic / neck structures, a range of extrinsic pathologies such as goitre, cardiomegaly and neoplasms can compress the esophagus (fig. 18). Of note are anomalous mediastinal vessels that can cause tracheo-esophageal compression. CT is especially useful for delineation of the aberrant vessels, vascular rings and slings [3] (fig. 19).

ADVANTAGES OF CT Vs. FLUOROSCOPIC ESOPHAGOGRAPHY AND UGIE:

- Ability to look beyond the lumen allowing visualisation of extramucosal esophagus, mediastinum and lungs
- Useful in sick and bed-bound patients in whom an esophagogram may be difficult to perform
- Useful in emergent cases, postoperative complications and for assessing thoracic complications of esophageal diseases
- Easy to perform, does not require a radiologist on site
- Can be performed as a first line imaging in patients with esophageal disease presenting as non specific chest pain

DISADVANTAGES OF CT Vs. FLUOROSCOPIC ESOPHAGOGRAPHY AND UGIE:
• Inadequate esophageal distension may limit assessment
• Inability to demonstrate mucosal details
• Findings are often nonspecific necessitating further workup with esophagography and UGIE, eg. esophageal wall thickening may be seen in number of conditions.
• Inability to obtain tissue sample cf. UGIE
Fig. 1: Axial, coronal and sagittal CT showing the esophagus and its relations (in clockwise order) (a) Axial CT shows the cervical esophagus related to the trachea anteriorly, thyroid laterally and vertebral bodies posteriorly. (b) The mid thoracic part is related to left main bronchus anteriorly, aorta along the left lateral aspect and azygos along the right lateral aspect. (c) Sagittal CT shows the thoracic esophagus as a tubular structure lying posterior to the left atrium and ventricle. (d,e) Coronal and axial CT showing the gastro-esophageal junction and the abdominal part posterior to the left hepatic lobe.

© Department of Diagnostic and Interventional Imaging, KK Women's and Children's Hospital, Singapore
Fig. 2: A 5 year old with an incidentally detected right paraspinal mass at the T8-T10 level on the plain radiograph (arrow). Axial and sagittal CT shows a well defined fluid attenuation lesion indenting the esophagus. An esophageal duplication cyst was confirmed on surgery and histopathology

© Department of Diagnostic and Interventional Imaging, KK Women's and Children's Hospital, Singapore
**Fig. 3:** Different examples of fish bones: Fish and chicken bones are the second most common FBs and are often found in the hypopharynx / cervical esophagus. Being sharp pointed, they require urgent removal

© National University Hospital - /

**Fig. 4:** An ingested denture in an elderly patient. A non contrast CT (NCCT) done in the emergency showed the denture in the thoracic esophagus (arrow). Pneumomediastinum and bilateral pneumothoraces are seen indicative of perforation. This was confirmed on a subsequent esophagogram which shows contrast leak at the site of perforation (arrow)

© National University Hospital - /
Fig. 5: A patient with esophageal perforation following an endoscopic ultrasound. CT shows contrast tracking from the posterior wall of the thoracic esophagus (arrow). Note the adjacent air locule within the mediastinum, right pneumothorax and bilateral pleural effusions, more on the left.

© National University Hospital - /

Fig. 6: Post esophagogastrectomy for distal esophageal stricture. A contrast enhanced CT (CECT) shows a mediastinal collection adjacent to the esophagus, bilateral pleural effusions and collapse-consolidation changes. Findings are in keeping with a postoperative leak.
Fig. 7: A young patient with an esophagocutaneous fistula following a road traffic accident. Axial CT shows an air-filled track leading from the cervical esophagus to the skin (arrow). This was confirmed on the esophagogram (arrow).
Fig. 8: A patient with esophageal candidiasis. CECT shows circumferential mural thickening and contour irregularity. An irregular luminal outline and ulcerations are seen on the esophagogram. Endoscopy shows the characteristic plaques.

© National University Hospital - /
Fig. 9: Patient with Nocardia pneumonia and dysphagia. CT thorax shows bilateral consolidative and cavitatory lesions with an air track between right upper lobe cavity/pleural space and the adjacent trachea indicative of a fistula (arrow). Findings were confirmed on the subsequent esophagogram which showed a fistulous connection between the proximal oesophagus, trachea and the right upper lobe cavity.
**Fig. 10:** A patient with acute lymphoblastic leukemia (ALL) with dysphagia due to a lower esophageal stricture. Axial CECT shows circumferential mural thickening and change in caliber of the lumen in the distal esophagus (arrow). The patient also had bilateral consolidations. Esophagogram confirms presence of a smooth long stricture. Esophageal strictures are rarely seen in patients with ALL who have not received radiotherapy and have been linked to previous candidiasis.

© National University Hospital - /
**Fig. 11:** A patient with non small cell lung carcinoma post chemo - and radiotherapy. CT shows change in calibre and mural enhancement in the upper - mid thoracic esophagus. A benign looking stricture with smooth tapering was seen on the esophagogram.

© National University Hospital - /
Fig. 12: The same patient later presented with acute onset dysphagia and chest pain following ingestion of food. Axial and coronal NCCT show an obstructing food bolus seen as a mottled density at the site of the prior stricture

© National University Hospital - /
Fig. 13: Axial CT shows a well defined homogenous soft tissue mass in relation to the mid thoracic esophagus. A smooth marginated submucosal mass was seen on the esophagogram. Histopathology confirmed diagnosis of leiomyoma

© National University Hospital - /
Fig. 14: Axial CT of a middle aged female patient with markedly dilated esophagus with debris and normal wall thickness. A characteristic bird beak appearance of the GE junction is seen on the esophagogram.

© National University Hospital - /
Fig. 15: Another patient with achalasia. Plain radiograph shows mediastinal widening with a tubular mediastinal opacity (arrow). CT confirms that the widening is due to a dilated esophagus. Abrupt change in caliber is seen at the GE junction on the coronal CT (arrow). Esophagogram confirms the diagnosis of achalasia.
Fig. 16: A 3 month child with a lucency overlying the right lower hemithorax on the chest radiograph; this was thought to represent a loculated pneumothorax. CT showed that the lucency was the stomach situated within the lower right hemithorax. A sliding hiatal hernia was confirmed on surgery.

© Department of Diagnostic and Interventional Imaging, KK Women’s and Children’s Hospital, Singapore

Fig. 17: HRCT of a patient with scleroderma showing a dilated esophagus with bilateral interstitial thickening and honeycombing.
Fig. 18: A patient with multinodular goiter and dysphagia. Esophagogram shows smooth narrowing of the cervical esophagus. Axial CT shows bilateral enlarged thyroidal lobes with nodules extending to the trachea-esophageal grooves.
Fig. 19: Sagittal and axial CECT in a young patient shows an aberrant right subclavian artery indenting and displacing the proximal thoracic esophagus (arrows)

© National University Hospital - /
Conclusion

• Increasing use of cross sectional imaging means that a number of benign esophageal conditions are first seen on CT.

• Knowledge of the imaging spectrum on CT can aid in early diagnosis, prompt recognition of complications and guiding further imaging work up.

• While esophagograms and UGIE form the mainstay for benign esophageal diseases, the ability of CT to look beyond the lumen at the mediastinum and lungs and the ease and speed of performing the study make it a useful tool.
References


4) Fadoo F, Ruiz DE, et al. Helical CT esophagography for the evaluation of suspected esophageal perforation or rupture. AJR 2004;182:1177-1179

5) Berkovich GY, Levine MS, Miller WT Jr. CT findings in patients with esophagitis. AJR 2000;175:1431-1434

Acknowledgements: This review includes CT studies done at the National University Hospital and KK Women's and Children's Hospitals, Singapore and we would like to thank the staff and radiologists of the imaging departments for their help.