30 Fluoroscopic Evaluation of the Upper GI Tract and Small Bowel

Objectives:
1. Identify normal anatomy on a "barium swallow" and "upper GI" series.
2. Be able to differentiate mucosal versus extramucosal lesions based on radiographic findings.
3. Describe the radiographic features of malignant esophageal lesions.
4. Know the common locations for esophageal diverticuli and their radiographic appearance.
5. Name two separate methodologies for imaging the small bowel.

Radiopaque enteric contrast material is commonly employed for radiographic visualization of the gastrointestinal (GI) tract. Traditionally for the upper GI tract, a barium sulfate mixture is ingested and traced radiographically as it passes through the oropharynx, hypopharynx, esophagus, and more distal GI tract. When there is a concern of perforation or obstruction, water-soluble contrast may be used.

Fluoroscopy

GI studies are observed fluoroscopically (real-time imaging) so that peristalsis and the rate of flow of contrast can be ascertained. Close-up images of small anatomic areas are obtained at the time of fluoroscopy for the purpose of recording any specific abnormalities. Finally, static images (called overhead images), which are large images covering a large region of the GI tract, are acquired at the end of the study for the purpose of giving a geographic perspective of the contrast distribution within the GI tract.

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Normal Esophageal Motility

Swallowed contrast is propelled by peristaltic waves, which are visible as smooth, segmental, and progressive narrowing of the esophagus. The normal peristaltic wave with swallowing is called the primary peristaltic wave. A secondary wave may occur if the patient swallows quickly after the primary swallow. These should not be confused with fixed abnormalities which may represent pathologic lesions (Fig. 30.1).

Figure 30.2 demonstrates a single image from a normal fluoroscopic exam of the esophagus. Sometimes abnormalities of esophageal motility may be manifest as so-called tertiary contractions. These appear as multiple disorganized small transient indentations of the contrast column within the esophagus and generally are related to abnormalities of the neurologic plexus, which propagate the peristaltic wave. They are commonly seen in older individuals.

When the neurologic plexus in the distal esophagus degenerates, spasm without relaxation of the lower esophageal sphincter may occur, producing a condition

FIGURE 30.1 - CONTRAST ESOPHAGRAM
On contrast swallow studies, benign (*left*) and malignant (*right*) lesions have a different appearance. Note the gradual narrowing with smooth margins of the benign lesion versus the overhanging edges and abrupt appearance of the malignant lesion

FIGURE 30.2 - NORMAL CONTRAST ESOPHAGRAM
Contrast UGI study, in this case barium, demonstrating a normal esophageal appearance

termed achalasia (Fig. 30.3). This results in distension of the proximal esophagus with collections of ingested food and secretions. A complication of achalasia is aspiration pneumonia.

Esophageal Carcinoma

Esophageal carcinomas are fixed narrowings, often with mucosal ulceration and overhanging edges or “shouldering” of the barium column.

Esophageal carcinomas occur most commonly in the mid to lower esophagus (Fig. 30.4). It may be difficult to distinguish an esophageal stricture caused by gastric acid reflux from one caused by a carcinoma. Endoscopic biopsy is often required.

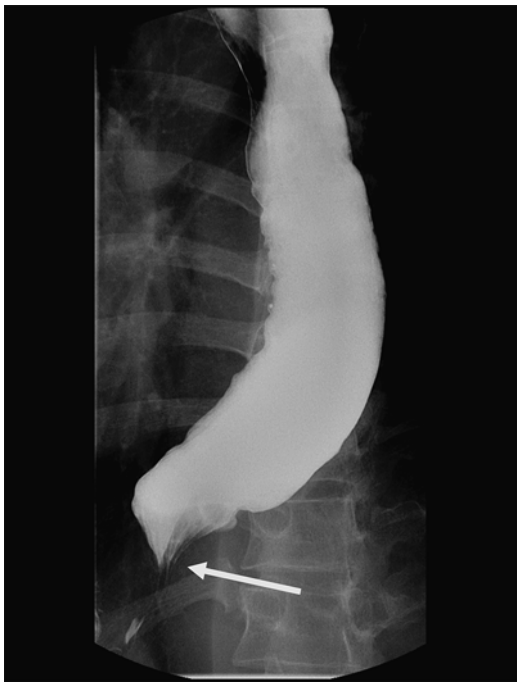

FIGURE 30.3 - ACHALASIA
Malfunction of the neurologic plexus leads to spasm of the lower esophageal sphincter resulting in a markedly distended esophagus and the classic "birds beak" (*arrow*) narrowing at the level of the lower esophageal sphincter

Esophageal Diverticuli

Diverticuli of the esophagus take two forms, traction diverticuli and pulsion diverticuli. Traction diverticuli most commonly arise in the region of the carina. They result from retraction of the inflamed subcarinal lymph nodes as they pull on the esophageal mucosa via fibrous adhesions. Pulsion diverticuli occur when the peristaltic waves exert a positive pressure within the esophageal lumen. Any weakness in the esophageal wall may lead to a "ballooning out" of the mucosa. A common location for an esophageal wall weakness is in the upper esophagus posteriorly where the constrictor muscles do not quite overlap to completely cover the esophageal wall. This is known as Killian's dehiscence. The pulsion diverticulum formed in this area is termed a Zenker's diverticulum and may be present as a mass in the upper neck. Another common location for pulsion diverticula is just above the lower esophageal sphincter. These diverticula are called epiphrenic diverticula.

FIGURE 30.4 - ESOPHAGEAL CARCINOMA
Note the irregularity and overhanging edges (*arrows*)

Double and Single Contrast GI Studies

Standard upper GI studies include tailored evaluations of the esophagus, stomach, and duodenal bulb.

In a double contrast study, barium and air are the two contrast agents. Within the stomach, the barium is made to coat the gastric mucosa, and the air distension allows the mucosal folds of the stomach to be clearly evident (Fig. 30.5).

In a single contrast upper GI series, barium is the only contrast agent. The stomach is nearly filled with contrast material and the mucosal detail is not as evident. Single contrast studies are faster to perform and result in less radiation exposure. But, less diagnostic information is obtained.

Generally, static images of the duodenal bulb and proximal loop ("C" loop) of the duodenum as it curves around the head of the pancreas are then obtained. The duodenal bulb and post-bulbar portion of the duodenum are common places for ulceration and diverticuli formation. The duodenum ends anatomically at the ligament of Treitz which should be at the same craniocaudal level as the duodenal bulb and lies to the left of the midline.

FIGURE 30.5 - DOUBLE CONTRAST GASTRIC STUDY
Note the detail of the gastric and duodenal mucosa

Filling of ulcer craters with barium produces small collections of contrast within the gastric wall. Gastric folds may radiate toward the ulcer as a result of inflammation. Ulcers may be malignant or benign and endoscopic biopsy is often required for evaluation.

Adenocarcinoma is the most common gastric malignancy and can present as an irregular solitary filling defect or as a diffuse infiltrative lesion that narrows the gastric body and antrum and makes it rigid, termed “linitis plastica.”

Small Bowel Follow-Through

A single contrast study of the contrast column may be followed through the small bowel as it passes distally through the GI tract, termed “a small bowel follow-through” (Fig. 30.6). This will reveal gross abnormalities such as mucosal masses, strictures, and mass effect displacing the small bowel loops. The small bowel follow-through terminates when contrast is seen within the cecum of the colon, having passed through the terminal ileum and the ileocecal valve.

FIGURE 30.6 - SMALL BOWEL FOLLOW-THROUGH
Detail of the mucosal lining is visible as barium passes through the small bowel

Conventional Enteroclysis

A double contrast study of the small bowel, termed an "enteroclysis," may be performed for the purpose of further elucidating small bowel anatomy. By placing an enteric tube distal to the ligament of Treitz, occluding the jejunal lumen with a balloon and injecting soluble barium and methylcellulose as a "solid column," the double contrast effect is achieved. Multiple single exposure images of the small bowel are obtained with the fluoroscopy machine. The study is concluded once contrast reaches the cecum.

Small bowel malignancies may be either primary or metastatic and usually will appear as focal narrowing or strictures of the small bowel and/or nodular filling defects. This study is also useful for detecting low-grade small bowel obstruction secondary to Crohn's disease and postoperative adhesions (Fig. 30.7). Active Crohn's disease can also be detected with this type of examination.

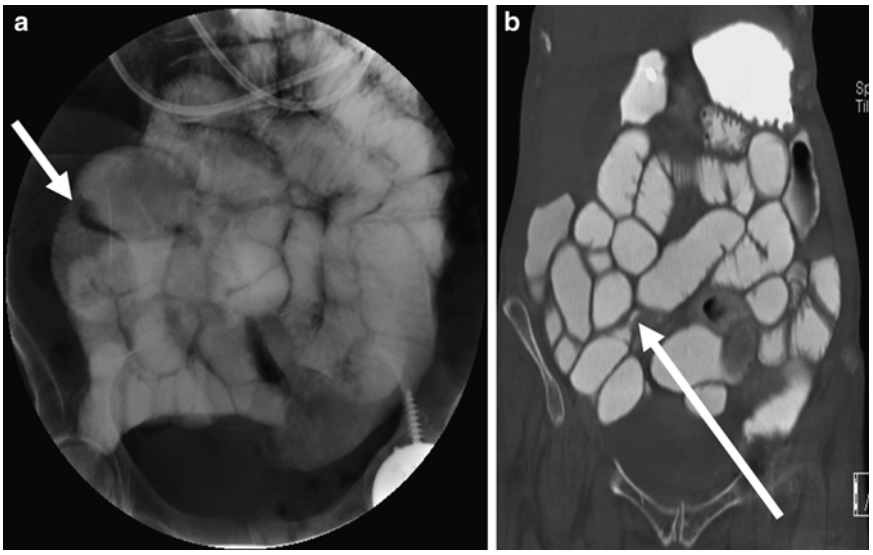

FIGURE 30.7 - CONVENTIONAL VERSUS CT ENTEROCLYSIS
(**a**) Conventional enteroclysis demonstrates a focal area of narrowing in the distal ileum (*arrow*). (**b**) Coronal image from a CT enteroclysis of the same patient demonstrates the focal area of narrowing in the distal ileum in the same location as the narrowing seen on conventional enteroclysis (*arrow*). CT enteroclysis had the added advantage of being able to demonstrate multiple different areas of narrowing in this patient (not shown) as well as evaluating bowel wall thickness and extraluminal pathology

This study is more difficult for the radiologist to perform and for the patient to tolerate. Therefore, it is used only in selected situations.

CT Enteroclysis

This type of study evaluates the small bowel in a similar manner to conventional enteroclysis. However, barium and methylcellulose are not used as contrast agents. The patient will receive either positive (radiopaque) contrast, such as barium or diluted water-soluble contrast, or negative (radiolucent) contrast, such as water, prior to being taken to the CT scanner. Typically the scan is performed once contrast has reached the cecum. CT enteroclysis is more sensitive for the detection of small strictures and mucosal inflammation such as in Crohn's disease.

Postoperative Imaging

Fluoroscopy is also useful in the postoperative evaluation of patients that have undergone partial GI resection. In the upper GI tract, fluoroscopy with a water-soluble nonionic contrast agent is commonly performed to identify anastomotic leakage or stenosis. Barium is contraindicated when leak is suspected because it can stimulate an inflammatory response and peritonitis.