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Gastrointestinal Fluoroscopy with Barium:

How can abdominal ascites manifest on an abdominal fluoroscopy study?

Small bowel loops can appear diffusely separated when ascites is present.

On a small bowel fluoroscopy follow-through study, what are differential considerations if diffuse thick folds are seen within the small bowel?

Think etiologies that cause edema in the bowel in a diffuse manner such as cirrhosis, hypoalbuminemia, and various causes of venous congestion.

On a small bowel barium fluoroscopy follow-through study, what are differential considerations for non-diffuse focal thick folds within the small bowel?

Think of etiologies that can result in more focal bowel edema such as bowel within a radiation field, bowel reacting to adjacent inflammation such as bowel adjacent to an inflamed gallbladder or pancreas, or bowel that is edematous due to ischemia related to a local low-flow state from a territorial vascular insult.

If thick folds AND bowel nodularity are seen on small bowel fluoroscopy, what are leading differential considerations?

Three leading causes I would remember for board exams are:

1. Bowel malignancy for which melanoma and lymphoma are classic, but other malignancies could also present similarly. Note also that lymphoma and other lymphatic processes such as lymphangiectasia and lymphoid hyperplasia can also appear similarly. Like pulmonary nodules, nodules of varying sizes are more concerning for metastatic disease whereas uniform small nodules are more likely to be benign and related to benign lymphoid hyperplasia.
2. Crohn's disease.
3. Infection for which bacterial infection by *Tropheryma whipplei* (Whipple's disease) is classic.

What if GI fluoroscopy with barium shows dilated bowel with thin folds?

Celiac sprue is classic here, as is scleroderma involvement of the bowel. Beyond those think of ileus and obstruction in the appropriate clinical setting. If fluoroscopy initially shows evidence of celiac sprue and later shows thickened folds with nodularity, this could be a manifestation of onset of small bowel lymphoma for which uncontrolled celiac sprue is a risk factor. For scleroderma of the small bowel, remember the classic "hide bound" appearance due to decreased separation of the valvulae conniventes due to muscular hypertrophy in the bowel wall.

A ribbon-like small bowel with thickened folds in an organ transplant patient is classic for what entity?

Graft versus host disease. As bowel wall edema progresses, folds eventually can become effaced causing a "featureless" bowel appearance. More chronic graft versus host disease can cause stricturing in the bowel and the upper esophagus.

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What are the two contrast agents used for a double-contrast barium enema study?

The two contrast-agents most used for a double-contrast barium enema are first, and obviously, barium, a positive contrast agent, combined with insufflation of carbon dioxide gas to provide negative contrast and distend the bowel lumen. The double-contrast technique can provide very high mucosal detail. By contrast (pun intended) a single-contrast study on fluoroscopy most typically would use barium alone.

On barium fluoroscopy, what are classic features of Crohn's disease and Ulcerative Colitis?

Crohn's disease can have a cobblestone appearance on barium fluoroscopy study, as well as fistulae, thickened folds from bowel wall edema, and a string sign due to chronic stricturing and/or acute spasms.

Ulcerative colitis: the lead pipe sign is most classic in chronic cases where the bowel becomes featureless, shortened, and narrowed. Prior to development of a featureless bowel, or if there is mixed acute and more chronic inflammation, mucosal ulcers and a granular appearance of the colonic mucosal surface can be seen. Remember that ulcerative colitis also has a colon cancer risk, so polyps or strictures can be a sign of co-existing colon malignancy.

True or false? A diagnosis of pancreatitis can be suspected based on barium small bowel follow-through.

True, though pancreatitis probably can't be confirmed based on barium small bowel fluoroscopy, and the same is also true for cholecystitis. But inflammation of bowel loops via fold thickening on fluoroscopy can be seen if the bowel is secondarily inflamed due to adjacent pancreatitis or cholecystitis, so these entities are in the differential for fold thickening of the duodenum, if seen surrounding the expected location of the pancreas or gallbladder.

What is Ménétrier disease, and how can this classically appear on fluoroscopy?

Ménétrier disease is a form of hypertrophic gastritis that is idiopathic and classically occurs in young children or middle-aged adults, more common in males. Hallmark features of this disease include a triad of hypoproteinemia, achlorhydria, and gastric edema. The systemic low-protein state can cause ascites and pleural effusions and excess mucus production. On upper GI barium fluoroscopy, expect classic features of enlarged gastric folds most pronounced along the greater curvature of the stomach with sparing or lesser involvement of the gastric antrum, as well as barium dilution in the stomach due to the mucus hypersecretion and high volume of fluid in the stomach.

What are the two classic types of gastric volvulus and how do you differentiate these?

The two classic types of gastric volvulus are mesenteroaxial and organoaxial.

Mesenteroaxial gastric volvulus involves the stomach twisting over the mesentery as the name suggests. If you draw a line that bisects the stomach and passes between the gastroesophageal junction and duodenum that approximates the axis of twisting in mesenteroaxial volvulus.

Organoaxial volvulus involves the stomach (an organ rather than the mesentery as the name organoaxial suggests) twisting where the greater curvature of the stomach rotates over the lesser curvature. If you

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draw a line passing through the stomach, and it courses nearly through the greatest length of the stomach without passing between the gastroesophageal junction or the duodenum this approximates the axis of organoaxial volvulus rotation. Organoaxial volvulus is more common following blunt trauma or with a paraesophageal hernia than is mesenteroaxial volvulus.

Which is more common between mesenteroaxial or organoaxial gastric volvulus?

It depends. In adults, organoaxial volvulus is more common than mesenteroaxial volvulus, accounting for about 2/3 of cases of gastric volvulus. In children, mesenteroaxial volvulus is more common than organoaxial volvulus, present in just under 2/3 of cases.

Which type of gastric volvulus is most likely to cause gastric obstruction and strangulation?

Mesenteroaxial volvulus is the type most likely to cause obstruction and strangulation. However, organoaxial volvulus can also obstruct and strangulate if rotation over 180 degrees along the axis occurs. If rotation is under 180 degrees organoaxial volvulus may be entirely asymptomatic. Symptoms of either type of volvulus include acute onset epigastric pain, intractable retching without ability to vomit, and inability to pass a nasogastric tube.

What are key upper GI barium fluoroscopy findings of gastric volvulus?

Possible fluoroscopy findings include gastric distention in the left upper quadrant with extension into the thorax, gastric inversion or twisting, obstruction with partial or absent passage of contrast beyond the stomach, possible beak-sign at the point of twisting and obstruction.

What are key findings of Zollinger-Ellison syndrome on an upper GI barium study?

First, remember that the clinical scenario of Zollinger-Ellison syndrome is presence of a gastrinoma causing elevated gastrin levels and can be part of multiple endocrine neoplasia type 1 when gastrinomas are functional to secrete gastrin. The gastrinoma itself may be identified on cross-sectional and/or molecular imaging exams but may be secondarily seen as a filling defect in the duodenum, or elsewhere in the bowel on an upper GI fluoroscopy study. Gastrinomas are more commonly located in the duodenum, and are less commonly located in the pancreas, and are often multiple. Peptic ulcer disease, GERD, diarrhea, and gastritis can result from gastric acid hypersecretion that results from the gastrinoma(s). Therefore, associated findings on an upper GI barium study include rugal fold thickening, gastric nodularity, erosions, and ulcer formation in the stomach and/or bowel (duodenal bulb most common but may occur elsewhere in atypical locations such as the jejunum; if you see multiple duodenal ulcers on a board exam, consider this highly), and dilution of barium in the stomach due to fluid hypersecretion within the stomach.

Fluoroscopy and Radiation Dose:

Given that fluoroscopy exposes patients and providers alike to radiation via x-rays, questions on radiation dose from fluoroscopy should be anticipated on radiology board exams.

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How does fluoroscopy dose change (i.e., increase or decrease) as a function of the following factors?

Increase in patient size (thickness of body part imaged)?

Dose increases.

Decrease in beam energy?

Dose increases (more radiation absorbed). Note that a decrease in beam energy can be achieved by lowering kVp or reducing the amount of filtration. Remember that beam filtration commonly filters low energy x-rays that increase radiation absorption by the patient without meaningfully increasing image quality.

Decrease in field size?

Dose decreases (less area is exposed to radiation)

Increase in magnification?

Dose increases.

Increase in grid ratio?

Dose increases.

As the distance between patient and x-ray source increases?

Dose decreases.

As the distance between the patient and image intensifier increases?

Dose increases according to the inverse square law.

True or false? To lower radiation dose to the operator (i.e., you) should you stand on the same side or opposite side of the x-ray tube during a fluoroscopy study.

The operator should stand on the opposite side of the x-ray tube to avoid scatter from the x-ray tube that increases operator radiation dose.