12 Acute Abdominal Plain Xray Signs - Must know for a Radiologist!

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Learning objectives

To illustrate classic abdominal signs in acute abdomen.

To describe in detail these signs with respect to features, causes and differentials.
Background

Xray is the least expensive, least invasive, least time consuming universal modality when imaging acute abdomen.

It is pertinent for us to recognise classical signs on abdominal xray which aid in spot on diagnosis and help in better management of the patient.
Findings and procedure details

COLON CUTOFF

The colon cutoff sign describes the abrupt termination of gas within the proximal colon at the level of the radiographic splenic flexure, usually with decompression of the distal colon. The sign was originally applied to conventional abdominal radiographs, but similar findings can be seen on computed tomographic and intraluminal contrast material enema studies.

Inflammatory exudate in acute pancreatitis extends into the phrenicocolic ligament directly through the lateral attachment of the transverse mesocolon results in functional spasm and/or mechanical narrowing of the splenic flexure at the level where the colon returns to the retroperitoneum. [fig. 1]

This transition point, or cutoff, is further accentuated by distention of the intraperitoneal transverse colon from the focal adynamic ileus, which is also a result of the underlying inflammatory process. This appearance can mimic a true colonic obstruction. [1]

THUMBPRINT SIGN

The "thumbprint sign" was first described in 1963. This sign describes smooth, rounded impressions causing filling defects classically seen in barium studies of ischemic colitis. It can also be identified on plain x-rays [fig. 2].

These nodular densities represent edema and hemorrhage into the wall of the colon most commonly secondary to ischemia. This sign is seen in roughly 75% cases of transient, nongangrenous ischemic colitis. These soft tissue densities resolve once the colon wall has been reperfused and healed. The thumbprint sign can also be seen on CT as nodular, soft-tissue thickening of the wall of the colon. Pseudomembranous colitis, ulcerative colitis, lymphoma, leukemia, and hemorrhage into the bowel wall from coagulopathies may also produce the thumbprint sign. [2]

DOUBLE BUBBLE SIGN

The "double bubble" sign represents the appearance of 2 gas-filled structures in the upper abdomen of newborns and infants on plain films of the abdomen. The left-sided,
proximal bubble is the distended gas and fluid-filled stomach. The second, right-sided, more distal bubble is the distended duodenum [fig. 3]. The double bubble sign indicates the presence of duodenal obstruction that can be caused by a number of intrinsic or extrinsic etiologies. The intrinsic causes include duodenal webs, duodenal atresia, and duodenal stenosis. The extrinsic etiologies include a predouodenal portal vein, malrotation of the gut with a midgut volvulus or by Ladd bands, or an annular pancreas. Duodenal atresia is the causative entity most commonly linked with a double bubble sign. Duodenal atresia is found in 1 in 10,000 newborns and is typically associated with other congenital anomalies; 30% of children with duodenal atresia have Down’s syndrome. [3][4]

STRING OF PEARLS

The "string of pearls" sign indicates the presence of a small-bowel obstruction. This sign is also commonly referred to as the "string of beads" sign. It represents a row of small gas bubbles oriented in a relatively linear fashion within the abdomen on plain films [fig. 4].

The observed rows of gas bubbles represent gas trapped between the valvulae conniventes of the nondependent wall of small bowel. These loops of small bowel are dilated and filled with fluid in the setting of a small-bowel obstruction, thus the meniscal effect of the surrounding fluid gives these pockets of gas a rounded or ovoid appearance. The string of pearls sign can be seen in both upright and decubitus plain radiographs in the setting of a small-bowel obstruction. [2]

STACK OF COINS

The "stack of coins" sign typically indicates the presence of a small-bowel hematoma. This sign is seen on plain films or MDCT images and represents adjacent, thickened folds with sharp demarcation and crowding of the valvulae conniventes. [fig. 5]

Small-bowel hematomas are being seen with increasing frequency due to the prevalence of anticoagulation therapy. Over-anticoagulation with warfarin is the most common cause of spontaneous intramural small-bowel hematoma. Other causes that may lead to the stack of coins sign include idiopathic thrombocytopenic purpura, leukemia, pancreatitis, pancreatic cancer, hemophilia, lymphoma, myeloma, chemotherapy, and vasculidites. [5][6]

FOOTBALL SIGN

Miller first described the "football" sign in 1960. This sign represents a large ovoid radiolucency extending in a cephalocaudal axis within the abdomen. The football sign is seen on supine abdominal plain radiographs in severe pneumoperitoneum most
frequently in infants with spontaneous or iatrogenic gastric perforation. Only 2% of adults with pneumoperitoneum demonstrate the football sign.

Abundant free gas within the abdominal cavity collects anterior to the viscera and creates a sharp interface with the parietal peritoneum, thus outlining the peritoneal cavity. [fig. 6]. This gaseous interface with the peritoneum creates the ovoid shape of an American football. The massive pneumoperitoneum may outline the falciform ligament in the right upper quadrant. The gas may also outline the median umbilical ligament that is composed of the urachal vestige. The medial and lateral umbilical folds may also be outlined. These folds are composed of the umbilical and inferior epigastric vessels, respectively, that form the seams of the football.[7]

**RIGLER/BAS-RELIEF SIGN**

The "Rigler " or "bas-relief" sign is also seen on supine plain radiographs of the abdomen in cases of pneumoperitoneum. Rigler first described this finding in 1941. This sign is seen only in the presence of moderate to large amounts of pneumoperitoneum. With a prevalence of 32%, the bas-relief sign follows right upper-quadrant, subdiaphragmatic free air as the second most common sign of pneumoperitoneum on supine plain radiographs.

The bas-relief sign represents the visualization of both the luminal and serosal surfaces of the bowel wall due to the accumulation of free intraperitoneal gas between bowel loops [fig. 7]. A variant of the Rigler sign occurs when only the external surface of the bowel wall is visualized due to the presence of fluid within the bowel lumen.

The bas-relief sign can be mimicked by two closely contiguous loops of bowel. In this case, intraluminal gas in one loop can appear to outline the wall of an adjacent loop. Residual oral contrast from a recent CT study can also increase the apparent bowel-wall attenuation and create a pseudo-Rigler sign. Mach bands can also create a false positive bas-relief sign because there is the perception of a line at the interface of two differing radiographic densities.[8]

**CUPOLA SIGN**

The "cupola sign" represents an inverted cup-shaped lucency seen within the upper abdomen on supine plain radiographs in pneumoperitoneum This arcuate radiographic lucency projects across the midline caudal to the heart in the subxiphoid region. [fig. 8]

The cupola sign represents free intraperitoneal air located within the subphrenic space. The subphrenic space is located anterior to the stomach and the gastrohepatic ligament. This space creates a well-defined superior border to the gas collection, thus forming the cupola sign.
The central tendon of the diaphragm forms the well-defined superior margin of the cupola sign. The central tendon is composed of the right, left, and central diaphragmatic leaves. Gas collects below the central leaf, the most anterior portion of the diaphragmatic tendon, when the patient is supine.

Potential mimickers of the cupola sign can occur with the presence of air within the lesser sac, gas within the high transverse colon, gas within a horizontally-oriented stomach, pneumopericardium, or pneumomediastinum. [9]

**COFFEE BEAN SIGN**

The "coffee bean" sign is seen on supine plain films of the abdomen in approximately 80% of cases of sigmoid volvulus. The appearance of the coffee bean is created by the dilated lateral walls of the sigmoid colon forming the outer walls of the coffee bean and the closely apposed medial walls forming the cleft of the coffee bean. This gas-filled segment of bowel arises from the pelvis and may fill the entire abdomen. Its apex often extends superior to the 10th thoracic vertebral body and the apex can be located to the left or right of midline. [fig. 9]

A cecal volvulus can appear very similar to a sigmoid volvulus; however, a cecal volvulus should have only one air-fluid level, whereas a sigmoid volvulus may demonstrate two air-fluid levels. A distended, transverse colon can also mimic a sigmoid volvulus. This dilated bowel, however, does not arise from within the pelvis and it extends superiorly in a U-shaped configuration. The coffee bean sign has also been used to describe small-bowel, closed-loop obstructions. [10]

**STEP LADDER SIGN**

Loops proximal to the point of obstruction will become dilated and fluid-filled. Usually greater than 2.5-3 cm in size. Loops of small bowel may arrange themselves in a step-ladder configuration from the left upper to the right lower quadrant in a distal obstruction [fig. 10]. Absence of, or disproportionately smaller amount of, gas in the colon, especially the rectosigmoid is another reliable sign. [2]

**AIR UNDER DIAPHRAGM**

Subdiaphragmatic free gas is well appreciated as air under the diaphragm and air in the lungs outline the diaphragmatic contour well as little as 1ml of free air can be detected but the patient may be needed to be kept in upright position for about 10 minutes for the air to rise. [fig. 11]
Erect chest xray covering the upper abdomen are often considered best for detecting the subdiaphragmatic gas. [11]

**SENTINEL LOOP**

A sentinel loop indicates localized ileus from nearby inflammation. Simply put, it is the dilatation of a segment of large or small intestine. An isolated distended loop of bowel is seen near the injured viscus or inflammed organ. [fig 12]. It arises from the bodies efforts to localise traumatic or inflammatory lesions. The local distention of that intestinal loop is due to local paralysis. In acute pancreatitis the sentinel loop is seen in left hypochondrium, in acute cholecystitis, it is seen in right hypochondrium and in acute appendicitis, it is seen in right iliac fossa. [1]
Fig. 1: colon cut off

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Fig. 2: thumb printing

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Fig. 3: double bubble

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Fig. 4: string of pearls

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Fig. 5: stack of coins

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Fig. 6: foot ball

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Fig. 7: riglers
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Fig. 8: cupola
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Fig. 9: coffee bean

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Fig. 10: step ladder

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**Fig. 11:** air under diaphragm

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**Fig. 12:** sentinel loop

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Conclusion

Knowledge of these classical signs help in instant diagnosis and plan for appropriate treatment.
References


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