Acute intestinal ischemia: CT features

Clinical History:

A Patient with a known history of arteriosclerosis and atrial fibrillation was presented with abdominal pain. Laboratory tests revealed only a slight increase in the amount of WBC. Plain abdominal X-ray photographs showed non-specific findings.

Imaging Findings:

A patient with a long known history of cardiac failure (due to myocardial infarction) was admitted to the hospital for management. During his hospitalization, he presented with an acute, diffuse and gradually aggravated abdominal pain. The ECG (electrocardiogram) revealed a severe episode of atrial fibrillation with a fast ventrical response. Laboratory investigations demonstrated a slight increase in the amount of WBC (white blood cells). The plain abdominal X-ray film showed non-specific findings, such as those pertaining to bowel air-fluid levels (Fig.1). Spiral computed tomography of the abdomen and the pelvis was performed before and after the IV administration of the contrast medium. Scanning was performed using 8 mm collimation, 12 mm table feed (pitch 1.5) from the dome of the diaphragm to the symphisis pubis. Iodinated (120 ml; 300 mg iodine/dl) contrast material was administered via an antecubital vein. A CT examination revealed dilated loops of the small intestine, intramural gas in some of the bowel loops (Fig.2c) as well as the presence of gas in the branches of the portal vein (Fig. 3a) and the mesentery (Fig.3b) (findings consistent with bowel necrosis). The patient passed away 3 hours later. His relatives did not consent to the necrotomy procedures. On taking account of both clinical and radiological signs, the patient was diagnosed to have acute occlusion of, at least, one of the major branches of the superior mesenteric artery.

Discussion:

Acute bowel ischemia accounts for up to 1% of all cases of acute abdominal pain. Its mortality rate reaches up to 50%–90% depending on the cause, the degree and the extent of the ischemic bowel wall damage. Elderly people with systemic atherosclerosis (Figs. 2a, 2b) are usually affected. Acute intestinal ischemia can be caused either by vascular occlusion (arterial or venous) or by non-occlusive reduction of the intestinal perfusion. Arterial occlusion accounts for most cases. This is usually due to the formation of atheromatous plaque, thrombus, or embolism, and it occurs under less common conditions such as arteritis. Acute occlusions of the superior mesenteric artery (SMA) due to thrombosis or embolization constitute 60%–70% of all cases of acute bowel ischemia and most commonly result from thromboembolism, where the embolus originates from the left atrium as a consequence of atrial fibrillation. The clinical presentation of acute intestinal ischemia depends on the cause, severity and duration of ischemia. Patients usually present with continuous and severe abdominal pain. Normal peristaltic activity is interrupted, and there is often clinical evidence of obstruction, peritonitis, or bloody diarrhea. In mesenteric venous
thrombosis, the clinical profile is similar, but its course is somewhat more gradual. In cases of suspected ischemia, CT can detect changes of the affected bowel loops and the mesentery. Bowel-wall thickening and bowel lumen dilatation suggest mural edema and loss of peristaltic activity, respectively. According to the literature, these consist of the most common CT findings regarding acute bowel ischemia (with reported sensitivity values exceeding 90%). However, these findings are non-specific. Bowel-wall thickening also takes place present in infectious, inflammatory, or neoplastic conditions. On the other hand, gas-filled dilated loops are also seen in mechanical obstruction and adynamic ileus. A fluid-filled dilated bowel containing minimal intraluminal gas is more suggestive of acute intestinal ischemia and reflects the exudation of blood and fluid into the lumen of the ischemic bowel. In addition, an irreversible shock bowel may manifest with thinning of the intestine wall due to the severe damage of the intestinal musculature and intramural nerves (Fig. 3c). Bowel-wall attenuation may appear to be quite heterogeneous, owing to the presence of mural edema along with hemorrhagic infarctions. Moreover, hyperemia and hyperperfusion in acute bowel ischemia can cause an abnormal enhancement of the intestine wall, on post-contrast CT images.

Owing to stasis that accompanies intestinal ischemia, compromise of venous outflow occurs. This pathologic state results in engorgement of the mesenteric veins as seen on CT images. The mesenteric veins appear as dilated and prominent tubular structures within the mesenteric fat. In ischemic conditions, transudation into the mesentery or the peritoneal cavity leads to mesenteric stranding/liquid or even ascites. Prominent mesenteric vessels and mesenteric stranding may be also seen in other inflammatory conditions affecting the mesentery. Intraperitoneal fluid can as well occur secondary to a variety of non-ischemic conditions such as those that are of an infectious, inflammatory, neoplastic, or traumatic nature. Breakdown of the mucosal barrier results in pneumatosis and formation of portomesenteric venous gas. Pneumatosis manifests as isolated gas bubbles within the ischemic bowel wall or as strands of gas dissecting the intestine wall into two layers (Fig. 2c). Porto-mesenteric gas reflects the propagation of intraluminal gas into the porto-mesenteric veins and manifests with small gaseous inclusions in the mesenteric veins that may extend into the branches of the portal vein reaching the periphery of the liver (Fig. 3a). Pneumatosis and porto-mesenteric venous gas are considered to be the less common but the most specific (97%) imaging features of acute bowel ischemia. However, these high specificities are based on retrospective studies in preselected groups, and there are other non-ischemic causes of pneumatosis such as pulmonary disease, peptic ulcer, collagen vascular diseases, steroid administration and ulcerative colitis. CT can determine the cause by evaluating the mesenteric vasculature for occlusion, compression or invasion by tumor, trauma, etc. The presence of non-enhancement of the main mesenteric vessels in association with the other CT features of ischemic bowel disease is what makes it highly diagnostic. CT sensitivity has been markedly improved over the past several years from a value as low as 39% to a current value as high as 82%. Furthermore, the introduction of multidetector CT offers the CT technology an attractive advantage, not only in routine studies but also in the field of CT angiography. Its increased speed and narrow collimation coupled with the possibility of multiplanar reconstructions and three-dimensional reformating definitely led to improved visualization of the intestine wall and mesenteric vasculature and upgrades the CT evaluation of patients with suspected bowel ischemia.

**Differential Diagnosis List:** Acute intestinal ischemia/ bowel wall necrosis.

**Final Diagnosis:** Acute intestinal ischemia/ bowel wall necrosis.

**References:**


Description: Plain abdominal X-ray photographs in the upright position showing gas filled bowel loops and multiple small air-fluid levels in the right upper quadrant, there is also spondylodesis of the lumbar spine and arthroplasty of the left hip. Origin:
Figure 2

Description: An unenhanced CT scan at the level of the origin of the superior mesenteric artery depicting calcifications of both the aorta and the superior mesenteric artery. Origin:

Description: An unenhanced CT scan at a lower level revealing circumferential calcifications of the superior mesenteric artery. Origin:
Description: An unenhanced CT scan showing extraluminal gas, located in the bowel wall (intramural gas) and in the mesentery. Origin:
Figure 3

a
Description: Contrast enhanced CT scans demonstrating gas in portal vein branches, which ramifies and is peripherally located taking a tree-shape configuration. Origin:

b
Description: Contrast enhanced CT scans revealing strands of extraluminal gas along the root of the mesentery. Origin:

c
Description: A contrast enhanced CT scan revealing intramural gas in the bowel wall, taking round and linear configurations. The wall of the bowel is thin. Origin: