CT applications for the diagnosis of nontraumatic emergency abdominal pathology

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Purpose

To identify indications of Computed tomography (CT) and to understand its role in the evaluation of acute abdominal pain.

To recognize CT appearance of common pathologic conditions that manifest with acute abdominal pain.
When we talk about acute abdomen we refers to any clinical condition characterized by important abdominal pain that develops over a period of hours. Accurate diagnosis is essential to improve posterior treatment and prognosis.

Clinical assessment is often difficult, and laboratory and conventional radiologic findings are frequently nonspecific. Computed tomography is very useful in patients with severe abdominal pain, mainly in those who may require surgery. It is a rapid, cost-effective technique, which offers important clues to diagnose these patients.

We show most important imaging findings in a variety of conditions that can manifest with acute abdominal pain, including those affecting pancreas, biliary system, gastrointestinal tract and vascular system.

We present 10 cases of patients who underwent imaging at Hospital Universitario Príncipe de Asturias (Alcalá de Henares, Madrid, Spain).

Utilizing a 16 and 64 detectors CT imaging system, the routine abdominal protocol was performed in each patient.

We include cases of:

**Abdominal aortic aneurysm rupture** (Fig. 1 on page 6, Fig. 2 on page 6 and Fig. 3 on page 7).

- Abdominal aortic aneurysms are segmental dilatations of the aortic wall. These can continue to expand and rupture spontaneously, exsanguinate, and cause death.
- Aortic aneurysm rupture is the most important diagnosis to exclude in patients with acute abdominal pain especially when they present with back or flank pain.
  The primary signs of aortic aneurysm rupture are periaortic stranding, retroperitoneal hematoma and extravasation of iv. contrast.
- The CT features of contained leak or pending rupture of an aortic aneurysm may be subtle and easily overlooked.
  We have to look for the high-attenuating crescent sign, focal discontinuity of intimal calcification or tangential calcium or the draped aorta sign.
**Aortic dissection** (Fig. 4 on page 8, Fig. 5 on page 9, Fig. 6 on page 10 and Fig. 7 on page 11).

- Acute aortic dissection is a cardiovascular emergency that requires prompt diagnosis and treatment. Helical computed tomography allows diagnosis of acute aortic dissection with a sensitivity and specificity of nearly 100%.
- In Stanford classification, type A dissections involve the ascending aorta and type B dissections are distal to the left subclavian artery.
- The classic feature of aortic dissection is a partition between the true and false channels; such a partition, which is formed by the intimal flap, is found in approximately 70% of cases. Secondary findings include internal displacement of intimal calcifications or a hyperattenuating intima; delayed enhancement of the false lumen; widening of the aorta; and mediastinal, pleural, or pericardial hematoma.

**Mesenteric ischemia** (Fig. 8 on page 12, Fig. 9 on page 13, Fig. 10 on page 14 and Fig. 11 on page 15).

- Mesenteric ischemia is characterized by inadequate blood flow to or from the involved mesenteric vessels supplying a particular segment of bowel. The organs typically affected are the small bowel or colon. The source of blood that is lacking can be arterial or venous.
- CT is the primary imaging modality, and it has been proved to be highly accurate in the diagnosis of mesenteric ischemia. CT scans show mesenteric edema with irregular thickening of the wall of the small or large bowel that is greater than 3 mm. A thrombus in a large vessel is seen as a soft-tissue filling defect in rare cases. With mucosal disruption and gas dissection, intramural air can be seen and this entity is called pneumatosis intestinalis. Gas may enter the portal circulation, and it may be found in peripherally located portal vein branches, usually in the nondependent left hepatic lobe.

**Inflammatory pathology**

- **Appendicitis** (Fig. 12 on page 16 and Fig. 13 on page 17): Acute appendicitis, at times, is a difficult clinical diagnosis. CT can play a valuable role in selected patients with suspected appendicitis. CT imaging findings are inflammatory stranding of the mesentenic fat; demonstration of an abnormally thickened (>6 mm), enhancing appendix with surrounding inflammatory changes or frank abscess formation on detection of pericecal phlegmon or abscess with a calcified appendicolith is diagnostic of acute appendicitis.
- **Emphysematous cholecystitis** (Fig. 14 on page 18): Emphysematous cholecystitis is an acute infection of the gallbladder wall caused by gas-forming organisms (eg, Clostridium or Escherichia coli) that is generally considered a surgical emergency. Elderly males, especially diabetics, are particularly susceptible to emphysematous cholecystitis. Evaluation with
abdominal CT scanning is now considered the primary imaging modality to confirm acute emphysematous cholecystitis, as it is the most sensitive and specific imaging modality for identifying gas in the gallbladder lumen or wall.

- **Acute pancreatitis** (Fig. 15 on page 19): Acute pancreatitis is defined as an acute inflammatory process of the pancreas with variable involvement of other regional tissues or remote organ systems. CT scanning of the abdomen and pelvis is the standard imaging modality for evaluating acute pancreatitis and its complications. Typical CT findings in acute pancreatitis include focal or diffuse enlargement of the pancreas, heterogeneous enhancement of the gland, irregular or shaggy contour of the pancreatic margins, blurring of peripancreatic fat planes with streaky soft tissue stranding densities, thickening of fascial planes, and the presence of intraperitoneal or retroperitoneal fluid collections. The fluid collections most commonly are found in the peripancreatic and anterior pararenal spaces but can extend from the mediastinum down to the pelvis. Complications of acute pancreatitis, such as pseudocysts, abscess, necrosis, venous thrombosis, pseudoaneurysms, and hemorrhage, can be recognized with CT. CT can be used to assess the severity of acute pancreatitis and to estimate the prognosis. Balthazar et al developed a grading system in which patients with acute pancreatitis are classified into 1 of the following 5 grades:

  - Grade A - Normal-appearing pancreas
  - Grade B - Focal or diffuse enlargement of the pancreas
  - Grade C - Pancreatic gland abnormalities associated with peripancreatic fat infiltration
  - Grade D - A single fluid collection
  - Grade E - Two or more fluid collections

**Duodenal perforation** (Fig. 16 on page 20, Fig. 17 on page 21 and Fig. 18 on page 22)

- Duodenal ulcers are common pathologic entities that occur most frequently in the duodenal bulb. Perforated duodenal ulcers can be diagnosed at CT from the presence of wall thickening, periduodenal fluid, retroperitoneal air, or free intraperitoneal air.
Fig. 1: Contrast-enhanced abdominal CT in an elderly patient who presented with severe back pain and was hemodynamically unstable. CT reveals an abdominal aortic aneurysm (AAA) with mural thrombus. In the anterior wall of the aorta there is focal discontinuity of intimal calcification consistent with contained rupture/pseudoaneurysm of 1.5 cm.

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Fig. 2: Coronal reconstruction: Aneurysm of the abdominal aorta and a small hyperdense retroperitoneal hematoma due to rupture.

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Fig. 3: Another patient with aortic aneurysm rupture. Retroperitoneal hematoma and contrast leakage outside the aorta.

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Fig. 4: Enhanced CT scans show an intimal flap in the descending aorta.

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Fig. 5: Intimal flap in the descending aorta and internal displacement of intimal calcifications. There is also delayed enhancement of the false lumen.

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Fig. 6: Descending aortic dissection involving left renal artery.

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Fig. 7: Coronal reconstruction: Descending aortic dissection involving left renal artery.

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Fig. 8: CT scan in a 85-year-old woman with abdominal pain shows portal-venous air. Findings consistent with mesenteric ischemia.

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Fig. 9: Contrast-enhanced CT scan depicts gas in mesenteric veins.

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**Fig. 10:** With proper timing of the contrast-agent bolus, a thrombus in the superior mesenteric artery is seen as a soft-tissue filling defect.

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Fig. 11: Coronal reconstruction showing all imaging findings consistent with mesenteric ischemia.

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**Fig. 12:** Axial CT scan at level of cecum shows a thickened, tubular structure arising from cecum; this is the inflamed appendix. Inflammation in this region has caused marked stranding of the pericecal fat.

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Fig. 13: Acute appendicitis with appendicolith. CT findings are diagnostic of acute appendicitis.

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**Fig. 14:** Emphysematous cholecystitis in a 75-year-old man with diabetes who experienced abdominal pain. This computerized tomography scan shows gas within the wall of the gallbladder as well as within the lumen of the gallbladder.

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**Fig. 15:** Typical CT findings in acute pancreatitis include focal or diffuse enlargement of the pancreas, heterogeneous enhancement of the gland, irregular or shaggy contour of the pancreatic margins, blurring of peripancreatic fat planes with streaky soft tissue stranding densities, thickening of fascial planes, and the presence of fluid collections in the peripancreatic and anterior pararenal spaces.

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**Fig. 16:** Pneumoperitoneum. Contrast-enhanced axial CT scan through the liver shows a collection of air anterior to the liver. Also note intra-abdominal free fluid with air bubbles.

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**Fig. 17:** Perforation of the duodenal anterior wall in the axial plane.

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Fig. 18: Perforation of the duodenal anterior wall in the coronal plane.

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Results

CT has become an increasingly important tool in the evaluation of patients with acute abdominal non-traumatic pathology and it often plays an important role in establishing the diagnosis and even in deciding on operative versus nonoperative therapy.

CT has proved to be extremely sensitive and specific in the diagnosis of a variety of acute abdominal conditions including cholecystitis, pancreatitis, appendicitis and acute aortic pathology. Some of them are life-threatening entities that requires emergent treatment and therefore any radiologist should recognize imaging findings to provide a rapid and accurate diagnosis.
Conclusion

The radiologist should be aware of common CT imaging findings in non-traumatic acute abdomen in order to improve diagnostic accuracy.

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