Introduction

When intra-abdominal hemorrhage is suspected, ultrasonography may be used as the initial method of evaluation, because its widespread availability and capacity for detecting free fluid in the abdomen. Computed tomography (CT) is the modality of choice because its speed and specificity to detect small amounts of intraabdominal blood, allowing identification of the source and cause of bleeding by identifying the sentinel clot. Magnetic resonance (MR), has a high sensitivity for characterization of blood at its various stages, but its role is been limited by its lower availability and higher cost, also is not useful for unstable patients because its longer time proceeding.

Causes of abdominal bleeding are diverse and are summarized in table 1.

The aim of this article is to review the various causes and imaging findings of spontaneous abdominal bleeding that may help to establish a correct diagnosis and to provide guidance on the proper treatment.

Topic review

Signs of spontaneous abdominal bleeding

On unenhanced CT, bleeding has an attenuation of 35-45 Hounsfield units (HU) in the hyperacute stage and of over 60 HU in the acute stage (then decreasing over time). Clots tend to form near the site of bleeding, allowing the identification of the site of the hemorrhage (sentinel clot) surrounded by areas of lower attenuation. (fig. 1).

Abstract

Spontaneous abdominal hemorrhage is defined as intra-abdominal hemorrhage from a non-traumatic cause. The clinical presentation of this condition is nonspecific, therefore the diagnosis is usually made on the basis of imaging findings. Imaging serves three basic purposes: detecting the presence of intra-abdominal hemorrhage, locating the source of bleeding and determining the presence or absence of active arterial extravasation.

The causes of non traumatic intra-abdominal hemorrhage are diverse and can be classified according to the organ of origin in hepatic, splenic, pancreatic, adrenal, renal, gynecologic and obstetric, vascular, and soft tissue-related (peritoneal and muscular).

Keywords: Hemorrhage; Spontaneous; Clot; Sentinel.

Figure 1 Sentinel clot. Unenhanced CT in a 56-year-old patient with cirrhosis and spontaneous rupture of hepatocellular carcinoma: sentinel clot sign (arrowhead) and perihepatic free blood (arrow).
On contrast-enhanced CT, the site of active bleeding may be occasionally depicted an area or foci of high attenuation, of 85 and 300 HU, suggestive of active hemorrhage. This finding may be indicative of the need for emergency embolization or surgery 1-3(fig. 2).

Ultrasonography may be used as the initial method of evaluation for detecting intraabdominal fluid. Its may be hypoechoic or appear as a heterogeneous collection, with multiple hypechoic areas surrounding solid organs or bowel loops. This finding play an important role, in making the diagnosis of spontaneous abdominal bleeding secondary to gynecologic causes.

MRI is highly sensitive for detecting blood content at various stages, but it plays a limited role in the emergency setting.

**Hepatic causes**

Spontaneous hepatic hemorrhage is an uncommon disorder

**Table 1:** Causes of spontaneous abdominal hemorrhage according to the organ of origin.

<table>
<thead>
<tr>
<th>Origin</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Hepatic</td>
<td>- Adenoma</td>
</tr>
<tr>
<td></td>
<td>- Hepatocellular carcinoma (HCC)</td>
</tr>
<tr>
<td></td>
<td>- Others: metastasis, hemangioma or angiosarcoma</td>
</tr>
<tr>
<td></td>
<td>- HELLP Syndrome</td>
</tr>
<tr>
<td>*Splenic</td>
<td>- Infectious spontaneous rupture: cytomegalovirus and mononucleosis</td>
</tr>
<tr>
<td></td>
<td>- Lymphoproliferative spontaneous rupture: lymphoma and leukemia</td>
</tr>
<tr>
<td></td>
<td>- Rupture of focal tumors</td>
</tr>
<tr>
<td>*Renal</td>
<td>- Angiomyolipoma</td>
</tr>
<tr>
<td></td>
<td>- Renal cell carcinoma</td>
</tr>
<tr>
<td></td>
<td>- Spontaneous bleeding (coagulopathy and vasculitis)</td>
</tr>
<tr>
<td>*Adrenal</td>
<td>- Spontaneous bleeding</td>
</tr>
<tr>
<td></td>
<td>- Tumors</td>
</tr>
<tr>
<td>*Pancreatic</td>
<td>- Necrohemorrhagic pancreatitis</td>
</tr>
<tr>
<td></td>
<td>- Rupture of peripancreatic pseudoaneurysm</td>
</tr>
<tr>
<td>*Gynecologic</td>
<td>- Rupture of hemorrhagic cyst</td>
</tr>
<tr>
<td></td>
<td>- Rupture of endometrioma</td>
</tr>
<tr>
<td>*Obstetric</td>
<td>- Rupture of ectopic pregnancy</td>
</tr>
<tr>
<td></td>
<td>- HELLP Syndrome</td>
</tr>
<tr>
<td>*Vascular</td>
<td>- Rupture of arterial aneurysm</td>
</tr>
<tr>
<td></td>
<td>- Dissection</td>
</tr>
<tr>
<td></td>
<td>- Wall hematomas</td>
</tr>
<tr>
<td></td>
<td>- Vascular erosion by tumor, inflammation, vasculitis or cysts.</td>
</tr>
<tr>
<td>*Soft tissues</td>
<td>- Hematoma in the psoas</td>
</tr>
<tr>
<td></td>
<td>- Hematoma in the rectus sheath</td>
</tr>
<tr>
<td></td>
<td>- Mesenteric hematoma</td>
</tr>
</tbody>
</table>
due to the rupture of a tumor or, less frequently to the HELLP syndrome (hemolysis, elevated liver enzymes, low platelet count).

Adenoma and hepatocellular carcinoma (HCC) have the highest incidence of spontaneous rupture. Adenoma usually occurs in women receiving oral contraceptives, and its complication should be suspected in the presence of hemorrhagic tumor and subcapsular hematoma, or blood in the peritoneal cavity (fig. 3)4. Rupture of the HCC occurs in cirrhotic patients, mainly in exophytic or peripherally located tumors (fig. 4) with discontinuity of the hepatic surface, presence of blood in the subcapsular region or peritoneal cavity5. Rarely, a hemangioma may rupture after hepatic trauma5. Bleeding has also been reported in association with hypervascular metastases and angiosarcomas.

The HELLP syndrome is a serious variant of preeclampsia that may be associated with necrosis and hepatic infarctions, as well as with intrahepatic or subcapsular hematomas4 (fig. 5).

**Splenic causes**

Spontaneous splenic rupture may occur in association with severe or massive splenomegaly due to hematologic malignancies (such as lymphoma or acute leukemia) and infectious causes (like mononucleosis and infection by cytomegalovirus [CMV])7 CT shows an enlarged spleen with perisplenic blood and the sentinel clot sign within the spleen (fig. 6). Less frequently, some splenic tumors (metastases, hemangioma and angiosarcoma) may be complicated by bleeding. In these cases, imaging scans show a focal lesion associated with intratumoral and perisplenic blood (fig. 7).

**Renal causes**

Renal tumors, such as renal cell carcinomas (RCC) and angiomyolipoma (AML) may complicate and cause spontaneous bleeding into the subcapsular and perinephric space. Diagnosis of complicated AML is based on the identification of gross fat in the tumoral lesion (fig. 8). RCC appears as a solid hypervascular lesion with blood content (fig. 9) and rarefaction of adjacent fat. If the tumor is too small, it may remain occult within the hematoma and be overlooked (for this reason, it is important to monitor progress of the lesion).

---

**Figure 3** Complication of hepatic adenoma with bleeding in a 35-year-old woman with acute abdominal pain and a decrease in hematocrit levels.

**Figure 4** Spontaneous rupture of hepatocellular carcinoma in a patient with chronic liver disease. (a) Contrast-enhanced CT and (b) T2-weighted MRI. Note the peripheral location of the tumor and the free blood content towards the peritoneum (arrows).
Figure 5 HELLP syndrome in a pregnant 27-year old woman with abdominal pain and a decrease in hematocrit levels. (a) Unenhanced CT shows a large acute hepatic subcapsular hematoma. (b) CT slices at the level of the pelvis show a pregnant uterus.

Figure 6 Spontaneous splenic rupture in a patient with acute lymphoblastic leukemia and splenomegaly. (a) Unenhanced CT shows the sentinel clot sign (arrow), while (b and c) intravenous contrast-enhanced CT shows a hypodense intrasplenic lesion, hemoperitoneum and a small focus of active bleeding (arrow in b).
Figure 7 Spontaneous rupture of splenic hemangioma in a 54-year-old woman with acute abdominal pain. (a and b) Intravenous contrast-enhanced CT shows a hypervascular nodular lesion in the upper region of the spleen (arrow in a) and a large perisplenic hematoma (arrow in b).

Figure 8 Spontaneous rupture of renal angiomyolipoma in a 40-year-old female patient with tuberous sclerosis. Contrast-enhanced CT shows bilateral angiomyolipomas with the sentinel clot sign (arrow) and a site of active bleeding (arrowhead) in the right kidney.

Figure 9 Renal cell carcinoma with sarcomatoid transformation in a 39-year-old woman who presents with pain of 3 days duration and a decrease in hematocrit levels. (a) Unenhanced CT scan shows a large left renal mass with internal bleeding and (b) T1-weighted MRI in the same patient shows the blood content of the tumor at different stages.
Less frequently, subcapsular or perinephric hematomas occur in association with coagulopathy or vasculitis (fig. 10), as such as Wegener’s disease or polyarteritis nodosa, and they may cause acute blood hypertension by parenchymal compression (known as Page kidney)⁸,⁹.

**Adrenal causes**

Spontaneous adrenal hematomas may occur in association with anticoagulation therapy, sepsis, severe stress and hematologic or idiopathic disease. CT shows enlarged hyperdense adrenal gland with no changes in density after intravenous administration of contrast material (fig. 11). Some tumors, such as metastases, adrenal carcinoma and lymphoma (fig. 12) may occasionally bleed¹⁰.

**Pancreatic causes**

Pancreatic necrosis occurs in 20% of acute pancreatitis and it is associated with hemorrhagic changes affecting the pancreatic parenchyma and neighboring tissues. The bleeding is usually small in volume and self-limited, but marked hemorrhage can occur (fig. 13). Formation of a peripancreatic pseudoaneurysm in the splenic or gastroduodenal artery may occur in 10% of cases. Rupture and bleeding can occur into the peritoneum, adjacent hollow organs, or pancreatic duct (hemosuccus pancreaticus)¹¹.

**Gynecologic and obstetric causes**

Rupture of a hemorrhagic cyst or rupture of an ectopic pregnancy are the most common causes of spontaneous abdominal bleeding in women of childbearing age. These conditions may have similar clinical and imaging features, but the key differentiating finding is the increased beta-human chorionic gonadotropin (hCG) in ectopic pregnancy. On ultrasonography, they appear as complex adnexal cystic mass or images with dense content and free fluid in the pelvis extending to the rest of the abdomen (fig. 14). CT may confirm the existence of adnexal blood content and free fluid (fig. 15). Diagnosis of complicated ectopic pregnancy may be definitively established upon visualization of adnexal ring on ultrasound or by the presence of a ring-enhancing mass on contrast-enhanced CT¹²,¹³. Very rarely endometriomas or other cysts may be complicated by intracavitary bleeding. In addition, another cause of spontaneous abdominal bleeding is the HELLP syndrome (previously described).
Figure 12 Bilateral adrenal hematoma in a patient with Burkitt lymphoma who developed acute abdominal pain. (a) Unenhanced CT shows an enlargement of both adrenal glands with internal density (suggestive of hemorrhage). (b) T2-weighted STIR MRI differentiates a liquid area and a solid area in both glands. (c and d). Unenhanced and gadolinium-enhanced T1-weighted images identify posterior hemorrhagic areas, with no enhancement and at different stages of blood (arrows), and an anterior solid area that enhances with contrast (arrowheads).

Figure 13 Necro hemorrhagic pancreatitis in a 35-year-old male patient. Unenhanced CT shows large hematoma in the region of the head and neck of pancreas.
Vascular causes

Arterial bleeding may be due to rupture of an abnormally dilated vessel or a vessel of normal size with weakened walls. These causes include aneurysm, pseudoaneurysm, arterial dissection, wall hematomas or erosion of a vessel by an adjacent mass, inflammatory disorders, vasculitis or cysts. The most common cause of vascular bleeding is a ruptured abdominal aortic aneurysm, followed by ruptured aneurysms of iliac, splenic and hepatic arteries. CT shows active bleeding, retroperitoneal hematoma and loss of wall continuity (fig. 16).14–19

Soft tissues

Hematoma of the iliopsoas muscle or the rectus sheath may be found in association with coagulopathy, vasculitis or unknown etiology. CT shows an enlargement and increased density of the muscle (figs. 17 and 18). Hematoma of the rectus sheath may extend extraperitoneally towards the pelvis below the linea alba and be misdiagnosed as pelvic masses (fig. 18); while a spontaneous mesenteric hematoma may be misdiagnosed as adenomegaly or tumor mass, hence the importance of follow-up of the lesion (fig. 19).
Figure 16 Ruptured abdominal aorta aneurysm. Contrast-enhanced CT shows typical signs: discontinuity of the aortic wall (arrow), contrast extravasation (arrowhead) and retroperitoneal hematoma (asterisk).

Figure 17 Hematoma of the rectus sheath in a patient on anticoagulation therapy. (a) Unenhanced CT shows hematoma with a hematocrit effect in the rectus sheath on the left side, extending contralaterally and extraperitoneally towards the right pelvis below the linea alba. (b) Ultrasonography of the same patient showing a complex fluid mass on the right pelvis that was initially misdiagnosed as adnexal blastoma.

Figure 18 Hematoma of the right psoas in a patient with abnormal coagulation factors. Unenhanced CT shows enlargement of the right psoas muscle with a hematocrit effect (cellular-fluid level).
Conclusion

Diagnosis of spontaneous abdominal bleeding is mainly based on radiologic findings. For this reason, the imaging specialist should be able to recognize its signs and be aware of the various causes that may originate such bleeding.

Conflicts of interest

The authors declare no conflicts of interest, except for Dr. Kozima who declares a possible conflict of interest as member of the Executive Committee of SAR.

References