Differential diagnosis of splenic lesions

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Learning objectives

To become familiar with the normal splenic anatomy and normal variants.

To illustrate the spectrum of congenital and acquired diseases of the spleen.

To determine the current role of ultrasound (US), computed tomography (CT) and magnetic resonance Imaging (MRI) in the detection and characterization of focal spleen lesions.

Background

A wide range of splenic variations and abnormalities can affect the spleen and may be found incidentally during an imaging evaluation for other reasons. Although primary splenic diseases are rare, the spleen is frequently involved secondarily by many infectious, vascular, hematologic, and oncological disorders. Ultrasound and CT are the first line imaging modalities to evaluate the spleen. MRI is generally used as a supplementary technique because of its excellent tissue characterization capability.

Imaging findings OR Procedure details

NORMAL ANATOMY

The spleen is an intraperitoneal organ that is located in the left upper quadrant of the abdomen. It is attached to the retroperitoneum by fatty ligaments that also contain its vascular supply. The lateral surface of the spleen has a smooth convex margin conforming to the adjacent abdominal wall and left hernidiaphragm. The hiliar margin is usually concave. A fossa is often formed posteromedially by the left kidney, and there may be a less discrete fossa anteromedially for the gastric fundus.

On US, the spleen has homogeneous mid-to low-level echotexture.
On unenhanced CT, the spleen has homogeneous attenuation, with CT numbers of 40-60 Hounsfield units (HU), approximately 5-10 HU less than those of liver. Appearance on contrast-enhanced CT depends on the timing after bolus injection of intravenous contrast material. The normal spleen enhances in a mottled pattern during the arterial and early portal venous phases of intravenous contrast material enhancement (detection of splenic lesions during these phases is problematic). The splenic parenchyma enhances homogeneously in the middle to late portal venous phase.

On MR imaging the signal intensity of the spleen is less than that of liver on T1W images and higher on T2W images.

(Fig.1) on page 12

CONGENITAL VARIATIONS

Accessory spleen

An accessory spleen refers to a congenital focus of normal splenic tissue that is separate from the main body of the spleen. Accessory spleens are found in up to 30% of unselected autopsy cases. They range in size from a few millimeters to several centimeters, may be single or multiple, and may enlarge after splenectomy. As their origin is congenital, they are restricted to sites within the embryologic dorsal mesentery of the stomach and pancreas. They occur most frequently in the hilar region and usually have no clinical significance. In splenosis, which is usually a result of trauma with autotransplantation of splenic tissue, implantation of splenic tissue may occur anywhere in the abdomen, pelvis, or even chest.

At CT and MR imaging, accessory spleens are suggested by their characteristic location and appearance similar to the spleen on nonenhanced and contrast material-enhanced images. However, if the location is atypical, an accessory spleen may be mistaken for a tumor. Confirmation can be obtained by means of scintigraphy, which although providing inferior spatial resolution, is the most specific imaging study for diagnosing functioning ectopic splenic tissue.

(fig.2 on page 13 and fig.3 on page 13)

Lobulations/Clefts

The notches or clefts on the superior border of the adult spleen are remnants of the grooves that originally separated the fetal lobules. These clefts can be sharp and are occasionally as deep as 2-3 cm

They may be erroneously interpreted as splenic laceration in patients with abdominal trauma.
Wandering spleen

Wandering spleen is a rare entity, in which the spleen is attached by a long, vascular pedicle. The mobility of the spleen due to its abnormally long vascular pedicle predisposes it to various complications such as torsion, infarction, gangrene, abscess formation, variceal haemorrhage and pancreatic necrosis.

Polysplenia and Asplenia

Polysplenia is rare and consists of situs ambiguous, with features of bilateral left sidedness. Multiple small spleens are usually on the patient's right side. Asplenia consists of situs ambiguous with features of bilateral right sidedness and occurs predominantly in male patients. Polysplenia and asplenia are frequently associated with other congenital abnormalities, including rotational anomalies of the intestinal tract, cardiac abnormalities and absence of the gallbladder. There may be absence or hypoplasia of the hepatic segment of the inferior vena cava and continuity of the cava with the azigous or hemyazigous veins.

Splenogonadal fusion

This anomaly is the result of an embryological fusion between gonad and spleen. Splenogonadal fusion has been classified into two types; continuous, where there is a direct connection between spleen and gonad; and discontinuous, where ectopic splenic tissue is attached to the gonad, but there is no connection to the spleen. Typically, the malformation manifests as a testicular mass, and the diagnosis is seldom made preoperatively. A definitive diagnosis cannot be made solely on the basis of radiological findings.

INFLAMMATORY DISEASE

Splenogenic abscesses

Splenogenic abscesses are uncommon entities but their prevalence have increased due to the increased number of immunosuppressed patients. Splenic abscesses are usually encountered in patients with underlying disorders, including infection, emboli, trauma, recent surgery, malignant hematologic conditions, and immunosuppression.
The cause and route of splenic abscesses can be divided into five distinct groups: metastatic infection (sepsis), contiguous infection (infected pancreatitis), ischemia and subsequent superimposed infection, trauma and immunodeficiency conditions. They can be solitary, multiple or multilocular. Bacteria are commonly the pathogenic agents that create unilocular abscesses. The most frequently encountered pathogens are Escherichia Coli and Salmonella.

US show poorly defined hypoechoic or anechoic masses, depending on the degree of proteinaceous fluids with the lesions. If gas has formed, high echogenicity associated with distal "dirty" shadowing may be present.

CT is currently the diagnostic method of choice because of its high sensitivity, noninvasiveness, applicability in unstable patients, and value in allowing accurate localization of the lesion in relation to contiguous viscera. With CT examination, bacterial abscesses are frequently visualized as a low attenuation lesions (fluid or necrotic changes). Minimal peripheral contrast enhancement may be present when a capsule has developed. The presence of gas in an intrasplenic collection is diagnostic for an abscess.

MR imaging shows the abscess as a lesion of fluid signal intensity, with low signal intensity on T1-weighted images and high signal intensity on T2-weighted images. As CT, there is minimal peripheral enhancement when the capsule develops.

(Fig.6 on page 15)

Fungal abscesses have been found to constitute up to 26% of splenic abscesses and occur almost exclusively in individuals with a compromised host defense mechanism. Candida fungus is most frequently encountered, followed by Aspergillus and Cryptococcus fungi. Multilocular abscesses have a fungal etiology in more than 60%. Lesions are usually very small. Multiple hypoechoic areas with a 'target' appearance are typically seen at US (the central nidus of necrotic hyphae is hypoechoic and is surrounded by a hyperechoic concentric band of viable fungal elements). CT shows multiple small lesions of relatively low attenuation. Use of MR imaging in fungal infection is limited, and optimal contrast-enhanced resolution of small lesions may be difficult to obtain. MR imaging may demonstrate multiple small lesions of intermediate signal intensity on T1-weighted images and high signal intensity on T2-weighted images. Ringlike enhancement may be seen with contrast-enhanced (less frequent than in bacterial abscess).

GRANULOMATOUS INFECTIONS

Tuberculosis

Infection with Mycobacterium tuberculosis of the spleen usually occurs in a miliary form by hematogenous dissemination. Splenic tuberculosis may appear micronodular (miliary) or macronodular. Miliary splenic disease manifests as multiple tiny, low-attenuation foci.
at CT. Often there is mild splenomegaly. The macronodular form is rare and manifests as diffuse splenic enlargement with multiple low-attenuation lesions or a single tumorlike mass. Occasionally, small peripheral wedge-shape areas of low attenuation may be present and represent infarcts from septic emboli. On contrast-enhanced images, early-stage lesions may demonstrate central enhancement whereas more advanced lesions may demonstrate calcification (representing healed calcified granulomas).

(Fig.7 on page 16)

**PNEUMOCYSTIS JIROVECII**

Intrasplenic Pneumocystis jirovecii infection is often discovered incidentally in the patient with AIDS who is undergoing CT examination for a fever of unknown origin. CT shows an enlarged spleen with focal low-attenuation splenic lesions, which may become progressively calcified either in rimlike or punctate fashion over a few months. Associated findings are punctate calcifications in the liver, kidneys, thyroid, and adrenal glands; calcification of lymph nodes; and pleural and peritoneal effusions with subsequent calcifications of the pleura.

(Fig.8 on page 16 and Fig.9 on page 17)

**INFLAMMATORY PSEUDOTUMOR OF THE SPLEEN**

Inflammatory pseudotumor is an extremely rare benign lesion of the spleen consisting of a well-circumscribed solitary mass composed of localized areas of inflammatory and reparative fibroblastic changes as well as a granulomatous component. Nonenhanced CT demonstrates a rounded mass of low attenuation. Calcification may be present in the mass. After a bolus injection of contrast media, contrast enhancement is observed with a progressive opacification of the lesion. Central stellate areas of low attenuation may persist within the mass, histologically corresponding to focal areas of fibrosis.

**CYSTIC LESIONS**

Splenic cysts are often found incidentally at radiologic examinations. Less commonly, splenic cysts may become symptomatic by becoming large enough to cause extrinsic mass effect on adjacent organs or by developing complicating features of hemorrhage, rupture, or superimposed infection.

Splenic cysts may be primary or secondary. **Primary or true cysts** have a cellular lining and are either nonparasitic (epidermoid) or parasitic (echinococcal). **Secondary cysts** are false cyst. A false cyst or pseudocyst lacks an epithelial lining. They account for 80% of splenic cysts and are considered to be posttraumatic in origin. Infarction and infection have been considered as other causes of pseudocysts.
Although imaging features are similar, clinical presentation, patient history, and ancillary imaging findings help narrow the differential diagnosis.

**Epidermoid cyst (or true nonparasitic cyst)**

Epidermoid cyst is defined by the presence of an inner endothelial lining. It is developmental in origin, and its lining is formed secondary to an infolding of peritoneal mesotheium or collections of peritoneal mesotheial cells trapped within the splenic sulci. They are solitary in 80% of cases and unilocular in 80%. Congenital cysts are often associated with cystic renal disease or von Hippel Lindau syndrome. On US, a well-defined, anechoic mass is seen, with occasional low-level interna echoes secondary to deposition of colesterol crystals. CT typically shows a large, low-attenuation, unilocular mass with imperceptible walls. Wall calcifications occur in 15% of cases and septations in 20%. No enhancement is seen after endovenous contrast (except possibly in the internal trabeculae). Rarely, congenital cysts contain blood. MR images show a well-defined, round mass. On T2-weighted images, the mass has markedly high signal intenstity.

(Fig.10 on page 17)

**Echinococcal cyst**

Echinococcal cysts are rare in nonendemic areas, and isolated splenic involvement occurs in less than 2% of all patients with hydatid disease. The most common organism is Echinococcus granulosus. Systemic dissemination and intraperitoneal spread from a ruptured liver cyst constitute the two most important sources of splenic infestation. The imaging appearance varies depending on the age of the cyst and complications, such as pyogenic superinfection or rupture. CT demonstrates a sharply marginated, round to ovoid masses of attenuation almost equal to that of water, and may have peripheral, ringlike calcification. Higher attenuation within the lesion is frequently encountered and may occur secondary to the formation of daughter cysts or as a result of the collection of dense debris (hydatid sand) within the cyst. Peripheral daughter cysts may have slightly lower attenuation than the mother cyst. Intracystic calcifications are rare. The presence of multiple cysts, the appearance of daughter cysts within a large cyst and calcified cystic structures in the liver or lung help differentiated echinococcus cyst from other types of cysts.

(Fig.11 on page 18 and Fig.12 on page 19)

**Posttraumatic cyst (or false cyst)**

Posttraumatic or false cyst (nonpancreatic pseudocyst of the spleen) is believed to be the end stage of intrasplenic hematoma. Postrauamtic cysts account for 80% of all splenic cysts. They are pseudocysts because they do not contain an inner endothelial lining. It is impossible to clearly distinguish between true and false cysts at US examination. On CT scans, false cysts appear as sharply demarcated masses with water attenuation values. Peripheral calcifications within the fibrous wall may resemble eggshell. The MR
imaging appearance is similar to that of true cysts. A false cyst appears as a well-defined, rounded mass with very high signal intensity on T2-weighted images but variable signal intensity on T1-weighted images, depending on the degree of proteinaceous material or hemorrhage present.

(Fig.13 on page 19)

**BENIGN NEOPLASM**

**HEMANGIOMA**

Hemangioma, although rare, is the most common primary benign neoplasm of the spleen. Most are small lesions that are discovered incidentally (very large masses can produce abdominal pain and splenomegaly). The imaging appearance varies depending on the gross morphology and ranges from predominately solid to mixed (with cystic and solid portions) to purely cystic. At ultrasound, they are often hyperechoic. Small cystic areas are frequently seen within an echogenic mass. Predominantly cystic hemangiomas can be seen occasionally. CT imaging features include hypoattenuating or isoattenuating, well-margined masses on unenhanced CT; with multi-phase enhanced CT, characteristic enhancement features may be observed, including peripheral hyperenhancement on early-phase images and partial or complete centripetal fill-in on more delayed images. Atypical features such as calcifications, flash-fill enhancement, or washout rather than fill-in are common. Splenic hemangiomas are hypo- to isointense, compared with normal spleen on T1-weighted images and hyperintense on T2-weighted images. Dynamic MR imaging after administration of gadopentetate dimeglumine has shown that splenic hemangiomas have three patterns of enhancement: immediate homogeneous enhancement that persists, early peripheral enhancement with uniform delayed enhancement, and peripheral enhancement with centripetal progression but persistent enhancement of a central fibrous scar. Others have described central persistent low signal intensity on contrast-enhanced T1-weighted images in those lesions with a central scar. Complications include rupture, hypersplenism, and malignant degeneration. Spontaneous rupture has been reported as the most common complication, occurring in 25% of patients.

(Fig.14 on page 20 and Fig.15 on page 21)

**LYMPHANGIOMA**

Lymphangiomas are benign malformations composed of endothelial-lined cystic spaces containing lymphatic fluid. Splenic lymphangiomas may be single or multiple (lymphangiomatosis). They are usually asymptomatic. Most splenic lymphangiomas occur in children. At US examination appears as a well-defined, hypoechoic mass that may have internal septations and occasional echogenic debris with the fluid-filled loculi. CT imaging features include splenomegaly and low attenuation masses on
nonenhanced CT with septa enhance on delayed-phase images. Curvilinear peripheral mural calcifications may be present and suggest the diagnosis. The MR imaging appearance of the lesions is very similar to that of cysts. Areas of high signal intensity may be shown on T1-weighted images if internal hemorrhage is present or if the lesions contain a large amount of proteinaceous fluid.

HAMARTOMA

Splenic hamartomas are usually solitary and may be solid or cystic. Hamartomas may occur at any age with equal gender predilection. Most patients have no symptoms. Larger lesions (more common in female patients) may manifest with a palpable mass, splenomegaly, or rupture. On US, splenic hamartomas are typically solid homogeneous masses. Calcifications are rare (usually secondary to ischemia or hemorrhage). Most hamartomas are hyperechoic relative to the adjacent normal splenic parenchyma. CT examinations usually show a solid lesion nearly equal in attenuation to that of the spleen on contrast-enhanced CT scans (a contour abnormality may be the only finding present). However, occasionally these tumors are hyperattenuating due to hemosiderin deposition. MR imaging may demonstrate a well-defined mass of isointensity on T1-weighted images and heterogenously hyperintense at T2-weighted images. After administration of contrast material, prolonged enhancement may be appreciated on both TC and MRI.

(Fig.16 on page 22)

MALIGNANT NEOPLASMS

LYMPHOMA

Lymphoma, which is a generalized lymphoproliferative disorder, constitutes the most common malignant splenic neoplasm and involves the spleen in both Hodgkin and non-Hodgkin types. Splenic lymphoma may be classified as either primary splenic lymphoma or lymphomatous involvement as part of diffuse systemic involvement. Primary or focal splenic lymphoma, without clinical evidence of nodal disease, is uncommon. Splenic lymphoma has a variety of appearances: homogeneous enlargement without discrete mass, solitary mass, multifocal masses or miliary nodules. It is unusual for lymphoma to enhance, and thus splenic lesions are best defined after contrast administration. Primary splenic lymphoma may be bulky, transgress the splenic capsule, and involve adjacent organs. Calcifications in splenic lymphoma before or after treatment are rarely detected but, when seen, probably represent dystrophic calcification secondary to necrosis, hemorrhage, and subsequent fibrosis. On MR the areas of lymphoma appear as slightly hypointense foci on T1-weighted MR images and as hyperintense foci on T2-weighted MR images.

Splenic lymphomas sometimes become secondarily infected, which results in abscess formation.
PRIMARY MALIGNANT TUMORS

Primary malignant splenic tumors are rare. Include mesenchymal (angiosarcoma, fibrosarcoma, leiomyosarcoma, and malignant fibrous histiocytoma) and germ-cell (malignant teratoma) tumors. These tumors tend to present as heterogeneous, round masses and typically contain cystic and solid components. The most common non lymphoid tumor of the spleen is ANGIOSARCOMA. This tumor is extremely rare and has a very poor prognosis, with early and widespread metastases (hypervascular metastases to the liver, to the lungs, bones, and lymphatic system). It enhance markedly on enhanced CT, with a variable pattern of filling. Enhancement tends to be heterogeneous because of intrallesional ischemia or necrosis. Evidence of intraperitoneal hemorrhage is seen in lesions that spontaneously ruptured. Scattered punctate calcifications may be seen. Differential diagnosis includes atypical hemangiomas. Helpful criteria of malignancy include distant metastases and tumor invasion through the splenic capsule.

METASTASES

Splenic involvement by metastases is seen relatively uncommon (7% of patients with widespread malignancy). 50% of all splenic metastasis are due to melanoma, and the remaining 50% are predominantly due to adenocarcinoma of the breast, lung, colon, ovary, endometrium, and prostate.

In most instances, the metastases are hypoechoic on US images. On CT, metastases appear as low-attenuation, ill-defined masses that become more visible after contrast administration; multifocal lesions are the rule, and metastases in other organs are commonly present. Calcifications may occur, particularly in mucinous adenocarcinoma. MR images of metastases typically show foci with low signal intensity on T1-weighted images; these foci become hyperintense on T2-weighted images.

INFARCTION

Splenic infarts may be secondary to occlusion of the splenic artery or its branches or to thrombosis of the splenic vein.

Arterial occlusion may be caused by emboli, inflammation (arteritis), atherosclerosis, splenic artery aneurysm, splenic torsion, neoplasm, trauma, or sickle cell disease.

The thrombosis of the splenic vein is usually caused by trauma, inflammation, or neoplastic processes.
Approximately 30% of infarcts are clinically occult. Differentiation from splenic abscess, hematoma, or neoplasm usually requires clinical correlation or, if necessary, percutaneous fine-needle aspiration biopsy.

On US partial infarcts usually appear as wedge-shaped hypoechoic areas based on the spleen capsule and pointing toward the hilum. On CT infarcts may have variable appearances and CT attenuation change depending on infarct age. Usually is a peripheral, wedge-shaped defect (without mass effect) that becomes more distinct after intravenous contrast enhancement. The infarct itself does not enhance, but there may be "rim enhancement" surrounding the infarcted zone. Calcifications may develop. Infarcts are seen as peripheral wedge-shaped defects that exhibit decreased signal intensity on both T1- and T2-weighted MR images and do not enhance after intravenous contrast material administration.

*(Fig.21 on page 25).*

**TRAUMATIC CONDITIONS**

The spleen is the most frequently injured intraperitoneal solid organ in blunt abdominal trauma. Associated injuries include lower rib fracture, left renal injury and diaphragmatic injury. CT is the imaging modality of choice for evaluation hemodynamically stable patients. CT findings of acute spleen trauma include:

**Free intraperitoneal fluid**

**Subcapsular hematomas:** is a peripheral, well-defined, lenticular, relatively low-attenuation mass that displaces the splenic parenchyma or indent the lateral margin of spleen.

**Intrasplenic hematomas** appear as irregular low-density areas within the spleen.

**Splenic lacerations** have a more variable appearance: usually are seen as a cleft, with irregular borders. It is associated with perisplenic or intraabdominal fluid.

Pitfalls in the diagnosis of splenic trauma include heterogeneous contrast enhancement due to early-phase scanning, splenic lobulations or clefts and a prominent left hepatic lobe.

*(Fig.22 on page 25)*

**MISCELLANEOUS CONDITIONS**

**Portal hypertension**
Portal hypertension is considered the most common cause of splenomegaly. Dilated collateral veins may also be demonstrated at the splenic hilium. Foci of hemosiderin deposition are seen in about 9%-12% of patients with portal hypertension. These foci are called Gamma-Gandy bodies. MR imaging usually demonstrates these foci as multiple tiny foci of decreased signal intensity with all pulse sequences, secondary to iron deposition.

**Sarcoidosis**

Sarcoidosis is a granulomatous systemic disease of unknown etiology that can involve numerous sites, infrequently involving the spleen. The most common imaging manifestation is mild, nonspecific homogeneous splenomegaly on precontrast images with inhomogeneous enhancement after contrast administration (this is due to multiple nodular lesions, 2-3 cm in diameter, which remain unenhanced 3 minutes after injection). Nodular sarcoidosis has been reported to demonstrate low signal intensity with all MR imaging sequences. The lesions are most conspicuous on T2-weighted fat-suppressed or early phase contrast-enhanced images.

Differential diagnosis of splenic sarcoid granulomas includes lymphoma, mycobacterial or fungal infection, and metastases.

(Fig.23 on page 25)

**Thorotrastosis**

Thorotrast particles are phagocytized by the neticuloendothelial cells of the liver, spleen, and bone marrow, with slow redistribution to the lymphatic vessels. Splenic thorotrastosis manifests on CT scans as a homogeneous or punctate pattern of increased attenuation. The spleen becomes small with marked attenuation over time.

(Fig.24 on page 26)
Fig. 1. (a) US of the normal spleen shows a diffusely homogeneous mid-level echotexture throughout the spleen. Contrast-enhanced CT images of the normal spleen show a mottled pattern of enhancement in the arterial phase (b) and homogeneous enhancement during the portal venous phase (c). On MR imaging the signal intensity of the spleen is less than that of liver on T1W (e) scans and higher on T2W images (f).

Fig. 2. US shows an accessory spleen near the hilum (arrows, a). CT scan of two different patients. Accessory spleen near the hilum (arrows, b) and near the anterior surface of the spleen (arrows, c). Renal cell carcinoma (red arrows, c).
**Fig. 3.** Intrapancreatic spleen (confirmed at surgery). Transverse unenhanced CT image of the abdomen (a) shows a small lesion in the tail of the pancreas (arrows). On the arterial phase image (b), early enhancement of the mass (arrow) is noted, similar to that of the spleen (arrowhead). On the delayed phase image, enhancement diminishes similarly in the mass (arrow) and spleen (arrowhead).

**Fig. 4.** CT appearance of two different defects within the spleen (arrows).
Fig. 5. Polysplenia. CT scan shows a large left-sided liver. The stomach is on the right side. Note the left-sided interrupted inferior vena cava with azygos continuation, and the agenesis of the pancreatic tail. Multiple right-sided spleens are evident.
Fig. 6. Pyogenic abscess in a 74-years-old female patient with fever and leucocitosis. Contrast-enhanced CT scan shows a low-attenuation cystic mass with a thin capsule secondary to a perforated sigmoiditis (a). CT after antibiotic treatment (b).

Fig. 7. Splenic TBC. US shows multiples hypoechoic nodules (a). Contrast-enhanced CT scan (b) shows multiple rounded areas of decreased attenuation scattered throughout the spleen.
Fig. 8. *Pneumocystis jirovecii* in a 43-year-old female patient with AIDS. US shows multiple hypoechoic nodules (a). Axial contrast-enhanced CT image (b) shows numerous small hypodense nonenhancing lesions within the spleen.

Fig. 9. Disseminated *Pneumocystis jirovecii* infection in a 40-year-old man with AIDS. US (a) and nonenhanced CT scan (b) demonstrates extensive calcifications in the spleen.
Fig. 10. Epidermoid cyst. True cyst in a 33-years-old female with abdominal pain. US shows a large anechoic splenic lesion. Note low-level interna echoes secondary to deposition of cholesterol crystals (a,b). Axial non-enhanced CT scan (c) demonstrates a large hypodense mass with sharp interface to normal splenic tissue. Axial CT post contrast (d): no evidence of enhancement is seen. Histological examination confirmed the resected mass to be an epidermoid cyst.
Fig. 11. Calcified hydatid cyst. Ultrasonography shows a well-defined, rounded splenic mass with a thick wall and brightly echogenic, shadowing calcifications (a). Axial enhanced CT image (b) demonstrates a round calcified mass with ring-like hypodense area. In this case, we also must consider splenic abscess secondary to Brucella as an alternative diagnosis.

Fig. 12. Multilocular cystic lesion at the spleen. US shows a loculated anechoic mass with daughter cysts. Hydatid positive serology in this patient confirmed the diagnosis.
Fig. 13. False cyst. Axial enhanced CT image demonstrates a small round, low-attenuation cystic splenic lesion with discontinuous rim calcifications. No contrast enhancement. The patient had a traffic accident about 9 months ago. No other cysts were observed. No history of hydatidosis.
Fig. 14. Solitary splenic hemangioma. US shows an hyperechoic mass (a). Axial arterial phase contrast-enhanced CT image shows small hypervascular lesion at the spleen (b). MR T2-weighted images shows a hyperintense nodule (c). Gadolinium T1-weighted images (d).
Fig. 15. Multiples splenic hemangiomas. US shows a multiples heterogeneous nodules predominately hyperechoic (a). Axial arterial phase contrast-enhanced CT image shows multiples large heterogeneous masses with peripheral contrast enhancement (b). Axial delayed contrast enhanced CT image demonstrates delayed enhancement of the lesions (c).

Fig. 16. Hamartoma. 31-years-old man with vague abdominal pain. US shows a well delimited hyperechogenic mass of spleen that bulges the splenic hilum (a). Axial CT scan (b,c,d) reveals a solitary splenic mass isodense on unenhanced scan (b) and hypodense on portal phase (c). Note the prolonged enhancement of the mass after administration of contrast material (d). MR images show the mass to be isointense with T2-weighted pulse sequences, with slightly heterogenous after intravenous gadolinium administration (e,f).
Fig. 17. Lymphoma with invasion. CT scans show a large solid mass arising from the spleen and invading the chest wall. Note the presence of adenopaties (gastrohepatic ligament and retrocrural space).

Fig. 18. Lymphoma with good response to chemotherapy. Cystic transformation and diminution of the size and number of the adenopaties.
Fig. 19. Non-Hodgkin splenic lymphoma in a 26-year-old female patient. US shows multiple hypoechoic nodules (a). Contrast-enhanced CT image shows low-attenuating masses (b). T2 weighted and T2 fat sat (c,d) show heterogeneous masses with hypointense rim. T1 weighted post gadolinium: peripheral enhancement of the nodules.

Fig. 20. Splenic metastases in a 77-year-old patient with colon carcinoma. US shows hypoechoic nodules with irregulars borders (a). Contrast-enhanced CT show low-attenuation masses in the spleen and liver (b,c).
Fig. 20

Fig. 21. Focal infarction. Contrast-enhanced CT scan show peripheral wedgeshaped low-attenuation areas in the spleen (arrows).

Fig. 21

Fig. 22. Splenic fracture. Axial contrast-enhanced CT images (b,c) of a male patient with blunt trauma shows a splenic desestructuration, multiples splenic lacerations extending to helium with hemoperitoneum.
Fig. 23. Splenic Sarcoidosis in a 43-years-old female with abdominal pain. US shows multiples hypoechoic nodules. Axial contrast-enhanced CT image (b) and MRI images (c,d) demonstrate a diffusely heterogeneous enlarged spleen with multiple hypodense/hypointense nodules.
Fig. 24. Thorotrastosis. CT scan shows a hyperattenuating shrunken spleen caused by an injection of thorotrast. Note the liver mass (angiosarcoma) and thorotrast within adenopaties.
Conclusion

The list of entities that may appear as splenic lesions on US, CT, and MR images is extensive. US, CT an MR imaging all play an important role in the detection and characterization of focal splenic lesions, and with sufficient clinical information, helps to make an accurate diagnosis and establish an appropriate management.

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