

Imaging of Splenic Abnormalities

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The spleen is the largest ductless gland and largest single lymphatic organ in the human body. The main functions of the spleen are immunologic surveillance, red blood cell breakdown and splenic contraction for blood volume augmentation during hemorrhagic shock. The most common splenic abnormalities are congenital anomalies of the spleen, traumatic injuries, inflammation, vascular disease-related changes, hematologic disease-related changes, benign splenic lesions, and malignant splenic lesions.



Anatomy of the Spleen

The spleen is an organ located in the left hypochondrium, it extends to the epigastrium and lies beneath the 9th- 11th rib. It has two main surfaces: a diaphragmatic surface that faces the diaphragm and a visceral surface that is facing the stomach and kidney.

The anterior portion of the visceral surface of the spleen faces the gastric ridge whereas the posterior portion is situated above the left kidney and is known as the renal splenic visceral portion. The splenic hilum is found on the anterior medial part of the spleen and has the splenic artery and vein with their multiple branches. The spleen has three borders, namely the superior, inferior and intermediate borders. The organ is surrounded by peritoneum and suspended by various ligaments such as the gastrosplenic ligament, splenorenal ligament, and phrenicocolic ligament.

Magnetic Resonance Imaging of the Spleen

The protocol and pulse frequencies used to examine the spleen on magnetic resonance imaging (MRI) are the same one would use to perform a routine abdominal MRI. **T2-weighted images, T1-weighted images, and dynamic gadolinium-enhanced MRI are the main protocols** used to examine the spleen in the clinical setting. Some of the common abnormalities that are likely to be identified on MRI include the accessory spleen, trauma, inflammation, malignant diseases, hematological diseases—such as those causing sequestration—and vascular abnormalities.

Congenital Splenic Diseases and Normal Variants

Accessory spleens are found in up to 10 % of the general population and are **considered as a normal variant**. They are usually multiple and smaller than 4 cm in diameter. They are usually situated at the splenic hilum. They show synchronized enhancement patterns with the main spleen on MRI and show an equal intensity to the spleen on T1- and T2-weighted images.

Polysplenia is seen in association with cardiac abnormalities and appears as numerous cystic splenic masses seen in the hypochondrium. The condition is more common in females.

Traumatic Splenic Injuries

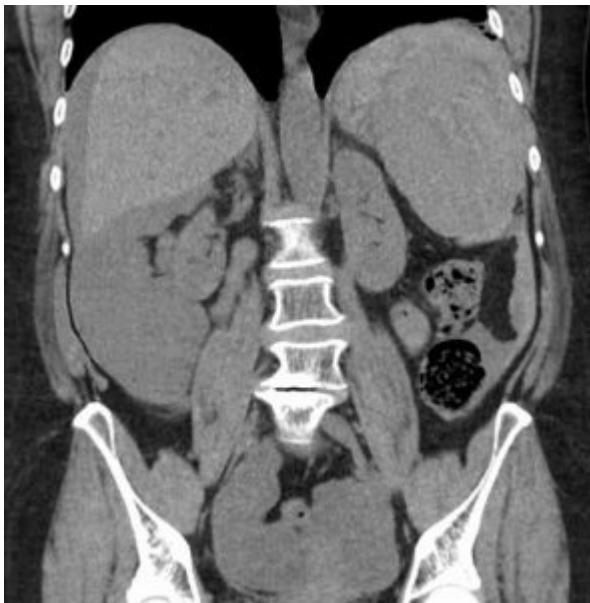


Image: "Splenic Hematoma" by James Heilman, MD. License: [CC BY-SA 3.0](#)

Blunt abdominal trauma can cause splenic injury and even splenic rupture. The main imaging findings on MRI are the presence of a hematoma with a variable degree of intensity depending on the age of the hematoma. **T2-weighted images typically show a prolonged intense lesion in case of a hematoma within the spleen.**

The intensity can be hyper- or hypo- depending on the presence of methemoglobin, deoxyhemoglobin and other degradation products within the hematoma. When a hematoma is identified on MRI, **follow-up imaging is indicated to exclude an expanding hematoma.**

Other patterns of splenic injury that can be identified on imaging include lacerations and

a completely shrunken spleen. A completely shrunken spleen should be treated surgically.

Splenic Inflammation

Splenic involvement in infectious processes is common and has been described in up to 0.7 % of the patients with candidiasis or histoplasmosis. As expected, the **involvement of the spleen is more common in immunosuppressed patients and those with acquired immunodeficiency syndrome (AIDS)**.

Splenic abscesses

Splenic abscesses are the **most common finding**, and they can be **single or multiple**. The lesions usually show low-intensity on T1-weighted images and high-intensity on T2-weighted images. Contrast administration might reveal peripheral capsule enhancement.

Splenic candidiasis

Splenic candidiasis typically presents with **multiple small ring-enhancing lesions** on gadolinium-enhanced MRI. These lesions are typically below 1 cm in diameter.

Histoplasmosis

Histoplasmosis can **cause acute or chronic splenic disease**. Acute and subacute splenic histoplasmosis is characterized by multiple scattered hypointense lesions on T1- and T2-weighted images. Old lesions typically have multiple sites of calcification which can cause significant MRI blooming artifacts.

Sarcoidosis

The other inflammatory process known to involve the spleen is sarcoidosis. The exact etiology of sarcoidosis is **still unknown**, but the condition can **cause multiple nodular granulomas within the spleen**. These lesions typically have low intensity on T1- and T2-weighted images. These granulomas typically show very little and delayed enhancement after the administration of gadolinium. **T2-weighted fat-suppressed images are the best in the visualization of sarcoidosis granulomas within the spleen**.

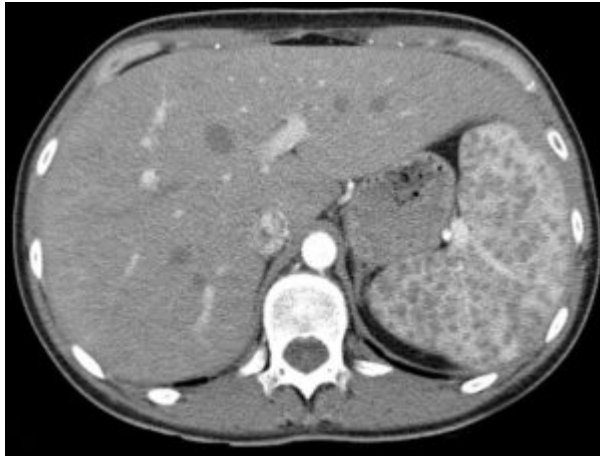


Image: "Sarkoidose der Milz CT axial" by Hellerhoff. License: [CC BY-SA 3.0](#)

Splenic Vascular Diseases

Splenic Infarction

Hematologic malignancies, sickle cell anemia, splenic torsion and portal hypertension can cause splenic infarction. The infarcts are usually peripheral in location and are wedge-shaped. They show low-intensity on both T1- and T2-weighted images. Splenic infarcts do not show contrast enhancement after the intravenous administration of gadolinium.

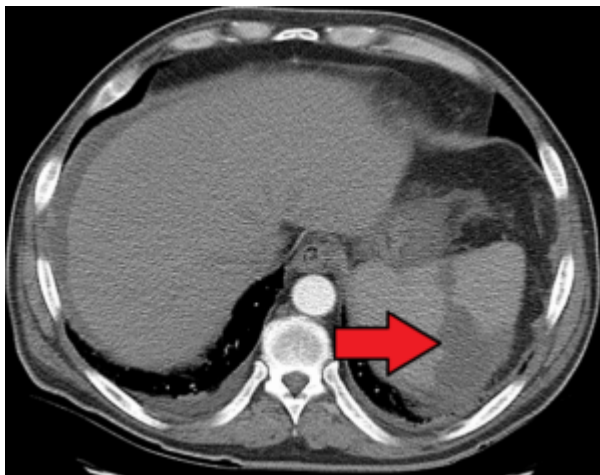


Image: "Splenic Infarct Mark" by James Heilman, MD. License: [CC BY-SA 4.0](#)

Splenic Artery Aneurysm

Medial degeneration of the splenic artery can happen because of **atherosclerosis, portal hypertension, pancreatitis or mycosis**. The three-dimensional gradient-echo sequence is the best for the examination and evaluation of the splenic artery and vein to exclude an aneurysm.

Splenic Vein Thrombosis

The most common cause of splenic vein thrombosis is pancreatitis. **Up to 20 % of patients with chronic pancreatitis have splenic vein thrombosis.** Gadolinium-enhanced MRI angiography can be used to visualize the splenic artery and vein. A filling defect within the splenic vein is characteristic and diagnostic of splenic vein thrombosis in a patient with chronic pancreatitis.

Splenic Abnormal Growths

Extramedullary Hematopoiesis

Patients with **chronic anemia and deficient bone marrow** usually have extramedullary hematopoiesis where the liver and spleen start producing red blood cells to compensate. In some patients, **a splenic mass can be identified when hematopoiesis has been going for a long period.**

T1-weighted images of the splenic mass show a lesion of intermediate intensity whereas T2-weighted images typically show a hyperintense lesion. The intravenous administration of gadolinium typically shows heterogeneous and variable enhancement. Old non-active lesions that are no longer involved with hematopoiesis are typically hypointense on both T1- and T2-weighted images and do not show any contrast enhancement.

Splenic Cysts

The most common form of a splenic cyst is **caused by a parasitic infection known as a hydatid cyst.** MRI images show a well-defined lesion that is filled with water. Computed tomography scans are usually helpful in the confirmation of the diagnosis, but when in doubt, MRI can be used to visualize a hypointense T1 lesion, a markedly hyperintense T2 lesion and no enhancement after contrast administration.

Splenic Hemangioma

Splenic hemangiomas are the **most common benign tumors of the spleen.** They appear as hypointense lesions on T1-weighted images and hyperintense on T2-weighted images. After the intravenous administration of gadolinium, splenic hemangiomas typically show early nodular centripetal enhancement followed by homogenous enhancement on delayed imaging.

Splenic Hamartoma

Patients with tuberous sclerosis can develop benign splenic tumors that are usually single and are composed of normal splenic tissue. These lesions are typically heterogeneous on T2-weighted images and usually show diffuse enhancement after the intravenous administration of gadolinium.

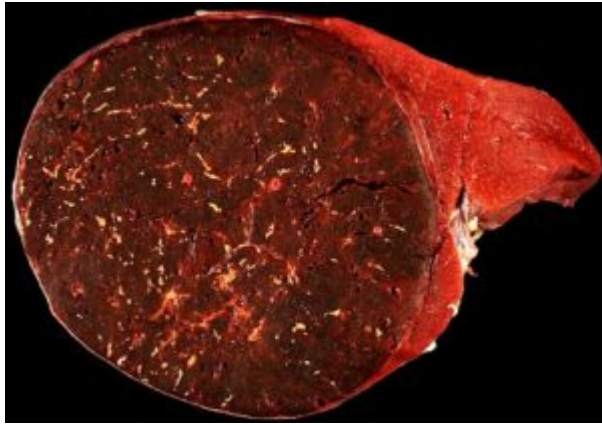


Image: "Hamartoma of the spleen" by Ed Uthman, MD. License: [Public Domain](#)

Splenic Sarcoma

Splenic sarcomas are **very rare and have a grim prognosis**. They appear as a hypointense lesion on T1-weighted images and a hyperintense lesion on T2-weighted images. After the administration of gadolinium, the lesions typically show heterogeneous nodular enhancement.

Splenic Lymphoma

This is the **most common malignant disease of the spleen**. Lymphoma of the spleen is usually visualized after the administration of intravenous gadolinium. They appear as contrast-enhancing multiple lesions within the spleen. The identification of lymphomatous deposits within the spleen on non-enhanced T1 and T2 weighted images is difficult.

Metastases to the Spleen

The involvement of the spleen in metastatic cancers is **rarely seen**. If primary cancer metastasizes to the spleen, one would expect to see multiple hyperintense T2-weighted lesions on MRI. These lesions would commonly show contrast enhancement.

Splenomegaly in Portal Hypertension

Patients with portal hypertension due to chronic liver disease and hepatic cirrhosis are at risk of developing splenomegaly. The diffuse enlargement of the spleen can be easily identified with ultrasonography, but magnetic resonance imaging can also provide evidence for splenic disease in a patient with portal hypertension. In addition to the diffuse splenic enlargement, which can be easily identified on anatomical MRI, one could also identify **multiple very small foci of low intensity on T1- and T2-weighted images**. These small foci represent deposits of hemosiderin which occur in up to 12 % of the patients with portal hypertension.

References

Elsayes, Khaled M. et.al. 2005. "[MR Imaging of the Spleen: Spectrum of Abnormalities.](#)" *RadioGraphics*. 25(4): 967-982. Available at: <http://pubs.rsna.org/doi/abs/10.1148/rg.254045154>

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