Sarcoidosis – Why you should look beyond the Lungs!

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Learning Objectives

The purpose of this paper is to list and review the imaging findings of the common abdominal manifestations of sarcoidosis.

Sarcoidosis – Why you should look beyond the Lungs!

Background

Sarcoidosis is a multisystemic inflammatory disease of unknown etiology characterized by noncaseating epithelioid cell granulomas in the absence of other granulomatous diseases such as tuberculosis, fungal infections, autoimmune processes, or delayed-type hypersensitivity reaction to foreign antigens.

The complexity of sarcoidosis is in part due to its multiple clinical manifestations that not only involve organs such as lungs but also sites such as liver and spleen.

Virtually any organ system may be involved!

Pulmonary changes are the most common manifestation, and the accompanying radiologic findings of bilateral hilar adenopathy with or without changes of interstitial lung disease are well known and characteristic.

Involvement of abdominal viscera is less frequent, but when it occurs, it may mimic more common infectious or neoplastic conditions and result in unnecessary morbidity.

Background

Epidemiology

Sarcoidosis is usually diagnosed between 20 and 40 years of age, with a slightly higher prevalence in women.

Although sarcoidosis is seen worldwide, **the disease has distinct geographic and racial predilections**.

Areas with high prevalence include the United States, particularly the African-Americans, Sweden, Denmark, and Japan, whereas a low prevalence is noted in Spain, China, and South America.

Background

Etiology

The etiology of the disease is still not exactly clarified.

Although the etiology of sarcoidosis is unknown, speculation has centered on the interaction of an unknown antigenic factor triggering an exaggerated cellular immune response in genetically susceptible individuals

Geographic variation in the organ system affected and the pattern of the illness suggest that there may be multiple antigenic triggers.

Familial occurrence of the disease has been described and is more common among blacks than whites.
Human leukocyte antigen analysis suggests a polygenic mode of risk inheritance.

Background

Diagnosis

Established on the basis of clinical and radiologic findings supported by histologic findings.

Clinical Findings
Symptoms associated with sarcoidosis are both systemic (e.g., fatigue, fever, or weight loss) and organ-specific (e.g., shortness of breath or cough)

- Löfgren's syndrome: association of bilateral hilar adenopathy, fever, and erythema nodosum.
- Heerfordt's syndrome: association of parotid gland enlargement, fever, uveitis, and cranial nerve palsies.
- Lupus pernio (indurated plaques on the cheeks, lips, nose, and ears): pulmonary infiltrates and lytic lesions that affect the small bones of the hands and feet.

However, sarcoidosis frequently produces no symptoms.

Background

Diagnosis

Established on the basis of clinical and radiologic findings supported by histologic findings.

Laboratorial Findings

- Angiotensin-converting enzyme (ACE) level is commonly elevated and may correlate with disease activity.
- CD4:CD8 ratio in the blood serum is commonly decreased.

These abnormalities are helpful in making the diagnosis of sarcoidosis, although they may also be seen in other granulomatous diseases.

- Hypercalcemia: occasionally seen due to increased intestinal absorption of calcium, which results from activation of vitamin D by macrophages in sarcoid granulomas.

Background

Diagnosis

Established on the basis of clinical and radiologic findings supported by histologic findings.

Pathological Findings
Estimates from autopsy research suggest that the number of cases of sarcoidosis may be 10 times more than the number of cases that are clinically apparent.

Lung biopsy specimens can be obtained with transbronchial biopsy or from extrapulmonary sites such as the cervical lymph nodes and liver.

- Non-caseating granulomas characterized by accumulation of histiocytes, lymphocytes, sparse lymphoid and a variable amount of fibrosis and collagen.
- Continuous inflammation process due to incomplete antigen degradation associated with chronic activity of cell mediated immunity.
- However, granulomas from other inflammatory processes such as tuberculosis, histoplasmosis and fungal infections, and tumor-related sarcoid reaction must be excluded.

Background

Natural History

The clinical expression, natural history, and prognosis of sarcoidosis are highly variable, with a tendency to wax and wane.

Sarcoidosis is the direct cause of death in 5% of patients.
Attributable causes of death differ significantly depending on geographic location.
In Japan, nearly 80% of patients die from cardiac involvement, whereas most patients in the United States die from pulmonary complications.

Corticosteroids are effectively used for treatment. Although some patients respond rapidly, others may require long-term therapy, or immunosuppressive drugs such as methotrexate and cyclophosphamide.

The overall prognosis is good, although most patients would have permanent organ impairment.

Imaging Findings or Procedure Details

Extrapulmonary involvement of sarcoidosis is reported in 30% of patients and the abdomen is the most common extrathoracic site with a frequency of 50%–70%.

Abdominal

Although usually asymptomatic, the presence of symptomatic abdominal involvement may affect the prognosis and treatment options.

- Symptomatic abdominal sarcoidosis requires treatment with immunosuppressant agents.
- Surgical interventions may be required in the presence of gastrointestinal complications such as massive hemorrhage, strictures, obstruction, or perforation.
- Splenectomy can be performed for symptomatic relief in splenic involvement or as prophylaxis for splenic rupture.

The lesions in abdominal sarcoidosis are less characteristic, mimicking more common neoplastic or infectious diseases such as lymphoma, diffuse metastasis, granulomatous or mycobacterial infections

Imaging Findings or Procedure Details

Liver

Hepatic involvement of sarcoidosis follows lymph nodes and lung in frequency (50%–79% by biopsy, and 67%–70% in autopsy series).

It is reported that a significant fraction (26%) of subjects may have hepatic sarcoidosis without pulmonary involvement.

Less than 5% of patients with sarcoidosis suffer from symptomatic liver disease.

Sarcoidosis of the liver can manifest clinically with a wide range of symptoms, such as:

- anorexia, weight loss, night sweats and fever.
- symptoms derived from intrahepatic cholestasis (e.g., jaundice and pruritus).
- symptoms derived from portal hypertension (e.g., ascites, bleeding from gastroesophageal varices rupture) due to granulomas involving the portal triad, rarely.
- liver failure, rarely,

Imaging Findings or Procedure Details

Liver

Frequency of liver function test abnormalities is about 35%.

Increase of liver enzymes (e.g., transaminases, gamma-gt and alkaline phosphatases) should not be considered a priori evidence of hepatic involvement in patients affected by pulmonary form of sarcoidosis unless confirmed by biopsy or, at least, by imaging.

Other concomitant etiologies can indeed occur such as non-alcoholic fatty liver disease and viral hepatitis and differential diagnosis can be challenging if a high clinical suspect does not occur in these situations.

Imaging Findings or Procedure Details

Liver

The most common radiographic finding of hepatic sarcoidosis is **hepatomegaly** (even > 25 cm).
Detected on Computed Tomography (CT) of the abdomen in about more than half of the patients.
Often associated with **splenomegaly**.

In most patients, the liver appears homogeneous.
However, a pattern of multiple low-density intrahepatic septa on contrast-enhanced CT has been described.

On ultrasound (US), a pattern of either diffuse increased homogeneous or heterogeneous echogenicity and coarsening of the parenchymal appearance with or without discrete nodules has been reported.

Contour irregularity can also be seen in sarcoidosis.

Imaging Findings or Procedure Details

Liver – Focal Nodules

Only 5%–15% of patients, focal nodules become apparent as multiple hypointense or hypoattenuating lesions.

These nodules are thought to represent the coalescence of small granulomas into macroscopically visible lesions.

- typically innumerable and diffusely distributed.
- size ranging from 1–2 mm to several centimeters.

Hepatomegaly, splenic nodules, and adenopathy are frequently, but not invariably, associated with the presence of liver nodules.

Imaging Findings or Procedure Details

Liver – Focal Nodules

Ultrasound

Nodules have been reported to be hypoechoic relative to the background liver, although some hyperechoic nodules can be seen.

It seems to depend on background liver echogenicity and the degree of fibrosis present in the granuloma.

Computed Tomography

On contrast-enhanced CT, liver nodules appear as hypodense masses relative to adjacent normal parenchyma.

Peripheral enhancement typically is not seen.

Imaging Findings or Procedure Details

Liver – Focal Nodules

Magnetic Resonance Imaging

Nodular lesions of 5–20 mm are characteristically hypointense on all sequences which are most apparent on the T2-weighted fat-saturated and on the early-phase gadolinium-enhanced T1-weighted images.

- helps excluding metastases and inflammatory diseases which are usually hyperintense on T2-weighted fat-saturated images.
- they enhance less than the background liver on gadolinium-enhanced T1-weighted images.

The periportal increase in signal intensity on T2-weighted images may reflect the tendency of sarcoid granulomas to appear along the portal tracts.

Imaging Findings or Procedure Details

Liver – Focal Nodules

Multiple nodules in hepatic sarcoidosis are easily mistaken for more common diseases, including metastases and lymphoma. In these conditions, screening for malignancy may be required.

Simultaneous involvement of the spleen favors a diagnosis of sarcoidosis and lymphoma.

Sometimes, peritoneum can be infiltrated by multiple nodules mimicking peritoneal carcinomatosis.

Because of these nonspecific imaging findings, tissue biopsy may be necessary to differentiate hepatic sarcoidosis from metastases and lymphoma.

Liver biopsy is the only way to make a definitive diagnosis of hepatic involvement.

Imaging Findings or Procedure Details

Liver – Other Findings

Portal hypertension and cirrhosis are rare.
Portal vein thrombosis as a result of stasis from obliterated small portal veins could also be observed.

Granulomas becomes more confluent with increasing size, leading to portal hypertension and cirrhosis because of chronic inflammation, granuloma formation, and fibrosis in the portal triads.

Calcification can rarely be seen if the disease is long-standing.

It has also been proposed that there is a correlation between chronic hepatic sarcoidosis and hepatocellular carcinoma.

Asymptomatic patients who present with isolated hepatosplenic sarcoidosis do not require treatment.
Liver involvement by sarcoidosis typically responds to steroids.

Sarcoidosis – Why you should look beyond the Lungs!

Imaging Findings or Procedure Details

Liver

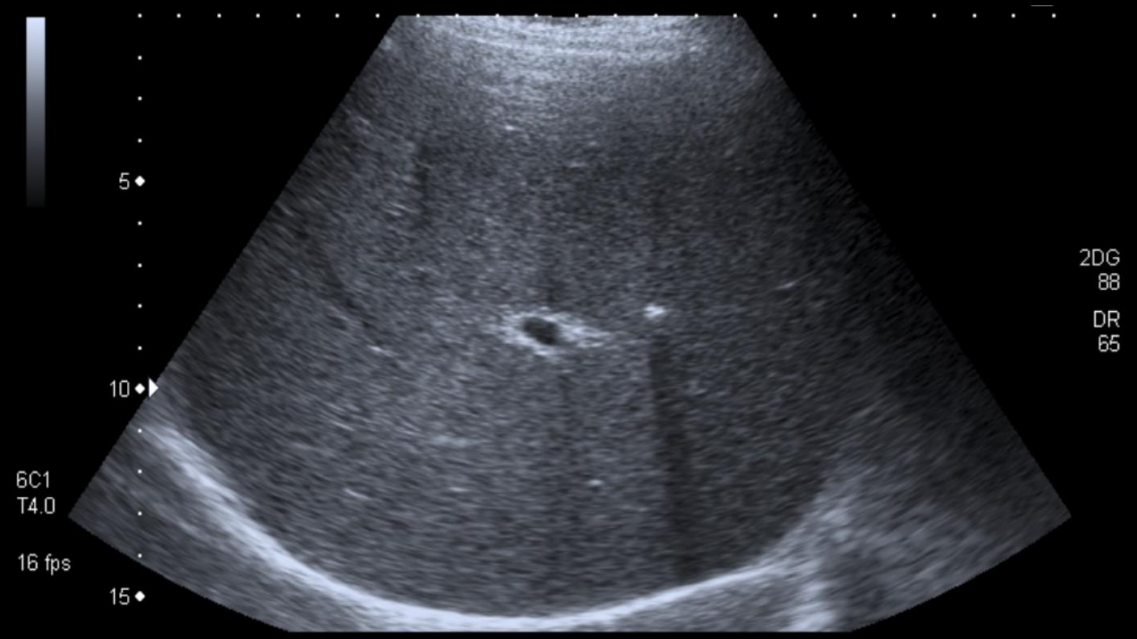


Fig. 1. Ultrasound. Calcified Granuloma. A usual finding in granulomatous diseases.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Sarcoidosis – Why you should look beyond the Lungs!

Imaging Findings or Procedure Details

Liver

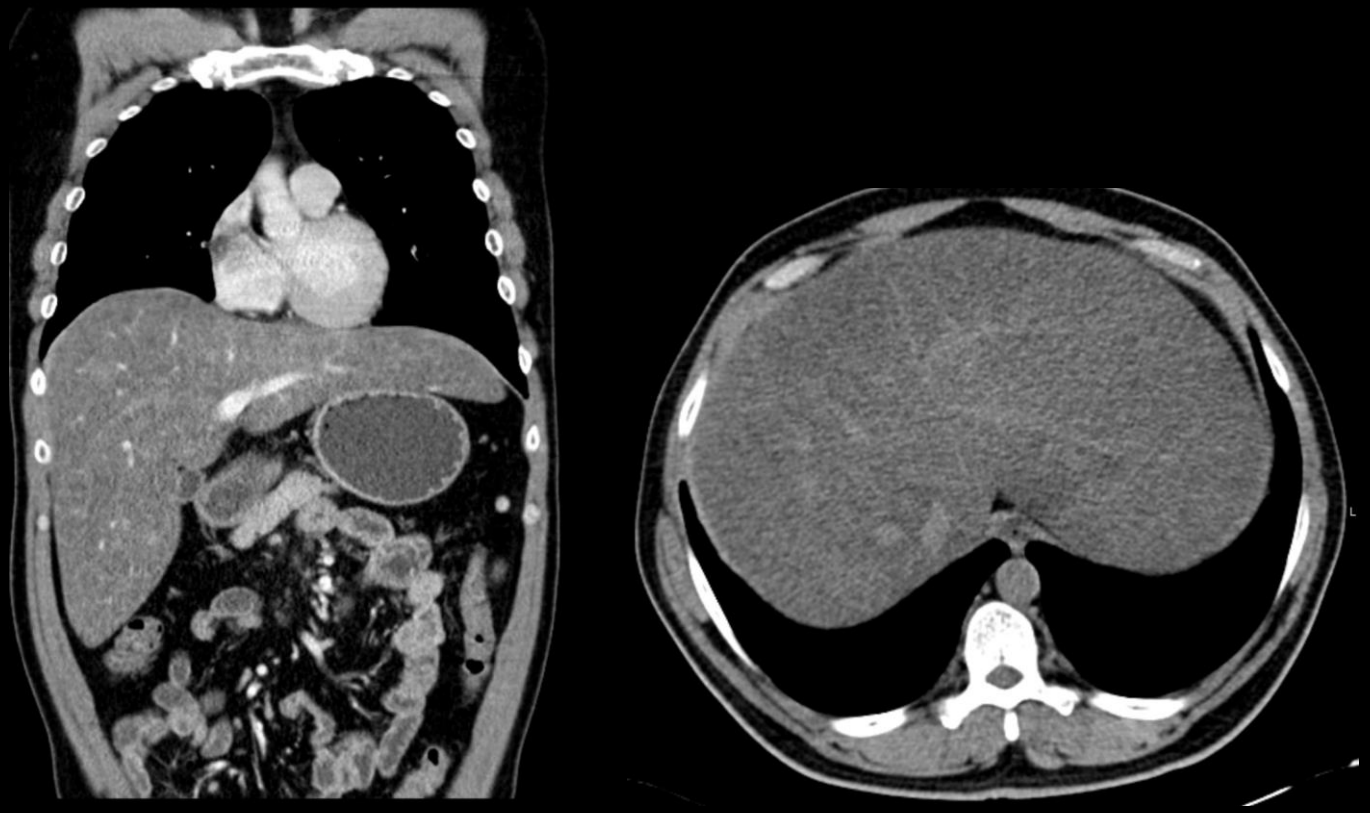


Fig. 2 and 3. Coronal and axial CT scans demonstrating hepatomegaly and difuse steatosis (low HU values, low density).

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Sarcoidosis – Why you should look beyond the Lungs!

Imaging Findings or Procedure Details

Liver

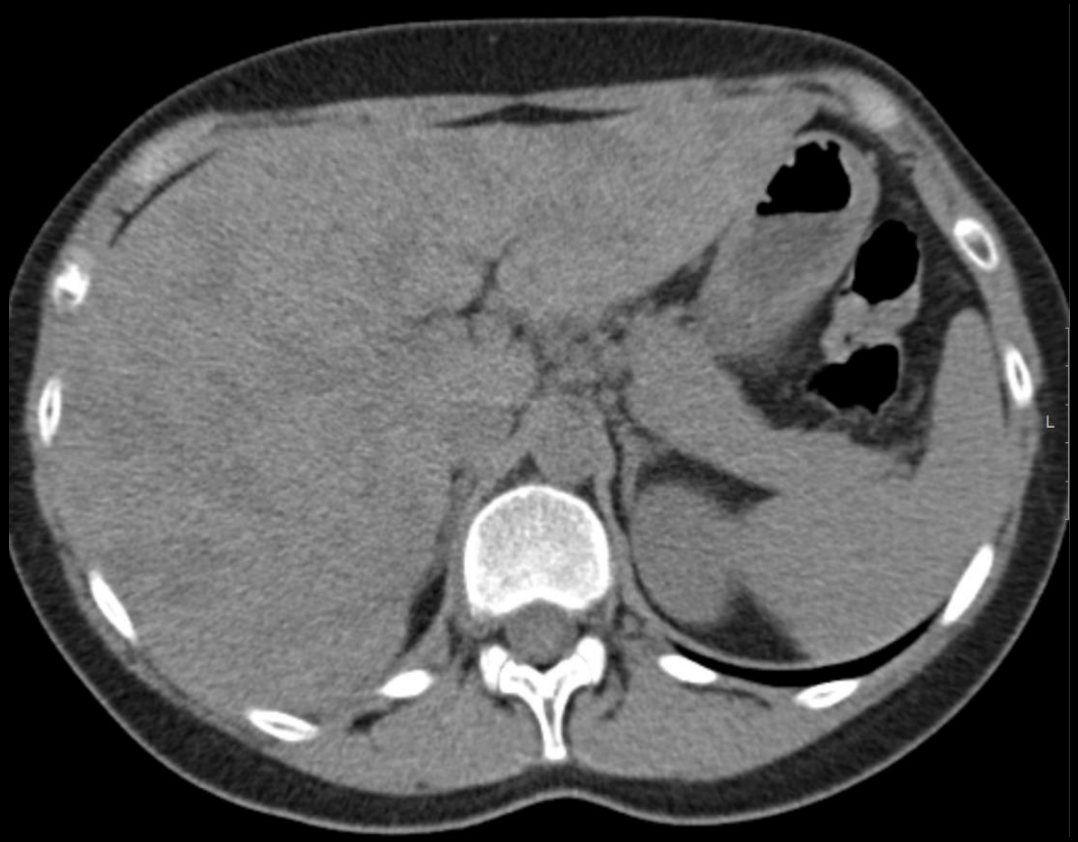


Fig. 4. Non-enhanced CT scan showing signs of chronic liver disease. The parenchyma is diffusely heterogenous with lobulated contorns.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Liver

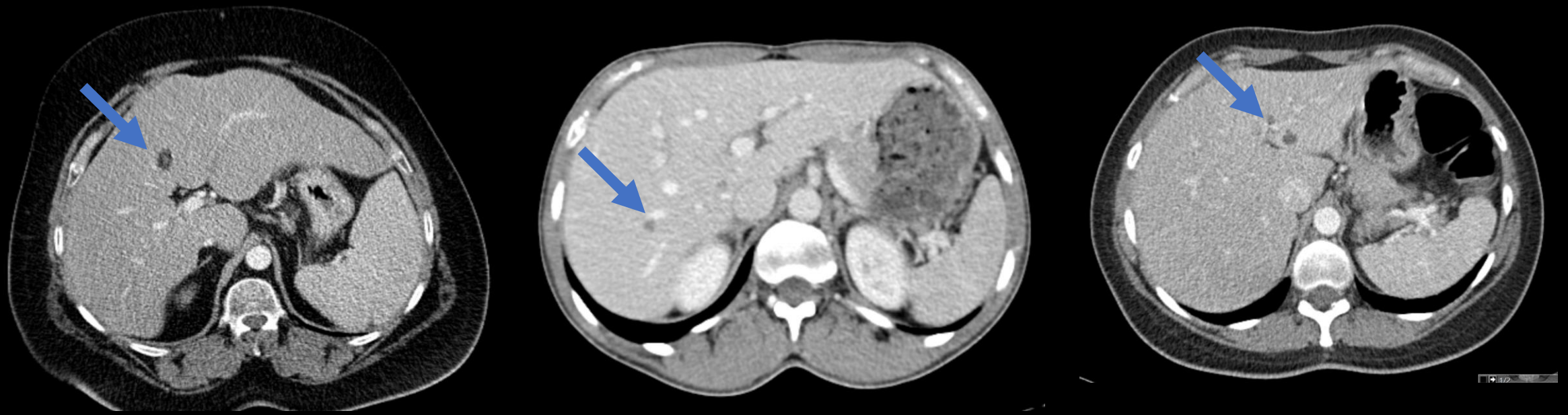


Fig. 5, 6 and 7. Examples of focal nodules, proved by biopsy, representing coalescence of small granulomas.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Liver

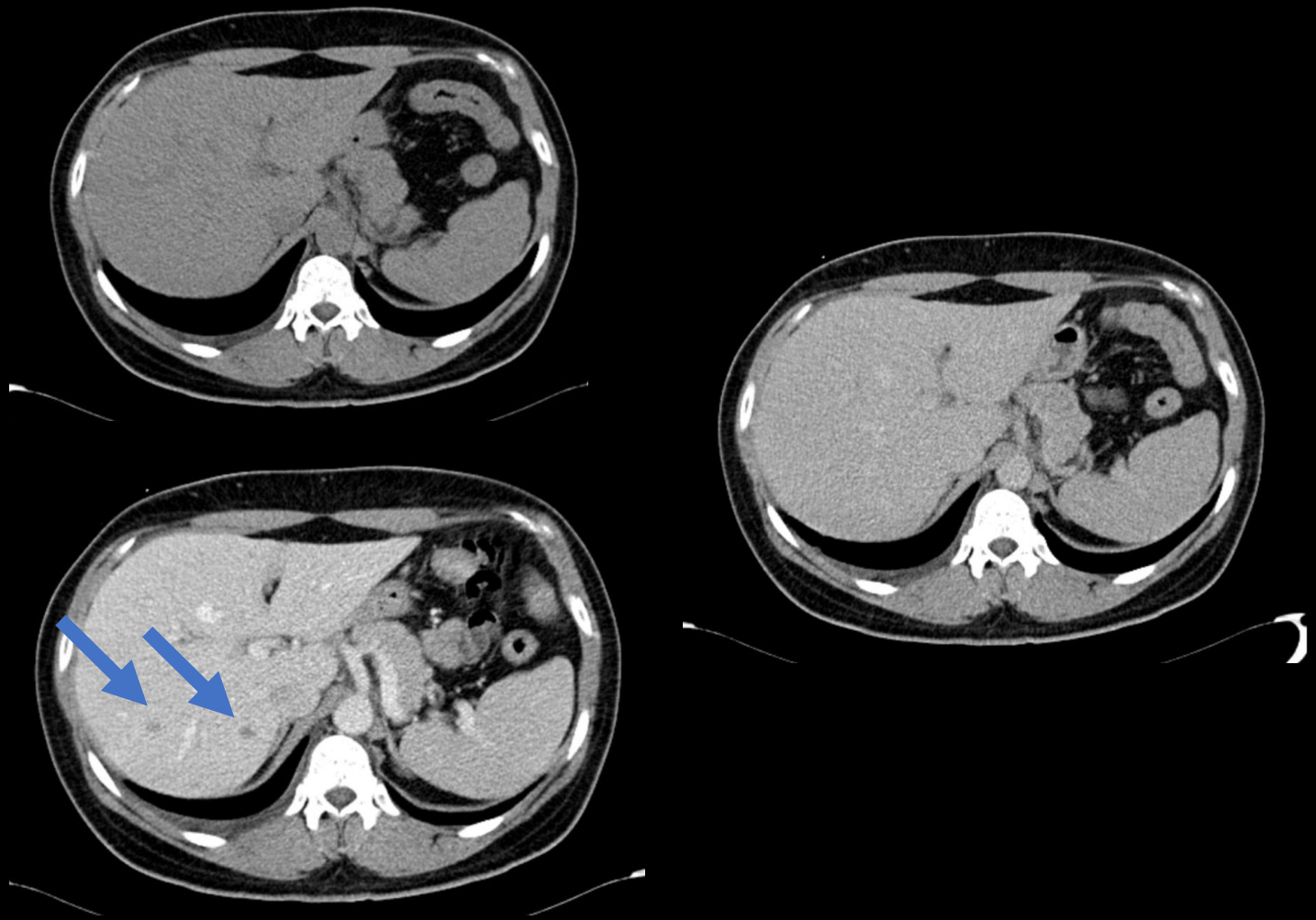


Fig. 8, 9 and 10. Focal Nodule. Axial CT scans (without contrast, portal phase, delayed phase). The lesions or only seen in portal phase, as hypodense focal lesion.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Liver

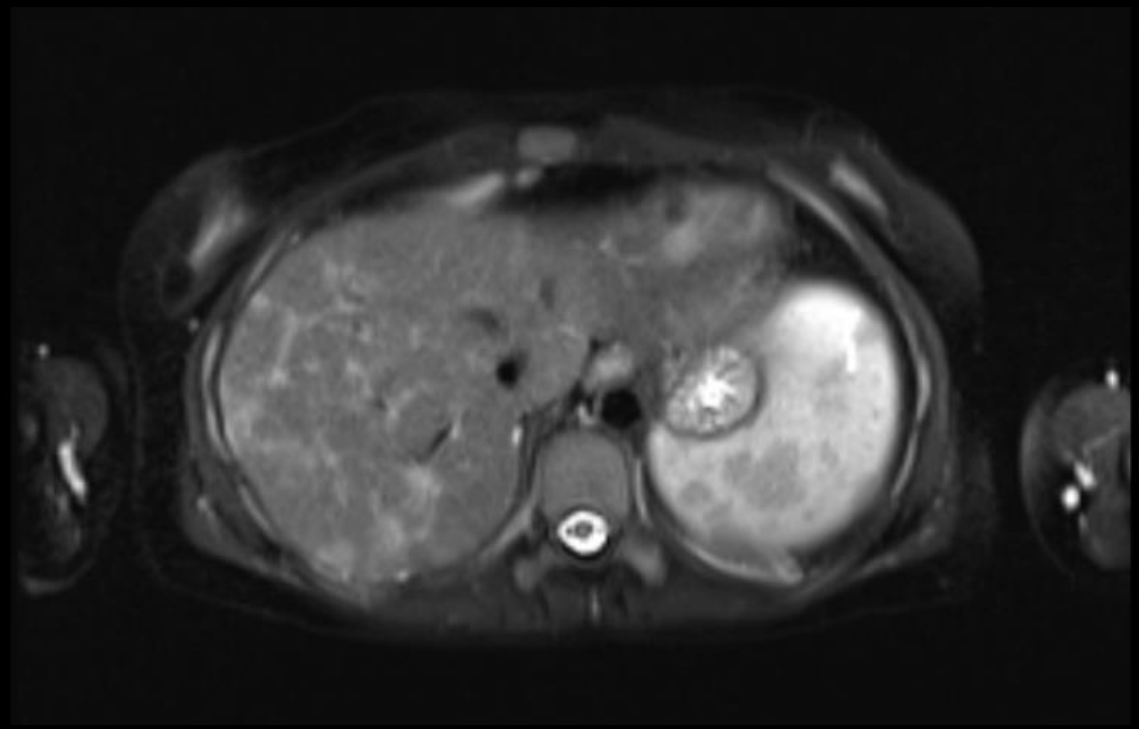


Fig. 11. MRI. T2-weighted axial image.
Periportal increase in signal intensity on T2-weighted images may reflect the tendency of sarcoid granulomas to appear along the portal tracts.
Also note some spleen nodules with low signal, compatible with spleen involvement by sarcoidosis.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Gallbladder

Granulomatous inflammation of the gallbladder or extrinsic compression of the cystic duct by enlarged lymph nodes may lead to acute cholecystitis.

Subacute or chronic cholecystitis due to granulomas in the gallbladder wall has also been reported.

Imaging Findings or Procedure Details

Spleen

Splenic involvement has been reported in 24%–53% of cases.

Usually asymptomatic.

Systemic complaints of fever, malaise, and weight loss are common, particularly in patients with splenomegaly.

The occurrence of nodular hepatosplenic sarcoid is more common during the first 5 years of sarcoidosis.

Splenomegaly is reported in about 25–60% of patients.

Splenomegaly due to sarcoidosis is commonly associated with involvement of the lungs and the liver.

Splenic infiltration can be homogeneous or in the form of multiple discrete nodules.

The **differential diagnosis** of hypodense nodules in both liver and spleen includes tuberculosis, lymphoma, metastasis, and abscess. Infections such as candidiasis should also be considered if the patient is immunocompromised.

Imaging Findings or Procedure Details

Spleen – Focal Nodules

Computed Tomography

Hypodense splenic nodules are seen in approximately 15% of patients with sarcoidosis.
Some studies have shown both lower (6%) and higher (33%) values, a variation that is probably linked to geographic and ethnic differences in study populations.

- Lesions are usually diffusely distributed and innumerable.
- Most nodules are between 0.1 and 3.0 cm, with a mean of approximately 1.0 cm.
- They tend to be discrete, but may coalesce as they increase in size.
- Isolated or predominant involvement of the spleen by nodules is more common than isolated or predominant hepatic nodular disease.

On contrast-enhanced CT, the splenic nodule are hypodense relative to adjacent normal spleen.
Peripheral enhancement is not seen.

Imaging Findings or Procedure Details

Spleen – Focal Nodules

Magnetic Resonance Imaging

Splenic nodules are hypointense on all sequences and hypoenhancing, although they become less conspicuous on delayed imaging, suggesting equilibration.

Best seen on early-phase gadolinium-enhanced T1-weighted fat-suppressed or T2-weighted images.

Ultrasound

Data on the typical sonographic appearance are limited.

Show a slightly hyperechoic or inhomogeneous appearance, although hypoechoic nodules have also been reported.

Punctate calcifications are relatively uncommon.

Contour irregularity is another abnormal finding of splenic sarcoidosis.

Imaging Findings or Procedure Details

Spleen

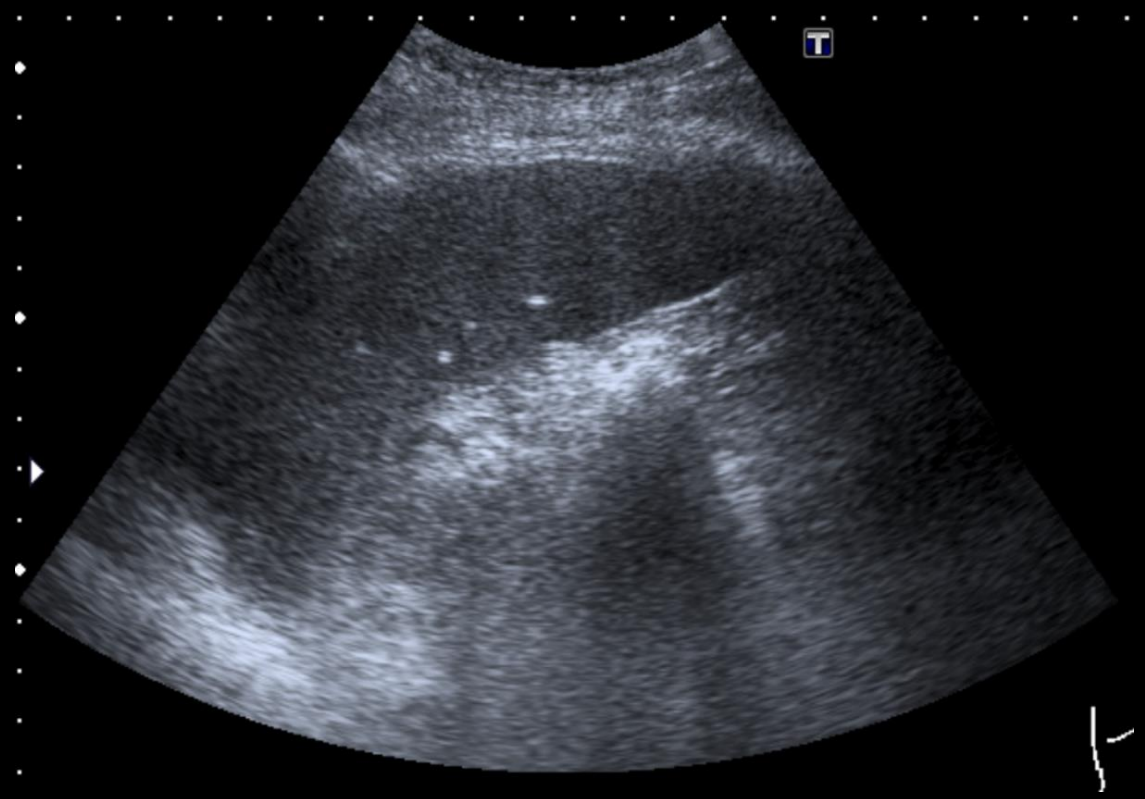


Fig. 12: Ultrasound. Calcified Granulomas. A usual finding in granulomatous diseases.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Spleen

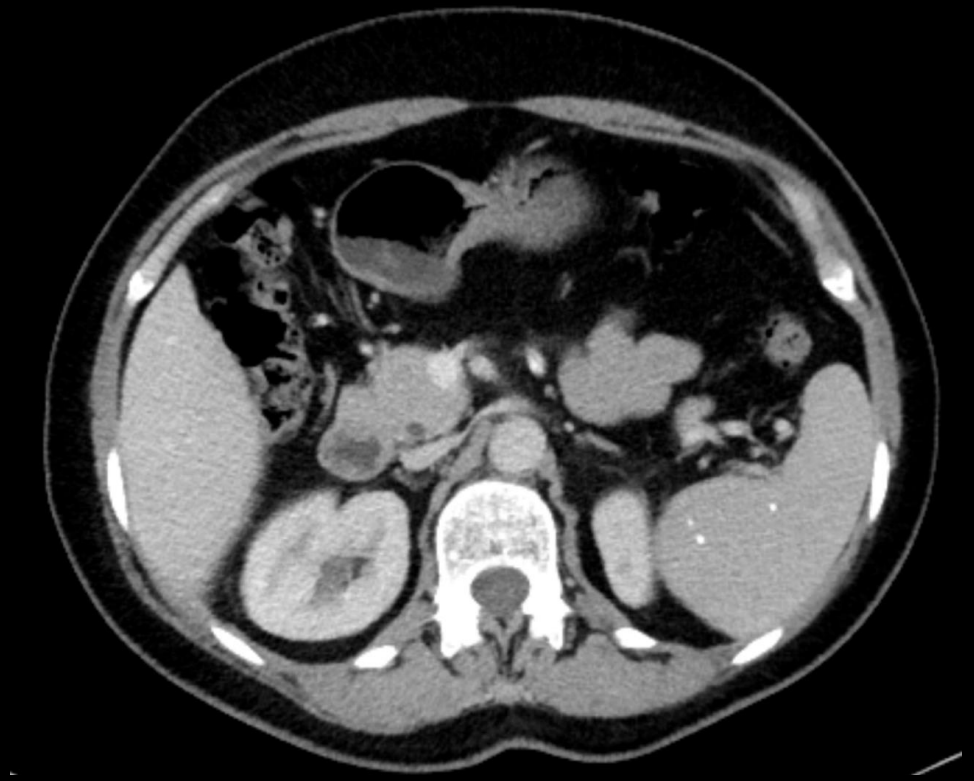


Fig. 13. Axial CT scan. Calcified Granulomas. A usual finding in granulomatous diseases.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Spleen

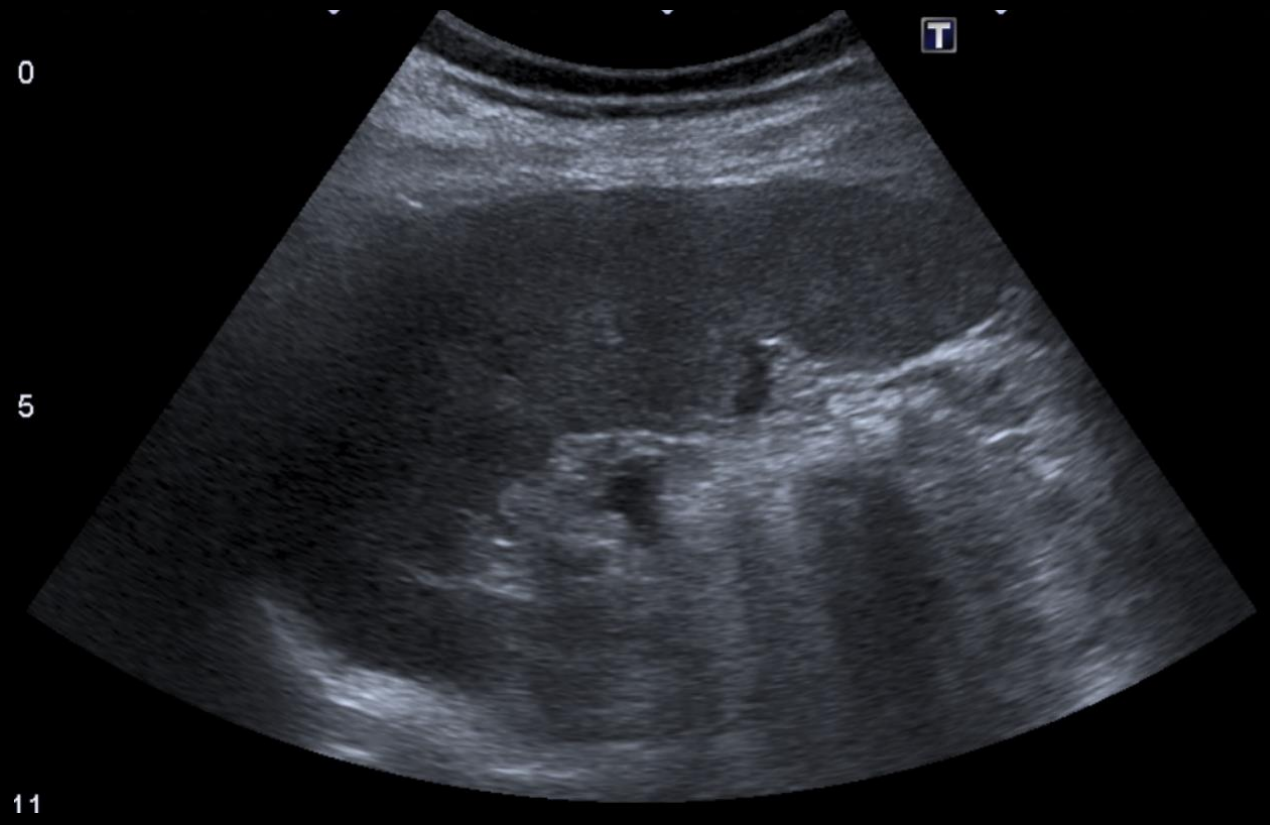


Fig. 14. Ultrasound. Splenomegaly (16 cm).

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Spleen

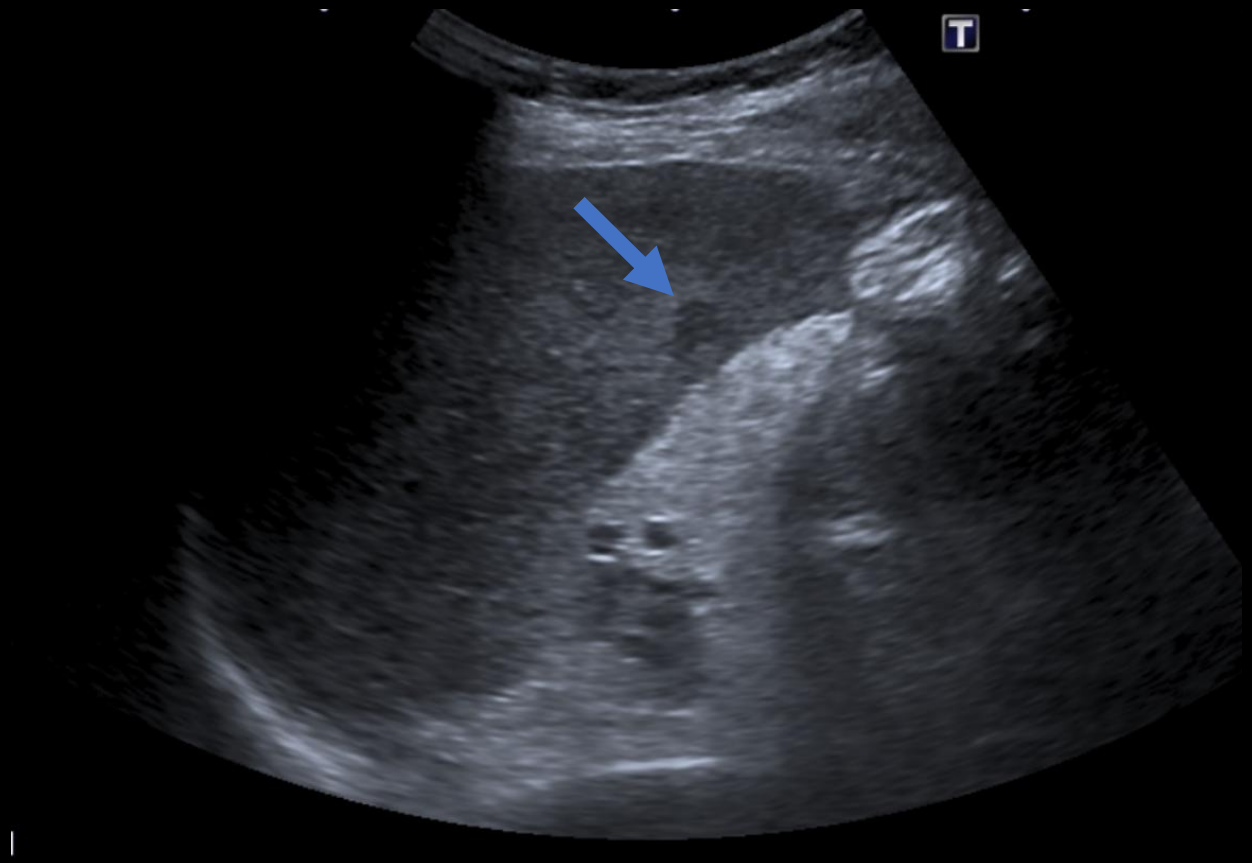


Fig. 15. Ultrasound. Focal hypoechoic nodule.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Spleen

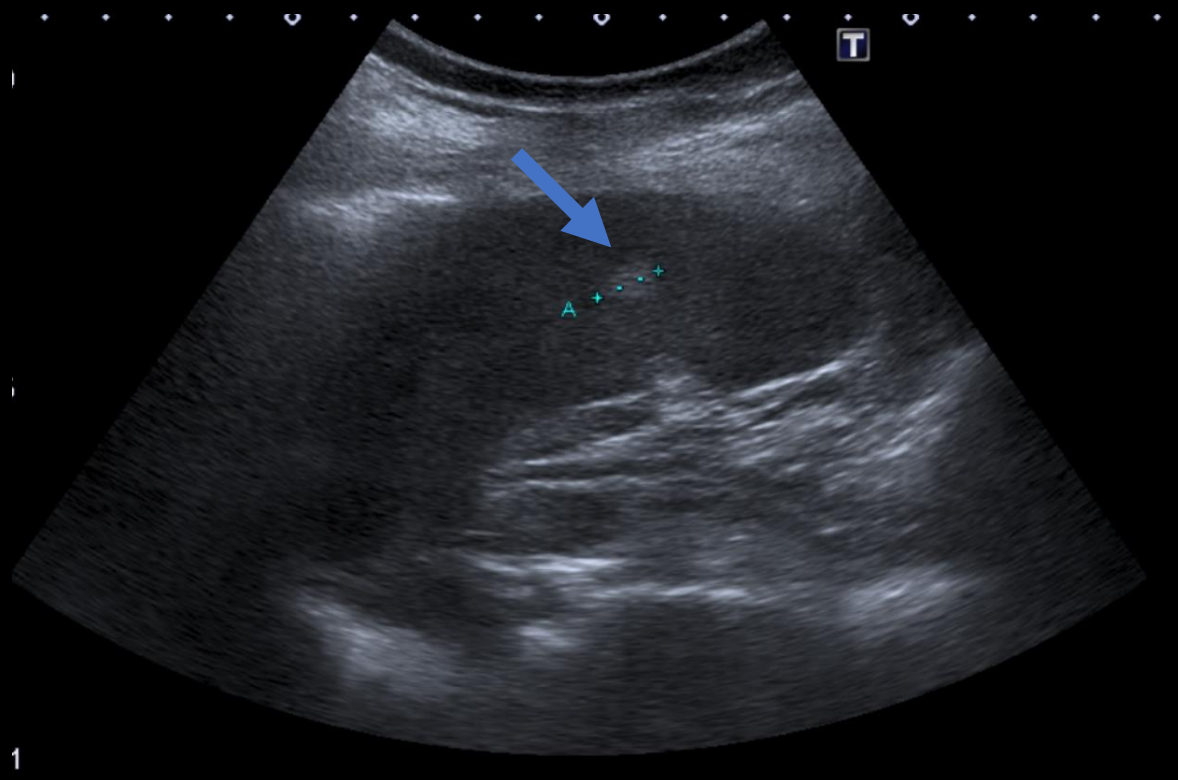


Fig. 16. Ultrasound. Focal hyperechoic nodule, a feature less common than hypoechoic spleen lesions.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Spleen

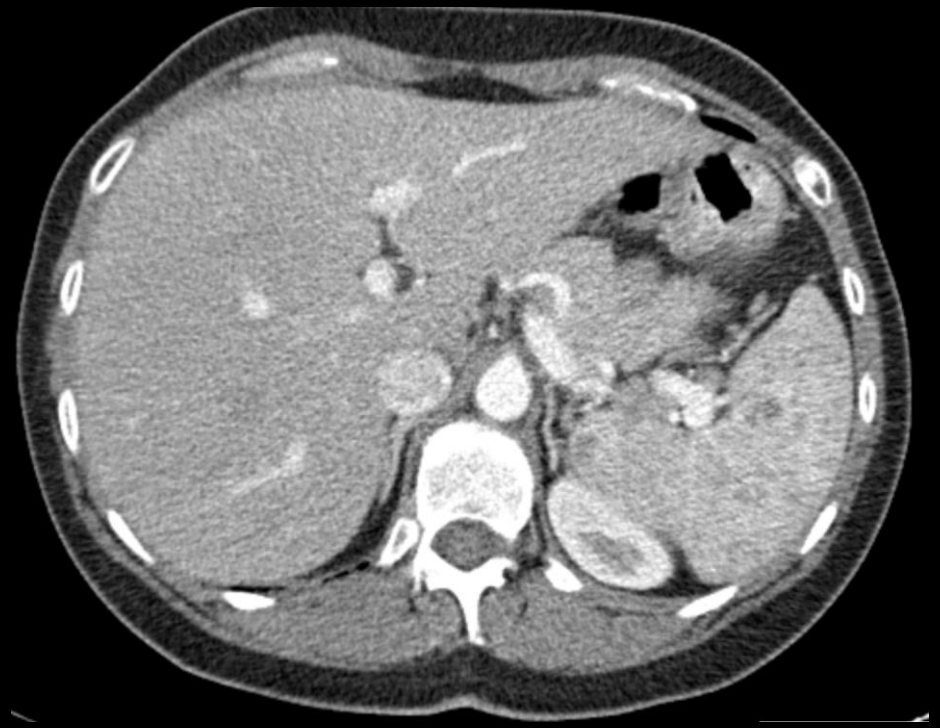


Fig. 17. Axial CT scan. There is a potential pittfall when looking only to the arterial phase, because of the expected spleen heterogeneity in this acquisition.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Spleen

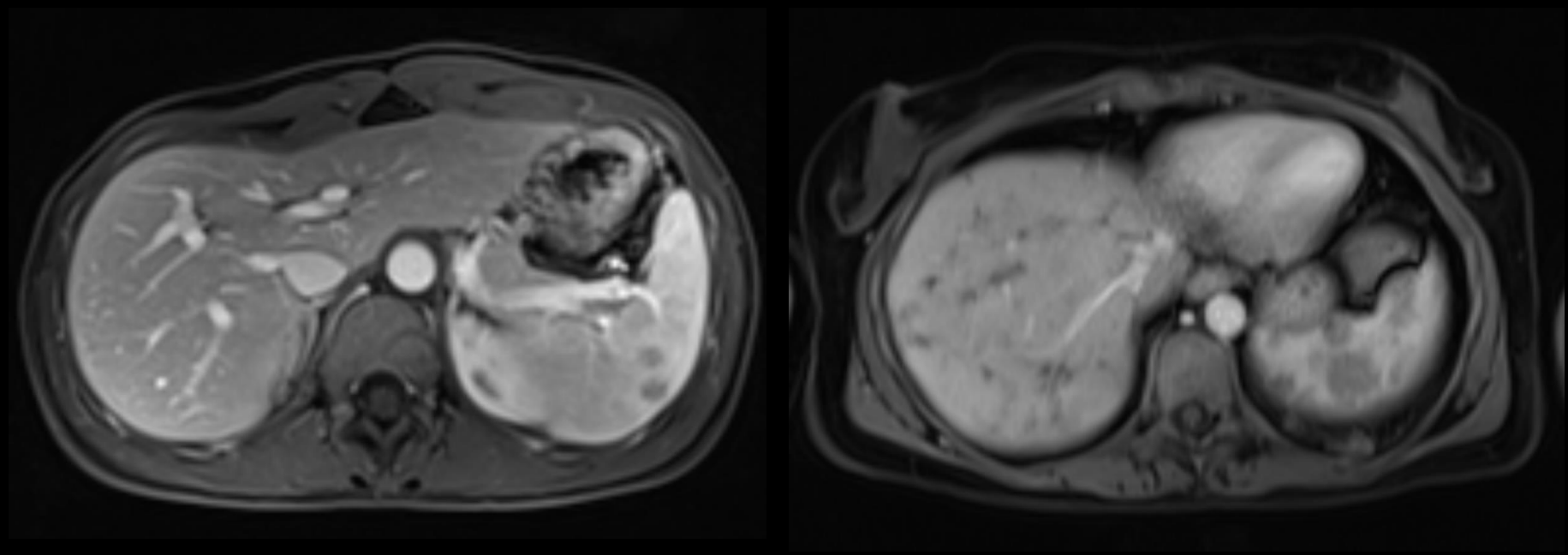
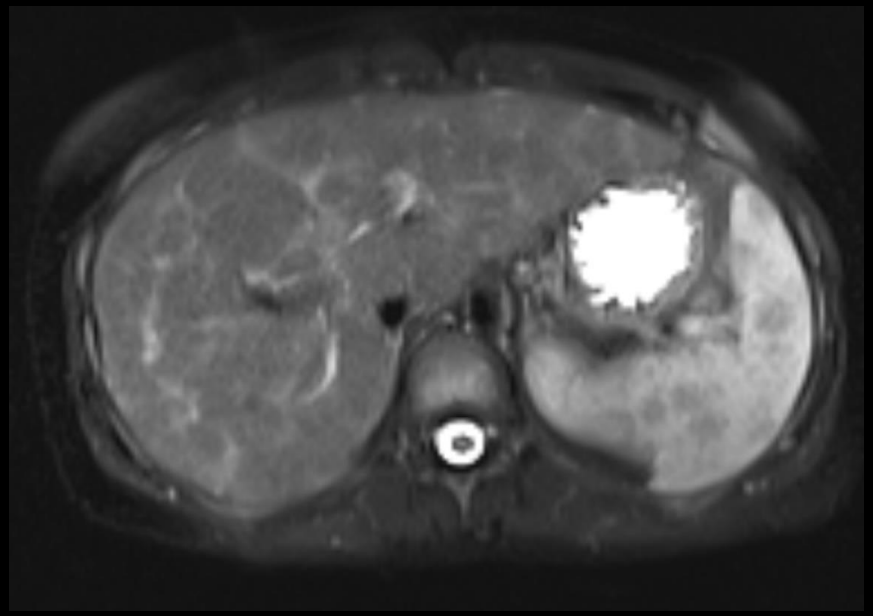


Fig. 18 and 19. MRI, T1-wheighted images with contrast (portal phase).
Focal spleen hypointense and hypoenhancing lesions.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Spleen



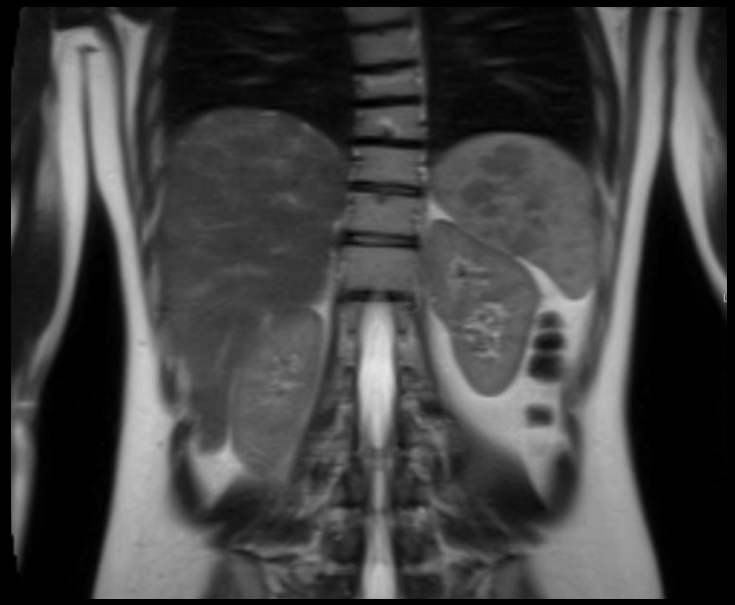


Fig. 20 and 21. MRI, T2-wheighted images. Focal spleen hypointense lesions.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Abdominal Lymph Nodes

Enlarged lymph nodes are detected in approximately 30% of patients particularly in the porta hepatis, para-aortic region, and the celiac axis.

Extensive adenopathy (node size > 2 cm and involvement of four or more sites) is found in approximately 10% of patients.

Enlarged abdominal lymph nodes may be the only abnormal finding on an imaging study, (approximately 50% of patients in one series).

Patients with lymphadenopathy tend to be younger more likely to have symptoms than those without lymphadenopathy (systemic distress such as fever, malaise, and weight loss).

Mean age in **patients with adenopathy**: 33 years
Mean age in **patients without** lymphadenopathy: 43 years

Imaging Findings or Procedure Details

Abdominal Lymph Nodes

Ultrasound

Described as containing low level echoes and increased through transmission, mimicking lymphoma.

Massive echolucent retrocardiac nodes resulting from sarcoidosis may simulate cor triatriatum.

A more nondescript appearance with a slightly hypoechoic echotexture compared with the liver has been reported.

Computed Tomography

The nodes affected by sarcoidosis generally show homogeneous soft-tissue attenuation.

Magnetic Resonance Imaging

Nodes appear hyperintense on T2-weighted fat-saturated images and show mild enhancement on gadolinium-enhanced images.

A fine hypointense speckled appearance of the nodes on T2-weighted fat-saturated images has been described, presumably reflecting macroscopic aggregation of granulomas.

Imaging Findings or Procedure Details

Abdominal Lymph Nodes

Nodal enlargement producing obstruction of adjacent structures has been observed in the biliary tree and ureter.

Nodal calcification is unusual in sarcoidosis.

Some cases of chylous ascites and venous insufficiency in the small intestine resulting from sarcoid nodes compressing the mesenteric vein has also been described.

In most cases resolution was observed after steroid therapy.

Imaging Findings or Procedure Details

Abdominal Lymph Nodes

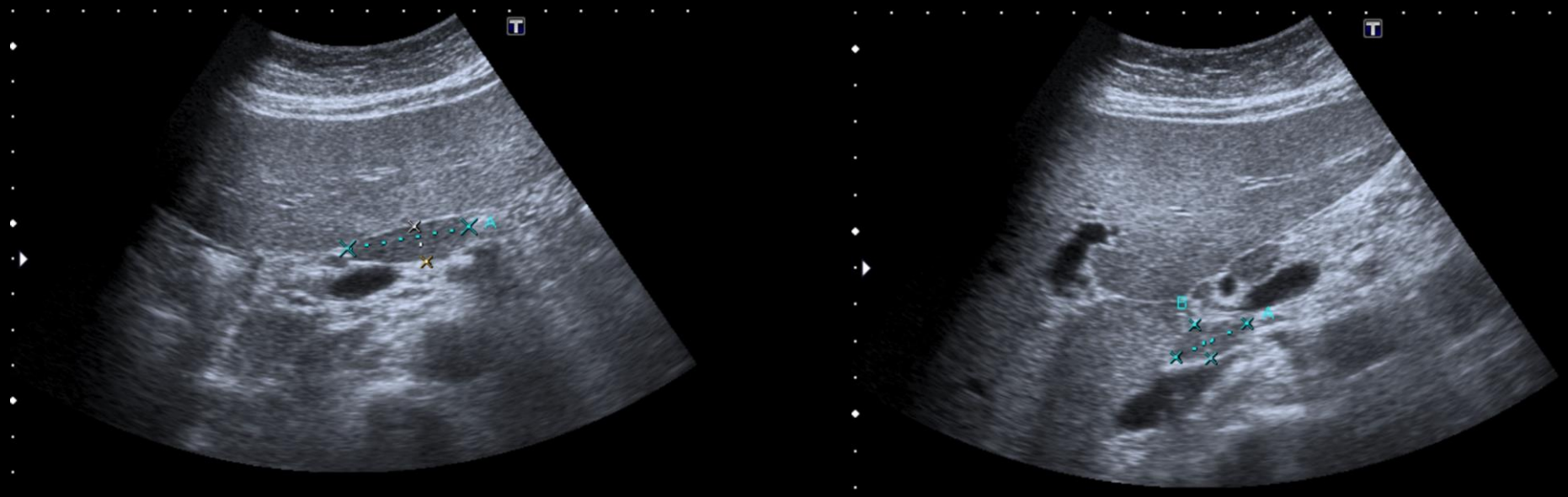
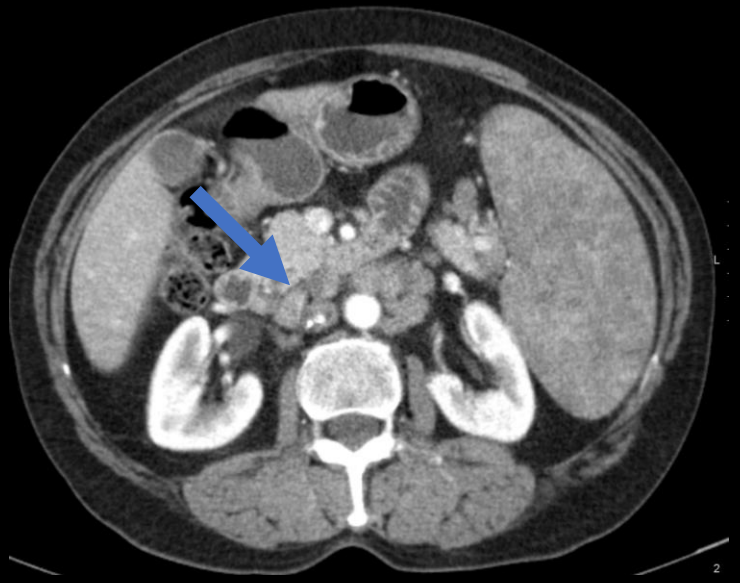


Fig. 22 and 23. Ultrasound. Perihepatic lymphadenopathies.

References: Radiology Department, Centro Hospitalar São João,
Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Abdominal Lymph Nodes



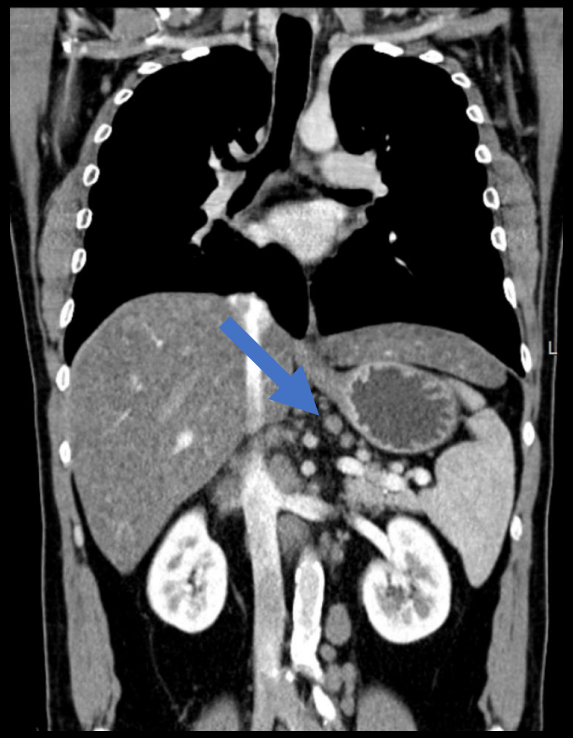


Fig. 24 and 25. Axial and Coronal enhanced CT scans. Retroperitoneal enlarged lymph nodes.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Abdominal Lymph Nodes

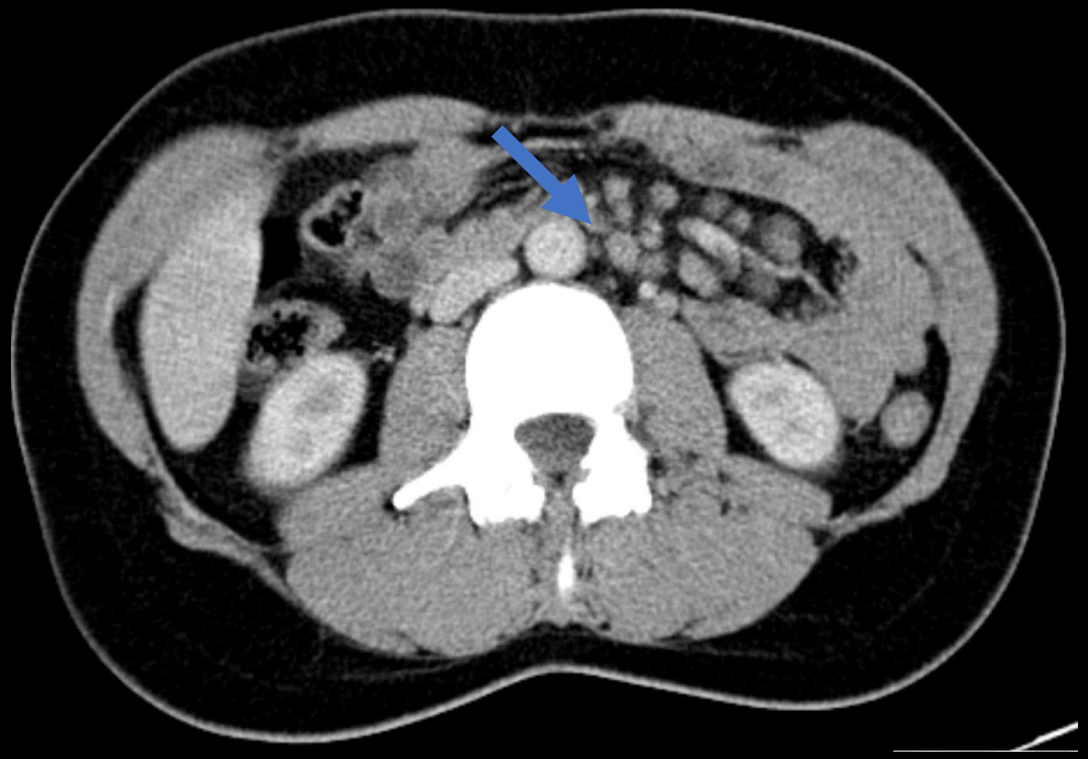


Fig. 26. Axial CT enhanced scan. Multiple mesenteric and latero aortic enlarged lymph nodes.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Abdominal Lymph Nodes

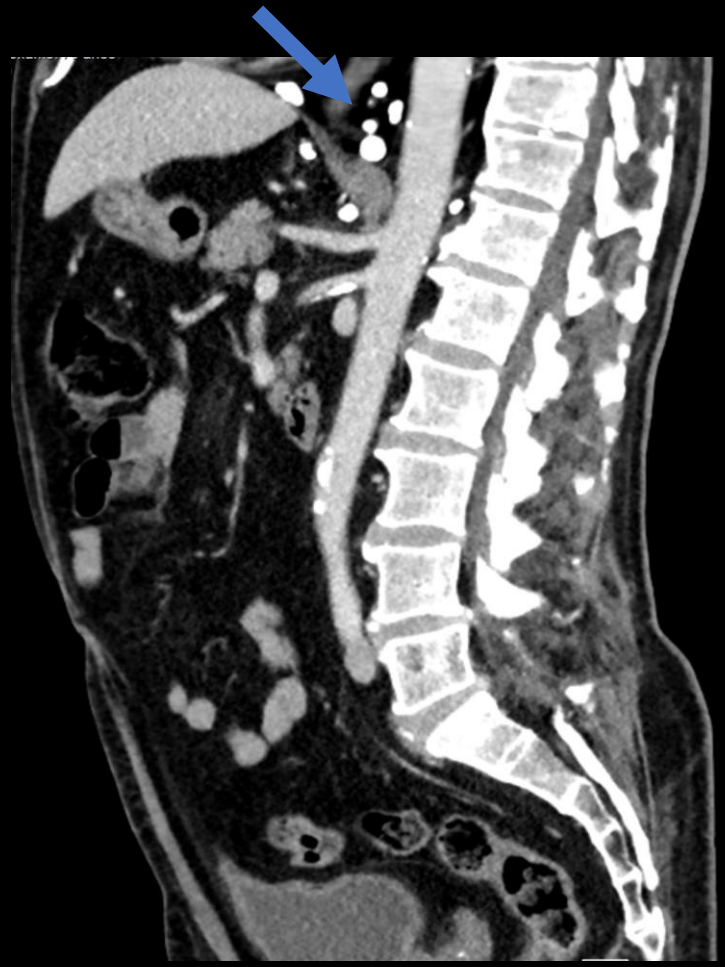


Fig. 27. Sagital enhanced CT Scan. Multiple enlarged lymph nodes with gross calcifications within.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Abdominal Lymph Nodes

Sarcoidosis vs Lymphoma

- retrocrural nodes involved significantly less frequently;

No significant difference in the frequency of involvement at other nodal stations was found between the patients with lymphoma and the patients with sarcoidosis.

- mean node size significantly smaller;

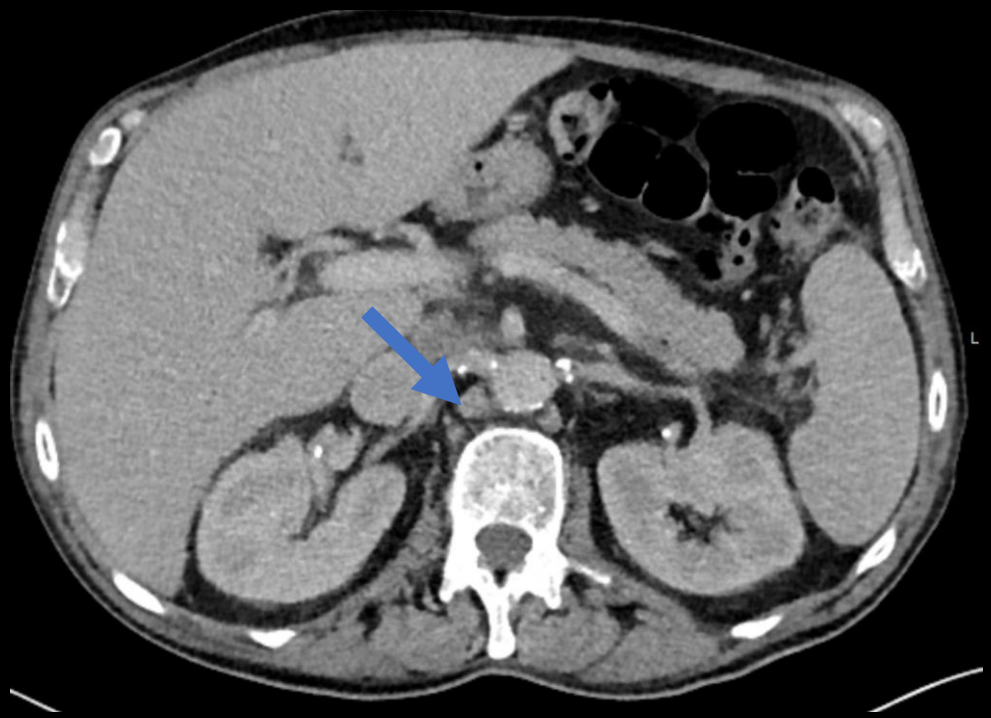
But diameters of some nodes in patients with sarcoidosis can be as large as 7.5 cm.

- confluent masses also significantly less common

Imaging findings in these nodes are usually nonspecific, and differentiation from metastatic carcinoma or malignant lymphoma may be difficult.

Imaging Findings or Procedure Details

Abdominal Lymph Nodes



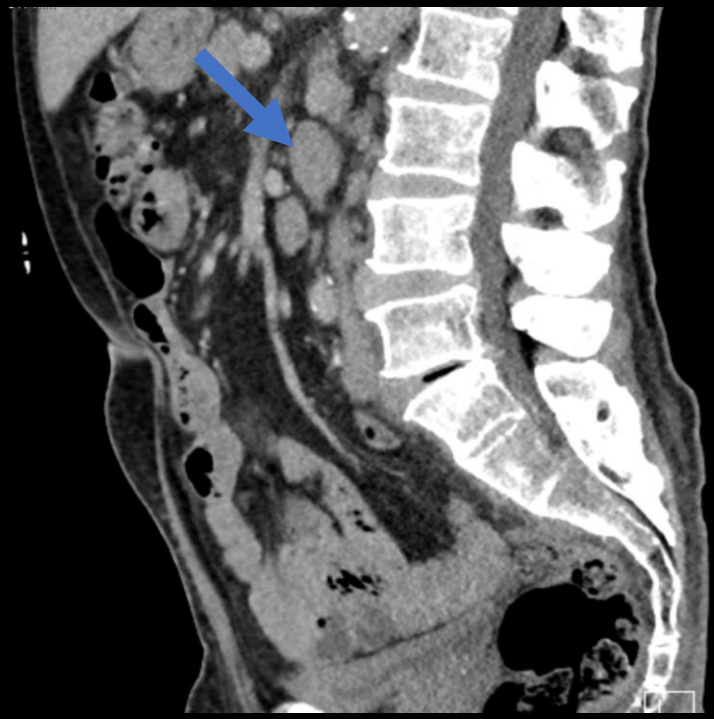


Fig. 28 and 29. Axial and Sagital CT scan of a patient with known lymphoma. In comparison with sarcoidosis, retrocrural adenopathies are more frequent and tend to be more larger.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Pancreas

Sarcoid involvement of the pancreas is uncommon.

Detected in 1%–3% of cases with systemic disease on autopsy series.

Clinically evident disease is rare and usually results from either direct infiltration of the gland or compression of pancreatic structures by enlarged peripancreatic nodes.
(Abdominal and back pain, weight loss, anorexia, jaundice, and pruritus)

Pancreatitis

Sarcoid-associated hypercalcemia also may induce acute pancreatitis.

It has been reported that prolonged sun exposure in patients with sarcoidosis may result in acute hypercalcemia and so an episode of pancreatitis may be the initial presentation of sarcoidosis in patients on vacation in sunny climates.

The imaging manifestations of pancreatitis resulting from sarcoidosis are indistinguishable from those of pancreatitis caused by other conditions.

Imaging Findings or Procedure Details

Pancreas

Sarcoidosis of pancreas may be in the form of direct tissue infiltration, duct obstruction, or constrictive peripancreatic lymphadenopathy.

Pancreatic mass lesions associated with sarcoidosis are rare but may mimic pancreatic adenocarcinomas in both their presentation and appearance.

Associated narrowing or obstruction of the common bile duct as well as the portal and splenic veins also has been observed.

50% - tissue infiltration is diffusely nodular
50% - focal pancreatic mass is seen usually in the head of the pancreas
This mass mimics pancreatic cancer and requires surgical resection for differential diagnosis.

Most patients with pancreatic sarcoidosis respond to corticosteroids, so resection should be avoided if possible.

Imaging Findings or Procedure Details

Pancreas

Ultrasound

On sonography, the masses are hypoechoic.

Computed Tomography

Typical lesions have been described as hypodense and hypo- or nonenhancing ill-defined lesions.
Dilatation of the common bile duct and pancreatic duct, or peripancreatic lymphadenopathy are also seen.

Magnetic Resonance Imaging

T1-weighted images: hypointense lesions.
T2-weighted images: mildly elevated signal intensity lesions.

After IV gadolinium-based contrast: reduced enhancement compared to normal pancreas.

Cholangiograms typically show a long, smoothly tapered narrowing rather than the more abrupt termination associated with tumor.

Imaging Findings or Procedure Details

Pancreas

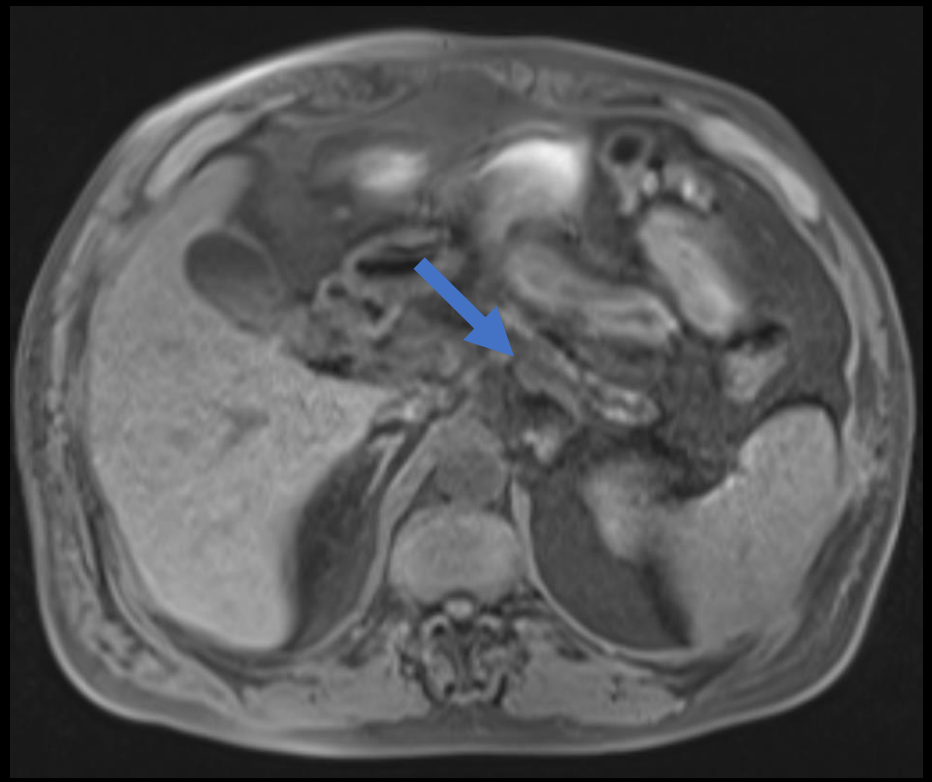


Fig. 30. MRI. T1-weighted images with contrast IV (portal phase). Marked pancreatic atrophy with dilatation of the Wirsung duct, that presents irregular shape (arrow). These imaging features suggests chronic pancreatic involvement.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Luminal Gastrointestinal Tract

Gastrointestinal tract involvement has a prevalence of less than 1% and is usually associated with pulmonary disease.

The most common site of sarcoid involvement in the gastrointestinal tract is the **stomach**, although reported locations range from the esophagus to the rectum.

Esophagus: plaquelike lesions have been reported.

Stomach
Mucosal nodularity and thickened irregular folds (DDx with Ménétrier's disease).
Apthous ulcers and larger ulcerations have been seen as well as linear and polypoid filling defects in the stomach.
A linitis plastica–type appearance has been identified (DDX with adenocarcinoma).

Predilection for the antrum.
Diagnosis of gastric involvement requires endoscopic biopsy.

Imaging Findings or Procedure Details

Luminal Gastrointestinal Tract

Small bowel

Circumferential obstructive process due to sarcoidosis also has been described in the duodenum.

Colon

May appear as irregular mass lesions mimicking carcinoma.
Sarcoidosis in the appendix may produce appendicitis.

Exclusion of other causes of granulomatous inflammation, including fungal and mycobacterial diseases and Crohn's disease, is important.

More extensive disease may result in abdominal pain, obstruction, bleeding, and malabsorption.

Lesions typically respond to steroids, although in some reported cases, the abnormal morphology remained, suggesting that fibrosis may persist after resolution of the granulomatous inflammation.

Imaging Findings or Procedure Details

Urinary Tract

Granulomatous involvement of the kidney has been reported in 7–22% of patients with sarcoidosis at autopsy.

Nephrocalcinosis, **nephrolithiasis**, and **interstitial calcium deposition** which may lead to renal failure have been reported in sarcoidosis.

The most frequent effects of sarcoidosis are related to hypercalcemia or hypercalciuria, secondary to production of calcitriol typically by the extrarenal granulomata.

Most patients with hypercalcemia have radiographic evidence of pulmonary disease.

Nephrotic syndrome, glomerulonephritis, and tubulointerstitial disease → rare

- may demonstrate a striated nephrogram on contrast-enhanced CT.
- nephromegaly or renal atrophy may result, depending on the extent and duration of involvement.

Hydronephrosis may be caused by compression of the ureters by enlarged retroperitoneal nodes.

Imaging Findings or Procedure Details

Urinary Tract – Focal Nodules

Direct granulomatous involvement of the kidneys is rarely observed.

Ultrasound

Focal, exophytic nodules which may be singular or multiple, unilateral or bilateral and echogenic.

Computed Tomography

They may be hypo-, iso-, or hyperdense on unenhanced CT relative to the normal renal parenchyma, and but are hypo-enhancing on contrast-enhanced CT.

Magnetic Resonance Imaging

Poor circumscription of the mass or masses from the renal parenchyma is demonstrated, indicating interstitial infiltration.

T1- and T2-weighted imaging: may be homogenous or slightly heterogenous, predominantly remaining isointense to the surrounding renal parenchyma.

After IV gadolinium-based contrast: less early and delayed enhancement relative to the normal renal cortex.

Imaging Findings or Procedure Details

Urinary Tract

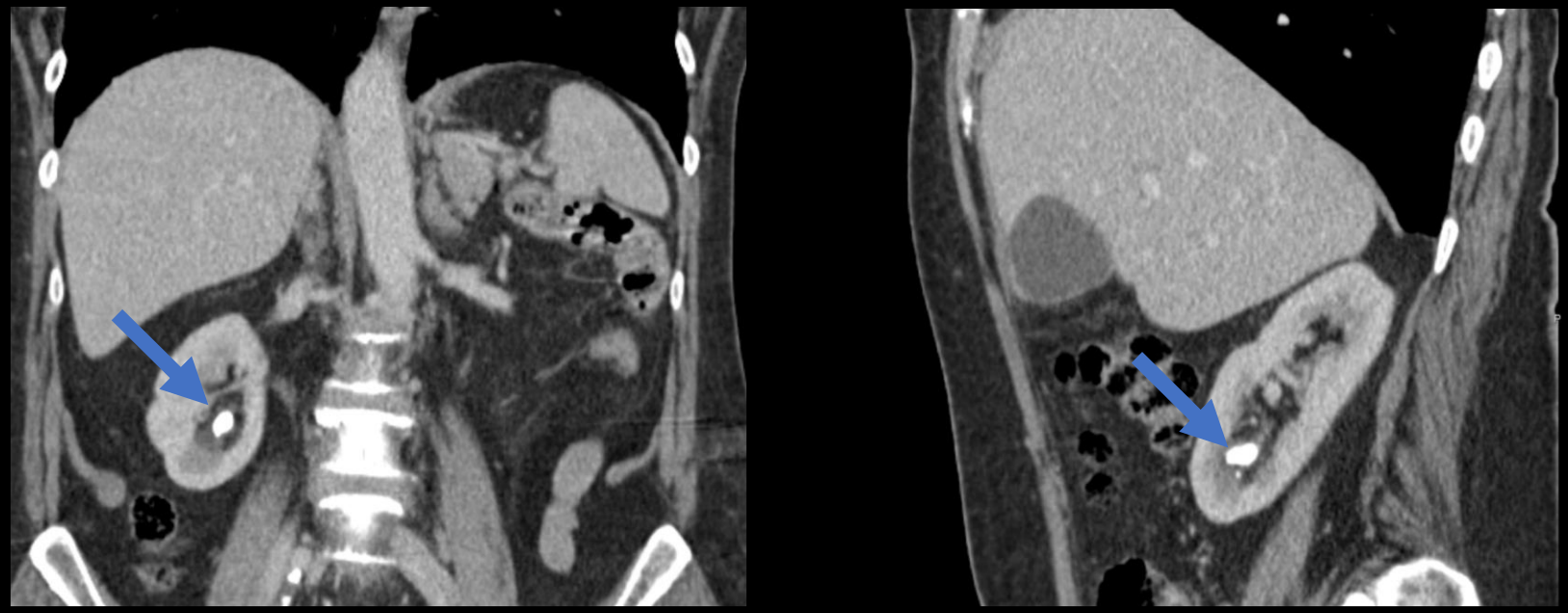
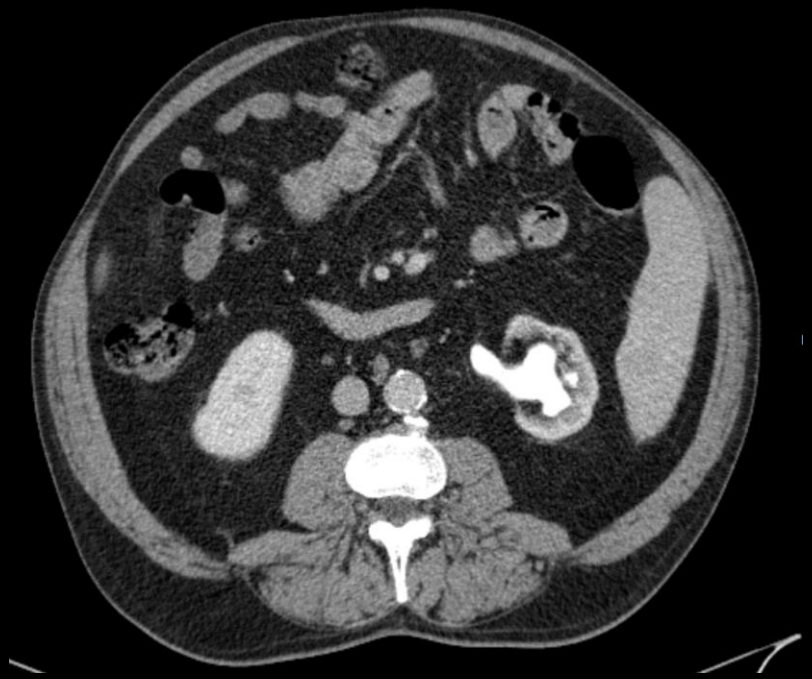


Fig. 31 and 32. Coronal and Axial CT scans. Nephrolithiasis.

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Urinary Tract



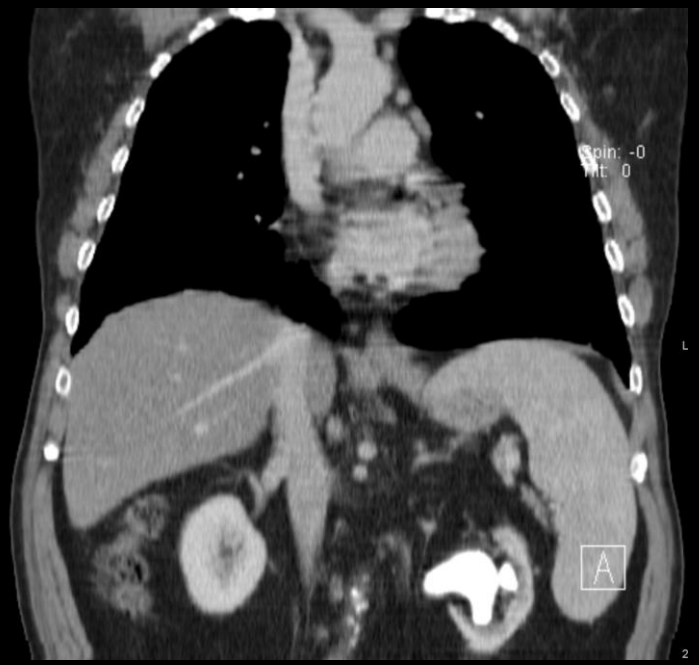


Fig. 33 and 34. Axial and Coronal CT Scan. Nephrolithiasis (staghorn stones).

References: Radiology Department, Centro Hospitalar São João, Faculdade de Medicina da Universidade do Porto – Porto/PT

Imaging Findings or Procedure Details

Urinary Tract

Although renal carcinoma, metastasis, lymphoma, xantogranulomatous pyelonephritis, angiomyolipoma, and oncocytoma are included in the differential diagnosis of such focal renal lesions, the clinical history of sarcoidosis and involvement of other organs would prevent unnecessary surgical interventions for the diagnosis.

Imaging Findings or Procedure Details

Female Genital Tract

Uterus is the most commonly involved site of the female genital system.

Usually detected while investigating the cause of abnormal uterine bleeding in patients with a previous history of sarcoidosis at other anatomic sites.

Ovarian sarcoidosis is extremely rare and known to mimic ovarian malignancy with soft tissue nodules.

Imaging Findings or Procedure Details

Male Genital Tract

Granulomas may be detected in the epididymis, testis, and prostate gland, in order of decreasing frequency.

Diagnosis of sarcoidosis should be strongly considered in cases of multiple masses that simultaneously affect the epididymis and testis.

Ultrasound

Masses are described as homogeneously hypoechoic.

Magnetic Resonance Imaging

Lesions exhibit low signal intensity on T2-weighted images and enhancement on contrast-enhanced T1-weighted images.

Testicular and extratesticular involvement need to be differentiated from other granulomatous diseases such as tuberculosis, syphilis, Wegener’s granulomatosis, granuloma inguinale, lymphogranuloma venereum, filariasis, coccidioidomycosis, blastomycosis, actinomycosis, and schistosomiasis.

Imaging Findings or Procedure Details

Abdominal Wall

Sarcoidosis can involve the skeletal muscle and produce either a nodular, myopathic, or myositic form.

Show signal intensity similar to that of muscle on T1-weighted images and heterogeneously increased T2 signal.

Slight enhancement of the lesion relative to the muscle is reported.

Sarcoidosis also may involve the subcutaneous fat-producing nodules or a more diffuse infiltrative lesion.

Peritoneum

Peritoneal involvement is extremely rare in sarcoidosis.

The most frequent clinical presentations of peritoneal sarcoidosis are exudative ascites, multiple granulomatous nodules studding the peritoneum, or a single peritoneal lesion

Imaging Findings or Procedure Details

Correlation of Abdominal Sarcoidosis with Pulmonary Involvement

Involvement of the abdominal viscera frequently occurs in the context of more extensive chest disease. However, abdominal sarcoidosis without pulmonary or mediastinal involvement is not rare.

Several authors have concluded that there was no correlation between the degree of chest abnormality and the involvement of liver, spleen, or node.

Conclusions

Since abdominal sarcoidosis is less common and long-standing, unrecognized disease can result in significant morbidity and mortality, the radiologist must be familiar of its main imagiologic fearures to ensure a better management of intra-abdominal sarcoidosis.

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