CT of lymphoma: spectrum of abdominal disease

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Keyword: Abdominal lymphoma

1. Learning objectives

Review the common and uncommon CT appearances of lymphoma in the abdomen.

Describe the implications of imaging findings for disease management.

2. Background

Abdominal lymphoma has a wide variety of imaging appearances and definitive diagnosis relies on histopathologic analysis. CT has been shown to be useful to define the extent of disease, assists in treatment planning, evaluate the response to therapy and monitor patient progress and possible relapse.

3. Imaging findings OR Procedure details

In this exhibit we describe and illustrate:

1. The CT technique, appearance and implications of imaging findings for disease management in patients with lymphomatous involvement of the:

1.1 Liver

1.2 Spleen

1.3 Kidney

1.4 Adrenal glands

1.5 Pancreas

1.6 Stomach

1.7 Small bowel and mesentery

1.8 Colon

1. CT technique, appearance and implications of imaging findings for disease management in patients with lymphoma

CT Technique

Computer tomography (CT) is the study of choice for the detection and staging of Hodgkin and non-Hodgkin lymphoma. CT offers the benefit of obtaining information about both mural and extramural components of the disease and provides information that can be used to plan an appropriate therapeutic regimen, evaluate the response to therapy, and monitor patient progress and possible relapse.

The patients routinely received oral and intravenously administered contrast material. CT scans were obtained at approximately 70 seconds after initiation of contrast agent injection.

Abdominal Lymphoma

Gastrointestinal lymphoma is an uncommon disease but is the most frequently occurring extranodal

and is almost exclusively of non-Hodgkin type.

Lymphomatous involvement of solid organs may occur as a focal, multifocal, or diffuse disease process. In focal and multifocal disease, discrete solid nodules are present. In diffuse disease, there is uniform infiltration of the involved organ.

On CT images, the nodules are commonly hypoattenuating when compared with the surrounding parenchyma and enhancement after administration of intravenous contrast material tends to be mild and uniform. However, central necrosis may occur and produce a heterogeneous appearance on unenhanced or contrast-enhanced images. Calcification is rare in the absence of treatment. Diffuse involvement of solid organs may produce no structural abnormalities and tends to be difficult to detect. The most common finding is organomegaly, but this feature has very low sensitivity and specificity for the diagnosis of lymphoma. Organ contour usually is normal or minimally abnormal, even if diffuse disease is advanced. Images obtained after administration of an intravenous contrast material may depict subtle heterogeneous areas that are not visible on unenhanced images.

Lymphomatous involvement of the gastrointestinal tract may occur in the following morphologic forms: nodular, polypoid, infiltrative, aneurysmal or cavitary, ulcerative, and mixed.

In nodular form, there is nodular thickening of the involved segment, with a range of nodules sizes.

In the polypoid form, which occurs most commonly in the stomach, solitary or multiple smooth polyplike masses are present, and the surrounding tissue is normal or thickened.

In the infiltrative form, there is focal or diffuse thickening of the involved segment because of tumor extension along the submucosal and muscularis propria. Peristalsis may be impaired, and the involved segment may have a tubelike appearance. Diffuse infiltration may lead to destruction of the muscularis propria and autonomic plexus. The involved segment becomes nonperistaltic, circumferentially dilates, and assumes an aneurysmal appearance. Rarely, there may be segmental luminal narrowing and obstruction.

The tumor may excavate the mesentery, producing a cavitated mass.

Infiltration by lymphoma also may lead to mural ulcerations.

1.1 Liver

Primary hepatic lymphoma is very rare and occurs most commonly in immunocompromised patients. Secondary involvement of the liver in advanced stages of lymphoma is relatively common. Both primary and secondary hepatic lymphomas are more often non-Hodgkin lymphoma than they are Hodgkin disease. Infiltration of the liver at the time of presentation occurs in up 16% of patients with non-Hodgkin lymphoma and 10% of patients with Hodgkin disease.

The CT appearances of hepatic lymphoma can be divided in three categories:

- Solitary hepatic mass, which may be indistinguishable in appearance from metastatic disease from any source or from primary hepatocellular carcinoma ([Fig. 1] Fig. 1). The lesions may range in size from less than 1 cm to approximately 10 cm. Calcification within these lesions is rare unless the patient has undergone radiation therapy. Larges lesions frequently display an irregular contour.

- Multifocal hepatic lesions, which can be also similar in appearance to metastatic disease or multifocal hepatocellular carcinoma. The lesions vary in size but typically are 1-5 cm in diameter ([Fig. 2] Fig. 2). Discrete nodules occur in about 10% of cases of Hodgkin disease and non-Hodgkin lymphoma of the liver and may appear with a miliary pattern ([Fig. 3] Fig. 3). Focal lesions are usually isoattenuating on

unenhanced scans, and most are poorly visualized. Portal phase images occasionally demonstrate multiple hypoattenuating lesions, which may have ill-defined margins.

- Diffuse hepatic infiltration is the most commonly occurring pattern and is a difficult feature to detect on CT scans, because this involvement is often homogeneous and have the same attenuation as hepatic parenchyma. Hepatomegaly may occur but is nonspecific for hepatic lymphoma ([Fig. 4] Fig. 4).

Diffuse infiltration of the liver is more common in secondary forms, while large focal nodular disease is the most common presentation of the primary form. In contrast to the homogeneous nodules typical of secondary hepatic lymphoma, the dominant masses of primary hepatic lymphoma may be heterogeneous. Primary lymphomas often appear hyperattenuating on delayed scans after contrast administration (due to the diffusion of contrast into the tumor interstitium). Concomitant abdominal lymph node enlargement, if present, will help to suggest the correct diagnosis.

1.2 Spleen

Lymphoma is the commonest primary malignancy of the spleen. Primary splenic lymphoma is rare (1-2% of all lymphomas) and is usually non-Hodgkin lymphoma of the small cell type. Secondary splenic involvement is frequent in both non-Hodgkin lymphomas (NHL) and Hodgkin disease (HD). Approximately 25-33% of all patients with HD and NHL are affected.

Splenic involvement in lymphoma can have four forms:

- Homogeneous enlargement without a discrete mass

- Military nodules

- Multifocal lesions (of 1 to 10 cm)

- Solitary mass

CT can detect focal or multifocal disease more reliably than diffuse infiltration. On CT, focal lymphomatous lesions typically show lower attenuation than normal splenic parenchyma.

Diffuse, uniform infiltration is the most common form of splenic lymphoma. Commonly, the spleen is usually normal and appears homogeneous on unenhanced scans, but ill-defined hypoattenuating foci with diameters of less than 1 cm may be apparent after intravenous contrast material administration ([Fig. 5] Fig. 5). Diffuse lymphomatous involvement may or may not lead to splenomegaly, but is not diagnostically specific ([Fig. 6] Fig. 6). Conversely, the presence of splenomegaly is not necessarily caused by lymphomatous involvement, even in a patient with confirmed lymphoma.

Discrete nodules are present in a minority of patients with splenic lymphoma (in fewer than 20% of cases). Nodules may be missed on arterial phase and early venous phase images because normal heterogeneous splenic enhancement. Late venous phase and equilibrium phase images allow a more reliable assessment of splenic involvement in lymphoma ([Fig. 7] Fig. 7).

Large focal lesions may cause bulging of the splenic contour. During the parenchymal phase of enhancement, focal lesions are clearly demarcated as hypodense areas. Occasionally their margins are ill-defined ([Fig. 8] Fig. 8 and [Fig. 9] Fig. 9). Rim enhancement is rarely observed. Necrosis of large lesions has been reported and causes an irregular cystic appearance that may mimic an abscess in patients with lymphoma and associated fever. Calcifications are rare before, and more frequent after therapy.

In NHL, splenic involvement is associated with para-aortic lymph node involvement in approximately 70% of patients.

1.3 Kidney

Primary renal involvement by lymphoma is very rare, because the kidneys do not contain lymphatic tissue. Secondary renal lymphoma, which occurs mainly in late-stage disease, is more common (30-50%) and it is much more frequently non-Hodgkin lymphoma than Hodgkin disease. Bilateral multifocal involvement is three times more common than a solitary focal mass.

All forms of renal lymphoma appear on CT scans as hypovascular lesions that may be visible only after IV contrast administration. The lesions are homogeneous and they enhance less markedly than does the normal renal parenchyma. Intralesional areas of heterogeneous low attenuation may occur after chemotherapy, representing tumor necrosis.

The CT appearance of renal involvement by lymphoma can be classified into four categories:

- Solitary nodular mass occurs in about 10%-20% of patients with renal lymphoma. Images depict a solitary renal mass that typically is homogeneous, well- circumscribed that may distort the renal contour and may infiltrate the perirenal fat.

The lesion may have the same attenuation as normal kidney on non-contrast-enhancement CT scans and is best detected on contrast-enhanced studies. They usually occur in a normal-sized kidney and may occur with or without associated paraaortic adenopathy.

- Bilateral multinodular involvement. The most common pattern of renal lymphoma (60% of cases) is multiple masses, usually in both kidneys. The size of renal lymphoma masses varies from small to large (usually between 1 and 4.5 cm in diameter), and large masses may distort renal contour. They are poorly marginated, visible only after contrast administration ([Fig. 10] Fig. 10). The kidneys are usually enlarged, but may be normal in size.

-Diffuse infiltration of kidney occurs approximately 20% of patients with renal lymphoma and is almost always bilateral. The kidneys are partially or totally replaced by tumor, and they are usually enlarged with preservation of renal contour, and with no circumscribed mass ([Fig. 11] Fig. 11). They show decreased contrast enhancement (parenchymal phase) and reduced excretion. Images obtained after the intravenous administration contrast material may show poorly enhancing areas in the kidneys.

- Infiltration by contiguous retroperitoneal disease. The contiguous extension of a retroperitoneal mass into the kidney accounts for about 24% of cases of renal lymphoma. Perirenal lymphoma typically manifests as a homogeneous, bulky, retroperitoneal mass that surrounds but does not invade the kidney ([Fig. 12] Fig. 12). It often invades the renal hilum and encases the ureter and may cause hydronephrosis. Encasement of the renal artery is common, but it does not obstruct the renal vessels. There is also thickening of Gerota fascia. Invasion of the psoas muscle is a relatively common finding.

In cases with massive adenopathy, the renal outline may be lost or poorly defined. The involved kidney occasionally is displaced.

1.4 Adrenal glands

Primary adrenal lymphoma is extremely. Secondary involvement of the adrenals is more frequent (in approximately 25% of the cases). Adrenal gland involvement is more common in non-Hodgkin lymphoma. Involvement is bilateral in about 50% of patients.

Imaging findings are nonspecific. On CT, adrenal lymphomas usually are seen as large soft tissue

masses replacing the adrenal. They usually alter the shape of the adrenal, but the adrenal may markedly expand while retaining a somewhat adreniform shape ([Fig. 13] Fig. 13). There is mild to moderate contrast enhancement. Necrosis can be seen in rapidly growing lesions. Retroperitoneal adenopathy or extranodal lesions are usually identified.

1.5 Pancreas

Primary lymphomas of the pancreas are rare (<1% of all pancreatic neoplasms) and are usually difficult to distinguish from pancreatic infiltration by peripancreatic nodes. Secondary lymphomatous involvement of the pancreas is also rare (30% of the cases) and is generally associated with extensive abdominal lymphomas. The majority are non-Hodgkin lymphomas.

- Diffuse infiltration causes organ enlargement and extensive and diffuse peripancreatic fat infiltration, and it may resemble acute pancreatitis on imaging. In comparision with the normal pancreas, the affected gland may have slightly lower attenuation on unenhanced CT, and contrast enhancement is diffusely reduced, yet homogeneous ([Fig. 14] Fig. 14).

- Unifocal pancreatic lymphoma usually manifests as a large, well-circumscribed and homogeneous mass, but is more common to find central tumor necrosis. Approximately 60% are larger than 4 cm when diagnosed. They may occur in any part of the gland. In the pancreatic head, it may cause mild dilation of the duct of Wirsung and the common bile duct and may mimic pancreatic adenocarcinoma.

They can be difficult to distinguish from pancreatic carcinoma. A bulky pancreatic head mass that causes little pancreatic duct dilatation and little pancreatic tail atrophy is more characteristic of lymphoma than of adenocarcinoma. Both lymphoma and adenocarcinoma may be associated with peripancreatic lymph node enlargement, however lymphadenopathy bellow the level of the renal veins is virtually never found in adenocarcinoma. Lymphomas can envelop and displace the peripancreatic vessels without invading them, and the pancreas may be displaced anteriorly by the enlarged peripancreatic nodes.

- Multifocal pancreatic lymphoma may occur but is uncommon.

With secondary pancreatic involvement by malignant lymphoma, images will typically show extensive manifestations of extrapancreatic disease.

1.6 Stomach

Primary gastric lymphoma represents 1-5% of gastric malignancies and is the most common type of extranodal lymphoma, accounting for 50-70% of all primary gastrointestinal lymphomas. Non-Hodgkin lymphoma accounts for approximately 80% of cases. Secondary gastric lymphoma is more common than primary lymphoma. Gastric lymphoma has no site predilection, and all portions of the stomach are equally likely to be involved, unlike gastric carcinoma, which commonly affects the greater curvature of the antrum and the body.

Lymphomas tend to infiltrate the stomach homogeneously, although low-attenuation regions may be seen, showing little contrast enhancement ([Fig. 15] Fig. 15). The mean thickness of the affected gastric wall is 4 to 5 cm and despite extensive lymphomatous infiltration the stomach usually remains pliable and distensible, and the lumen is preserved, making gastric outlet obstruction a rather uncommon feature. Advanced lesions may become very large.

Gastric lymphoma may also produce sharply circumscribed areas of pronounced polypoid or nodular wall thickening. Ulcerations may be present. Only very rarely gastric lymphoma presents as cavited lesion caused by tumor necrosis and excavation.

Transpyloric spread of lymphoma into the duodenum is quite common and represents a differentiating feature to adenocarcinoma that invades the duodenum in less than 10%.

Direct invasion of the pancreas, spleen, colon, and liver may occur. While splenic involvement is suggestive of lymphoma, hepatic metastases are characteristic of adenocarcinoma. Adenopathy is seen with both adenocarcinoma and lymphoma, but if it extends below the renal hila or the lymph nodes are bulky, lymphoma is more likely. Preservation of the perigastric fat planes at CT is more likely to be seen in lymphoma than in adenocarcinoma, particularly in the presence of a bulky tumor.

1.7 Small bowel and mesentery

Lymphomas are the commonest primary small bowel tumors. The small bowel is the second most frequent site of gastrointestinal tract involvement by lymphoma and accounts for 20%-30% of all primary gastrointestinal lymphomas. Non-Hodgkin lymphoma can involve the gastrointestinal tract due either to secondary spread from nodal disease elsewhere or as a primary disease. The ileum is the most common site of occurrence because of the greater amount of lymphoid tissue in this portion of the bowel. The duodenum is the least frequent site of involvement.

CT appearance of lymphoma is variable.

Small bowel lymphoma may appear as a circumferential bulky mass in the intestinal wall (average size 5 cm), that shows only slight enhancement. It is frequently associated with extension into the small bowel mesentery and regional lymph nodes.

The tumor may involve a relatively long segment of bowel, resulting in pronounced eccentric or circumferential wall thickening ([Fig. 16] Fig. 16) and may ulcerate and perforate into the adjacent mesentery, resulting in the formation of a confined, usually sterile abscess. The intestinal lumen may be narrowed as consequence of wall thickening.

Aneurysmal dilatation of the lumen may be seen due to replacement of the muscularis propria and destruction of the autonomic nerve plexus by lymphoma ([Fig. 17] Fig. 17). Obstruction is uncommon in the small bowel, since the tumor does not elicit a desmoplastic response.

Small-bowel lymphoma usually occurs as a solitary lesion, but multiple sites are involved in 10%-24% of cases.

Mesenteric involvement by lymphoma may involve the small bowel directly by direct extension or indirect by displacement due to mass effect, and is usually seen as part of a more systemic involvement.

Mesenteric involvement can be manifest by any of the four general patterns of mesenteric disease: rounded masses, ill-defined masses, cakelike masses, and stellate mesentery. The rounded mass appearance is the most common and is usually seen with non-Hodgkin lymphoma ([Fig. 18] Fig. 18). Discrete mesenteric nodes may directly involve or encase small bowel with a classic “sandwich” appearance.

1.8 Colon

Primary colonic lymphoma is uncommon and is responsible for less than 0.4% of primary rectal tumors, and colorectal lymphomas constitute 6-12% of gastrointestinal lymphomas. Non-Hodgkin lymphoma is the most frequent histologic type in these cases. The cecum and rectum are the most common sites of involvement.

CT may demonstrate the following findings in lymphoma: polypoid masses, most frequently near the

ileocecal valve; circumferential infiltration (with or without ulcerations); a cavitary mass excavating into the mesentery; endoexoenteric tumors; mucosal nodularity; and focal thickening. Occasionally, extension into the terminal ileum, focal strictures, aneurysmal dilatation, or ulcerative forms with fistula formation may be seen. Intussusception may occur with cecal involvement. Other features are: well-defined margins with preservation of fat planes, and no invasion into adjacent structures.

Diffuse infiltration, with infiltration of variable lengths of colon is often associated with abdominal adenopathy or extensive bowel infiltration by tumor.

Despite the severe luminal narrowing, lymphoma is less likely to cause obstruction because is does not elicit a desmoplastic response and submucosal lymphoid infiltration weakens the muscularis propria of the wall.

4. Conclusion

CT continues to remain the imaging study of choice for the staging and follow-up of cases of lymphoma. Because some findings are nonspecific and because lymphomatous disease may mimic a broad spectrum of diseases and treatment-related complications, a familiarity with the features specific to lymphomas may help improve the accuracy of diagnosis and staging and thus allow better disease management.

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7. Mediafiles

Fig. 1

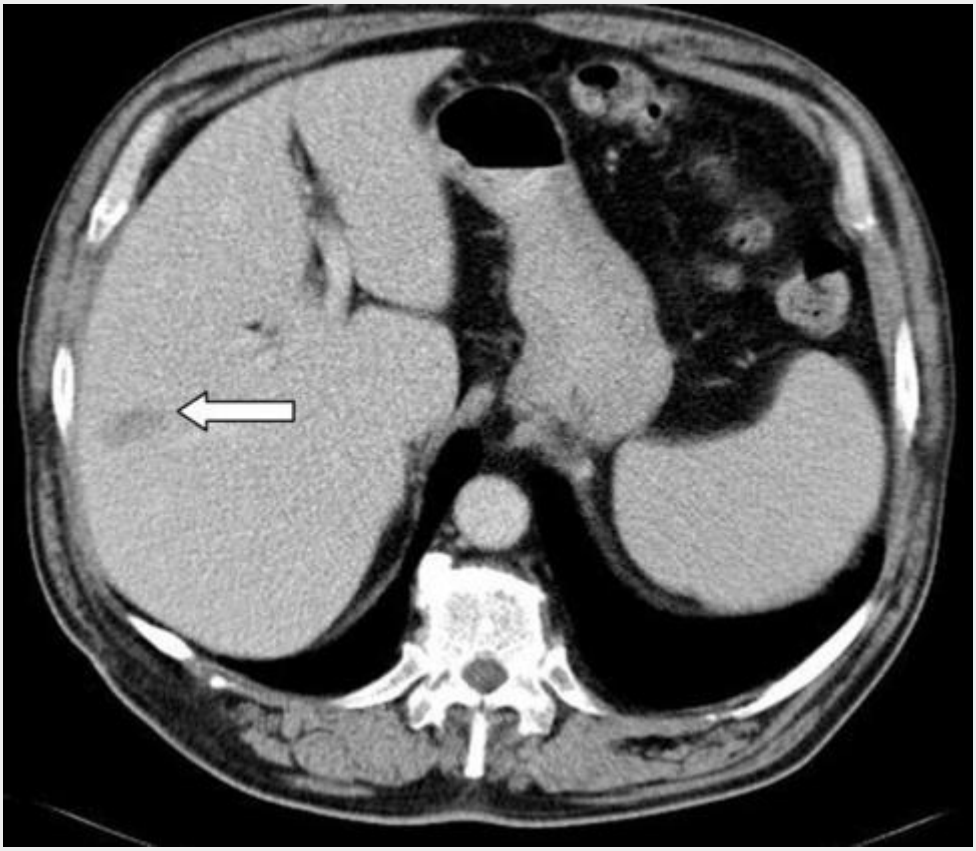
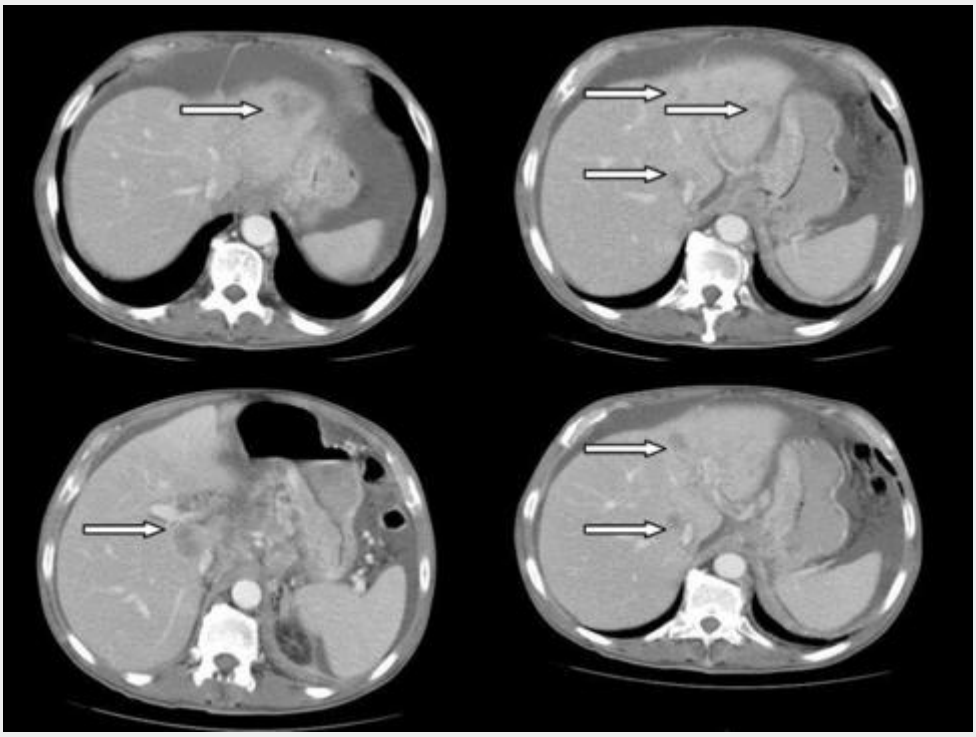


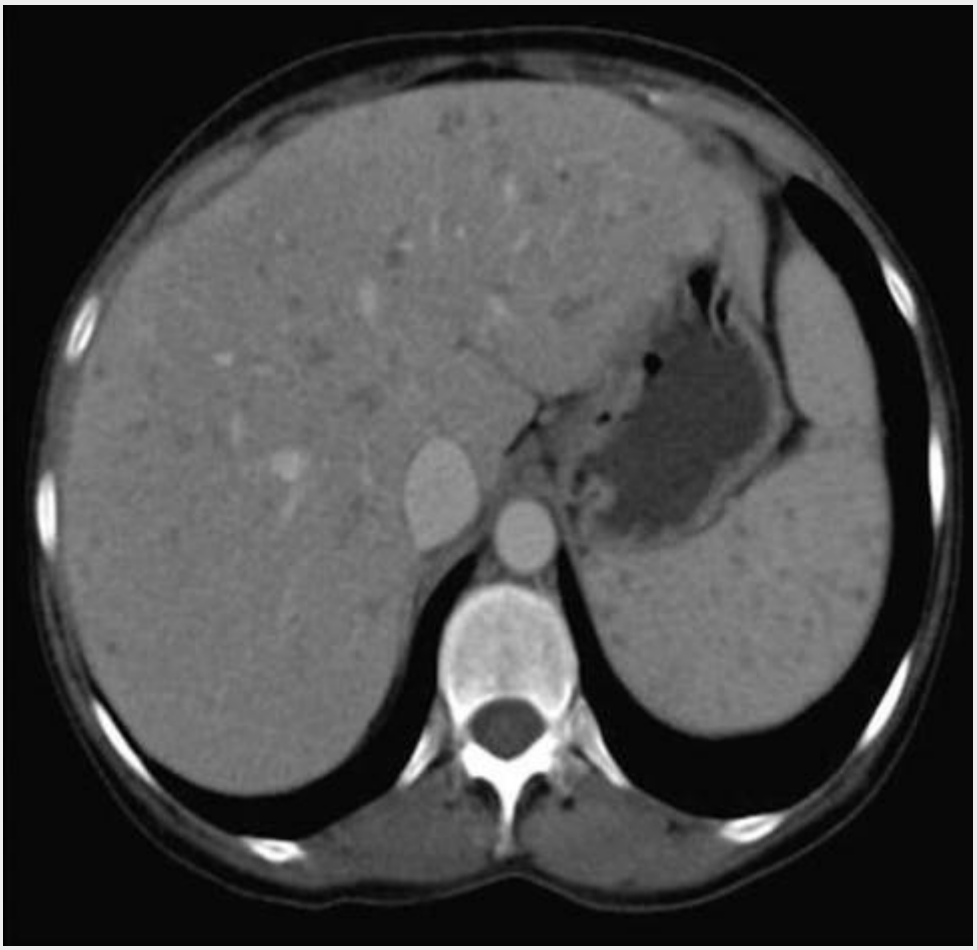
Fig. 1 – Focal Hepatic Lymphoma. Axial contrast-enhanced CT shows a solitary hypoattenuating lesion, with ill-defined margins (arrow).

Fig. 2



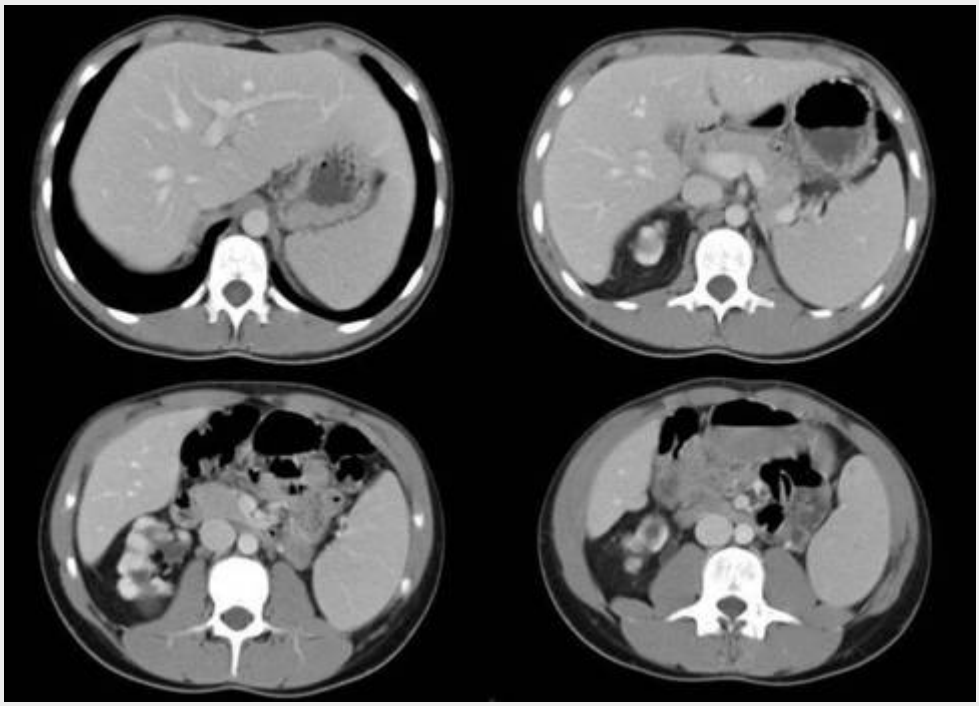
Multifocal Hepatic Lymphoma. Axial contrast-enhanced CT shows multiple hypoattenuating lesions with ill-defined margins (arrows).

Fig. 3



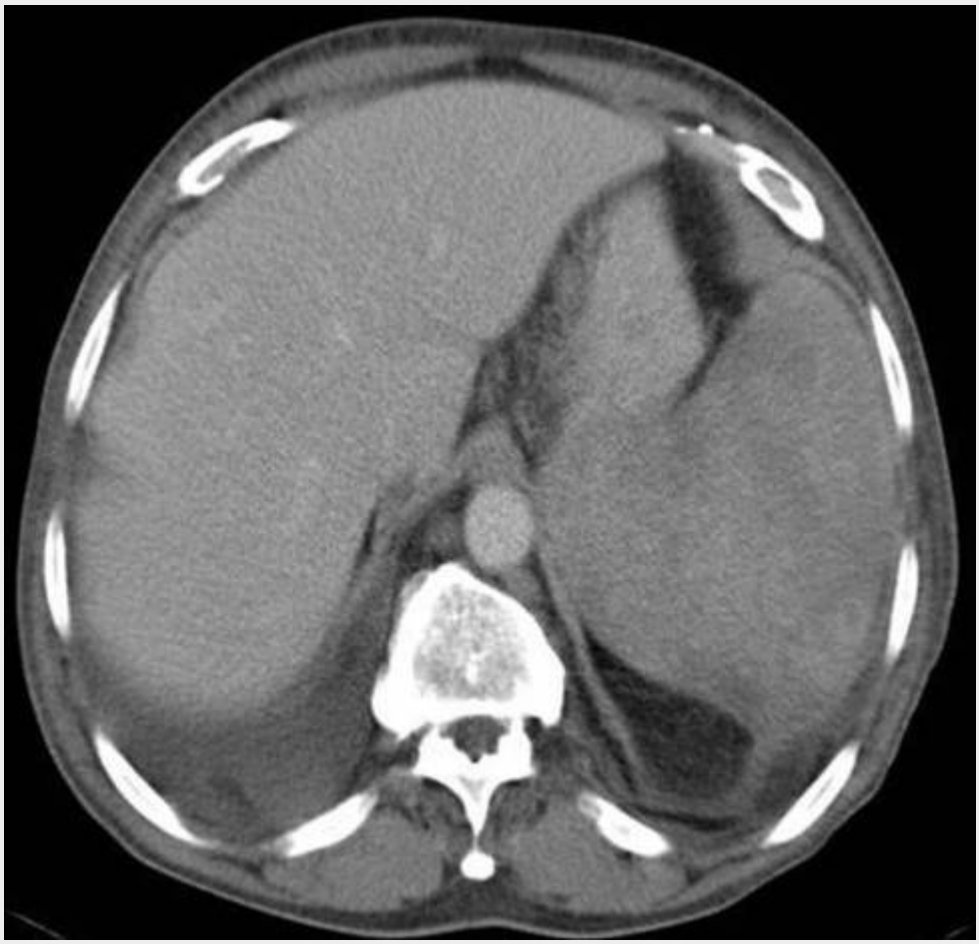
Miliary pattern. Axial contrast-enhanced CT shows hepatic and splenic multifocal hypoattenuating lesions, typically 5-10 mm in diameter.

Fig. 4



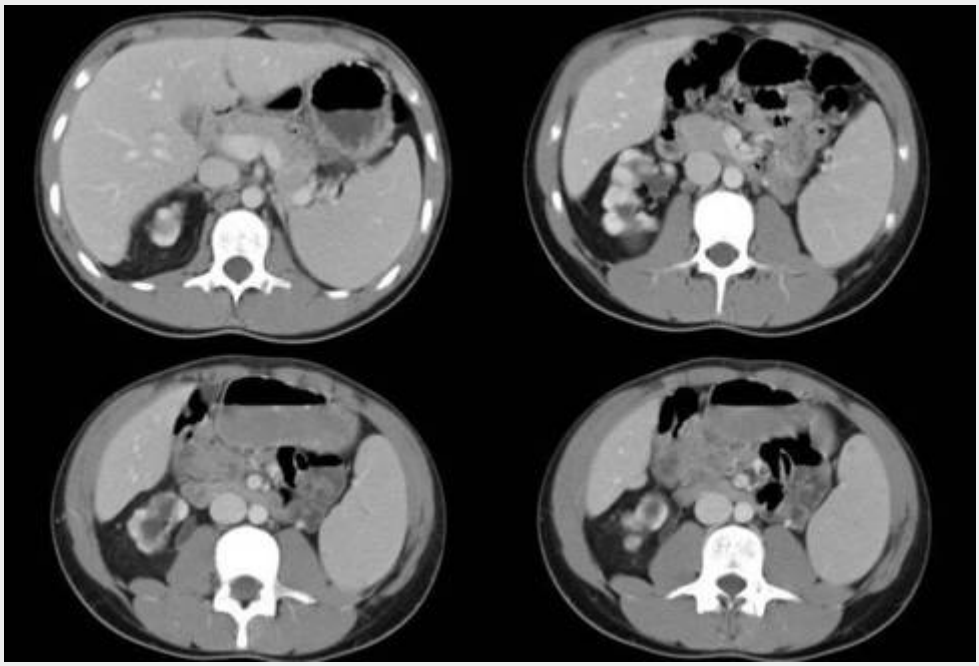
Diffuse lymphomatous infiltration. Axial contrast-enhanced CT shows hepatomegaly due to diffuse hepatic infiltration.

Fig. 5



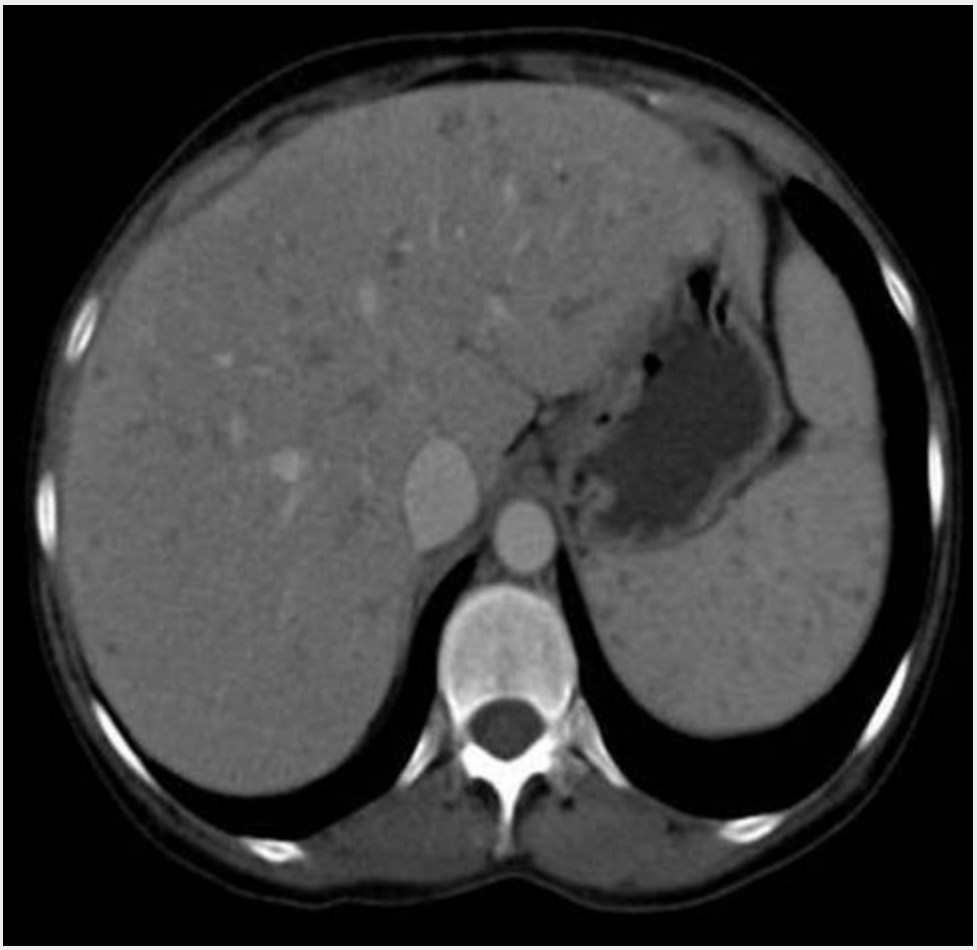
Splenic Lymphoma. Axial contrast-enhanced CT shows heterogeneous spleen, with ill-defined hypoattenuating areas corresponding a lymphomatous infiltration.

Fig. 6



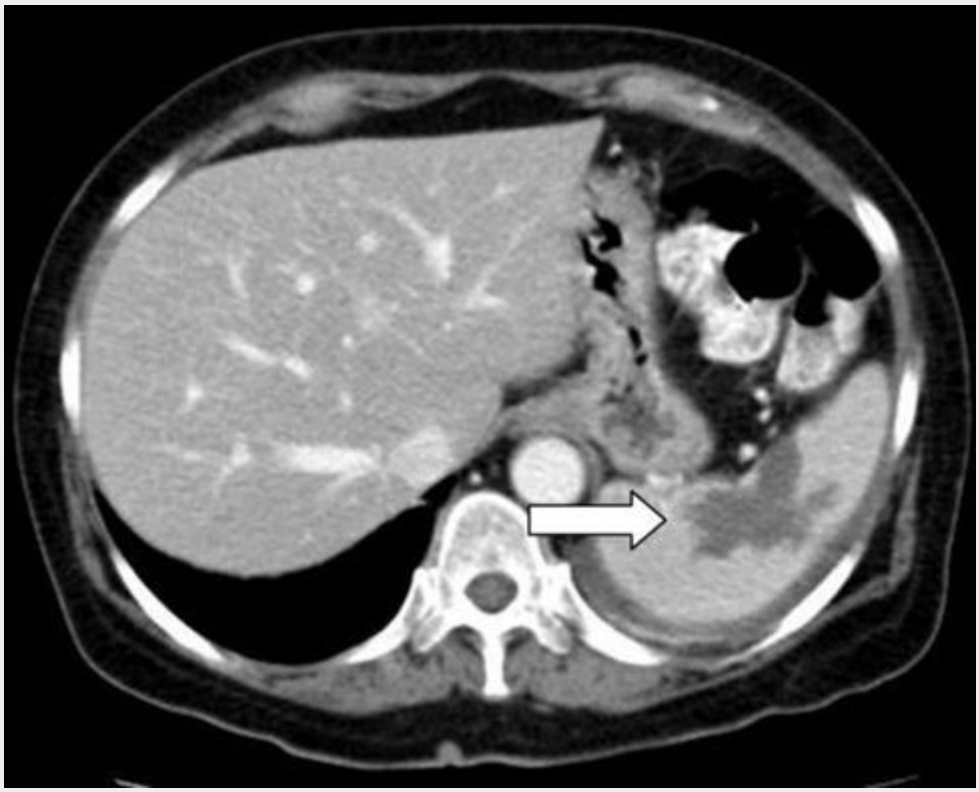
Splenic Lymphoma. Axial contrast-enhanced CT shows homogeneous splenomegaly due to diffuse and uniform infiltration of the spleen.

Fig. 7



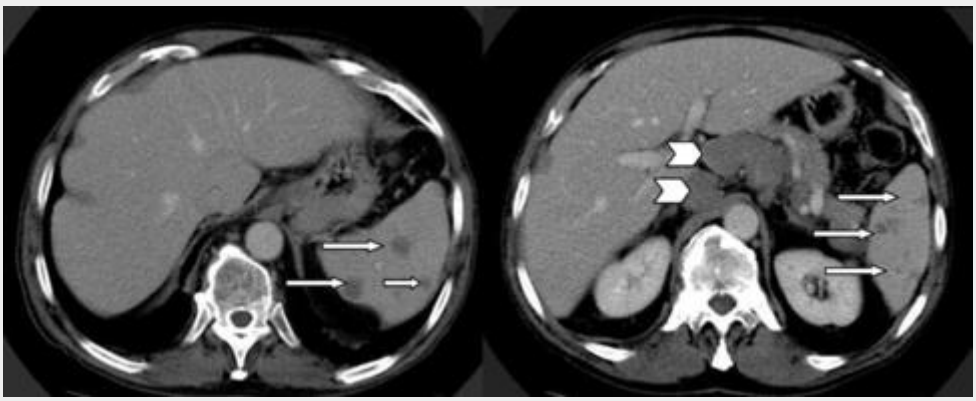
Miliary pattern. Axial contrast-enhanced CT shows splenic and hepatic hypoattenuating multifocal lesions, typically 5-10 mm in diameter.

Fig. 8



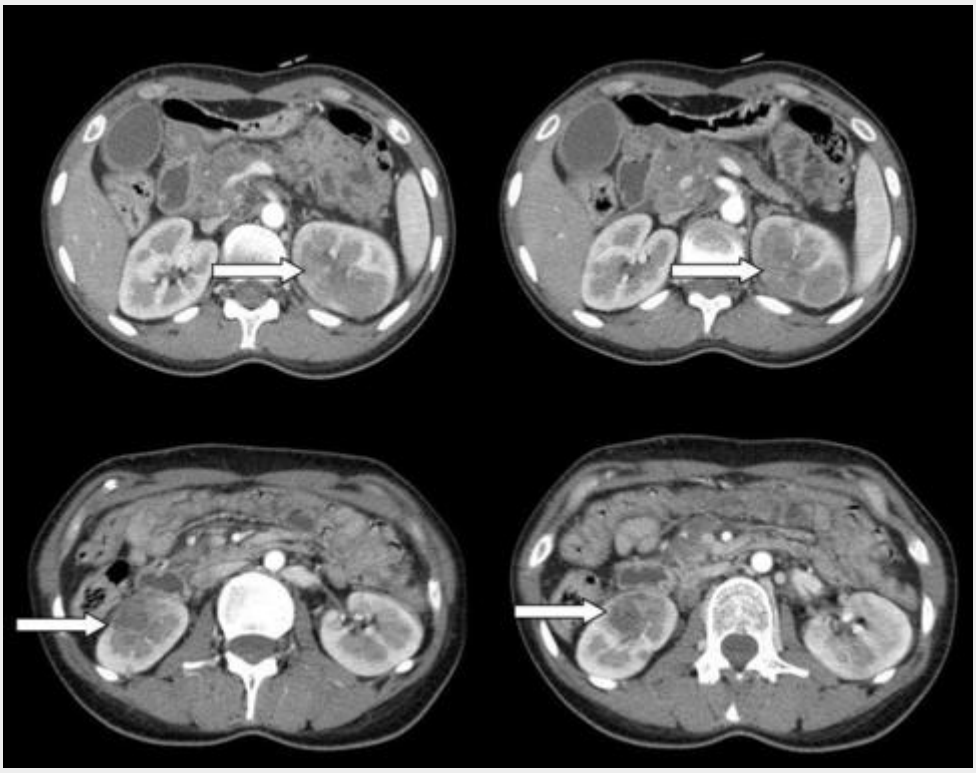
Splenic Lymphoma. Axial contrast-enhanced CT shows a large solitary hypodense nodular splenic lesion with ill-defined margins (arrow).

Fig. 9



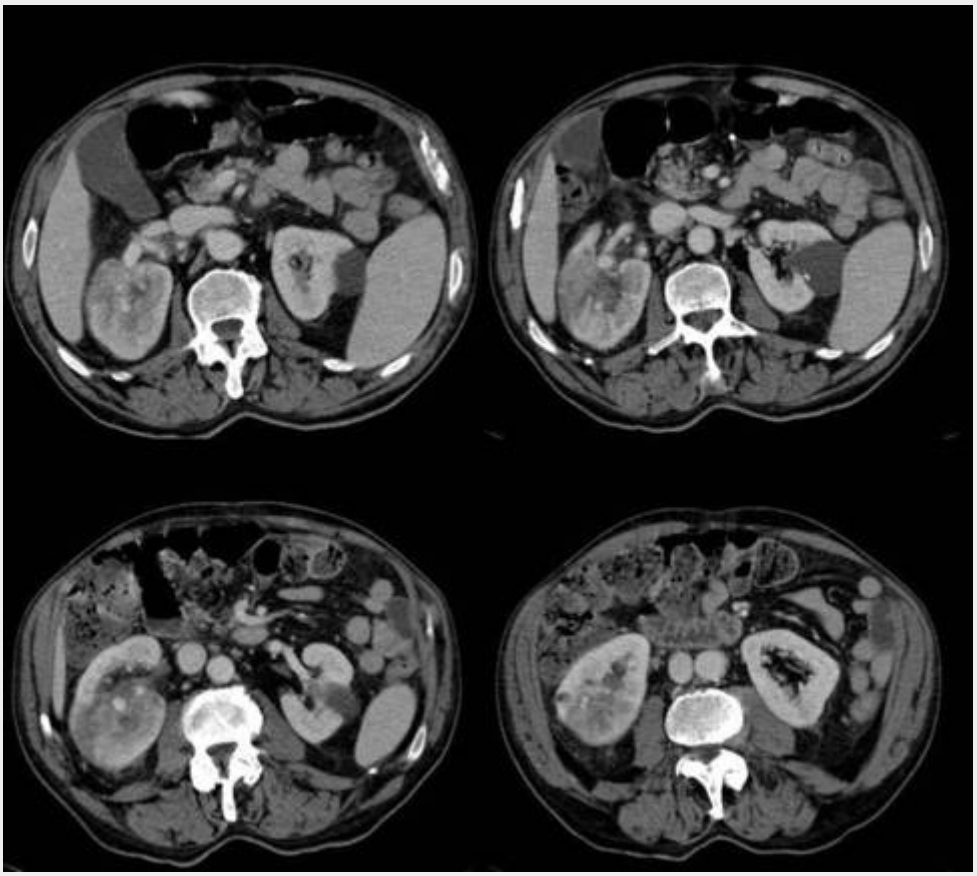
Multinodular splenic lymphoma. Axial contrast-enhanced CT shows multiple hypodense splenic nodules (arrows) and enlarged retroperitoneal adenopathy (arrowheads).

Fig. 10



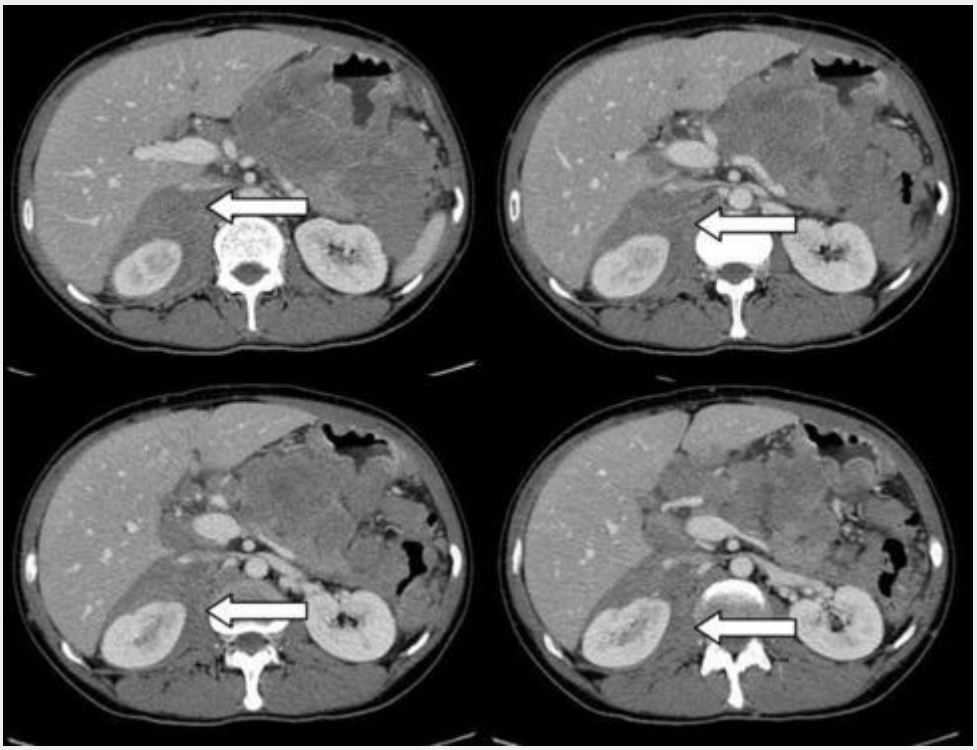
Bilateral multinodular renal involvement. Axial contrast-enhanced CT shows multiple nodules (arrows) in both kidneys, which are poorly marginated, visible only after contrast administration.

Fig. 11



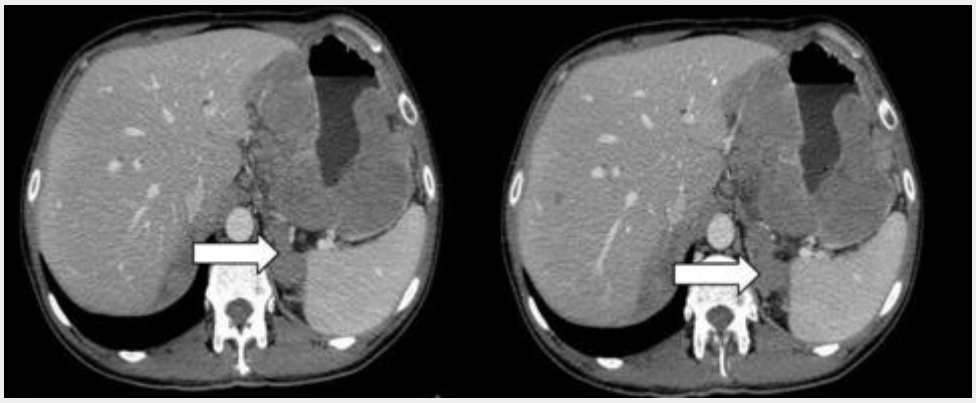
Diffuse lymphomatous infiltration of the right kidney, with no circumscribed mass. Axial contrast-enhanced CT shows a infiltrative, hypodense renal mass (arrows) that enlarges the kidney.

Fig. 12



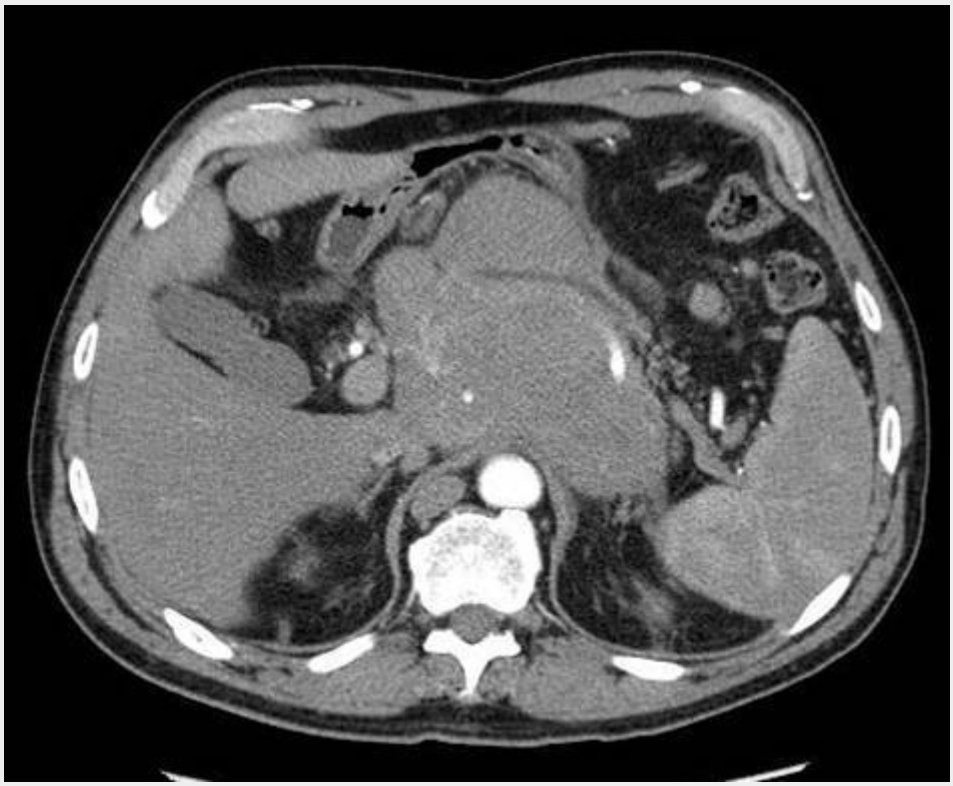
Retroperitoneal lymphoma involving the right kidney. Axial contrast-enhanced CT shows a large, amorphous, predominantly hypoattenuating retroperitoneal mass that surrounds but does not invade the kidney (arrows).

Fig. 13



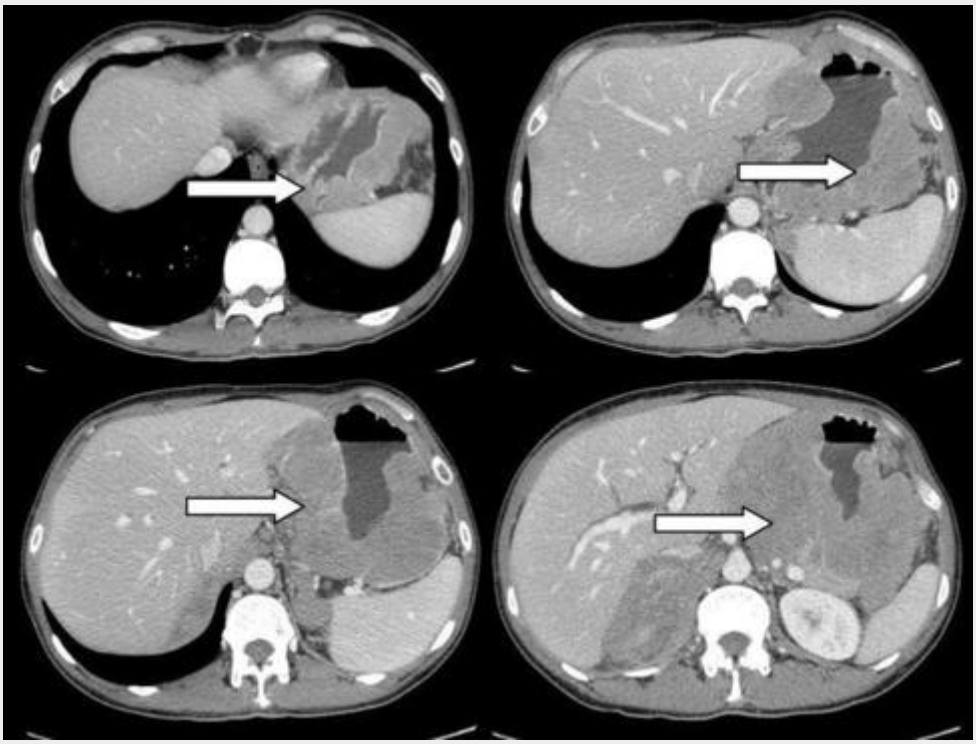
Left Adrenal Lymphoma. Axial contrast-enhanced CT shows development of slightly lobular hypoattenuating adrenal masses (arrows). There is also extensive, circumferential thickening of the gastric wall.

Fig. 14



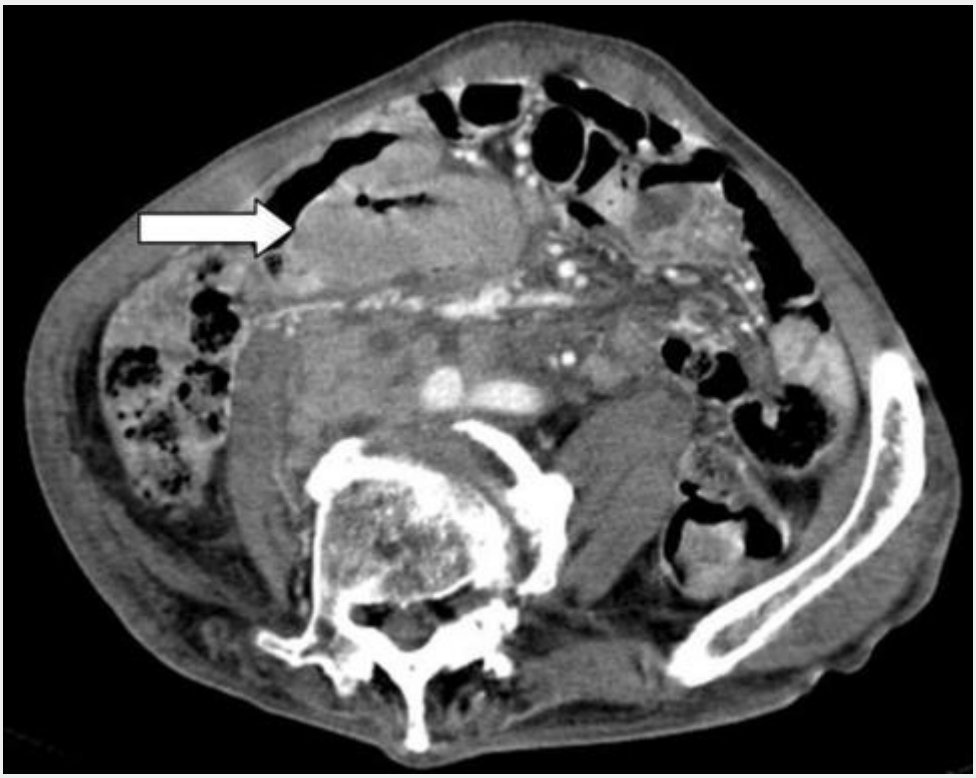
Diffuse pancreatic infiltration by contiguous mesenteric disease. Axial contrast-enhanced CT shows a large rounded mesenteric masse that involve the pancreas.There is moderated dilatation of the duct of Wirsung (arrow).

Fig. 15



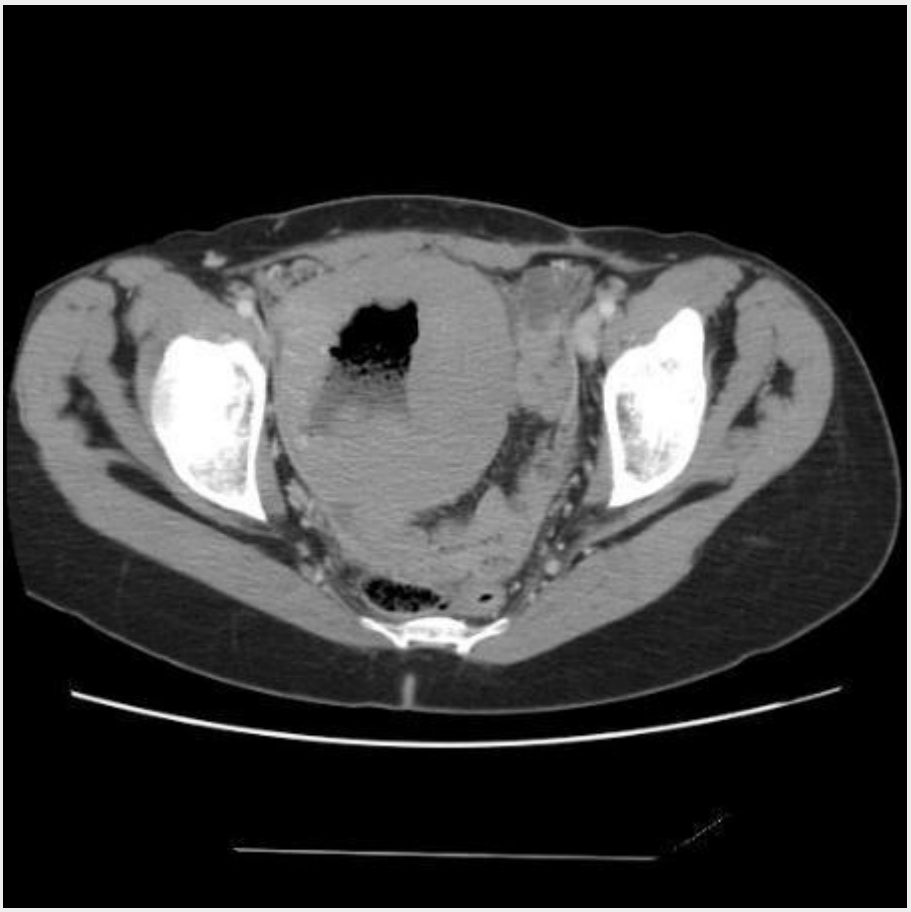
Extensive Gastric Lymphoma. Axial contrast-enhanced CT shows diffuse gastric infiltration, with extensive and circumferential thickening of the gastric wall (arrows).

Fig. 16



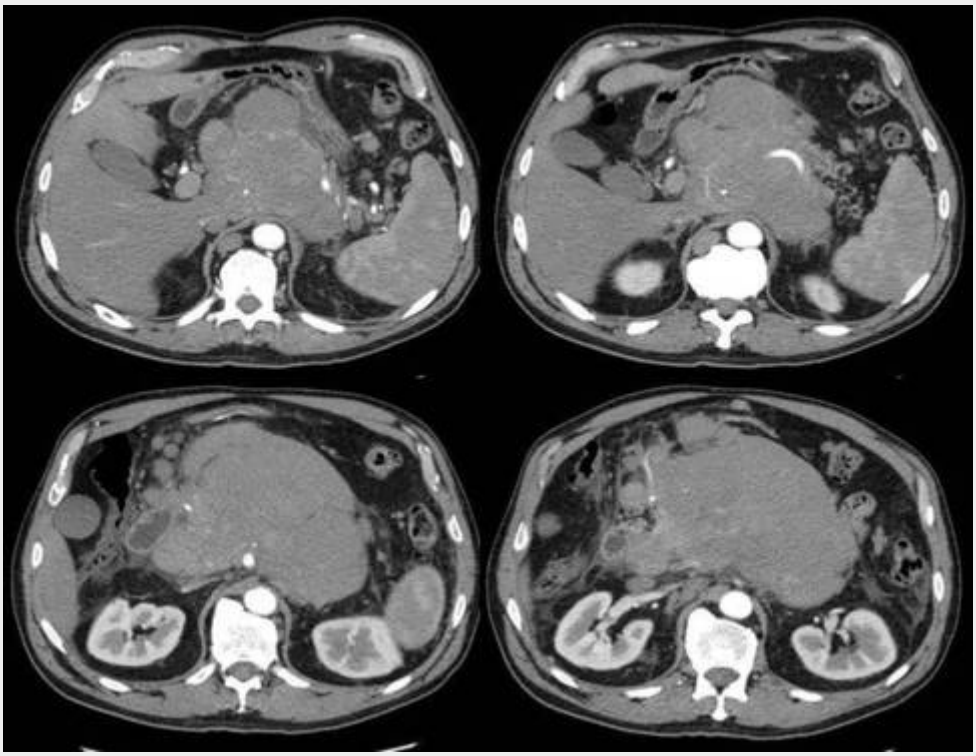
Small Bowel Lymphoma. Axial contrast-enhanced CT shows pronounced circumferential wall thickening of the small bowel (arrow).

Fig. 17



Aneurysmal dilatation of the Small Bowel. Axial contrast-enhanced CT shows pronounced circumferential wall thickening of the small bowel and dilatation of the lumen (arrows).

Fig. 18



Mesenteric Lymphoma. Axial contrast-enhanced CT shows a rounded mesenteric mass that involve the mesenteric vessels and the pancreas.