

Mesenteric Lymph Nodes Seen at Imaging: Causes and Significance¹

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CME FEATURE

See accompanying test at http://www.rsna.org/education/rg_cme.html

LEARNING OBJECTIVES FOR TEST 2

After reading this article and taking the test, the reader will be able to:

- Discuss the reasons why mesenteric lymph nodes seen at imaging may be a normal finding.
- List the causes of mesenteric lymphadenopathy.
- Describe the imaging features characteristic of each cause of mesenteric lymphadenopathy.

With the advent of multidetector computed tomography, routine evaluation of mesenteric lymph nodes is now possible. For the first time, normal mesenteric nodes may be reliably identified noninvasively. Because of the increasing volume of cross-sectional imaging examinations being performed, lymph nodes in the mesentery are being detected with increasing frequency. This is often an unsuspected finding. Although the detected lymph nodes may be normal, there is a large number of disease processes that may lead to mesenteric lymphadenopathy. The most common causes of mesenteric lymphadenopathy are neoplastic, inflammatory, and infectious processes. Many of these causes may also result in lymphadenopathy elsewhere in the body. It is important to recognize mesenteric lymphadenopathy in patients with a history of a primary carcinoma because the lymphadenopathy affects the staging of the disease, which in turn will affect further management. In addition, mesenteric lymphadenopathy may be the only indicator of an underlying inflammatory or infectious process causing abdominal pain. The distribution of the lymph nodes may indicate the exact nature of the underlying disease process, and the correct treatment may then be instituted. Besides neoplastic, inflammatory, and infectious processes, many other disease processes may occasionally result in mesenteric lymphadenopathy.

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Abbreviations: AIDS = acquired immunodeficiency syndrome, HIV = human immunodeficiency virus, MAC = *Mycobacterium avium* complex

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Introduction

With the advent of multidetector computed tomography (CT), routine evaluation of mesenteric lymph nodes is now possible. For the first time, normal mesenteric nodes may be reliably identified noninvasively. With the increasing volume of cross-sectional imaging being performed, lymph nodes in the mesentery are being detected with increasing frequency. This is often an unsuspected finding. In addition to normal lymph nodes, there are a large number of disease processes that may lead to mesenteric lymphadenopathy. This article will describe the pathologic processes that are reflected by mesenteric lymphadenopathy. These include but are not limited to malignancy, inflammation, and infection.

Normal Lymph Nodes

Normal mesenteric lymph nodes may now be routinely identified at the mesenteric root and throughout the mesentery (Fig 1). The reasons for this include the widespread use of multidetector CT for imaging the abdomen and pelvis. This permits routine thin collimation imaging on the order of a few (two to three) millimeters. This results in fewer difficulties with volume averaging. As a result, lymph nodes may be more easily separated from bowel and other structures. Also, with faster scanning times, better opacification of mesenteric vessels is possible. This greatly helps one distinguish between mesenteric lymph nodes and mesenteric vessels, which previously was more challenging.

In addition to the benefits of routine use of multidetector CT for identifying lymph nodes, the routine use of picture archiving and communication systems (PACS), which allow scrolling through images, greatly aids the ability to distinguish lymph nodes from vessels. Vessels appear as tubular structures, identifiable over multiple images. Lymph nodes appear as round or oval soft-tissue masses that appear and disappear over several images. A recent report (1) has shown that mesenteric lymph nodes with a mean maximum

short-axis dimension of 4.6 mm may be seen in the normal mesentery at CT. Given that normal lymph nodes may be identified in the mesentery, it is important not to misdiagnose these nodes as the early manifestation of a lymphoproliferative disorder. Enlarged lymph nodes in the mesentery, however, may have many causes, including but not limited to tumor, inflammation, and infection. In addition, it is important to remember that the size of the nodes alone does not always reflect disease, and the number and distribution of lymph nodes is also important (1).

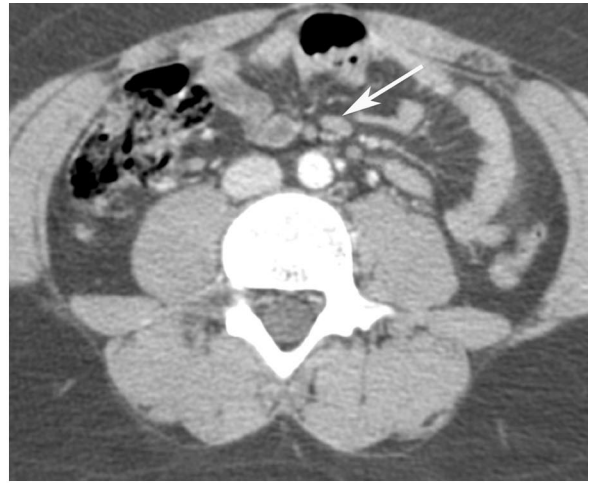
Malignancy

Mesenteric lymphadenopathy may result from metastatic malignancy. Almost any malignancy may produce mesenteric lymphadenopathy, although some malignancies are more commonly associated with this finding. The most common malignancy resulting in mesenteric lymphadenopathy is lymphoma (2). Lymphoma may result in lymphadenopathy almost anywhere in the body. It more frequently results in lymphadenopathy in the chest, retroperitoneum, or superficial lymph nodes chains; however, mesenteric lymphadenopathy is not uncommon. Enlarged nodes may be seen at the mesenteric root, scattered throughout the peripheral mesentery, or in a mixed root-peripheral pattern. Early in the course of the disease, the lymph nodes may be small and discrete. As the disease progresses, the nodes often coalesce, forming a conglomerate soft-tissue mass (Fig 2). Lymphoma is a soft tumor, and extensive mesenteric lymphadenopathy due to lymphoma has a characteristic appearance. The tumor tends to grow around and displace normal anatomic structures that are in the location of the nodal mass, such as vessels or bowel.

Following treatment for lymphoma, calcification may occur in involved mesenteric lymph nodes, as with nodes involved by lymphoma elsewhere. However, calcification is rare prior to treatment, with a prevalence of less than 1%. Mesenteric lymph node involvement by lymphoma is not always associated with lymphomatous involvement of the small or large bowel.



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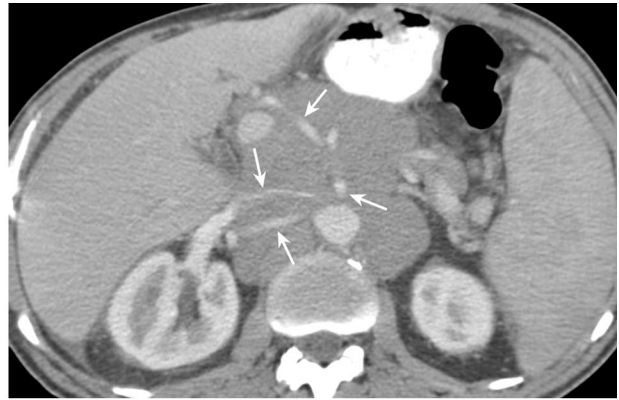


b.

Figure 1. Normal mesenteric nodes in a 17-year-old boy who experienced blunt abdominal trauma. CT images (a obtained at a higher level than b) show normal lymph nodes in the mesentery (arrow).



a.

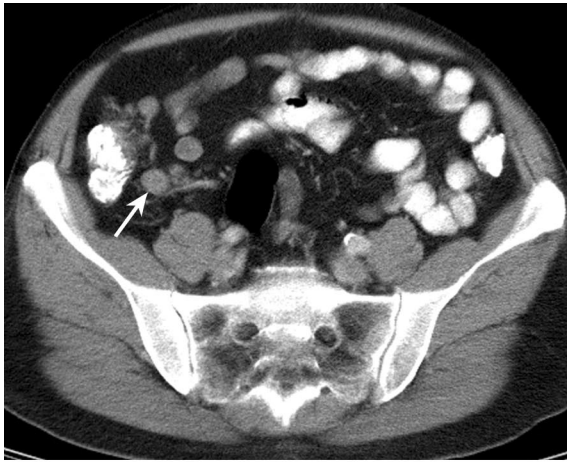


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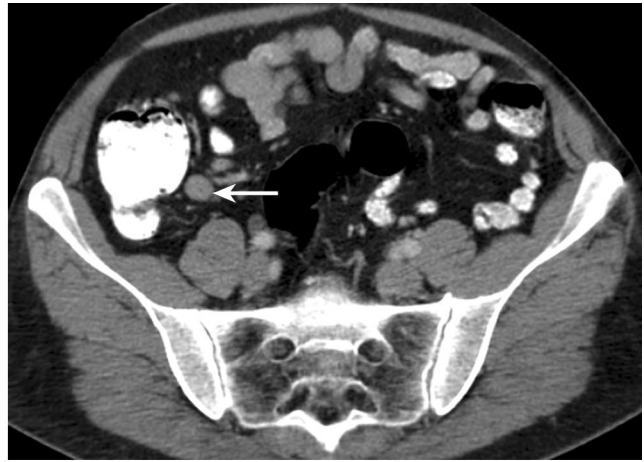


c.

Figure 2. Coalescent nodes in a 42-year-old man with lymphoma. (a) CT image shows a homogeneous conglomerate mass formed by mesenteric and retroperitoneal lymphadenopathy (arrows). (b) CT image shows that the mass surrounds but does not occlude the mesenteric vessels (arrows). (c) CT image shows that the mass displaces bowel loops but does not occlude them (arrows).

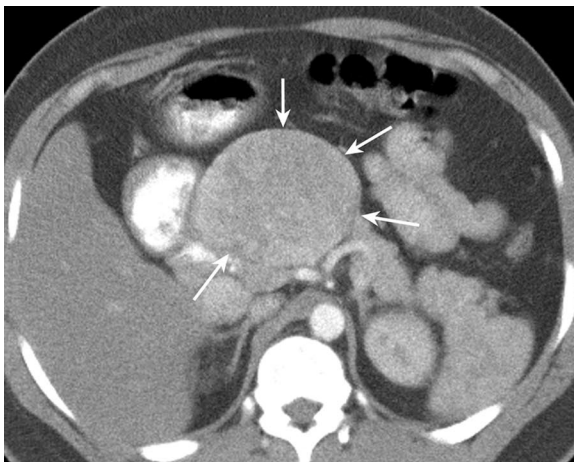


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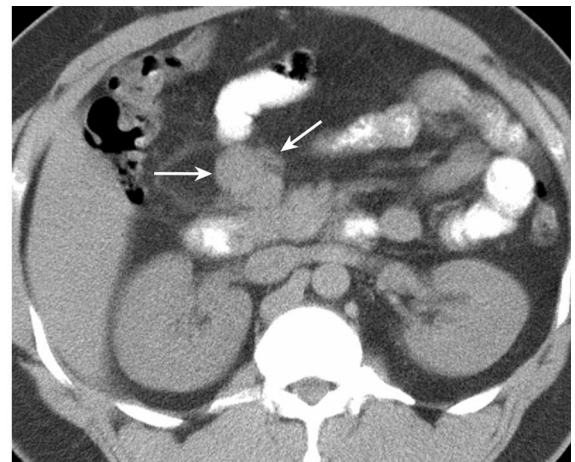


b.

Figure 3. Persistent lymphadenopathy in a 62-year-old woman with lymphoma. (a) CT image shows lymphadenopathy in the mesentery of the right lower quadrant (arrow). (b) Posttreatment CT image obtained 2 years later shows persistent, unchanged lymphadenopathy (arrow). The disease was in remission when this image was obtained.

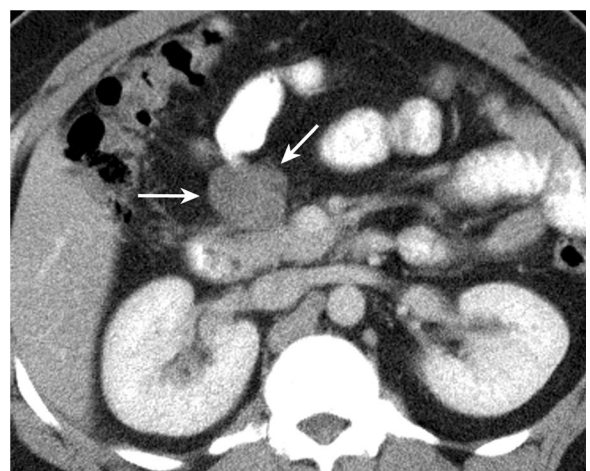


a.



b.

Figure 4. Mesenteric lymphadenopathy in a 38-year-old man with carcinoid tumor. (a) CT image shows a primary soft-tissue mass (arrows). (b) Non-enhanced CT image obtained 1 year later shows recurrence in a mesenteric lymph node (arrows). (c) Contrast-enhanced CT image obtained at the same time as b shows minimal enhancement of the nodal mass (arrows).



c.

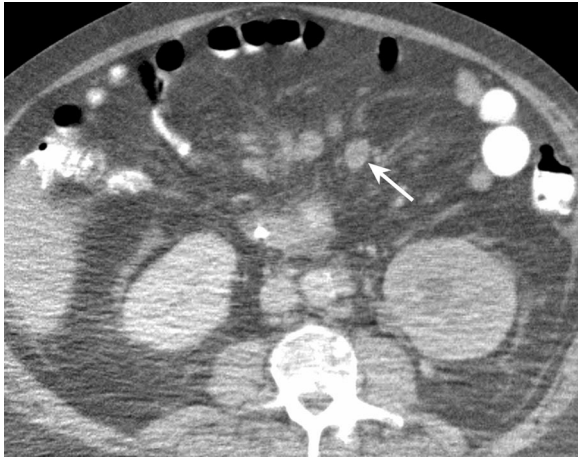
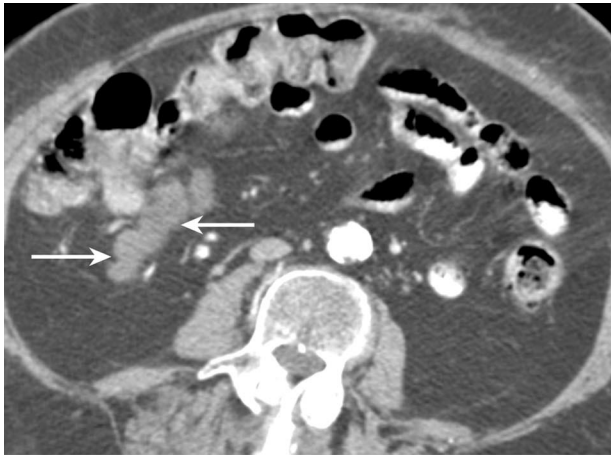
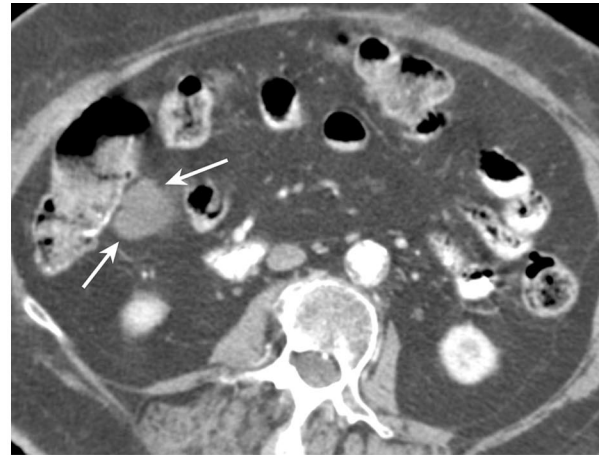


Figure 5. Nodal involvement in a 71-year-old man with esophageal carcinoma. CT image shows extensive mesenteric lymphadenopathy (arrow). The surrounding mesenteric stranding may be related to tumor infiltration or edema.



a.



b.

Figure 6. Nodal involvement in a patient with appendiceal carcinoma. **(a)** CT image shows a soft-tissue mass in the region of the appendix (arrows). **(b)** CT image shows enlarged lymph nodes (arrows) around the mass.

Mesenteric lymph nodes involved by lymphoma usually have an attenuation value close to that of soft tissue. Following intravenous administration of contrast material, these nodes usually demonstrate homogeneous enhancement. On rare occasions, peripheral enhancement may be seen.

Mesenteric lymphadenopathy in patients with lymphoma does not always suggest active disease. Lymphoma with mesenteric lymph node involvement that has been treated may result in persistent lymphadenopathy, with or without calcification (Fig 3). As a result, when one is evaluating the CT scans of patients with previously treated lymphoma with persistent mesenteric lymphadenopathy at imaging, care must be taken to accurately measure the size of the lymph nodes on each CT scan and to compare the scans directly. Evaluating multiple prior CT scans often makes small interval growth more obvious. Any increase in size of the lymph nodes may suggest recrudes-

cent disease; however, enlarged nodes that are not increasing in size should not be mistaken for this.

Primary malignancies that more commonly result in mesenteric lymphadenopathy include carcinoma of the breast (3), lung, pancreas, and gastrointestinal tract (4,5). Carcinoid tumor may also result in mesenteric lymphadenopathy (Fig 4). Most primary malignancies involve local lymph nodes before more distant metastases are detected. Involvement of mesenteric nodes by breast or lung cancer is uncommon in the absence of mediastinal, hilar, or axillary lymphadenopathy but may occur, particularly with small cell lung cancer. Mesenteric lymph nodes are more commonly involved by malignancy of the pancreas or gastrointestinal tract (Figs 5–7). Colonic carcinoma is one of the most common cancers occurring in both men and women. This is frequently

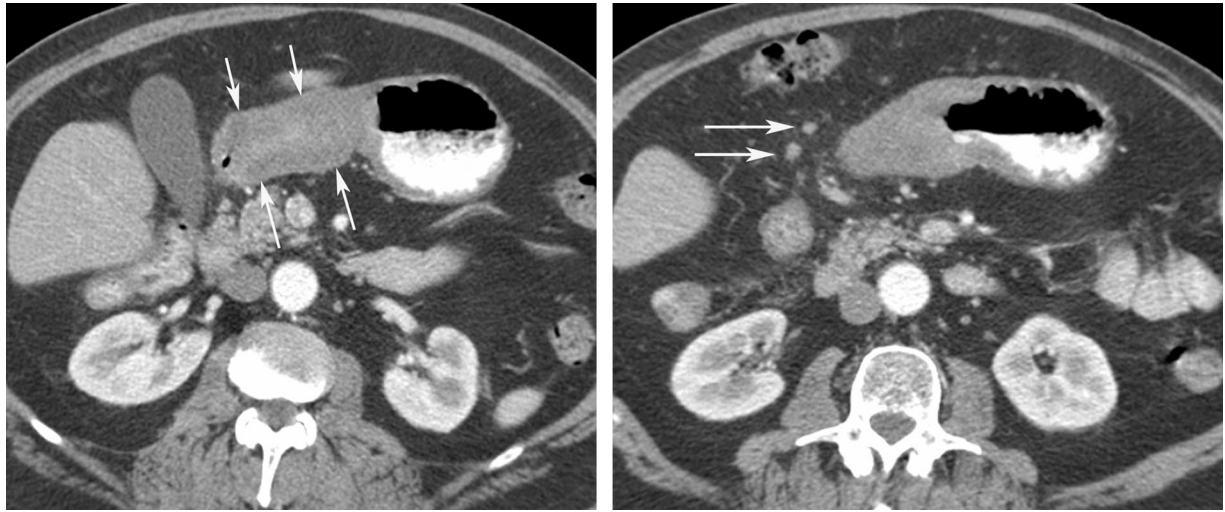


Figure 7. Nodal involvement in a 51-year-old man with gastric carcinoma. **(a)** CT image shows a concentrically thickened gastric antrum (arrows). **(b)** CT image shows small mesenteric lymph nodes (arrows), which contained tumor at resection.

associated with local mesenteric lymphadenopathy (Fig 8). A tumor extending beyond the colonic wall with involvement of local mesenteric lymph nodes is considered a stage C cancer in the Dukes classification, with a decreased 5-year survival rate. Adenocarcinoma of the duodenum and mesenteric small bowel, although less common, is also frequently associated with mesenteric lymphadenopathy. Pancreatic carcinoma also often results in local lymph node spread. This is initially in a retroperitoneal and peripancreatic distribution, but mesenteric lymph node involvement is not infrequent.

Other malignancies that may result in mesenteric lymphadenopathy include malignant melanoma (Fig 9), carcinoma of the bladder, leukemia (Fig 10), and sarcoma arising from the mesentery, gastrointestinal tract, or peritoneum. However, certain primary tumors are rarely associated with mesenteric lymphadenopathy. An example is prostate carcinoma. Enlarged mesenteric nodes in patients with prostate cancer should raise suspicion for an alternative cause, such as lymphoma, since metastatic prostate cancer rarely involves the mesenteric lymph nodes (6).

Kaposi sarcoma, although often thought of as a dermatologic disease, frequently affects both the respiratory and gastrointestinal tracts. Kaposi sarcoma may also lead to lymphadenopathy both at the mesenteric root and throughout the periphery of the mesentery (7). This is frequently extensive, with multiple greatly enlarged lymph nodes often measuring 3–5 cm in short-axis dimension. These enlarged nodes may also coalesce, forming a conglomerate mass of soft-tissue attenuation (Fig 11). Kaposi sarcoma usually occurs in the setting

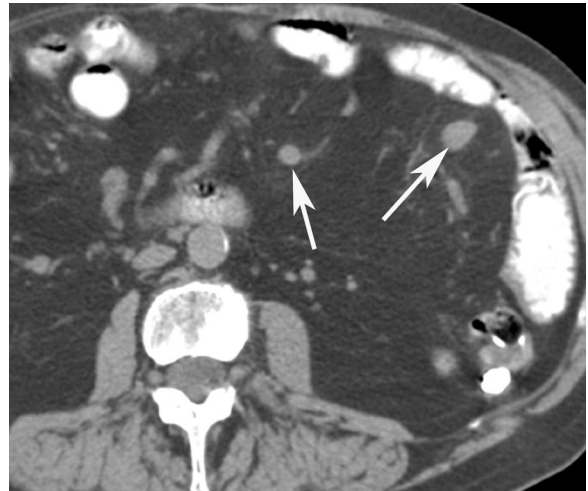
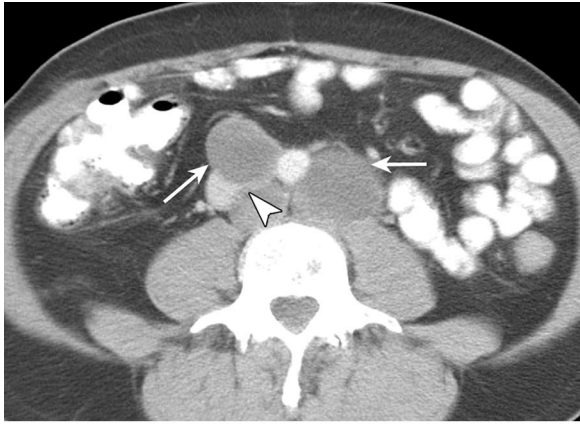


Figure 8. Local lymphadenopathy in a 68-year-old woman with colonic carcinoma. CT image shows mesenteric lymphadenopathy (arrows), which is easily seen against the intraabdominal fat.

of acquired immunodeficiency syndrome (AIDS). Patients with Kaposi sarcoma may have evidence of small bowel disease in addition to mesenteric lymphadenopathy, although this is not always the case. The concomitant presence of small bowel nodules with lymphadenopathy in a patient with AIDS may help distinguish this from other causes of conglomerate mesenteric lymphadenopathy, although these findings may also be seen with lymphoma.

Enlarged mesenteric lymph nodes resulting from malignancy are usually of soft-tissue attenuation and demonstrate homogeneous enhancement following intravenous contrast material administration. However, lymph nodes involved by Kaposi sarcoma have been reported to be hyperattenuating when compared to the iliopsoas

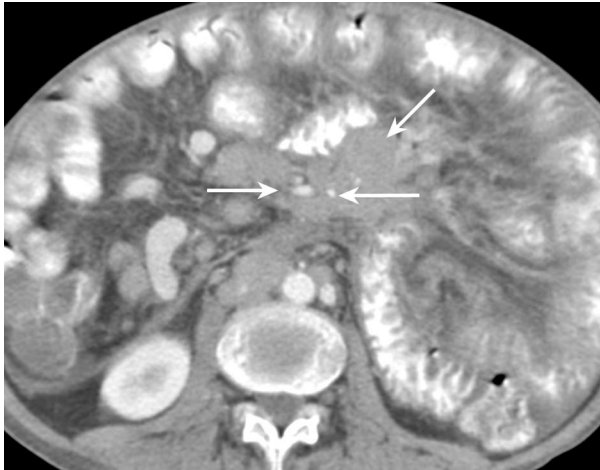


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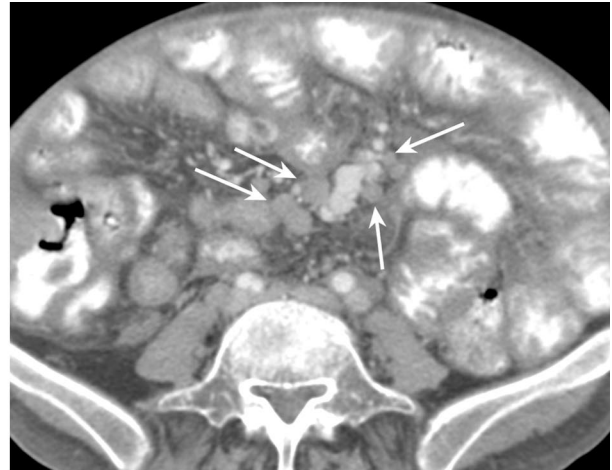


10.

Figures 9, 10. (9) Mesenteric lymphadenopathy in a 54-year-old woman with metastatic malignant melanoma. The patient underwent resection of a skin lesion 4 years earlier. CT image shows low-attenuation lymphadenopathy (arrows). This appearance is not typical of malignant melanoma, which usually has homogeneous soft-tissue attenuation. Note the compression of the inferior vena cava (arrowhead). (10) Mesenteric lymphadenopathy in a 68-year-old patient with chronic lymphatic leukemia. CT image shows extensive bulky lymphadenopathy both at the mesenteric root and throughout the periphery of the mesentery (arrows).



a.



b.

Figure 11. Mesenteric lymphadenopathy in a 38-year-old man with AIDS and Kaposi sarcoma. (a) CT image shows a homogeneous soft-tissue mass formed by mesenteric lymphadenopathy (top arrow). The mass surrounds the mesenteric vessels (bottom arrows) but does not occlude them. (b) CT image shows that the lymphadenopathy may also take the form of discrete masses in the mesentery (arrows).

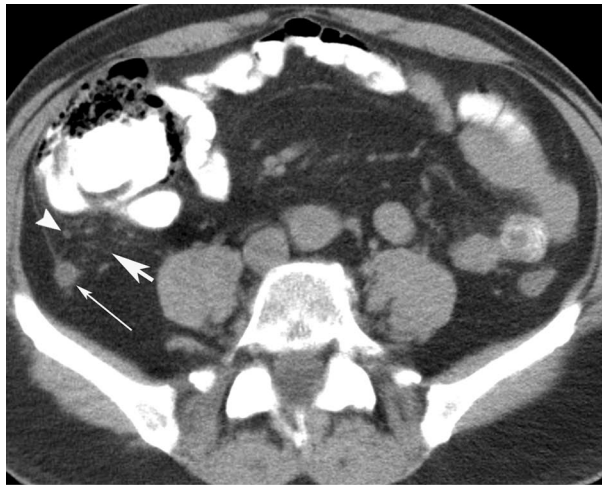
muscle in 68% of patients, isoattenuating in 29%, and hypoattenuating in 3% following intravenous contrast material administration (8). Occasionally, malignant lymph nodes may undergo central necrosis. When this occurs, the nodes are of lower attenuation and may demonstrate peripheral enhancement following intravenous contrast material administration.

Inflammation

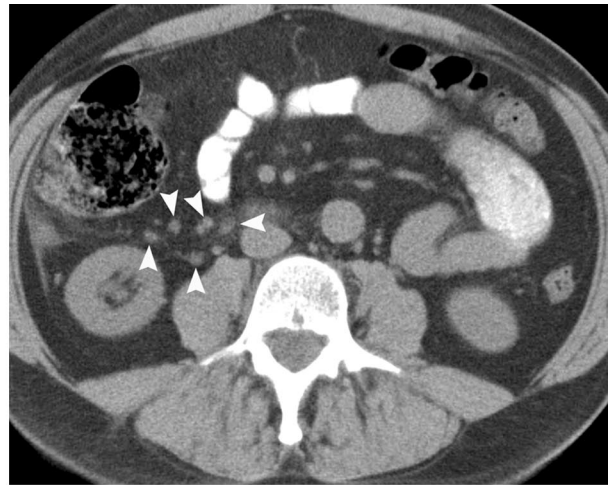
Mesenteric lymphadenopathy may also be secondary to an underlying inflammatory process. This may be either a localized inflammatory dis-

ease process or a systemic inflammatory condition. Local inflammatory causes resulting in mesenteric lymphadenopathy include but are not limited to appendicitis (9), diverticulitis, cholecystitis, and pancreatitis. Mesenteric lymphadenopathy may also occur as part of the inflammatory response following perforation of an abdominal viscus (Fig 12). Indeed, any cause of local mesenteric inflammation may result in mesenteric lymphadenopathy.

Figure 12. Isolated lymphadenopathy in a 72-year-old woman with an unsuspected small bowel perforation, diagnosis of which was delayed. CT image shows isolated mesenteric lymphadenopathy (arrows), which represents an inflammatory response.



a.



b.

Figure 13. Local lymphadenopathy due to appendicitis. **(a)** CT image of a 28-year-old woman with acute appendicitis shows a thickened appendix (long arrow). Lymph nodes are present in the mesentery of the right lower quadrant (arrowhead) along with stranding of the mesenteric fat (short arrow), which reflects the inflammatory process. **(b)** CT image of a 24-year-old woman with acute appendicitis shows multiple lymph nodes in the mesentery of the right lower quadrant (arrowheads).

Appendicitis is frequently associated with lymphadenopathy, most commonly in the mesentery of the right lower quadrant (Fig 13). Although lymph nodes may be identified in the mesentery of the right lower quadrant in the normal patient population (Fig 14), these are usually small and few in number (1). Multiple enlarged right lower quadrant lymph nodes in the presence of an abnormal appendix help confirm the diagnosis of appendicitis, although lymphadenopathy does not have to be present to make the diagnosis. Appendiceal carcinoma is a rare entity but may have similar manifestations to those of acute appendicitis if the appendix becomes perforated. However, there is usually a soft-tissue mass involving the appendix with appendiceal carcinoma

as opposed to an inflamed distended appendix with acute appendicitis. The associated lymphadenopathy with carcinoma is usually larger, and there is often less inflammatory change in the surrounding mesentery.

The presence of enlarged lymph nodes in the mesentery of the right lower quadrant with a normal-appearing appendix may reflect mesenteric adenitis in the correct clinical setting (10).

Mesenteric lymphadenopathy may also be seen in cases of diverticulitis. The enlarged nodes are usually identified close to the area of inflamed colon. These reactive nodes associated with diverticulitis are generally small; however, as diverticulitis may mimic perforated colonic carcinoma, the presence of enlarged lymph nodes adjacent to an area of diverticulitis is not specific to diverticulitis, and an underlying carcinoma may still be present (5).

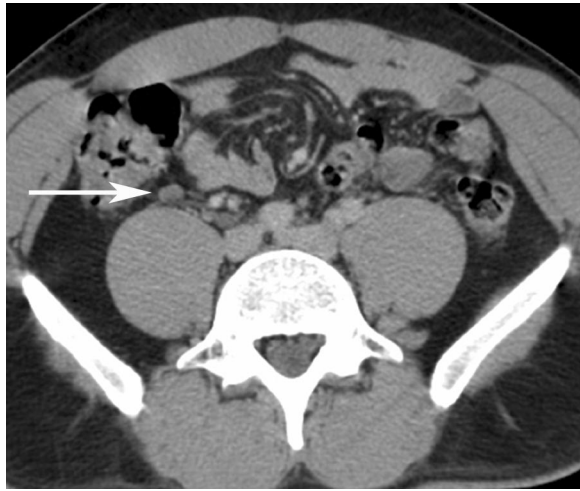


Figure 14. Normal mesenteric node in a 32-year-old man who experienced blunt abdominal trauma. CT image shows a normal lymph node in the mesentery of the right lower quadrant (arrow). The results of the CT study were otherwise unremarkable.

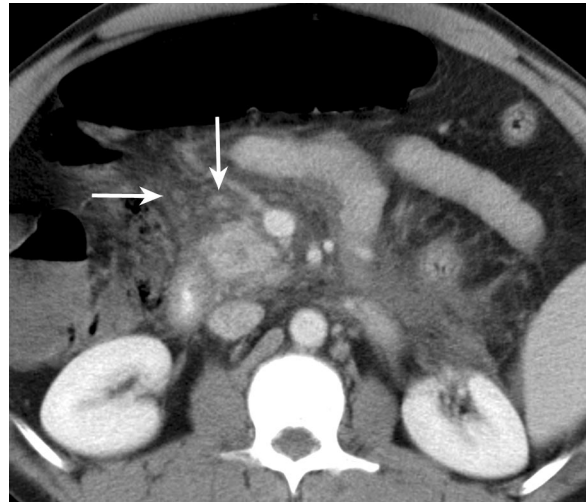
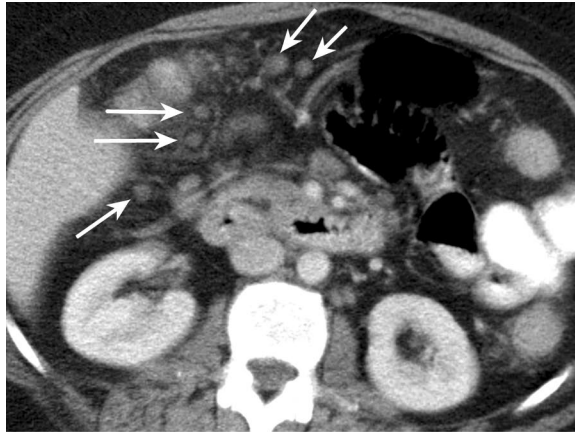
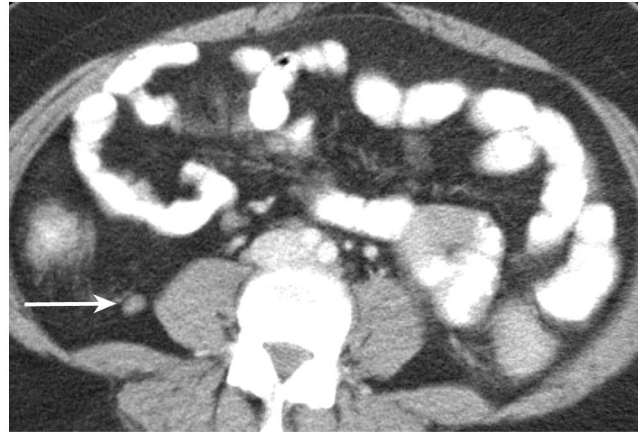


Figure 15. Mesenteric lymphadenopathy in a 48-year-old woman with acute pancreatitis. CT image shows mesenteric lymph nodes (arrows). There is extensive inflammatory stranding throughout the mesentery.



16a.



16b.



17.

Figures 16, 17. (16) Mesenteric lymphadenopathy in a 40-year-old man with Crohn disease. CT images show lymphadenopathy throughout the periphery of the mesentery (arrows in **a**) and in the mesentery of the right lower quadrant (arrow in **b**). (17) Mesenteric lymphadenopathy in a 33-year-old woman with Crohn disease. CT image shows lymphadenopathy at the mesenteric root (arrows).

As with pancreatic carcinoma, in cases of pancreatitis, the retroperitoneal or peripancreatic nodes are often enlarged. However, pancreatitis may also result in mesenteric lymphadenopathy, as the inflam-

mation associated with pancreatitis may be extensive and involve any location within the abdomen and pelvis (Fig 15). Acute cholecystitis may also result in local reactive lymphadenopathy.

Mesenteric lymphadenopathy is commonly found in patients with inflammatory bowel disease, both Crohn disease and ulcerative colitis (11,12), although it is more commonly seen with Crohn disease. The lymph nodes may be found at the mesenteric root, the mesenteric periphery, or the right lower quadrant (Figs 16, 17). Inflammatory changes in the small or large bowel are usually but not always present. The lymph nodes

may usually be described as large or prominent, but rarely does massive lymphadenopathy occur. The nodes are of soft-tissue attenuation and demonstrate homogeneous enhancement following intravenous contrast material administration.

Mesenteric panniculitis is a nonspecific inflammatory and fibrotic process affecting the fatty tissue of the mesentery (13). Most cases are idiopathic. Criteria for the diagnosis require exclusion of pancreatitis, inflammatory bowel disease, and extraabdominal fat necrosis. Symptoms are variable and include abdominal pain, fever, nausea, vomiting, and weight loss. The appearance of the lesion can range from a well-defined soft-tissue mass to ill-defined areas of higher attenuation in the mesenteric fat related to inflammation and fibrosis. Local mesenteric lymphadenopathy is also often present in cases of mesenteric panniculitis (Figs 18, 19). These findings are nonspecific, and the differential diagnosis includes carcinoma, lymphoma, carcinoid tumor, and desmoid tumor. Mesenteric edema of any cause may result in the appearance of increased attenuation in the mesenteric fat; however, in cases of mesenteric edema, this is not usually accompanied by mesenteric lymphadenopathy. The “fat halo” sign, a rim of preserved fat around the adjacent vessels, has been reported to differentiate mesenteric panniculitis from malignant causes with similar CT findings (14). The spectrum of disease of mesenteric panniculitis is wide and varies from minor abdominal pain to severe unremitting disease that may cause vessel occlusion or necessitate resection. Occasionally, simultaneous colonic resection may be required at the time of surgical excision, as the inflammatory mass may be intimately related to vessels or colon.

Connective tissue diseases including systemic lupus erythematosus, systemic sclerosis, or rheumatoid arthritis may result in mesenteric lymphadenopathy (15–17) (Fig 20). Diffuse lymphadenopathy is associated with all of the connective tissue disorders. Mesenteric lymphadenopathy is seldom the only manifestation of lymph node involvement and is not identified unless CT or magnetic resonance imaging is performed. In these cases, the lymphadenopathy is



Figure 18. Mesenteric lymphadenopathy in a 43-year-old man who presented with abdominal pain. CT image shows multiple enlarged lymph nodes in the mesentery (arrows). Note the inflammatory changes in the surrounding mesentery (arrowhead). This finding represents mesenteric panniculitis.

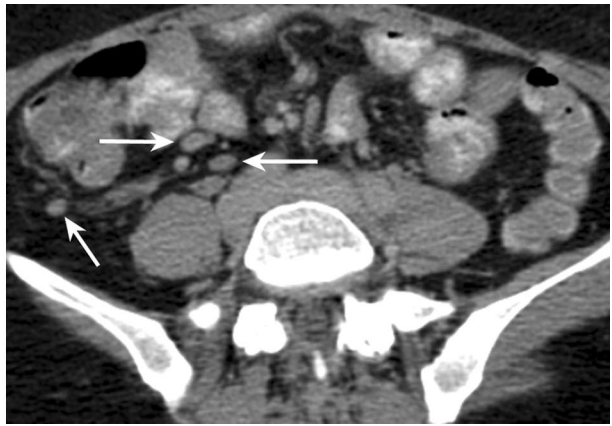


Figure 19. Mesenteric lymphadenopathy in a 34-year-old woman with mesenteric panniculitis. CT image shows lymph nodes with increased mesenteric attenuation (arrows).

rarely massive, with lymph nodes seldom being greater than 2 cm in short-axis dimension. The lymph nodes may be present either at the mesenteric root, scattered throughout the mesenteric periphery, or both. Lymphadenopathy is usually present at multiple sites in these patients and may also be found in the retroperitoneum, thorax, neck, axilla, or inguinal regions. Lymphadenopa-



a.



b.

Figure 20. Mesenteric lymphadenopathy in a 44-year-old woman with systemic lupus erythematosus. CT images (a obtained at a higher level than b) show multiple enlarged lymph nodes throughout the mesentery (arrows).



Figure 21. Mesenteric lymphadenopathy in a 40-year-old man with a history of sarcoidosis who presented with nonspecific abdominal pain. CT image shows multiple enlarged lymph nodes at the splenic hilum (arrows).

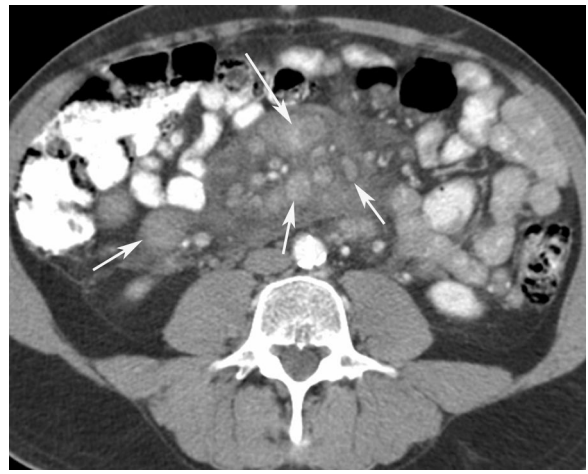


Figure 22. CT image of a 40-year-old man with a long history of primary amyloidosis shows mesenteric lymphadenopathy (arrows).

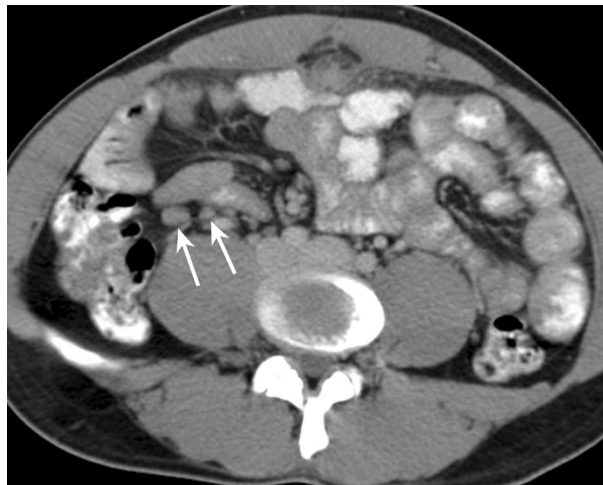
thy in patients with connective tissue diseases does not tend to cavitate, and as a result, these nodes are of uniform soft-tissue attenuation and demonstrate homogeneous enhancement following intravenous contrast material administration.

There are many other inflammatory conditions that have been reported to result in mesenteric lymphadenopathy. There include primary biliary cirrhosis (18), sarcoidosis (19) (Fig 21), amyloidosis (Fig 22), mastocytosis (20), and Henoch-Schönlein purpura (21). In all of these conditions, mesenteric lymphadenopathy is seldom the only manifestation of the disease process and is

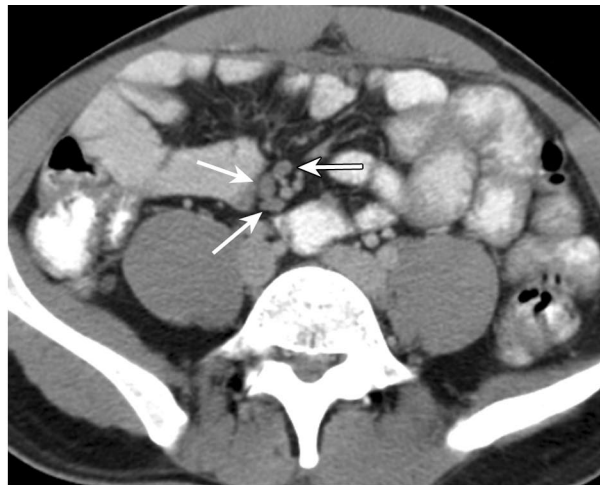
rarely the presenting feature. The importance of understanding the association between these conditions and mesenteric lymphadenopathy lies primarily in recognizing that the lymphadenopathy is likely due to the underlying disease and is not an early manifestation of a lymphoproliferative disorder.

Infection

As with lymph nodes elsewhere, infection may result in mesenteric lymphadenopathy. The infection may be local or systemic. Mesenteric adenitis

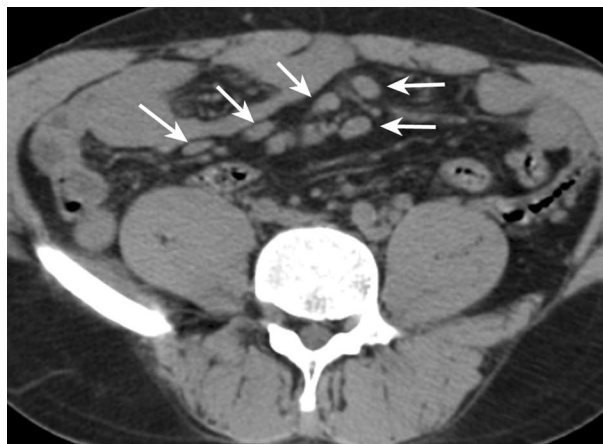


a.



b.

Figure 23. Mesenteric lymphadenopathy in a 28-year-old man who presented with acute abdominal pain. CT images show innumerable lymph nodes in the mesentery of the right lower quadrant (arrows in **a**) and at the mesenteric root (arrows in **b**). The CT findings were otherwise unremarkable. This appearance represents mesenteric adenitis.



a.



b.

Figure 24. Mesenteric lymphadenopathy in a 28-year-old man with HIV infection. The patient presented with flank pain, and the CT study was performed as a renal stone protocol with the patient prone. **(a)** CT image shows multiple lymph nodes scattered throughout the mesentery (arrows). **(b)** CT image obtained 15 months later for evaluation of abdominal pain shows that the enlarged lymph nodes have resolved.

reflects the mesenteric lymph node response to an underlying infection of uncertain etiology, usually viral (10,22). Traditionally, this was identified more commonly in the pediatric population. With multidetector CT, this is being identified in adults with increasing frequency (Fig 23). The diagnosis is made by identifying mesenteric lymphadenopathy in the absence of an underlying

cause in the setting of abdominal pain, malaise, lethargy, and sometimes fever. When associated with gastrointestinal symptoms and CT changes in the small bowel consisting of minimal dilatation with excessive small bowel fluid, mesenteric lymphadenopathy may reflect gastroenteritis.

Infection with *Yersinia enterocolitica* may result in changes in the region of the terminal ileum that resemble those of Crohn disease. In addition to the changes in the small bowel, mesenteric lymphadenopathy has also been reported (23).

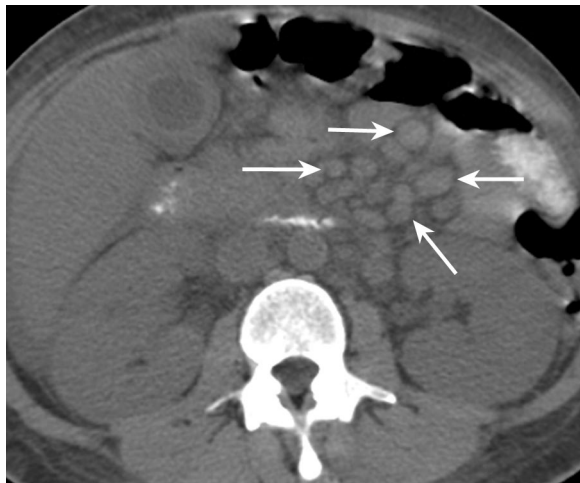


Figure 25. Mesenteric lymphadenopathy in a 39-year-old man with HIV and MAC infection. CT image shows extensive mesenteric lymphadenopathy of uniform soft-tissue attenuation (arrows). The lymph nodes are discrete with no formation of a conglomerate mass and no displacement of vessels or intestine.

Bowel wall thickening in the right lower quadrant along with adjacent mesenteric lymphadenopathy are characteristic of *Yersinia* infection; although uncommon, it should be considered in patients presenting with right lower quadrant pain. The clinical scenario and radiologic findings are similar to those of acute appendicitis, and thus a high level of clinical suspicion is required to diagnose this entity.

Infection with the human immunodeficiency virus (HIV) may produce isolated lymphadenopathy. This may result from direct infection by the virus or from secondary infection (24). Mesenteric lymphadenopathy in patients with HIV is far more likely to result from an opportunistic infection or even an underlying malignancy than to be caused by direct viral infection. When the cause is direct HIV infection, the lymph nodes are enlarged but not massively so (Fig 24). There is a host of opportunistic infections that may result in mesenteric lymphadenopathy. A not uncommonly identified cause in patients with a CD4 cell count of 50/mL or less is *Mycobacterium avium* complex (MAC). Mesenteric lymphadenopathy is seldom the presenting feature of HIV infection; however, up to 30% of patients with HIV will develop MAC infection and up to 42% of these patients will develop mesenteric lymphadenopathy (25). Mesenteric lymphadenopathy in patients with MAC is frequently massive (Figs 25, 26),



Figure 26. Mesenteric lymphadenopathy in a 34-year-old woman with HIV and MAC infection. CT image shows multiple discrete mesenteric lymph nodes (arrows), all of which have uniform soft-tissue attenuation.

particularly in long-standing disease, with the nodes forming a conglomerate mass. Although more typically thought of as hypoattenuating lymph nodes, 80% of nodes infected with MAC are of homogeneous soft-tissue attenuation. The remaining 20% are of low central attenuation. MAC infection should always be considered in patients with HIV with mesenteric lymphadenopathy (25,26).

Tuberculosis is a chronic granulomatous disease that has a myriad of presenting features (27). Almost any organ in the body, including the abdominal cavity, may be affected by tuberculosis. The imaging findings of tuberculous peritonitis have been well described (28,29). Tuberculous infection may result in mesenteric lymphadenopathy. Lymph nodes infected with tuberculosis frequently have different CT characteristics than lymph nodes that are enlarged secondary to malignancy, inflammation, or other infective agents. Tuberculous lymph nodes generally have a lower attenuation value, closer to that of fluid or fat, than malignant or inflammatory nodes. In addition, tuberculous nodes tend to demonstrate peripheral enhancement following intravenous contrast material administration (30). Malignant and inflammatory lymph nodes generally demonstrate homogeneous enhancement. Tuberculous

disease may result in mesenteric lymphadenopathy alone; however, in patients with gastrointestinal tuberculous infection, there is frequently mesenteric lymphadenopathy present.

Other causes of mesenteric lymphadenopathy that characteristically demonstrate central low attenuation at CT are Whipple disease (31) and the cavitating mesenteric lymph node syndrome of celiac disease (32,33). Whipple disease is a systemic bacterial infection. The causative organism is *Tropheryma whippelii*. Lymph nodes affected in Whipple disease have a high fat content and this is responsible for the low CT attenuation value, usually between 10 and 20 HU. The lymphadenopathy responds to antibiotic therapy, and response to treatment may be evaluated with serial CT. The lymphadenopathy associated with the cavitating mesenteric lymph node syndrome of celiac disease also has a low CT attenuation value. However, these lymph nodes are truly cavitating nodes. These nodes regress when the underlying celiac disease is treated with a gluten-free diet. In cases of celiac disease, the distinction between the CT appearances of the mesenteric lymphadenopathy is important, as celiac disease is also associated with a higher incidence of lymphoma. Mesenteric lymphadenopathy in patients with celiac disease always raises concern about the development of lymphoma, and the cavitating appearance of the nodes leads to the correct and treatable diagnosis.

Mesenteric lymphadenopathy has also been reported in up to one-third of patients with familial Mediterranean fever during an acute abdominal attack (34). Mesenteric lymph node involvement has also been reported in association with Castleman disease (35).

Conclusions

With use of multidetector CT, lymph nodes are frequently identified in the mesentery. These may be a normal finding. Mesenteric lymphadenopathy has a myriad of causes. These most com-

monly include tumor, inflammation, and infection, but there is a wide differential diagnosis. The appearance, distribution, and enhancement pattern of the lymph nodes may give an indication of the underlying pathologic condition.

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