

Imaging for abdominal involvement in amyloidosis

H. Nursun Özcan
Mithat Haliloğlu
Cenk Sökmensüer
Deniz Akata
Mustafa Özmen
Muşturay Karçaaltıncaba

ABSTRACT

Involvement of the abdominal organs has variable presentations mostly without specific findings. The objective of this pictorial essay was to illustrate the computed tomography and magnetic resonance imaging (MRI) findings of abdominal involvement in systemic amyloidosis. Heterogeneous appearance of the liver, periportal involvement, diffuse low signal intensity of spleen on T2-weighted MRI, and thickened bowel wall may be helpful imaging findings when accompanied by presence or history of chronic inflammatory disease and clinical suspicion for amyloidosis.

Amyloidosis is a collection of pathophysiologically related diseases caused by extracellular deposition of abnormal fibrillary proteins called amyloid. Pathologic examination establishes the diagnosis with demonstration of Congo red positive substance with apple green birefringence (1). A wide variety of clinical syndromes emerge with occurrence of organ dysfunction that happens as a result of compression and displacement of normal tissue by progressive accumulation of amyloid (2). Amyloidosis is mostly presented in systemic form; however, 10%–20% of presentations are localized (3). Systemic amyloidosis is generally classified in two main forms according to the biochemical structure of the amyloid fibrils; primary amyloidosis (AL-amyloidosis) and secondary amyloidosis (AA-amyloidosis). AL-amyloidosis is associated with B-cell dyscrasia, particularly multiple myeloma and monoclonal gammopathy. AA-amyloidosis is caused by chronic infection or inflammation, including, osteomyelitis, tuberculosis, pyelonephritis, rheumatoid arthritis, and neoplastic disorders (4).

In the literature, there are very few studies describing the imaging findings of abdominal manifestations of amyloidosis (5–7) and they comprise mostly barium studies and ultrasonography (US) and few computed tomography (CT) examinations (2–6). In this study we aimed to review abdominal amyloidosis imaging findings as regards CT and magnetic resonance imaging (MRI).

Radiologic features

Radiologic findings of abdominal involvement in systemic amyloidosis are nonspecific and can present in a variety of ways. Heterogeneous appearance of liver, periportal involvement, diffuse low signal intensity of spleen on T2-weighted images and thickened bowel wall can be helpful if accompanied by history of chronic inflammatory disease and clinical suspicion for amyloidosis.

Hepatic involvement typically results in organ enlargement with abnormal liver function tests. Amyloid can accumulate in the hepatic parenchyma throughout the sinusoids or in vessel walls (Fig. 1) (8). On US, hepatic involvement of amyloidosis has nonspecific findings such as, heterogeneous echogenicity, diffuse or focal areas of decreased parenchymal attenuation (Fig. 1). The most important CT and MRI findings of hepatic involvement in systemic amyloidosis are hepatomegaly, heterogeneous appearance of liver (Figs. 1, 2) and periportal involvement (Fig. 1). Periportal involvement is seen as low signal intensity on T1-weighted and T2-weighted images. Diffuse low signal intensity on T2-weighted images can be an indication of diffuse involvement of hepatic amyloidosis (Fig. 3). It has been

From the Department of Radiology, Liver Imaging Team (H.N.Ö., M.H., D.A., M.Ö., M.K. ✉ musturayk@yahoo.com) and the Department of Pathology (C.S.), Hacettepe University School of Medicine, Ankara, Turkey.

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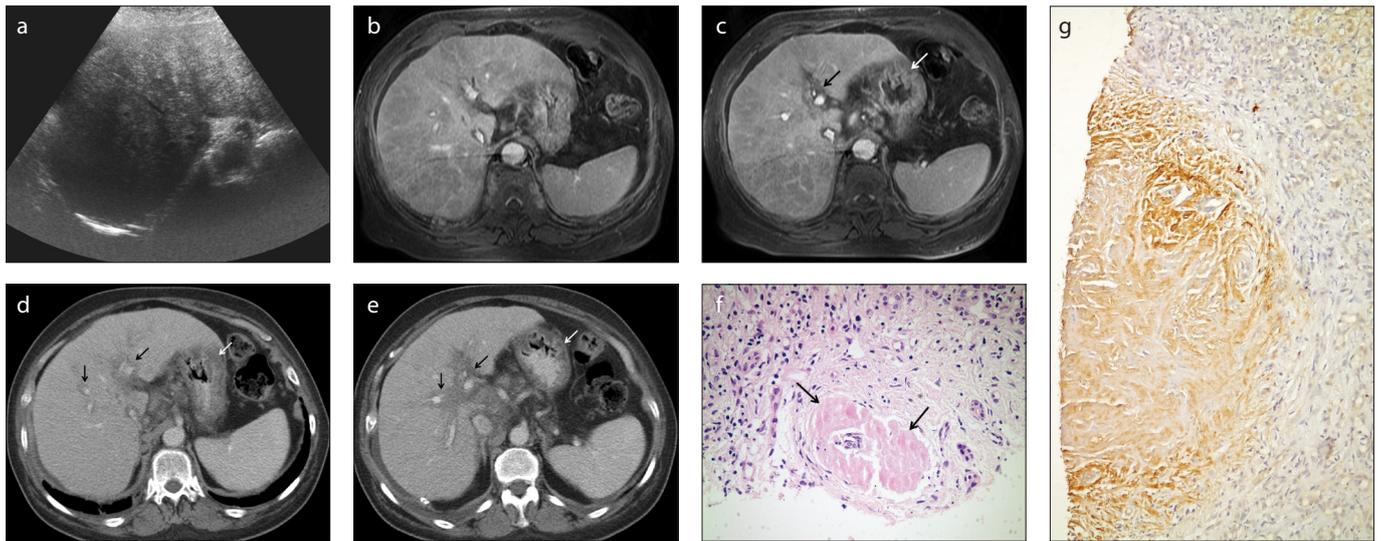


Figure 1. a–g. A 59-year-old woman with primary amyloidosis. Ultrasonography (a) shows diffuse heterogeneous liver parenchyma. Axial contrast-enhanced T1-weighted images (b, c) demonstrate diffuse heterogeneous liver parenchyma with periportal involvement (c, *black arrow*). Note also diffuse irregular wall thickening of stomach (*white arrow*). Axial contrast-enhanced CT images (d, e) show periportal involvement (*black arrows*) and diffuse wall thickening of stomach (*white arrow*). In panel (f), microscopic finding (hematoxylin and eosin stain [H-E]; original magnification, $\times 400$) reveals acute amorphous amyloid deposition in the portal area (*arrows*). Panel (g) shows immunohistochemical staining ($\times 400$) of amorphous depositions in liver.

reported that asymmetric contour, triangular hepatomegaly (its apex at the falciform ligament) and heterogeneous attenuation might aid in distinguishing amyloidosis from other infiltrative diseases (5). Hepatic rupture and prominent calcification can rarely be seen (2, 9). The differential diagnosis includes cirrhosis, fatty liver, and iron overload. Differentiation from cirrhosis can be made by absence of segment four atrophy, fatty liver by absence of signal drop in out-of-phase images, and iron overload by absence of signal drop in in-phase images.

As in the liver, the main radiologic finding of splenic involvement in amyloidosis is splenomegaly, which occurs in 4%–13% of patients (5). Calcification and absence of contrast enhancement can rarely be seen (partic-

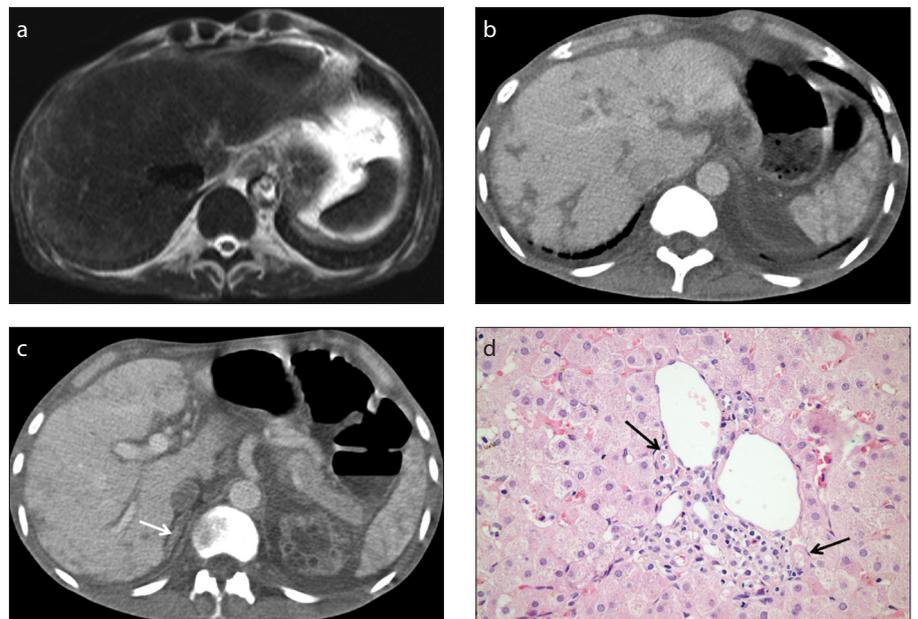


Figure 2. a–d. A 27-year-old man with familial Mediterranean fever. Axial T2-weighted image (a) demonstrates heterogeneous liver parenchyma. After one year, axial contrast-enhanced CT images (b, c) demonstrate infarct areas in the liver. Note also enlargement in the right adrenal gland (c, *arrow*). In panel (d), microscopic finding (H-E stain; original magnification, $\times 400$) reveals acute amorphous amyloid deposition around blood vessels in the portal area (*arrows*).

ularly on CT examinations) usually due to vascular involvement and diffuse parenchymal amyloid infiltration (Fig. 4) (5). Some studies in the literature indicated that MRI of amyloidosis demonstrated splenic involvement with high signal intensity on T1-weighted images and low signal intensity on T2-weighted images (Fig. 3) (2, 10, 11). Low signal intensity on T2-weighted imaging findings might be

due to reduced blood content caused by accumulation of amyloid in the spleen (5). The differential diagnosis includes iron overload. In-phase and out-of-phase images or T2* measurements may help to differentiate iron overload from amyloidosis.

Kidney involvement is a prominent result in systemic amyloidosis and almost 50% of the patients with secondary amyloidosis

Main points

- Radiologic findings of abdominal involvement in systemic amyloidosis are nonspecific and can present in a variety of ways.
- Together with the clinical history of inflammatory disease in a patient, heterogeneous appearance of liver, periportal involvement, diffuse low signal intensity of spleen on T2-weighted images with bowel wall thickening findings can suggest systemic amyloidosis.
- Interpretation of multiple organ involvement by CT and/or MRI and getting acquainted with these imaging findings is essential for early diagnosis and prompt management.

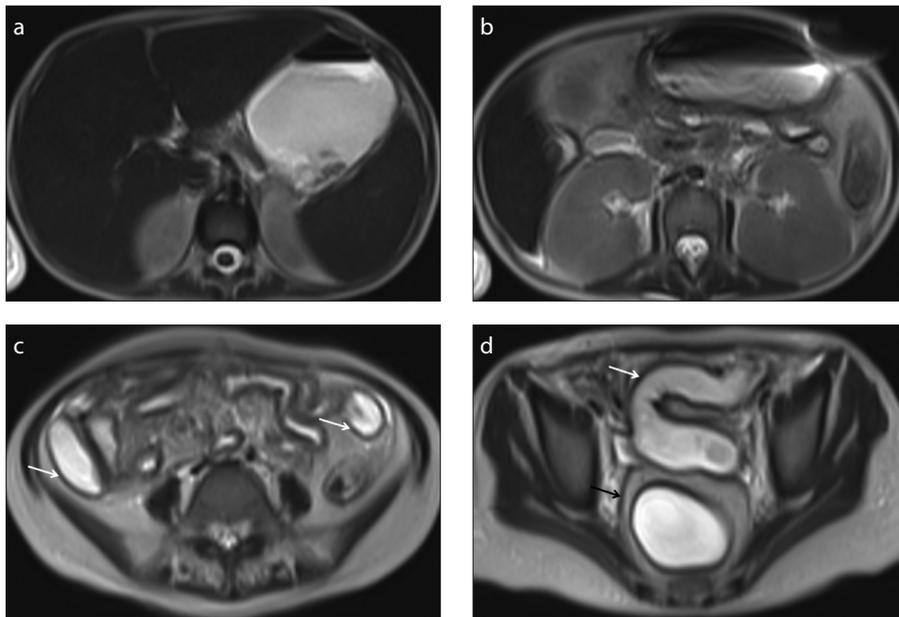


Figure 3. a–d. A 9-year-old girl with systemic amyloidosis. Axial T2-weighted images demonstrate (a) diffuse low signal intensity of liver and spleen, (b) enlargement of kidneys, (c) wall thickening of small intestine (arrows), (d) wall thickening of rectosigmoid colon (white arrow) and infiltration of perirectal fat plane (black arrow).

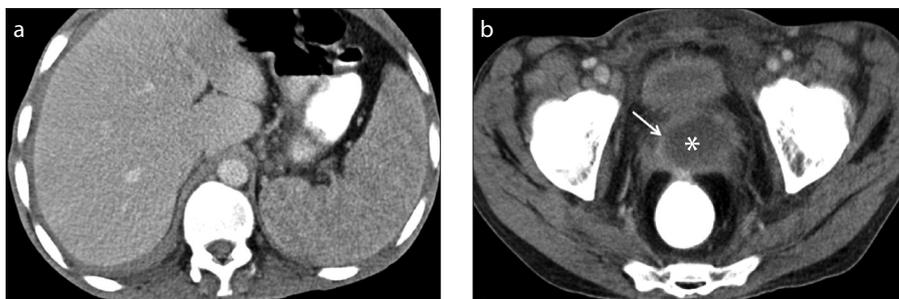


Figure 4. a, b. A 38-year-old man with primary amyloidosis. Axial contrast-enhanced CT images show (a) heterogeneous attenuation of spleen, (b) ascites (asterisk) and peritoneal involvement (arrow).

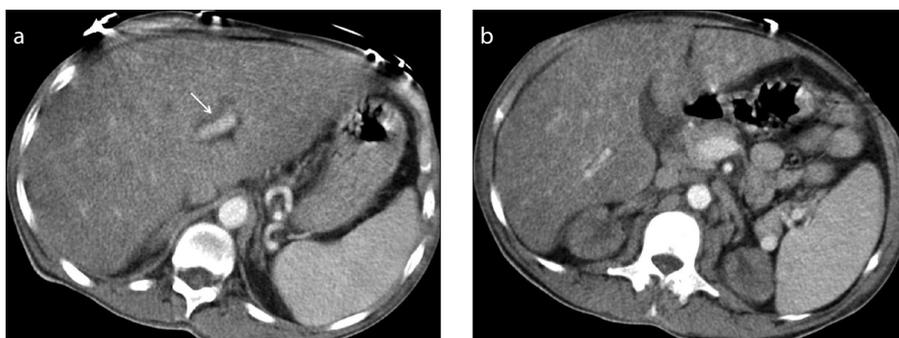


Figure 5. a, b. A 46-year-old man with familial Mediterranean fever. Axial contrast-enhanced CT images show (a) heterogeneous attenuation of liver and periportal involvement (arrow) and (b) bilateral small kidneys.

die of renal failure (8). Radiologically, kidneys are generally imaged as smaller with cortical thinning—referred as amyloid contracted kidneys—which is found in nearly 50% of systemic amyloidosis cases (Fig. 5) (12). Enlarged kidneys with smooth con-

tours may be seen, probably in the early phase (Fig. 3). US characteristics of renal involvement are nonspecific; the renal parenchyma shows diffusely increased echogenicity and corticomedullary differentiation is present. Doppler US findings of renal in-

volvement are also nonspecific and consist of a normal or increased interlobar artery resistive index, which can be seen in other renal parenchymal diseases, corresponding to increased peripheral vascular resistance of the affected kidney. Other renal imaging findings are focal renal parenchymal mass, renal calcifications, and renal pelvic masses due to amyloid deposition and perirenal soft tissue mass with calcifications (13).

The main radiologic finding of adrenal gland involvement is enlargement of the gland (Fig. 2). This appearance is a nonspecific finding, which can occur in adrenal gland hyperplasia and granulomatous diseases (14).

According to the previous reports, small bowel is the most commonly involved organ in the gastrointestinal system (15, 16). The most frequent imaging finding of small intestinal amyloidosis is regular thickening of the folds (focal or diffuse), which displays edema due to ischemia as a result of vascular accumulation. Barium enema findings include regular thickening of the folds, jejunalization of the ileum, granular mucosal pattern, tiny polypoid protrusions, and amyloid tumor (5). Descending and rectosigmoid colon are the most commonly involved sites of the large intestine. Barium enema findings of colonic involvement are nonspecific: i.e., luminal narrowing, loss of colonic haustrations, thickened mucosal folds, and a nodular mucosal pattern. CT and MRI of small and large intestinal involvement include bowel wall thickening, dilatation, and mesenteric infiltration (Figs. 3, 4). MRI plays an important role in demonstrating bowel wall thickening and thickening of the mesenteric and perirectal fat planes. Mesenteric involvement can be seen as high signal intensity on T2-weighted images.

Patients with gastric involvement have symptoms resulting from pyloric obstruction (17). Mucosal granules, mucosal or intramural filling defects and thickened folds can be seen in barium enema studies. The pertinent imaging findings include diffuse or focal gastric wall thickening, focal deposits, amyloid tumors, and gastric wall calcifications (Fig. 1). Gastric involvement with diffuse wall thickening can be demonstrated by MRI (Fig. 1). Diffuse or focal wall thickening mimic gastric tumors, thus histologic analysis is essential.

As in the other organs, involvement of the ureters and bladder may be focal or diffuse. Amyloid deposition frequently involves the

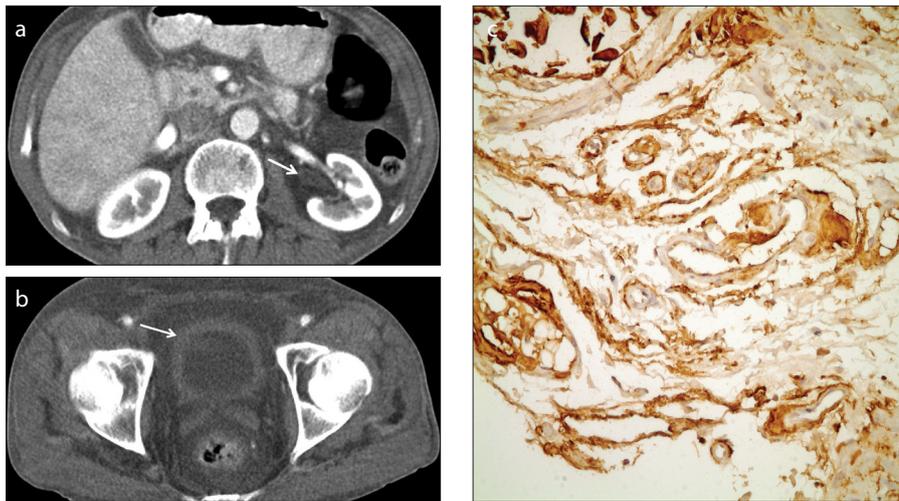


Figure 6. a–c. A 61-year-old man with familial Mediterranean fever. Axial contrast-enhanced CT images (a, b) show left renal pelvis involvement (a, arrow) and diffuse bladder wall thickening (b, arrow). Panel (c) shows immunohistochemical staining ($\times 400$) of amorphous depositions in the colonic wall.

lower ureter and is usually unifocal. Linear submucosal or intramural calcification of the renal pelvis and ureter is a characteristic of amyloidosis. CT or MRI can demonstrate filling defects, irregular ureteral narrowing, stricture, and diffuse or focal wall thickening (Fig. 6) (16). Diffuse bladder wall thickening or a filling defect in the lumen can be seen. Linear submucosal or intramural calcification of the bladder wall is specific for amyloidosis. It is difficult to distinguish focal masses from primary bladder cancer.

Conclusion

In conclusion, abdominal involvement can occur in primary and secondary forms of systemic amyloidosis. Imaging findings are usually nonspecific and display variable presentations. Together with a clinical

history of inflammatory disease, heterogeneous appearance of liver, periportal involvement, diffuse low signal intensity of spleen on T2-weighted images, and bowel wall thickening findings can suggest systemic amyloidosis. Getting acquainted with these imaging findings is essential for the early diagnosis and prompt management.

Conflict of interest disclosure

The authors declared no conflicts of interest.

References

1. Glenner GG. Amyloid deposits and amyloidosis. The beta-fibrilloses (first of two parts). *N Engl J Med* 1980; 302:1283–1292. [\[CrossRef\]](#)
2. Monzawa S, Tsukamoto T, Omata K, Hosoda K, Araki T, Sugimura K. A case with primary amyloidosis of the liver and spleen: radiologic findings. *Eur J Radiol* 2002; 41:237–241. [\[CrossRef\]](#)

3. Scott PP, Scott WW, Jr, Siegelman SS. Amyloidosis: an overview. *Semin Roentgenol* 1986; 21:103–112. [\[CrossRef\]](#)
4. Kyle RA, Bayrd ED. Amyloidosis: review of 236 cases. *Medicine* 1975; 54:271–299. [\[CrossRef\]](#)
5. Kim SH, Han JK, Lee KH, et al. Abdominal amyloidosis: spectrum of radiological findings. *Clin Radiol* 2003; 58:610–620. [\[CrossRef\]](#)
6. Urban BA, Fishman EK, Goldman SM, et al. CT evaluation of amyloidosis: spectrum of disease. *Radiographics* 1993; 13:1295–1308. [\[CrossRef\]](#)
7. Tada S, Iida M, Yao T, et al. Gastrointestinal amyloidosis: radiologic features by chemical types. *Radiology* 1994; 190:37–42. [\[CrossRef\]](#)
8. Pear BL. Other organs and other amyloids. *Semin Roentgenol* 1986; 21:150–164. [\[CrossRef\]](#)
9. Gertz MA, Kyle RA. Hepatic amyloidosis: clinical appraisal in 77 patients. *Hepatology* 1997; 25:118–121. [\[CrossRef\]](#)
10. Benson L, Hemmingsson A, Ericsson A, et al. Magnetic resonance imaging in primary amyloidosis. *Acta Radiol* 1987; 28:13–15. [\[CrossRef\]](#)
11. Rafal RB, Jennis R, Kosovsky PA, Markisz JA. MRI of primary amyloidosis. *Gastrointest Radiol* 1990; 15:199–201. [\[CrossRef\]](#)
12. Ekelund L. Radiologic findings in renal amyloidosis. *AJR Am J Roentgenol* 1977; 129:851–853. [\[CrossRef\]](#)
13. Moon WK, Kim SH, Im JG, et al. Castleman disease with renal amyloidosis: imaging findings and clinical significance. *Abdom Imaging* 1995; 20:376–378. [\[CrossRef\]](#)
14. Kawashima A, Alleman WG, Takahashi N, Kim B, King BF Jr, LeRoy AJ. Imaging evaluation of amyloidosis of the urinary tract and retroperitoneum. *Radiographics* 2011; 31:1569–1582. [\[CrossRef\]](#)
15. Tada S, Iida M, Yao T, et al. Gastrointestinal amyloidosis: radiologic features by chemical types. *Radiology* 1994; 190:37–42. [\[CrossRef\]](#)
16. Seliger G, Krassner RL, Beranbaum ER, Miller F. The spectrum of roentgen appearance in amyloidosis of the small and large bowel: radiologic–pathologic correlation. *Radiology* 1971; 100:63–70. [\[CrossRef\]](#)
17. Menke DM, Kyle RA, Fleming CR, et al. Symptomatic gastric amyloidosis in patients with primary systemic amyloidosis. *Mayo Clin Proc* 1993; 68:763–767. [\[CrossRef\]](#)