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REVIEW

Immunoglobulin G4-related systemic disease: mesenteric and peritoneal involvement with radiopathological correlation and differential diagnoses

Ali Devrim Karaosmanoglu[1] · Omer Onder[1] · Can Berk Leblebici[2] · Cenk Sokmensuer[2] · Deniz Akata[1] · Mustafa Nasuh Ozmen[1] · Musturay Karcaaltincaba[1]

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Abstract

Since its first introduction in 2003 by Kamisawa et al., IgG4-related disease has gained wide interest in the imaging community, and several manuscripts have been published regarding its imaging features. In addition to initial observations in the pancreaticobiliary system, it is now well known that the disease may involve every organ system in the body. There is not much information in the imaging literature about the involvement of mesentery, omentum, and peritoneum in this disease. This article aims to provide more information about the imaging findings of IgG4-related disease regarding these areas by making radiopathological correlations and discussing the possible differential diagnoses.

Keywords Immunoglobulin G4-related disease · Mesentery · Peritoneum · Omentum · Diagnostic imaging

Introduction

Immunoglobulin G4-related disease (IgG4-RD) is an autoimmune, systemic, multi-organ, fibroinflammatory syndrome characterized by elevated serum IgG4 levels and tissue infiltration with IgG4-positive plasma cells [1]. However, it is important to know the fact that serum IgG4 is elevated in only about 85% of the patients with IgG4-RD, and it should not be used to confirm (or exclude) a diagnosis of IgG4-RD. Instead, a thorough evaluation considering clinical, biochemical, radiological, and pathological findings needs to be done to make the diagnosis. Therefore, in the presence of radiological findings which may indicate the IgG4-RD, it is necessary to carry out a clinical investigation and refer to histopathologic confirmation despite low serum IgG4 levels [2].

Although the pancreatobiliary system appears to be the most commonly involved organ in the abdomen, virtually every compartment in the abdomen may be affected in the disease's course.

Peritoneal and mesenteric involvement in the course of IgG4-related disease appears to be rare compared to other parts of the abdomen, and information about this unusual involvement mostly depends on anecdotal case reports. As isolated peritoneal and mesenteric involvement, without associating radiologic abnormality in the other intra- or extra-abdominal organs may closely mimic several other benign and malignant abdominal conditions, diagnosis may be challenging. IgG4-RD should be considered in the differential diagnosis of these patients not to delay the diagnosis and treatment.

The purpose of this article is to review imaging findings of IgG4-RD with peritoneal and mesenteric involvement together with differential diagnoses. According to the peritoneal and mesenteric involvement patterns, we will examine the imaging findings of IgG4-RD in two main categories, as diffuse and focal. In doing so, we will also discuss other diseases that can have similar imaging findings to IgG4-RD, known as one of the great mimickers [3].

CME activity This article has been selected as the CME activity for the current month. Please visit https://ce.mayo.edu/node/111598 and follow the instructions to complete this CME activity.

✉ Ali Devrim Karaosmanoglu
alidevrim76@yahoo.com

[1] Department of Radiology, Hacettepe University School of Medicine, 06100 Ankara, Turkey

[2] Department of Pathology, Hacettepe University School of Medicine, 06100 Ankara, Turkey

Diffuse mesenteric and peritoneal ınvolvement

Diseases of the peritoneum are very common, with sometimes grave clinical consequences. As there may be many overlapping imaging features between several benign and malignant conditions affecting the peritoneum, the correct diagnosis may be even more complicated in certain patient groups. Computed tomography (CT) and magnetic resonance imaging (MRI) are beneficial for identifying the disease and potential primary intra-abdominal sources of peritoneal disease if ever present. A comprehensive list of diseases related to diffuse mesenteric and peritoneal involvement other than IgG4-RD can be found in Table 1 [4–14].

IgG4-RD-mimicking peritoneal carcinomatosis

Peritoneal carcinomatosis (PC) is a generic term that defines the intraperitoneal dissemination of tumor cells that does not primarily originate from the peritoneal and subperitoneal spaces [15]. This term was first introduced in 1931 and was used to describe the metastatic peritoneal implants originating from ovarian adenocarcinoma [16]. Although ovarian tumors are the most common PC source, almost any organ-based epithelial malignancy in the gastrointestinal tract may give rise to this clinical situation (Fig. 1) [15].

IgG4-RD involving peritoneum and mimicking PC appears to be extremely rare. Clinical presentation is nonspecific, and abdominal distension with associating pain has been reported as the presenting symptom [1]. The presence of ascites and contrast-enhancing thickened peritoneum has been reported as the main imaging findings [1]. Both CT and MR may clearly demonstrate these imaging findings (Fig. 2). Increased nodular density within the mesentery, close to the peritoneal lining, is another important finding. These imaging findings may closely simulate PC. Moreover, elevated serum CA-125 level has also been reported in patients with peritoneal IgG4-RD, making it even harder to differentiate them from patients with ovarian tumors from a clinical standpoint [17].

In the case of the above-mentioned findings, peritonitis should also be considered in the differential diagnosis. Portal hypertension (Fig. 3), post-surgical and bacterial peritonitis (Fig. 4) are common etiologies that should be kept in mind, characterized by diffuse peritoneal/mesenteric thickening and associating ascites [13, 14]. Less commonly, tuberculosis, fungal and parasitic infections like Histoplasmosis, Coccidioidomycosis, Candidiasis, Paragonimiasis may also present with PC-like imaging findings and should also be considered in the differential diagnosis, especially in patients from endemic areas (Fig. 5). Additionally, foreign materials in the peritoneal cavity such as talc or barium, gallstones, bowel contents, or bile, as well as certain systemic diseases such as sarcoidosis, Whipple disease, and Crohn disease, may induce granulomatous peritonitis, which can mimic peritoneal carcinomatosis [4].

Furthermore, primary peritoneal neoplasms such as malignant mesothelioma and peritoneal papillary serous carcinoma may present with PC-like imaging findings. They should be mentioned in the differential diagnosis in the absence of a primary malignancy such as ovarian cancer (Fig. 6) [6, 18].

IgG4-RD-mimicking encapsulating peritoneal sclerosis

Encapsulating peritoneal sclerosis (EPS) is a rare disease. In certain patients, this disease may be debilitating and is typically characterized by chronic fibrotic thickening of the peritoneal lining [19]. In advanced stages of the disease, the fibrotic and thickened peritoneum may encase small bowel loops in an “abdominal cocoon” which may eventually cause recurrent small bowel obstruction [20, 21]. The exact etiology is unclear, but chronic, repetitive trauma has been blamed as the main underlying reason. It is most commonly seen in patients on continuous ambulatory peritoneal dialysis, but idiopathic cases have also been reported [21].

The most common imaging finding in EPS is the smooth thickening of the peritoneum with contrast enhancement. Calcification may be seen in both the visceral and parietal peritoneum, which can be easily detected with CT (Fig. 7). The thick and fibrotic peritoneum may encapsulate the bowel loops in advanced stages and may cause adhesions between the bowel segments. Eventually, it may result in small bowel obstruction and related potential complications.

To the best of our knowledge, IgG4-RD simulating EPS has not been reported in the literature. In our case, the patient presented with progressively increasing abdominal pain with intermittent vomiting. The main imaging feature was the smooth thickening in the peritoneum with no obvious nodular component. Also noted was the brisk enhancement of the peritoneum with clustered small bowel loops.

Table 1 Differential diagnoses of diseases related to diffuse mesenteric and peritoneal involvement

Disease	Imaging findings	Other auxiliary findings
Peritoneal carcinomatosis (PC)	Ascites, peritoneal thickening/nodularity, omental cake, small nodules within the omental and mesenteric fat, increased mesenteric fat density	Abdominal pain, distention, nausea-vomiting. Presence of a primary malignancy. Mostly associated with ovarian and gastrointestinal system malignancies
Peritoneal sarcomatosis	PC-like findings. Large masses with necrotic and hemorrhagic areas. Associated with fewer ascites than PC. Hypervascular, bulky, heterogeneous peritoneal implants. Hemoperitoneum can be seen	Presence of primary malignancy. Mostly associated with gastrointestinal stromal tumors, liposarcoma, and leiomyosarcomas
Peritoneal lymphomatosis	PC-like findings. Bulky homogenous peritoneal lesions. Splenic enlargement. Wall thickening and aneurysmal dilatation of bowel segments. Conglomerating mesenteric lymphadenopathy with vascular encasement	Presence of primary lymphoma. Mostly associated with non-Hodgkin lymphoma
Pseudomyxoma peritonei	May mimic massive ascites. Mucin accumulation within the peritoneum with low CT attenuation. Scalloping of intraperitoneal organs	Progressive abdominal pain, abdominal distention, weight loss. Mostly associated with low-grade mucinous carcinoma of the appendix
Primary peritoneal neoplasms Peritoneal papillary serous carcinoma Peritoneal malignant mesothelioma	Nodular or diffuse thickening of the peritoneum with or without ascites. May present with large confluent masses	Absence of a source for primary malignancy other than peritoneum. History of asbestos exposure could be helpful information for diagnosing peritoneal mesothelioma
Encapsulating peritoneal sclerosis	Thickened peritoneum with prominent, continuous enhancement. Encapsulated bowel loops. Loculated ascites. Calcifications in the visceral surface of the bowel segments and parietal peritoneum	Mostly associated with long-term peritoneal dialysis
Peritoneal tuberculosis	Wet type: Free or loculated ascites with relatively high attenuation Dry-fibrotic types: Omental cake, peritoneal thickening with necrotic mesenteric lymph nodes	Patient demographics and tuberculosis history. May coexist with gastrointestinal tuberculosis. Calcified mesenteric lymph nodes may also be detected
Peritoneal fungal infections Coccidioidomycosis Histoplasmosis Candidiasis Cryptococcosis	PC-like findings. Mesenteric lymph nodes. Large mesenteric/omental masses have been reported in the peritoneal coccidioidomycosis	Rare. Geographical location and patient demographics may be helpful (For example, Coccidioidomycosis is a common endemic fungal infection in the southwestern United States). The involvement of other organ/systems could be a clue. Immunocompromised patients and the elderly are more susceptible
Peritoneal parasitic infections Paragonimiasis Echinococcosis Fascioliasis	PC-like findings. Single or multiple peritoneal masses	Geographical location and patient demographics may be helpful. For example, Paragonimiasis is commonly seen in the Far East countries, whereas Echinococcosis is prevalent in the Middle East. Other signs, symptoms, and findings for parasitic infestation
Peritoneal sarcoidosis	Non-specific PC-like findings	Rare. History and/or findings of sarcoidosis. Histopathological examination is needed
Post-surgical and bacterial peritonitis	Peritoneal–mesenteric thickening, fat-stranding and enhancement with or without associating ascites. Intraperitoneal free air can be seen in the early postoperative period	Patient's history. Presence of an infectious focus such as perforated appendicitis or intra-abdominal abscess
Portal hypertension	Ascites. Thickening and enhancement of peritoneum. Omental and mesenteric fat-stranding	Signs, symptoms, and imaging findings of cirrhosis and/or portal hypertension (Splenomegaly, portal enteropathy, varices, etc.)

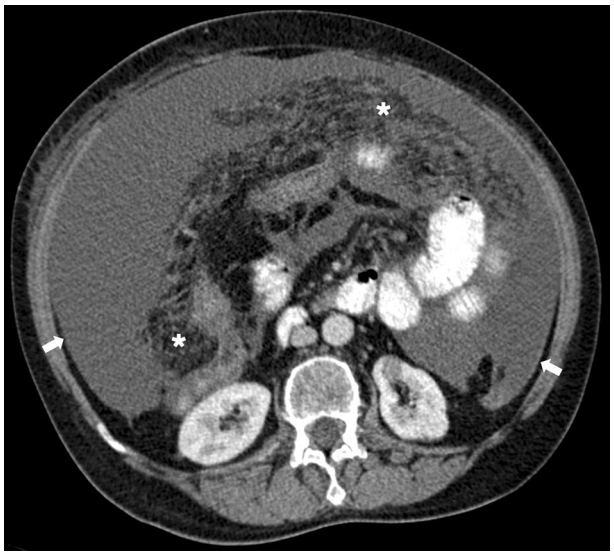

Fig. 1 Peritoneal carcinomatosis. A 68-year-old female with a known diagnosis of pancreatic adenocarcinoma now presents with progressive abdominal pain and distention. Axial plane postcontrast abdominal CT image demonstrates ascites, contrast-enhancing thickened peritoneum (arrows), and extensive nodular densities within the mesenteric fat (asterisks). Cytologic examination of the peritoneal fluid showed malignant cells and confirmed peritoneal carcinomatosis

Large and loculated ascites with no associating mesenteric nodularity was the other significant finding (Fig. 8). Besides these findings, abdominal solid organs and pelvis were unremarkable. The patient's past medical history was also unremarkable, with no history of chronic renal disease. The putative diagnoses were peritoneal carcinomatosis or peritoneal tuberculosis. Amyloidosis was also considered in the differential diagnosis. Fluid aspiration was inconclusive, and the patient received the diagnosis after laparoscopic biopsy and histopathologic evaluation.

Focal ınvolvement of the mesentery

Focal mesenteric involvement of IgG4-RD may present with mass-forming lesions and/or lymphadenopathy.

Mass-forming lesions

Sclerosing mesenteritis (SM), an uncommon fibroinflammatory disease of unknown etiology, is now considered as one of the abdominal presentations of IgG4-RD. A study in 2007 found that approximately 33% of all SM cases (4 of 12) have histopathological features of IgG4-RD [22]. In another study of 57 patients with IgG4-RD and autoimmune pancreatitis, two patients were found to have SM [23].

SM typically involves the root of the small bowel mesentery. The disease is mostly observed as a soft-tissue mass encasing, and sometimes obstructing, the mesenteric vessels. Calcification may or may not be visually observed, and differential diagnosis of non-neoplastic SM from its neoplastic counterparts such as carcinoid tumor and mesenchymal tumors may be challenging (Fig. 9). Histopathologic confirmation is almost always necessary for a definitive diagnosis.

Omental involvement is even rarer, and not much is known about their progress [24]. According to our limited experience, it appears as solid masses in the omentum not distinguishable from other more common neoplastic omental diseases such as implants and mesenchymal tumors. Calcifications may be seen inside these masses, and they may be solid or multiple (Fig. 10). When they are seen as multiple masses, differentiation from implants may be even more difficult (Fig. 11).

Several different entities may affect the mesentery and may closely mimic Ig4-RD in this anatomic location. Focal mass-forming diseases of the mesentery and peritoneum other than IgG4-RD are discussed in Table 2 [4, 5, 25–27].

It will be useful to know that mesenteric carcinoids may closely mimic IgG4-RD. Primary mesenteric carcinoids are rare, whereas secondary involvement is relatively common [28]. These tumors classically are seen as soft-tissue structures with spiculated radiations into the mesenteric fat (Fig. 12). Retraction and tethering of the adjacent small bowels are common, reflecting the desmoplastic process [29]. This process, which is thought to be secondary to the secretion of serotonin and other vasoactive molecules from the tumor tissue, may cause severe bowel ischemia and intestinal wall thickening. Calcifications may also be observed in some instances [29].

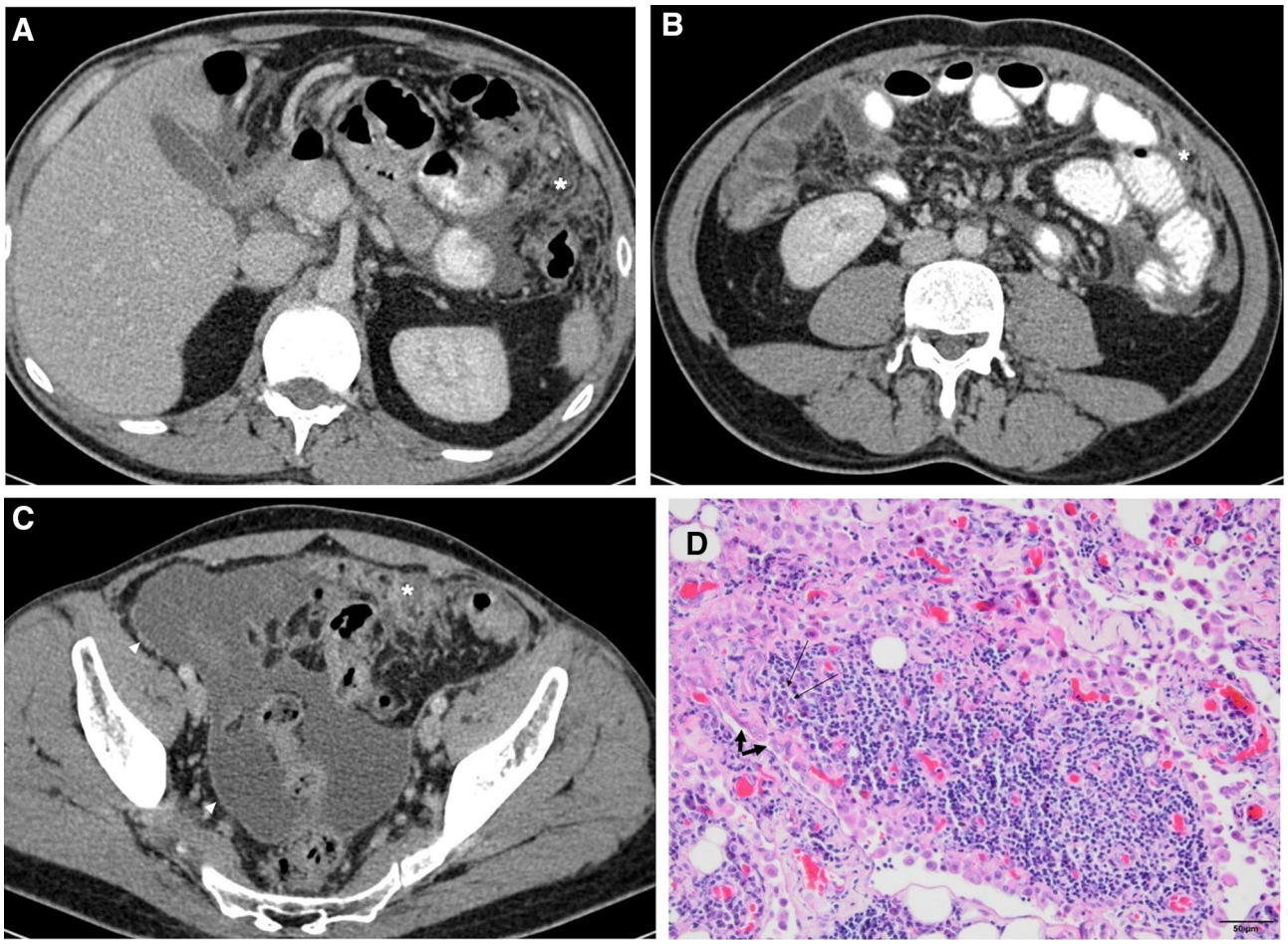

Fig. 2 IgG4-RD-mimicking peritoneal carcinomatosis. A 39-year-old female patient with no significant medical history now presents with fatigue, abdominal pain, and distention. **a**, **b** Axial plane postcontrast abdominal CT images show extensive stranding and nodularity in the gastrosplenic ligament (asterisk in figure **a**) and left paracolic gutter (asterisk in figure **b**). **c** Pelvic peritoneum appears diffusely thickened, and contrast-enhancing (arrowheads), and also note is made of diffuse nodularity in the greater omentum (asterisk). The patient was operated on with a putative diagnosis of papillary carcinoma of the serous surfaces after non-conclusive cytologic examinations of ascites. Histopathological examination revealed diffuse involvement of the peritoneum by IgG4-RD. **d** Medium-power view of an H&E-stained section shows infiltrating plasma cells (thin and long black arrows) into omental fibroadipose tissue and reactive mesothelium (short and thick black arrows) with congestive vascular vessels

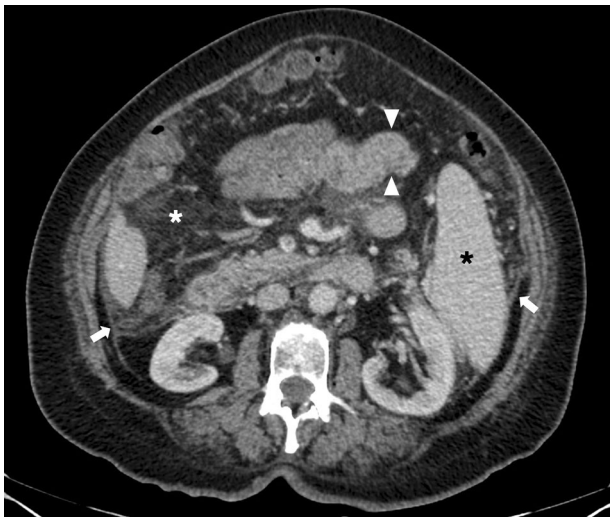

Fig. 3 Mesenteric and peritoneal changes related to portal hypertension. A 67-year-old female with a known history of cirrhosis and portal hypertension presented with abdominal pain. Axial plane postcontrast abdominal CT image demonstrated mesenteric fat-stranding (white asterisk) and peritoneal thickening (arrows). Also, notes were made of the enlarged spleen (black asterisk) and edematous small bowel loops (arrowheads). After a comprehensive clinical and radiological evaluation, findings were found to be consistent with mesenteric congestion secondary to portal hypertension

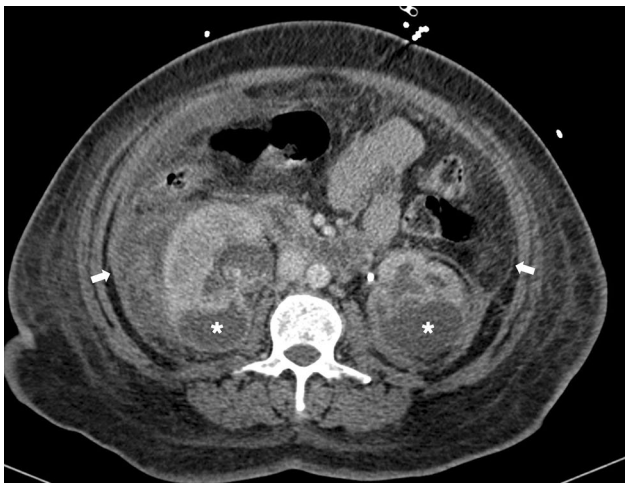

Fig. 4 Acute bacterial peritonitis. A 35-year-old female with a history of uncontrolled diabetes mellitus and recurrent urinary tract infections presented with fever, hypotension, and altered mental status. Axial plane postcontrast abdominal CT image demonstrated bilateral renal abscesses (asterisks), contrast-enhancing thickened peritoneum (arrows), mesenteric fat-stranding, and minimal intra-abdominal free fluid. Direct microscopic examination of abscess content and intraperitoneal fluid showed abundant polymorphonuclear leukocytes with Gram-negative rods. Culture grew Klebsiella pneumonia, and the final diagnosis was confirmed as acute bacterial peritonitis associated with bilateral renal abscesses

Last but not least, mesenchymal tumors of the mesentery, including gastrointestinal stromal tumors and desmoids, are relatively rare but may be among the differentials (Fig. 13) [25]. Liposarcomas appear to be a relatively common mesenteric tumor and should be considered in the differential diagnosis in the case of a newly detected mesenteric solid mass. In the presence of macroscopic fat in these tumors, the diagnosis may be relatively easy, but macroscopic fat may not be detected in a certain subgroup of these lesions (Fig. 14). Other sarcomas can also be included in the differential diagnoses list and are seen as large, heterogeneous, necrotic masses in the cross-sectional imaging (Fig. 15) [25, 27].

Mesenteric lymphadenopathy

Histopathologically, IgG4-RD lymphadenopathy is characterized by infiltration with IgG4-positive plasma cells. They have been described almost everywhere in the body, including retroperitoneum, mesentery, and peripancreatic areas [30–32]. The enlarged lymph nodes' size varies, they may be as large as 2 cm, and these lymph nodes also respond well to corticosteroids (Fig. 16) [32]. From the imaging standpoint, it is again almost always impossible to differentiate (especially when they represent the only imaging finding) from other neoplastic and non-neoplastic causes of intra-abdominal lymphadenopathy, shown in Table 3 [33].

It is worth mentioning that lymphoproliferative diseases, including lymphoma being the most frequent, are relatively common differentials in this location. The classic so-called sandwich sign is a very typical finding and was reported to be highly suggestive for this group of diseases (Fig. 17). This sign refers to the presence of confluent, conglomerating enlarged lymph nodes around the mesenteric vessels [34]. In these patients, mesenteric vessels are typically patent. The detection of retroperitoneal conglomerating lymph nodes may be a helpful finding for diagnosing lymphoma in these patients.

Conclusion

IgG4-RD is a systemic disorder that may affect almost every organ system in the body. Despite relatively common involvement in the biliary system and the pancreas, the mesenteric, peritoneal, and omental involvements are extremely rare, and differential diagnosis is broad in these patients. Diagnosis is not straightforward, especially when other more suggestive imaging findings in the liver and pancreas are lacking. In these patients, the surgical or percutaneous biopsy is almost always necessary for a correct diagnosis, as the list of differential diagnoses can be very wide in these patients.

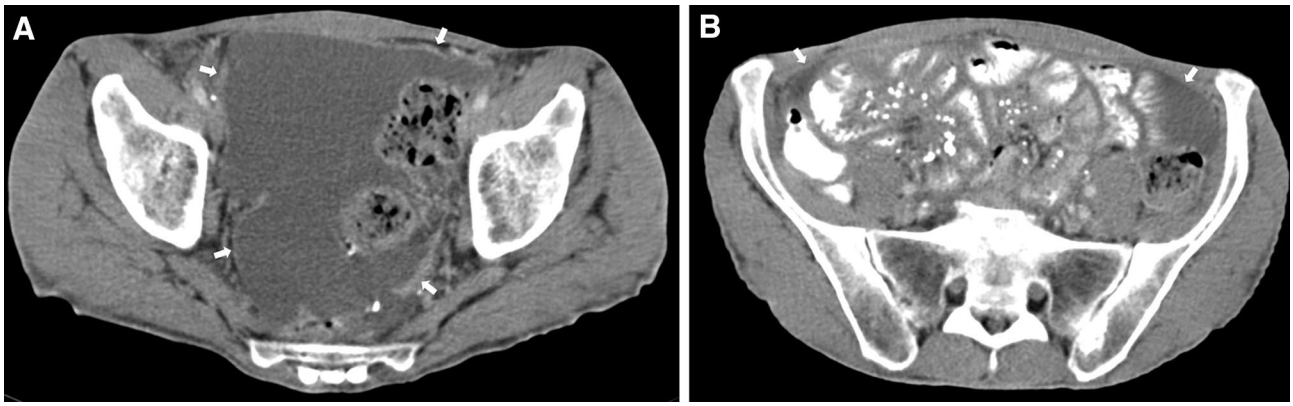

Fig. 5 Peritoneal tuberculosis. A 55-year-old male with a history of pulmonary tuberculosis presented with abdominal pain and weight loss. **a** Axial plane postcontrast abdominal CT image demonstrated diffuse irregular thickening of the peritoneum (arrows) with loculated ascites. **b** Multiple calcified mesenteric lymph nodes accompanying contrast-enhancing thickened peritoneum (arrows) were also noted. Microbiological evaluation of the loculated pelvic fluid confirmed peritoneal tuberculosis

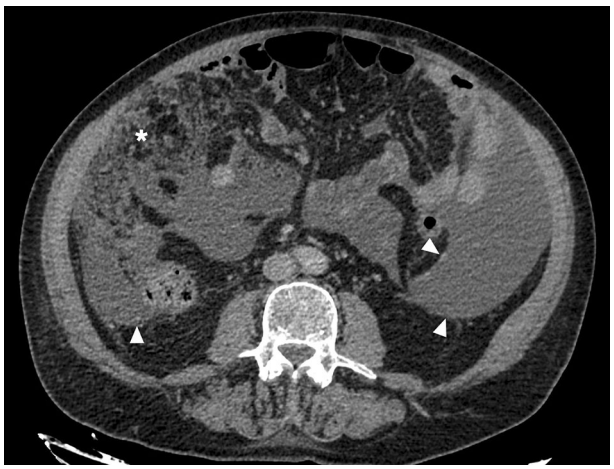

Fig. 6 Peritoneal malignant mesothelioma. A 74-year-old male with a history of long-term occupational asbestos exposure presented with abdominal discomfort and progressive abdominal distention. Axial plane postcontrast abdominal CT image demonstrated intra-abdominal free fluid, nodular thickening of peritoneal surfaces (arrowheads), and extensive nodularity within the mesentery and omentum. Abdominal solid organs and pelvis were unremarkable. Percutaneous biopsy from the omentum and subsequent histopathological examination confirmed peritoneal malignant mesothelioma

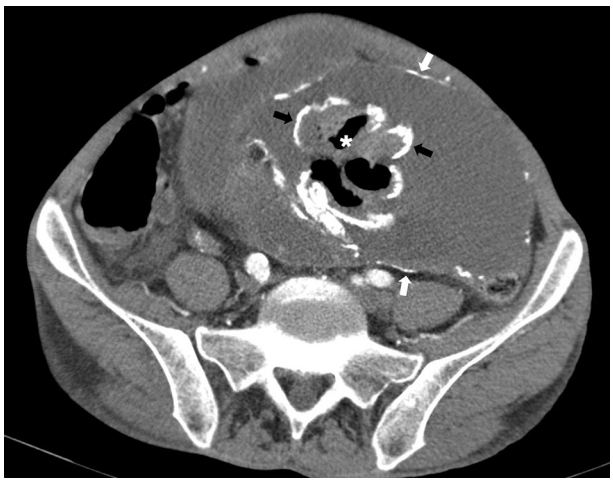

Fig. 7 Encapsulating peritoneal sclerosis. A 47-year-old male patient, who had been on peritoneal dialysis for a long time due to chronic kidney disease, presented with abdominal pain. Axial plane postcontrast abdominal CT image demonstrated centrally clustered small bowel segments (asterisk) and loculated peritoneal fluid surrounded by thickened and calcified visceral (black arrows) and parietal peritoneum (white arrows). Imaging findings were found to be consistent with encapsulating peritoneal sclerosis

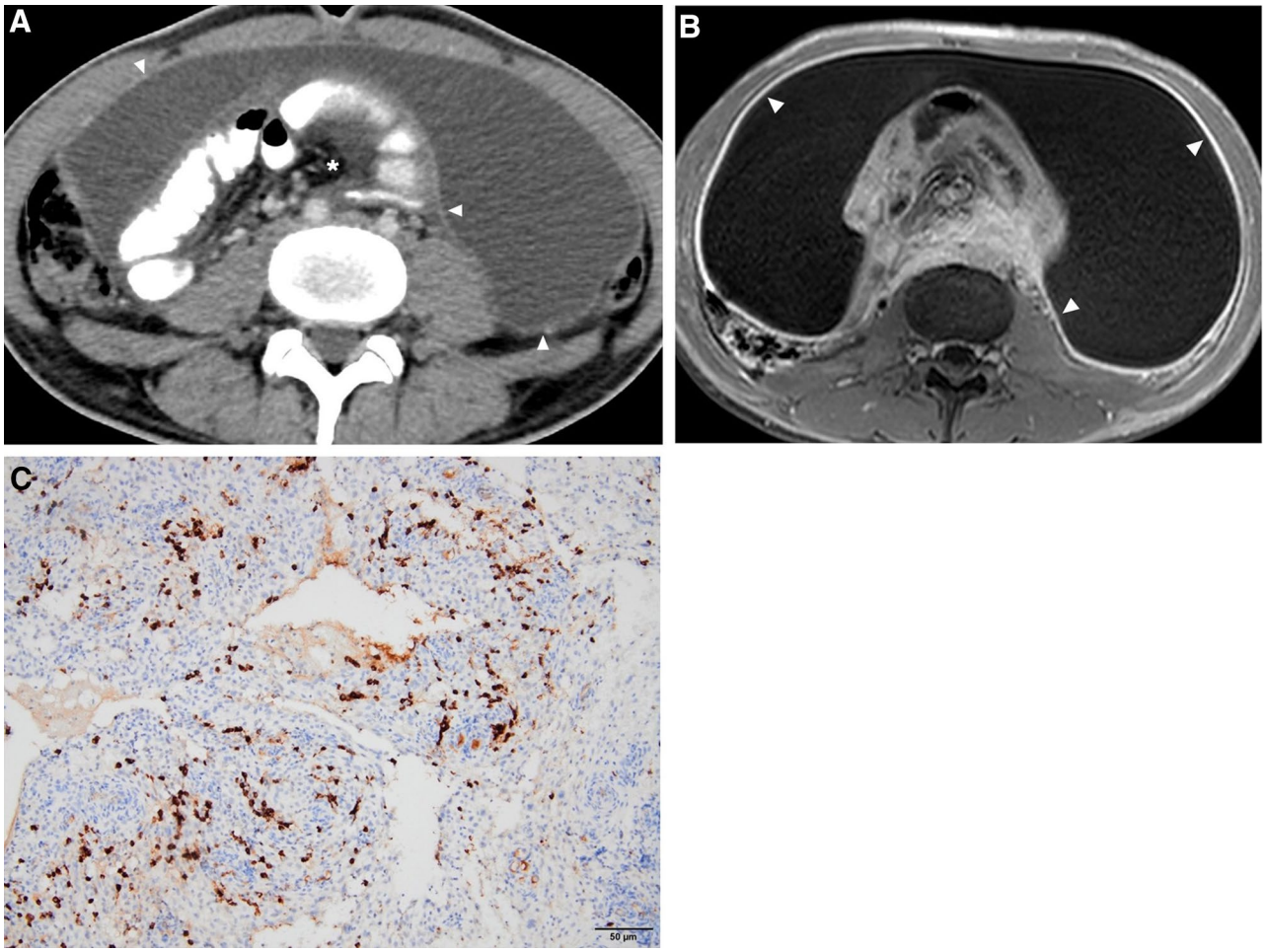

Fig. 8 IgG4-RD-mimicking encapsulating peritoneal sclerosis. A 36-year-old male patient presenting with chronic progressive abdominal pain, intermittent vomiting, and unintentional weight loss. **a** Axial plane postcontrast abdominal CT image shows diffusely thickened and contrast-enhancing peritoneal layers (arrowheads) with centrally clustered small bowel segments (asterisk). **b** Axial plane postcontrast T1W-fat-suppressed image better demonstrates smooth peritoneal thickening and enhancement (arrowheads). The patient underwent laparoscopic evaluation and peritoneal biopsy. Histopathological examination revealed IgG4-RD involvement of the peritoneum. **c** Medium-power view of an IgG4-immunohistochemistry stained section of the biopsy sample demonstrates densely infiltrating plasma cells

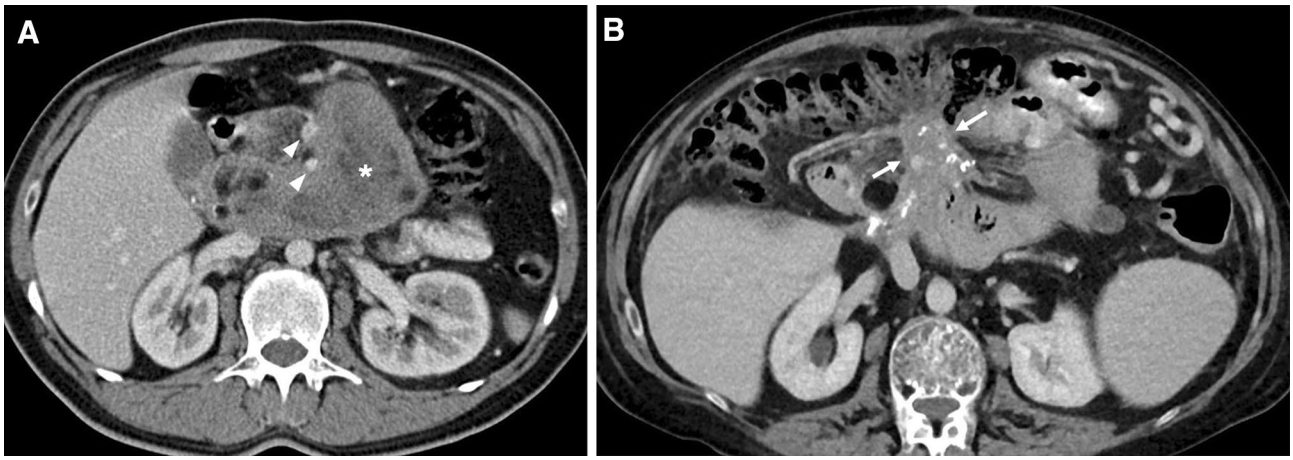

Fig. 9 Sclerosing mesenteritis associated with IgG4-RD. A 34-year-old male patient presenting with abdominal discomfort, unintentional weight loss, and fatigue. **a** Axial plane postcontrast abdominal CT image shows a large, lobulated mesenteric mass (asterisk) encasing the mesenteric vessels without any sign of mass effect (arrowheads). The percutaneous biopsy confirmed that this mass was a pseudotumor related to IgG4-RD. The patient was placed on medical treatment. **b** Axial plane postcontrast follow-up CT image shows that the previous mass is now significantly diminished in size with prominent spiculated margins and scattered calcifications (arrows)

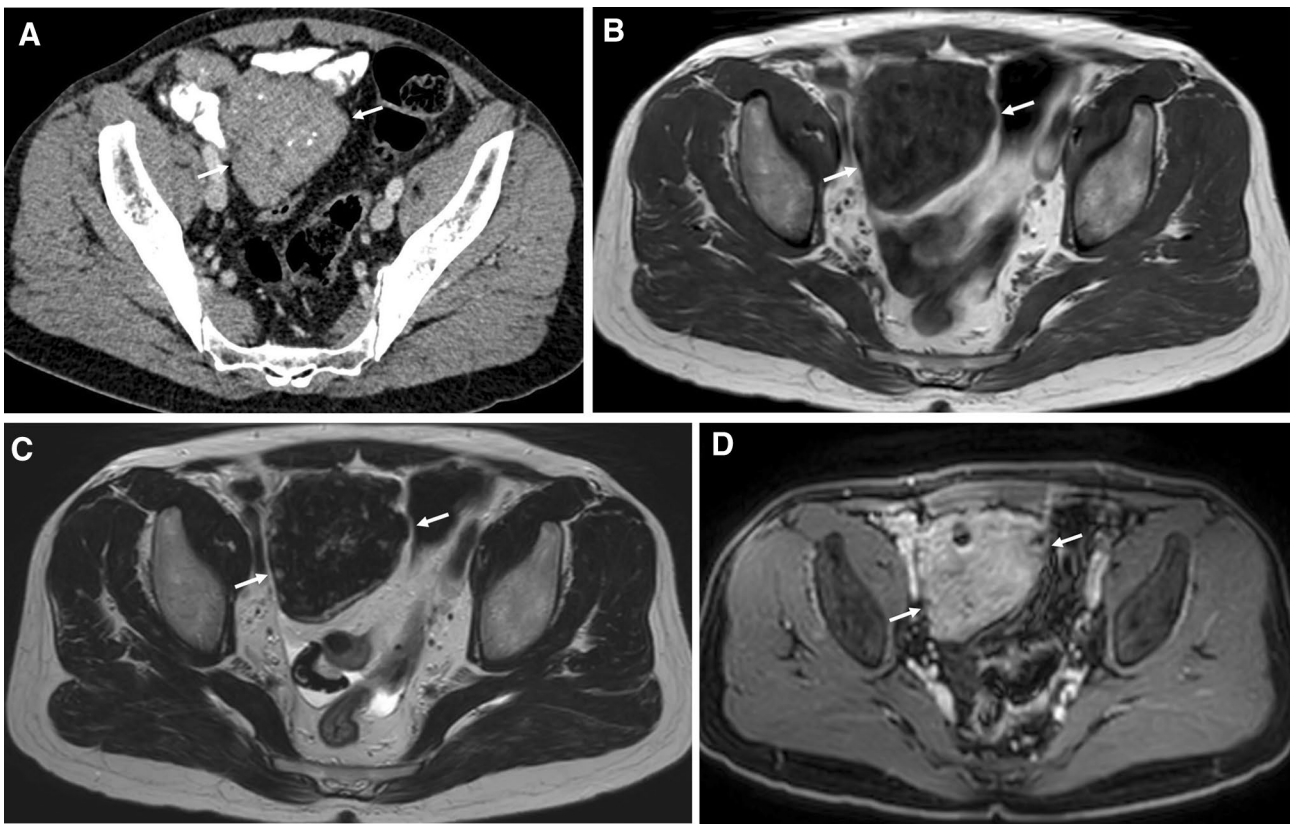

Fig. 10 IgG4-RD presenting with a pelvic mass. A 48-year-old male patient with no significant medical history presented with an incidentally detected mass on ultrasonography performed for unrelated reasons. The patient was referred to MRI for a presumptive diagnosis of the mesenteric mesenchymal tumor. **a** Axial plane postcontrast abdominal CT image shows a solid mass (arrows) with internal calcifications. **b**, **c** On axial plane T1W (**b**) and T2W (**c**) images, the mass was hypointense, which may suggest fibrotic nature (arrows). **d** On postcontrast axial plane T1W image, this mass demonstrates avid contrast enhancement (arrows). After surgical removal, histopathological examination revealed an IgG4-RD pseudotumor

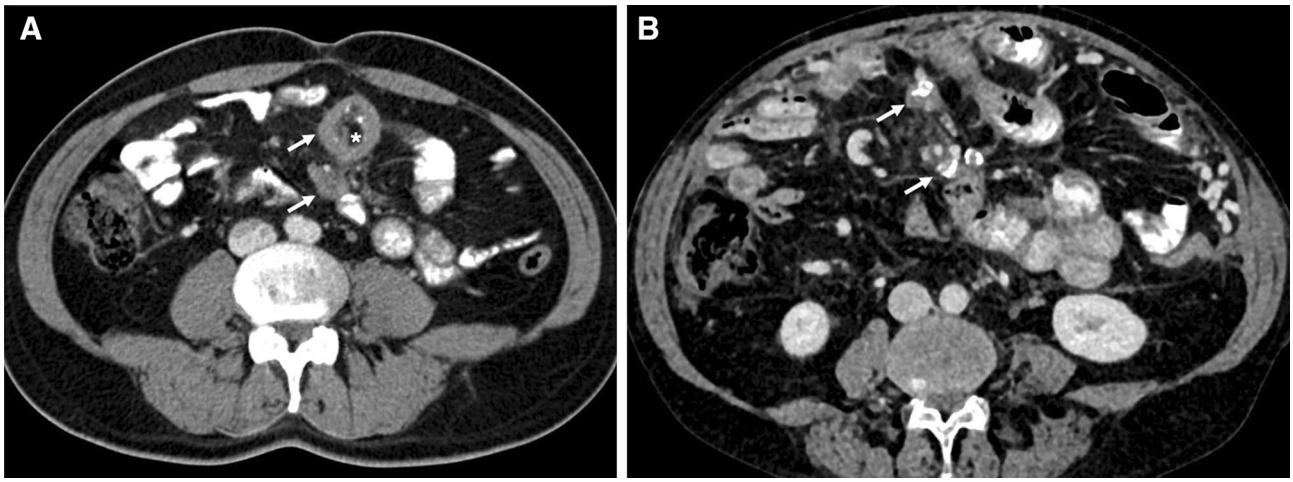

Fig. 11 IgG4-RD with multiple mesenteric masses. A 34-year-old male patient with a known mesenteric mass histopathologically proven to be IgG4-RD pseudotumor (same patient as in Fig. 9). **a** Solid mesenteric masses (arrows) with larger lesion demonstrating central fat density (asterisk) in the small bowel mesentery. **b** Follow-up imaging 5s years after initial presentation and medical treatment. Both lesions demonstrated significant regression with dystrophic calcifications (arrows)

Table 2 Differential diagnoses of focal mass-forming lesions of mesentery and peritoneum

Disease	Imaging findings	Other auxiliary findings
Mesenteric carcinoids	Bowel loop tethering. Spiculated contours. Arterial hyperenhancement and intratumoral calcifications	Secondary mesenteric carcinoids are mostly due to ileal tumors and are located in the right lower quadrant. Hyperenhancing liver metastases and symptoms of carcinoid syndrome
Mesenteric gastrointestinal stromal tumor	Well-defined heterogeneous solid masses	Rare. Vessel invasion and/or encasement are not typical
Desmoid tumor of the mesentery	Soft-tissue mass with irregular or well-defined borders. Delayed enhancement pattern. Locally aggressive mass	Associated with familial adenomatous polyposis and Gardner syndrome. Surgery, trauma, and pregnancy could be predisposing factors
Desmoplastic small round cell tumor	Multiple disseminated heterogeneous soft-tissue masses in the omentum, mesentery, or along the peritoneal surfaces. Tumoral calcification may be seen	Male predominance (3,8/1). Adolescent age group, absence of primary malignancy, extensive peritoneal involvement
Lymphoma	Confluent, conglomerating masses/enlarged lymph nodes encasing the mesenteric vessels	History of primary lymphoma. Presence of "b" symptoms
Inflammatory pseudotumor (Myofibroblastic tumor)	Non-specific mesenteric mass. Variable contrast enhancement such as non-enhancing, peripheral enhancement, or heterogeneous enhancement. Central necrosis may be seen	Unusual, benign, chronic, inflammatory lesion. Mostly presented with mass effect. Nearly %25 of patients have systemic findings such as fever, weight loss, thrombocytosis, anemia
Liposarcoma	Large heterogeneous mesenteric mass. Well-differentiated types may contain macroscopic fat	Areas with soft-tissue attenuation represent dedifferentiated components
Other sarcomas	Large, heterogeneous, necrotic mesenteric masses	Symptoms due to the mass effect
Metastases/Peritoneal carcinomatosis	Multiple mesenteric masses with variable characteristics. Metastases mostly follow imaging features of the primary	History of primary malignancy and/or previous metastases elsewhere
Amyloidosis	Highly non-specific. May present with PC-like findings. Multifocal mesenteric/omental masses with coarse calcifications	Could be primary or secondary to various underlying diseases such as familial Mediterranean fever, rheumatoid arthritis, or multiple myeloma
Peritoneal extramedullary hematopoiesis	Multiple bulky masses in the mesentery with no significant mass effect on the adjacent bowel loops	History of hemoglobinopathy or myelofibrosis. Involvement of other common locations such as the liver, spleen, paraspinal areas
Endometriosis	All visceral and parietal peritoneal surfaces may involve. Non-specific masses is seen on CT. MRI demonstrates blood products within the lesions	Presence of endometrioma or previous history of endometriosis. Gynecological symptoms. Alternating symptoms in line with the menstrual cycle
Fat inflammation/necrosis	Mesenteric fat-containing mass with associated peritoneal thickening and peripheral fat-stranding	Epiploic appendagitis, segmental omental infarction, and secondary inflammation of mesenteric fat tissues may present as inflammatory fatty masses

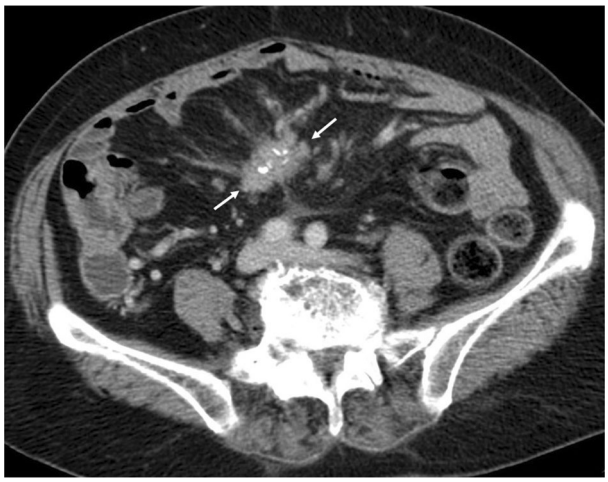

Fig. 12 Mesenteric carcinoid as a differential. A 71-year-old male with recent-onset abdominal pain and diarrhea. Axial postcontrast abdominal CT image demonstrates a solid mesenteric mass with irregular contours and internal calcifications. Surgical resection confirmed carcinoid tumor (asterisk)

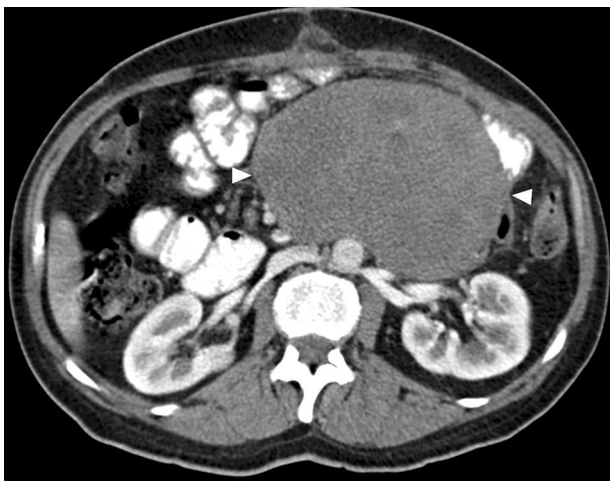

Fig. 13 Mesenteric desmoid. A 51-year-old male with no significant past medical history now presented with a palpable abdominal mass. Axial plane contrast-enhanced CT image showed a large-sized, solid mesenteric mass with well-defined borders (arrowheads). Surgical excision confirmed mesenteric desmoid

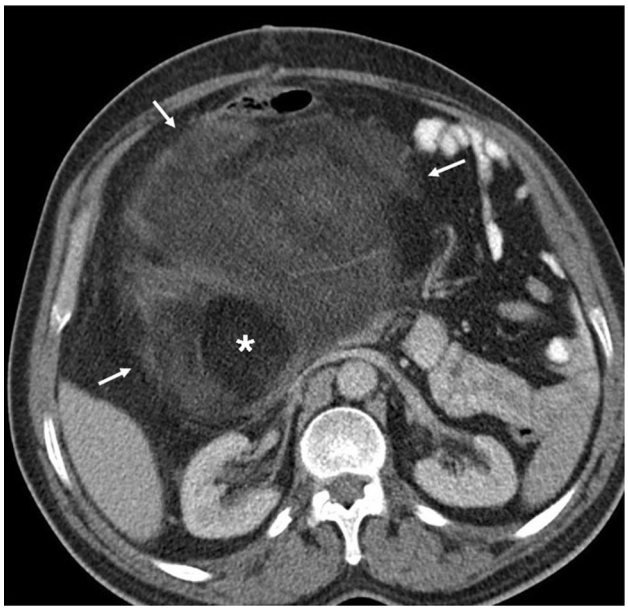

Fig. 14 Mesenteric liposarcoma. A 58-year-old male with a newly detected abdominal mass on physical examination. Axial plane postcontrast abdominal CT image demonstrates the large mesenteric mass (arrows) containing large macroscopic fat (asterisk). Surgical resection confirmed low-grade liposarcoma

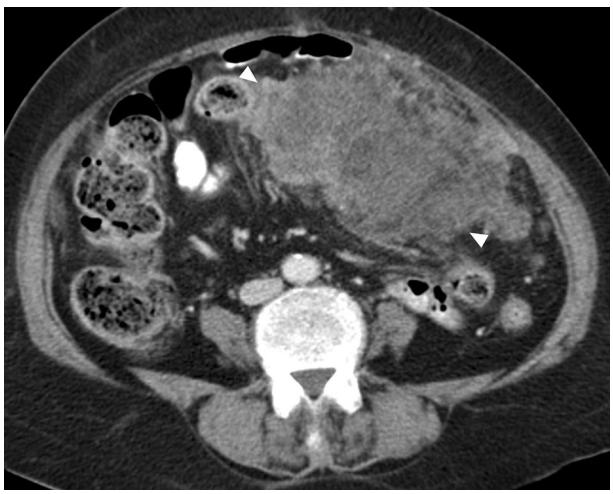

Fig. 15 Mesenteric leiomyosarcoma. A 71-year-old male presenting with a palpable abdominal mass. Axial plane postcontrast CT image shows a heterogeneously enhancing solid mass (arrowheads) within the omentum and the mesentery. Surgical excision confirmed leiomyosarcoma

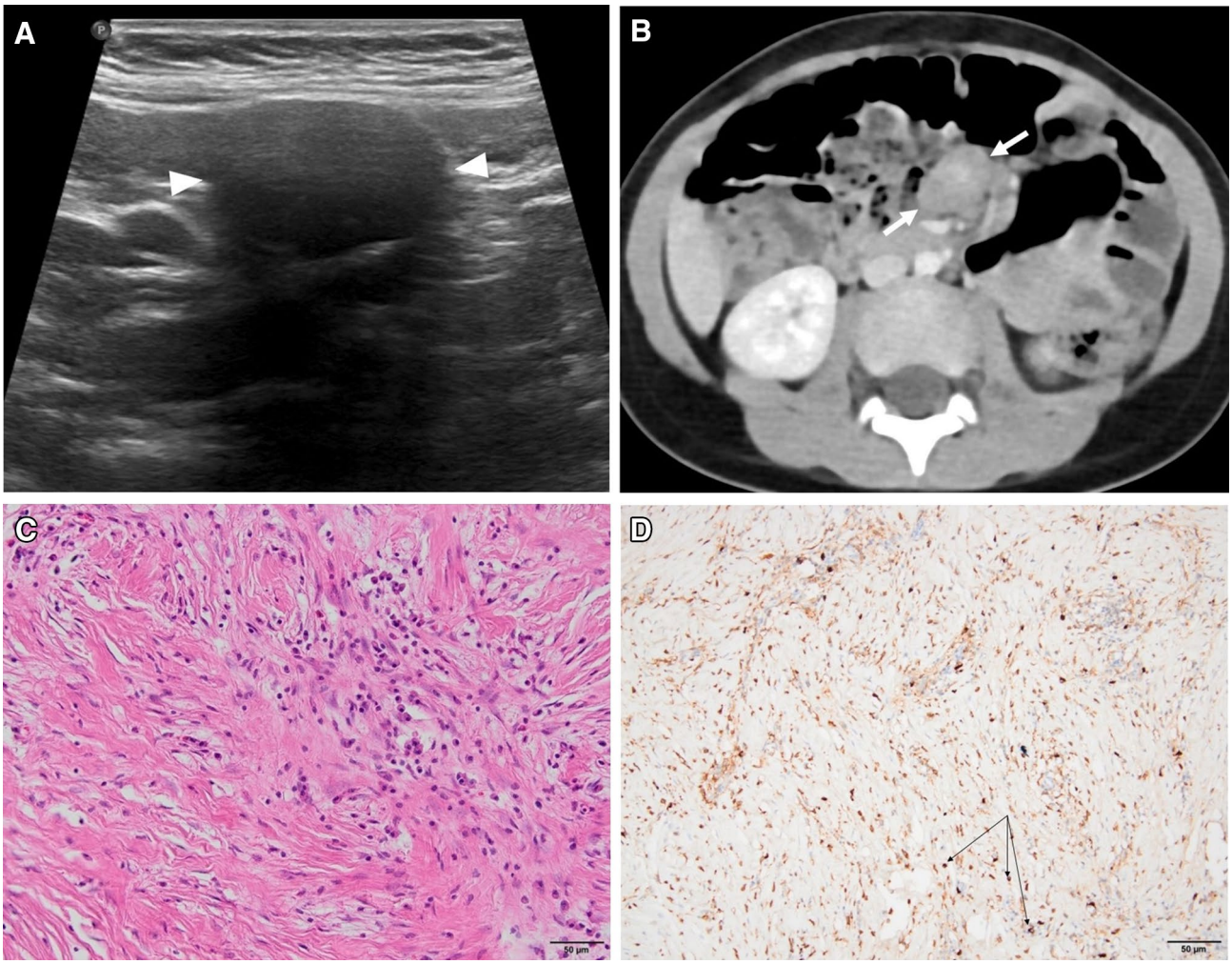

Fig. 16 Mesenteric lymphadenopathy secondary to IgG4-RD. A 4-year-old male patient presenting with intermittent abdominal pain. **a** Abdominal US reveals a hypoechoic nodular lesion suggesting an abnormally enlarged mesenteric lymph node (arrowheads). **b** Axial plane postcontrast abdominal CT image better demonstrated the same lesion adjacent to the mesenteric vessels (arrows). With these findings, the patient underwent surgical resection of this mass. **c** High-power view of an H&E-stained section shows the collagenized background and densely infiltrating plasma cells into the fibrous tissue. **d** Low-power view of an IgG4-immunohistochemistry stained section depicts densely infiltrating plasma cells (thin black arrows). The final diagnosis was an enlarged lymph node due to IgG4-RD

Table 3 Some differential diagnoses of mesenteric lymphadenopathy

Lymphoproliferative diseases
Metastatic lymphadenopathies
Cavitating lymph node syndrome
Localized inflammatory processes
Appendicitis
Diverticulitis
Hollow viscus perforation
Pancreatitis
Mesenteric panniculitis
Systemic diseases
Inflammatory bowel diseases
Connective tissue diseases
Sarcoidosis
Henoch-Schönlein purpura
Infections
Mesenteric lymphadenitis (secondary to bacterial and viral pathogens, mainly Yersinia spp.)
Tuberculosis
Whipple disease
HIV

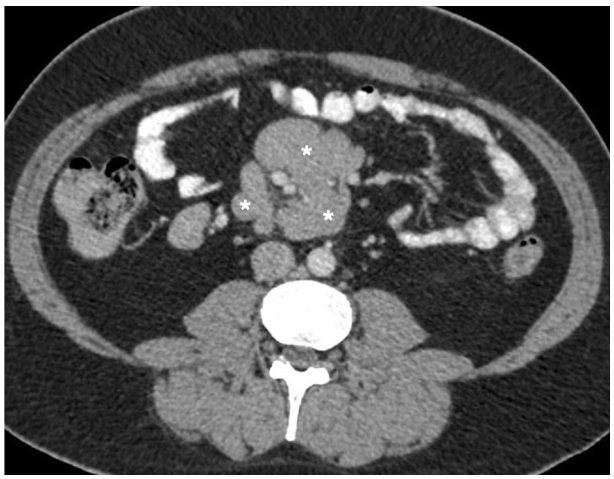

Fig. 17 Lymphoma as a differential. A 28-year-old male with severe night sweats and mild fever. Axial plane postcontrast abdominal CT image shows conglomerating enlarged lymph nodes (asterisks) encircling the mesenteric vessels (the so-called «sandwich sign»). The percutaneous biopsy confirmed mesenteric non-Hodgkin lymphoma

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

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