Abdominal Tuberculosis - Imaging Findings

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Learning objectives

Tuberculosis is a life-threatening disease that can affect any organ or system. Its prevalence is increasing in both immunocompetent and immunocompromised patients in recent years. Tuberculosis has a great variety of clinical and radiologic features and has a known propensity to dissemination from its primary site, usually the lung. Diagnosis of extra-pulmonary tuberculosis is often difficult as it can mimic numerous other disease entities. Thus, it is important to be familiar with its various radiologic features.

In this poster we will illustrate and describe imaging findings of abdominal tuberculosis. We revised the imaging studies performed in our institution in the last two years. We also made a literature review to understand the pathophysiology, prevalence, common imaging findings and main differential diagnosis of the abdominal disease.

Background

Although manifestations of tuberculosis are usually limited to the chest, the disease can affect any organ. Classically, pulmonary tuberculosis is divided in primary and post-primary infection. However there is considerable overlap in the radiological manifestations of these two entities. Post-primary tuberculosis results from reactivation of a previous dormant primary infection. It is almost exclusively a disease of adolescence and adulthood. Post-primary tuberculosis may appear as parenchymal, airway or pleural disease as well as it can affect other organs outside the thorax. Abdominal organs are usually affected after ingestion of infected material such as sputum or by haematogenous or lymphatic dissemination of M*ycobacterium tuberculosis*. Clinical manifestations of abdominal disease are unspecific and depend on the organs involved. It often course with abdominal pain and distension, low grade fever, anorexia and weight-loss. Diarrhoea is usually present when the gastro-intestinal tract is affected.

Abdominal tuberculosis is an uncommon condition in most western-countries, but there has been a resurgence of the disease, associated with AIDS epidemics and migratory fluxes. In our institution tuberculosis is a common disease, probably due to the disfavoured social environment and elevated number of African and Asian immigrants living in the area. Over a period of two years (July 2010 to July 2012), 14 patients with abdominal tuberculosis were diagnosed in our institution. They had a median age of 42 years, 50% were men, 8 were African or Asian immigrants and 6 were HIV positive.

Imaging findings OR Procedure details

There are no pathognomonic features of abdominal tuberculosis in radiological examinations and therefore, microbiological or histological proof should always be obtained by percutaneous aspiration or biopsy. However, imaging studies may suggest the diagnosis, especially in those patients whit multi-organ involvement. The combination of multiple suggestive imaging features in the appropriate clinical context may be the clue to the diagnosis.

Imaging findings in AIDS patients are usually indistinguishable from those seen in non-AIDS patients.

Although tuberculosis can affect any organ in the abdomen, emphasis is placed to intestinal involvement, lymphadenopathy, peritoneal tuberculosis and solid organ disease.

1. Lymphadenopathy

We found lymphadenopathy in 10 of our patients (Fig. 1 to 4). It was the most common abdominal finding. Mesenteric lymph nodes were the most commonly affected (7 patients). In 3 patients nodes were markedly necrotic.

Lymphadenopathy is the most common manifestation of abdominal tuberculosis. Although tuberculosis can affect any lymphatic region in the abdomen, the distribution of the pathologic lymph nodes reflects the lymphatic drainage of the involved organs. Mesenteric, omental, porta hepatis, celiac and peripancreatic lymph nodes are most commonly involved. The commonest route of transmition is the ingestion of infected material (sputum or milk), with associated intestinal tuberculosis. Haematogenous spread from a distant site of infection or direct invasion of the lymph nodes by adjacent infected organs are also possible routes of transmition. Lymphadenopathy patterns vary widely, from increased number of normal sized nodes to large conglomerated masses (Fig. 1). More commonly, affected lymph nodes are multiple, mildly enlarged circular or ovoid nodes. They often have central areas of necrosis (Fig. 2).

At US pathologic lymph nodes may appear as discrete nodular structures or appear as conglomerated masses (Fig. 3). Enlarged nodes commonly have a central hypoechoic area. At CT affected nodes may have low attenuation values or soft tissue density. At contrast enhanced CT, they have typical peripheral enhancement with central non-enhancing areas (Fig. 2). This pattern reflects significant central liquefactive or caseous necrosis and perinodal highly vascular inflammatory reaction. Homogeneous nodal enhancement (Fig. 4) or calcifications may also be seen.

The differential diagnosis of abdominal lymphadenopathy includes metastases, Whipple disease, lymphoma and *mycobacterium avium-intracellulare* infection.

2. Solid organ disease

At our institution 10 patients showed typical manifestations of hepatosplenic disease, appearing as liver and splenic enlargement and multiple abscesses of variable size (Fig. 5 to 7).

Solid organ involvement may occur in association with intestinal tuberculosis, caused by dissemination through the portal venous system. *Mycobacterium tuberculosis* may also reach the liver and spleen by haematogenous or lymphatic spread.

Accordingly to the literature the prevalence of hepatosplenic disease is as high as 80-100%. However, the most common presentation is a nonspecific hepatosplenomegaly, which occurs due to a fine miliary infiltration of the parenchyma (Fig. 5). Individual lesions are often below the resolution limits of imaging methods. Visible abscesses appear at US as round hypoechoic lesions of variable sizes. Larger lesions may have a heterogeneous appearance. At CT microabscesses are multiple tiny hypoenhancing focci (Fig. 6). The macronodular form is rare, presenting with single or multiple hypoechoic, heterogeneous and sometimes calcified abscesses. On CT they appear as solid, hypodense, heterogeneous masses with rim enhancement after contrast administration (Fig. 7). MRI shows hypointense and slightly hyperenhancing lesions on T1-weighted images. On T2-weighted images, the lesions are hyperintense with a hypointense rim relative to the surrounding liver.

Tuberculous microabscesses of the liver and spleen may simulate metastases, fungal infections, sarcoidosis and lymphoma. The differential diagnosis of the macronodular form includes metastases, abscess and primary malignancy.

3. Intestinal tuberculosis

Intestinal wall thickening was found in 8 patients (Fig. 8 and 9). All the patients with intestinal involvement showed alterations in the ileocecal region. Three patients had concomitant jejunal disease and one patient had involvement of the ascending and transverse colon.

The ileocecal region is the most common area of involvement in the gastrointestinal tract, due to the abundance of lymphoid tissue, followed by the ileum, cecum, ascending colon, jejunum, the rest of the colon, duodenum and stomach in descending order of frequency. *Mycobacterium tuberculosis* bacilli infect the gastrointestinal tract after ingestion of sputum or infected milk. The bacilli penetrate the mucosa and infect the submucosal lymphoid tissue. Ulceration of the mucosa occurs, which can be demonstrated by barium studies. Disease progresses with oedema of the intestinal wall, granuloma formation and

caseous necrosis. Dissemination to abdominal viscera can also occur by haematogenous and lymphatic routs from a distant source of infection.

Intestinal involvement is present in in 80-90% of patients, however, radiologic alterations are seen only in 50% of cases. The number of cases found in our institution supports this prevalence.

Barium studies may show mucosal ulcerations, thickening of the ileocecal valve and a wide gapping between the valve and the narrowed terminal ileum (Fleischner sign). In advanced disease the cecum appears conical and shrunken. US may reveal regular and concentric bowel wall thickening. At CT, the most common findings are circumferential wall thickening of the cecum and terminal ileum and asymmetric thinking of the ileocecal valve (Fig. 8 and 9).

The differential diagnosis for ileocecal tuberculosis includes Crohn disease, amebiasis, lymphoma and colon carcinoma.

4. Peritoneal tuberculosis

Peritoneal tuberculosis was also common among our patients (Fig. 10 to 13). Ascites was found in 8 cases and peritoneal thickening in 5 patients. Three of those 5 patients had multiple peritoneal nodules. One patient had omental involvement.

Peritoneal disease is usually associated with widespread abdominal tuberculosis involving lymph nodes or intestine. Tuberculous involvement limited to the peritoneum is rare. Indeed, all the patients with peritoneal tuberculosis diagnosed in our hospital had concomitant involvement of other abdominal organs.

Peritoneal involvement is most commonly caused by rupture of an infected lymph node into the peritoneal cavity. Haematogenous or lymphatic seeding may also occur. Other possible routes of transmition are direct invasion of the peritoneal layers from adjacent infected structures or the discharge of caseous material from the fallopian tubes.

US shows the presence of free or loculated fluid, often with multiple mobile strands of fibrin and echogenic debris (Fig. 10). Echogenic thickened mesentery with or without enlarged mesenteric lymph nodes is also characteristic (Fig. 3).

At CT, ascites has high attenuation values due to the high protein content of the fluid (Fig. 11). Chylous ascites is rare and when present, a fat-fluid level is seen. In rare cases, ascites may have low attenuation values, close to those of water. This probably reflects a transudative phase of the disease, due to immune reaction without infectious peritonitis. CT may also show regular or nodular peritoneal and mesenteric thickening, with loss of normal mesenteric architecture and increased mesenteric vascularity (Fig. 12). Thickened peritoneum usually shows contrast enhancement. Omental involvement

may appear as omental nodules, diffuse infiltration and thickening. Omental cake may be seen (Fig. 13)

Peritoneal tuberculosis is traditionally described in three different types. The wet-ascitic type is the most common and is associated with large amounts of free or loculated ascitic fluid. The fibrotic-fixed type is less common and is characterized by omental involvement, matted bowel loops and mesentery and occasionally loculated ascites. The dry-plastic type is uncommon and is characterized by fibrous peritoneal reaction, peritoneal nodules and dense adhesions. However this classification is not accurate enough to describe all combinations of imaging features.

The differential diagnosis of peritoneal tuberculosis includes peritoneal carcinomatosis, malignant mesothelioma and nontuberculous peritonitis.

5. Associated Findings:

5.1 Thoracic findings

On literature reports only 15% of patients with abdominal tuberculosis have evidence of pulmonary disease. Surprisingly, in our institution, all the cases of abdominal tuberculosis had associated thoracic findings and lungs were normal in only two patients. Most of the affected lungs (10 patients) showed miliary disease and 7 patients had condensation and cavitation of the pulmonary parenchyma (Fig. 14 and 15). Pleural disease characterized by pleural effusion with or without pleural thickening was found in 8 patients. We found mediastinal or hilar lymphadenopathy in 9 cases (Fig. 16).

In post-primary tuberculosis parenchymal disease is usually characterized by parenchymal condensation and cavitation with predilection for the apical or posterior segment of the upper lobes. Multiple segments are involved in most cases and bilateral disease may be present. Cavitation usually occurs within areas of consolidation and indicates activity. Endobronchial spread is also common in active disease appearing as small, poorly defined centrilobular nodules ("tree-in-bud" appearance) (Fig. 14). Pleural effusion is usually small and associated with parenchymal disease. Tuberculous empyema and bronchopleural fistulas may also occur.

Miliary disease reflects haematogenous dissemination of the *Mycobacterium tuberculosis* and appears in lungs as multiple, well defined micronodules with a random distribution (Fig. 15). Miliary disease is usually associated with multiple organ involvement.

The presence of suspicious features in thoracic imaging, such as parenchymal cavitation and miliary disease, although not pathognomonic, should raise the possibility of pulmonary tuberculosis with concomitant abdominal disease.

5.2 Genitourinary tuberculosis

Although genitourinary tuberculosis is the most common manifestation of extra-pulmonary tuberculosis, in our institution genitourinary involvement was found in only 1 male and 2 female patients, involving bladder and fallopian tubes respectively (Fig. 17 and 18). The kidneys are often primary sites for genitourinary tuberculosis, being achieved by haematogenous route. Ureters and bladder may be involved by descent infection. Female genital tuberculosis involves fallopian tubes in 94% of cases (Fig. 17). Tubo-ovarian abscesses may form (Fig. 18). Prostate is the most affected organ of the male genitals. Prostatitis or prostatic abscesses are common.

5.3 Musculoskeletal tuberculosis

Among patients with abdominal tuberculosis, we found 2 cases of concomitant musculoskeletal disease, both affecting thoracic spine (Fig. 19). Tuberculous spondylitis typically affects more than one vertebra, with predilection for the anterior half of vertebral body. Infection involves disc spaces which may collapse. Paravertebral abscesses are also common (Fig. 19).

Other forms of musculoskeletal involvement include extraspinal osteomyelitis, most commonly seen in extremities and tuberculous arthritis mainly affecting large weight-bearing joints.

5.4 Other findings

In our study we also found 1 patient with adrenal involvement and another patient with orbital tuberculosis. Adrenal involvement in tuberculosis is rare. It may manifest as unilateral or bilateral adrenal masses with central areas of necrosis (Fig. 20). Orbital tuberculosis (Fig. 21) is extremely rare.

Although any patient in our study had central nervous system disease, it should also be mentioned due to its prevalence and clinical relevance. Tuberculous meningitis is the most common manifestation of neurotuberculosis. Parenchymal disease can occur with or without meningitis and usually manifests as either solitary or multiple tuberculomas.

Images for this section:

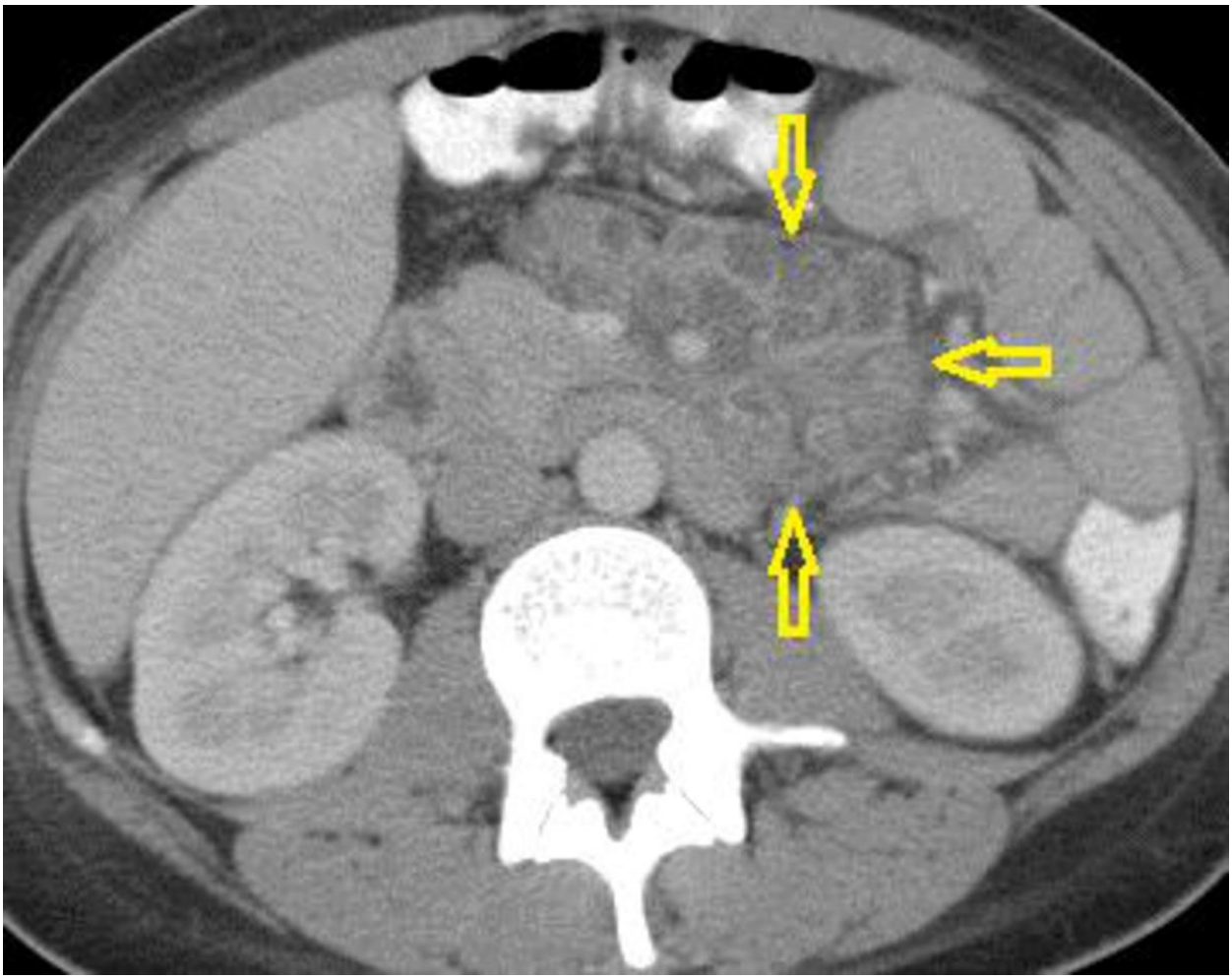

Fig. 1: Contrast enhanced abdominal CT of a 21 year-old female patient demonstrates multiple mesenteric lymphadenopathy forming a conglomerate mass (arrows) with 6 cm in major axis. Most enlarged nodes have central hypoenhancing areas due to necrosis.

Fig. 2: Contrast enhanced abdominal CT of a 55 year-old HIV positive man demonstrates large necrotic mesenteric lymphadenopathies (*). Nodes have a characteristic enhancement pattern with rim enhancement and central hypoenhancing areas.

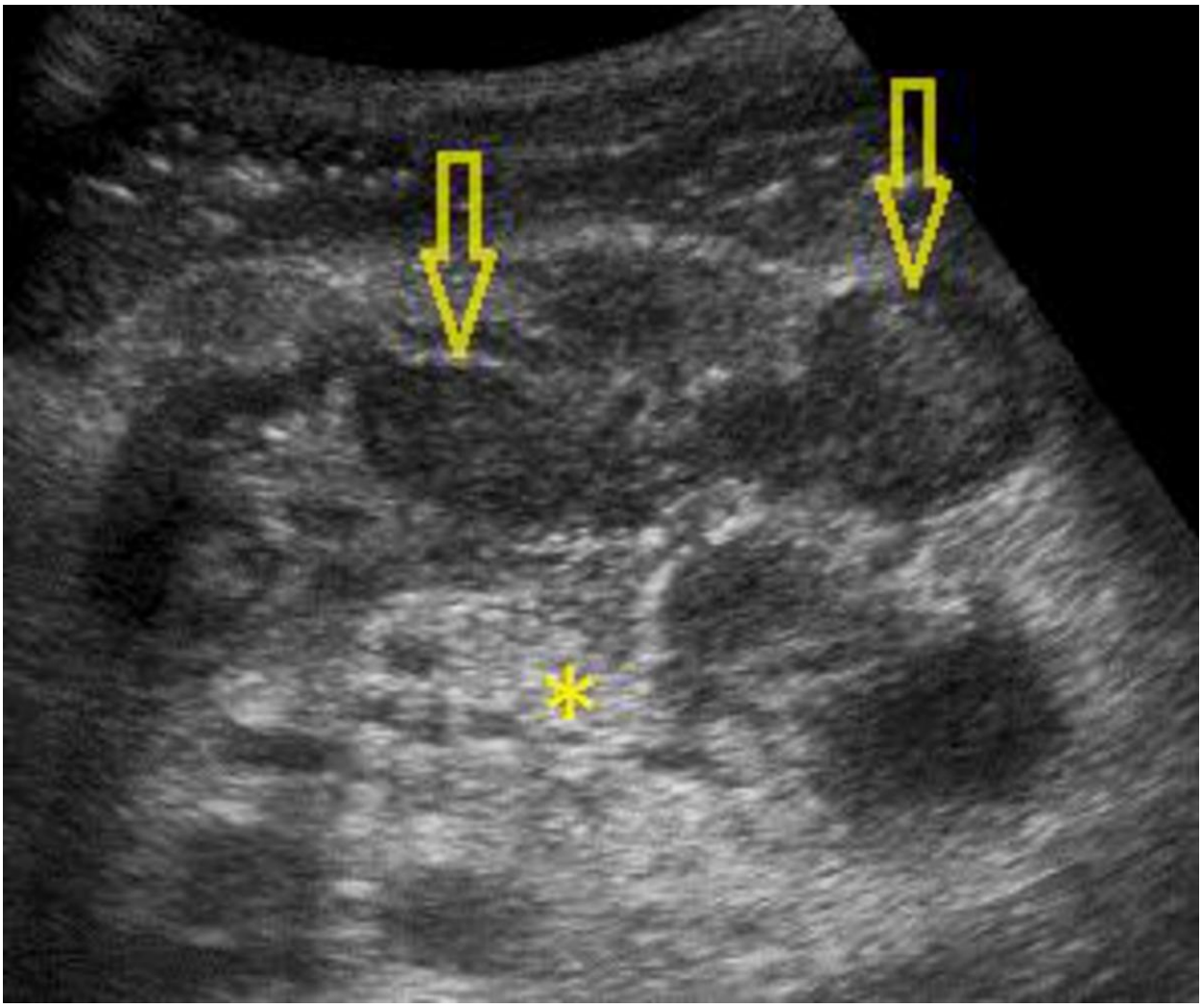

Fig. 3: Abdominal ultrasound of a 41 year-old HIV positive man demonstrates multiple enlarged hypoechoic nodes (arrows) in a thickened hyperechoic mesentery (*).

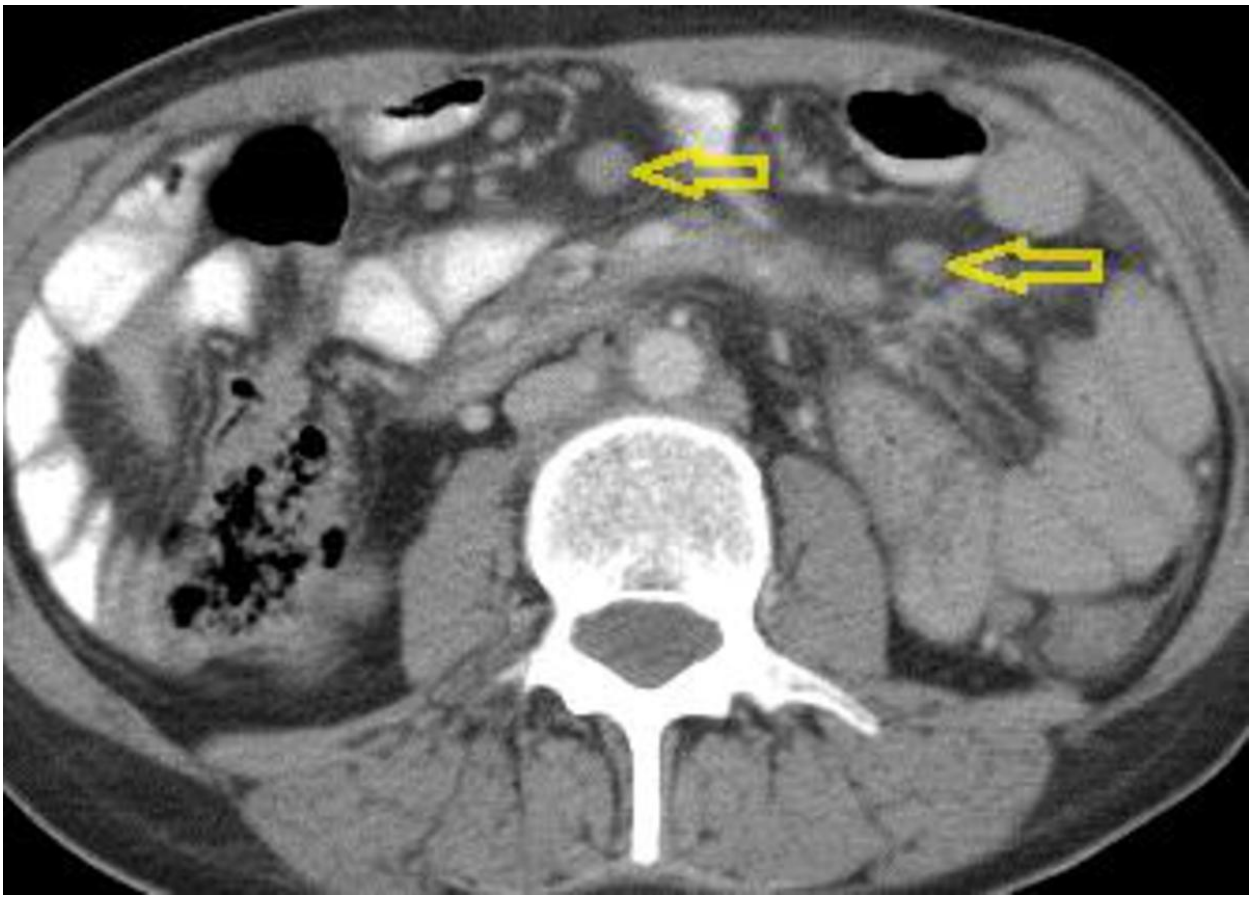

Fig. 4: Contrast enhanced abdominal CT of a 33 year-old female patient demonstrate slightly enlarged mesenteric lymph nodes (arrows) with homogeneous enhancement.

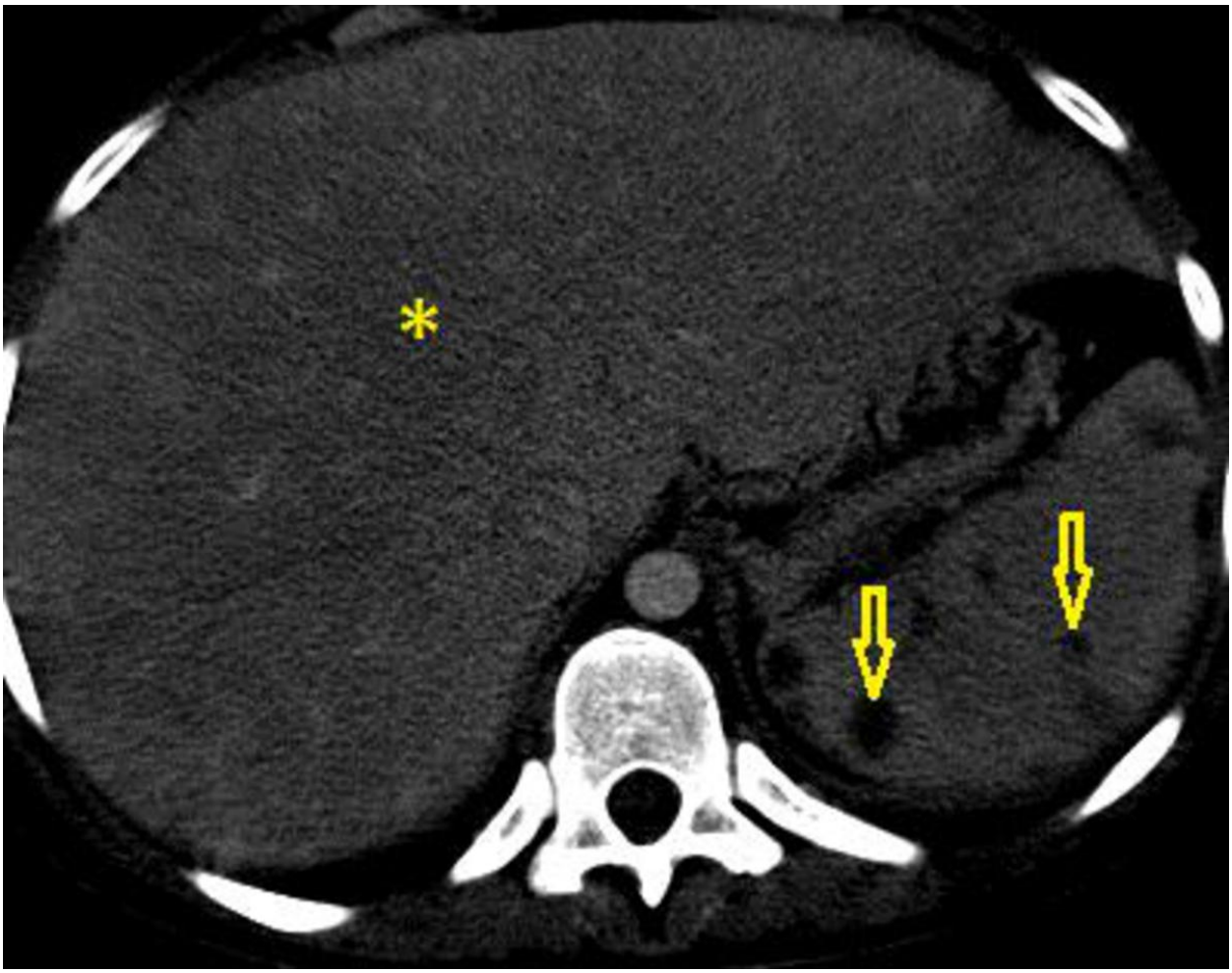

Fig. 5: Contrast enhanced abdominal CT of a 21 year-old woman demonstrates an enlarged liver with heterogeneous parenchyma (*) and multiple hypoenhancing nodules in the spleen (arrows).

Fig. 6: Contrast enhanced abdominal CT of a 45 year-old HIV positive man demonstrates multiple small hypoenhancing focci in the liver parenchyma corresponding to small tuberculous abscesses (arrows).

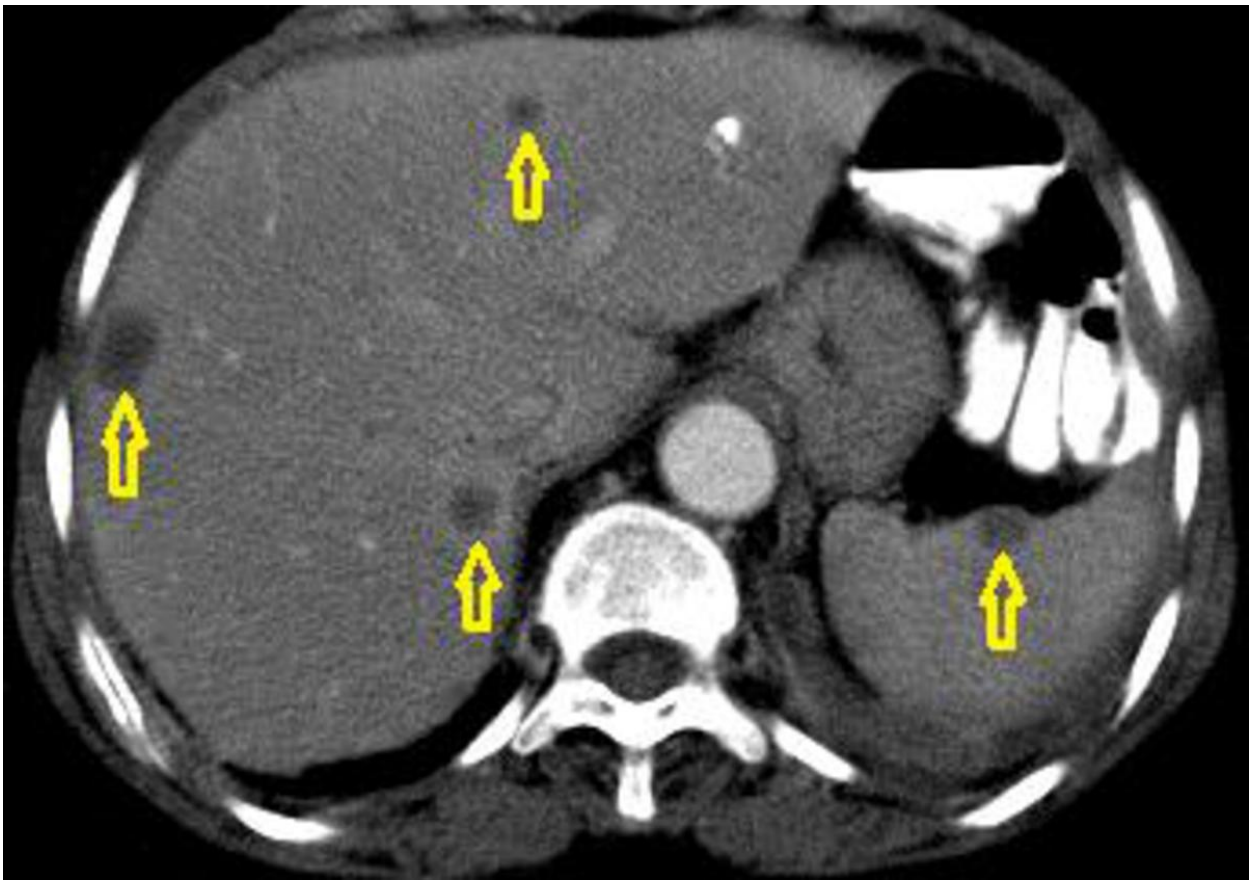

Fig. 7: Contrast enhanced abdominal CT of a 61 year-old HIV positive woman demonstrates multiple hepatic and splenic abscesses (arrows) appearing as hypoenhancing, nodular, well defined lesions. They have a slightly rim enhancement.

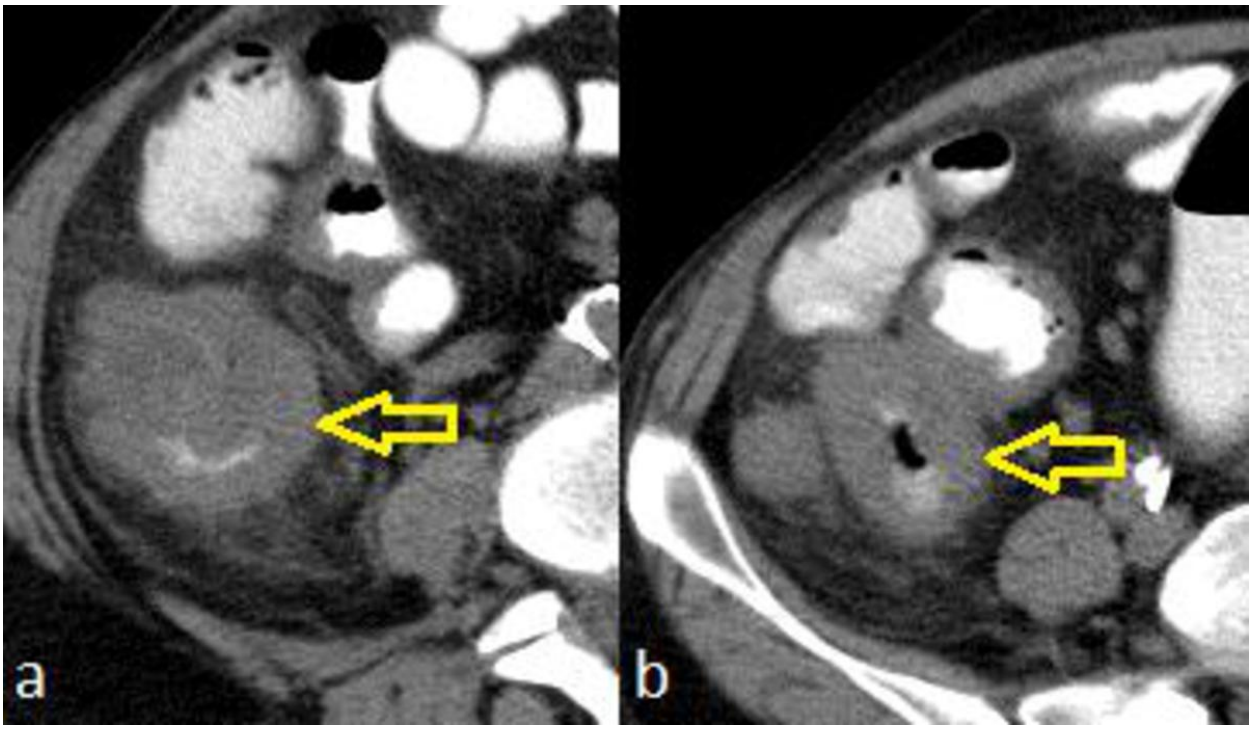

Fig. 8: Contrast enhanced abdominal CT of a 65 year-old male patient demonstrating regular and concentric thickening of the ascending colon (arrow in a) and cecum (arrow in b).

Fig. 9: Contrast enhanced abdominal CT of a 25 year-old male patient demonstrating regular and concentric thickening of the jejunum.

Fig. 10: Abdominal ultrasound of a 49 year-old male patient demonstrates large amounts of free peritoneal fluid with floating echogenic debris.

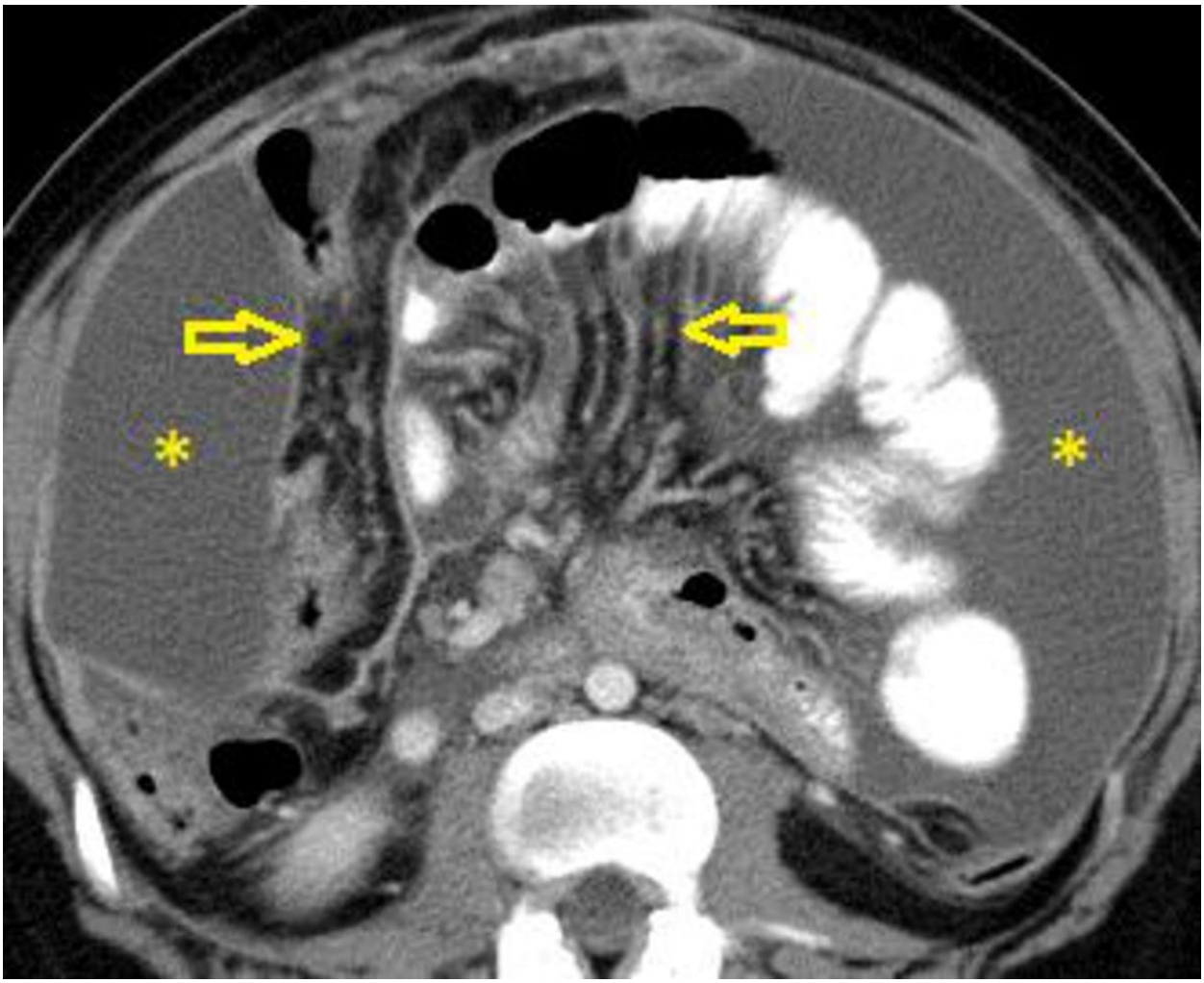

Fig. 11: Contrast enhanced abdominal CT of a 19 year-old female patient demonstrates large volume of high density ascitic fluid (*). It is also visible pronounced peritoneal and mesenteric thickening and enhancement (arrows).

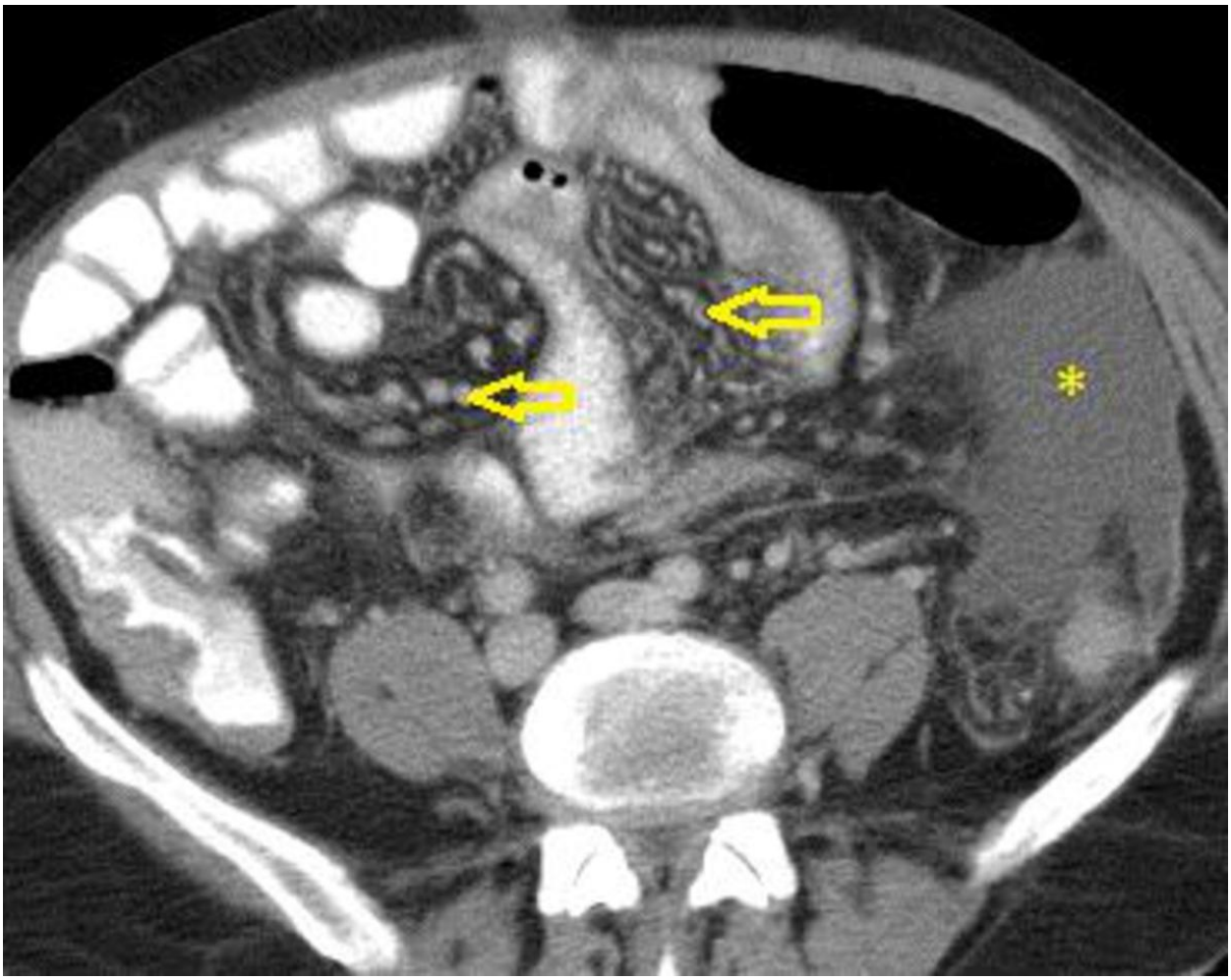

Fig. 12: Contrast enhanced abdominal CT of a 49 year-old male patient demonstrates mesenteric thickening, with loss of normal mesenteric architecture and increased vascularity (arrows). Thickened mesentery also shows contrast enhancement. Small volume of ascites in the left parietocolic gutter is also visible in this section (*).

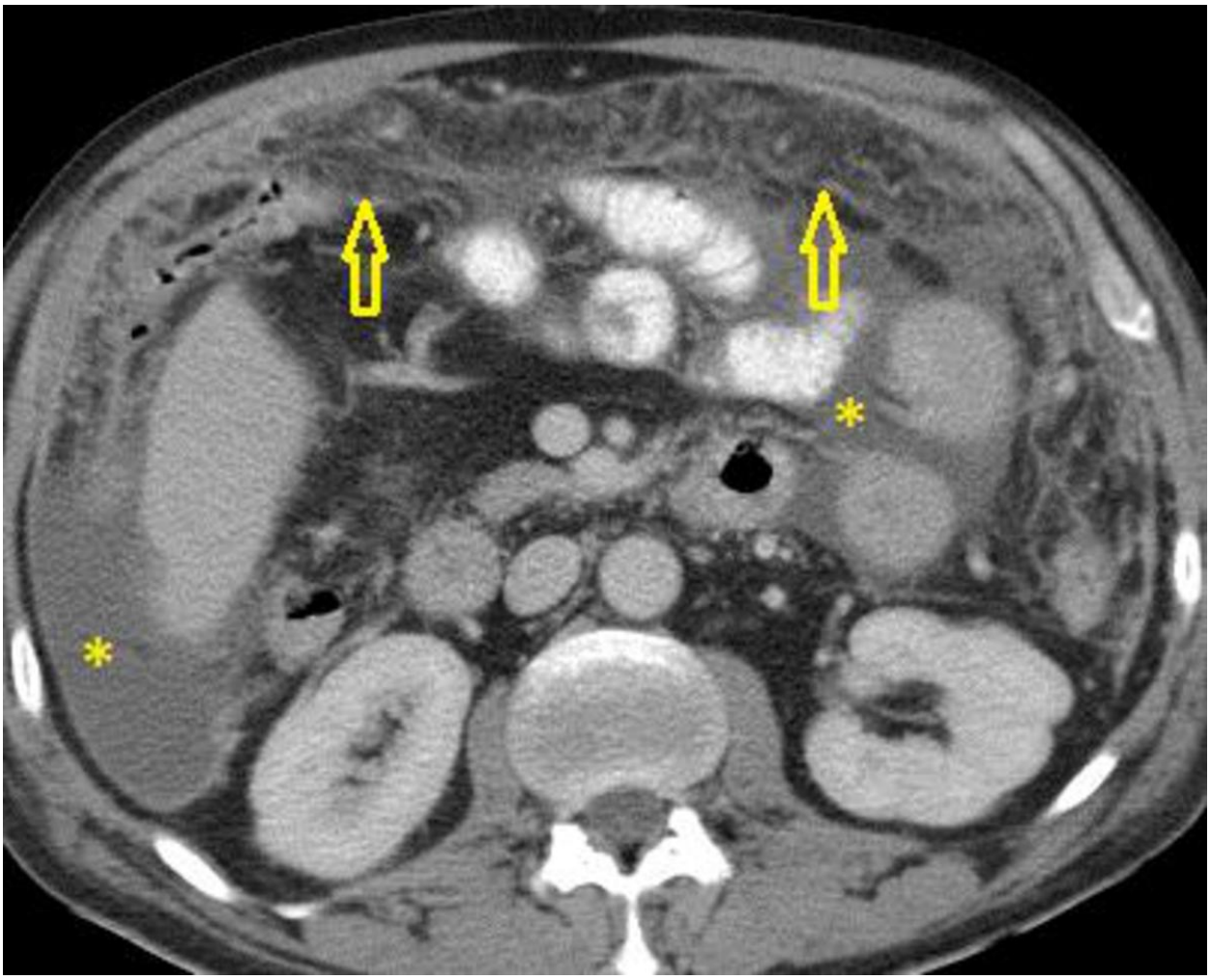

Fig. 13: Contrast enhanced abdominal CT of the same patient shown in Fig. 12 demonstrates diffuse peritoneal involvement with omental thickening, forming an omental cake (arrows). Free peritoneal fluid is also present (*).

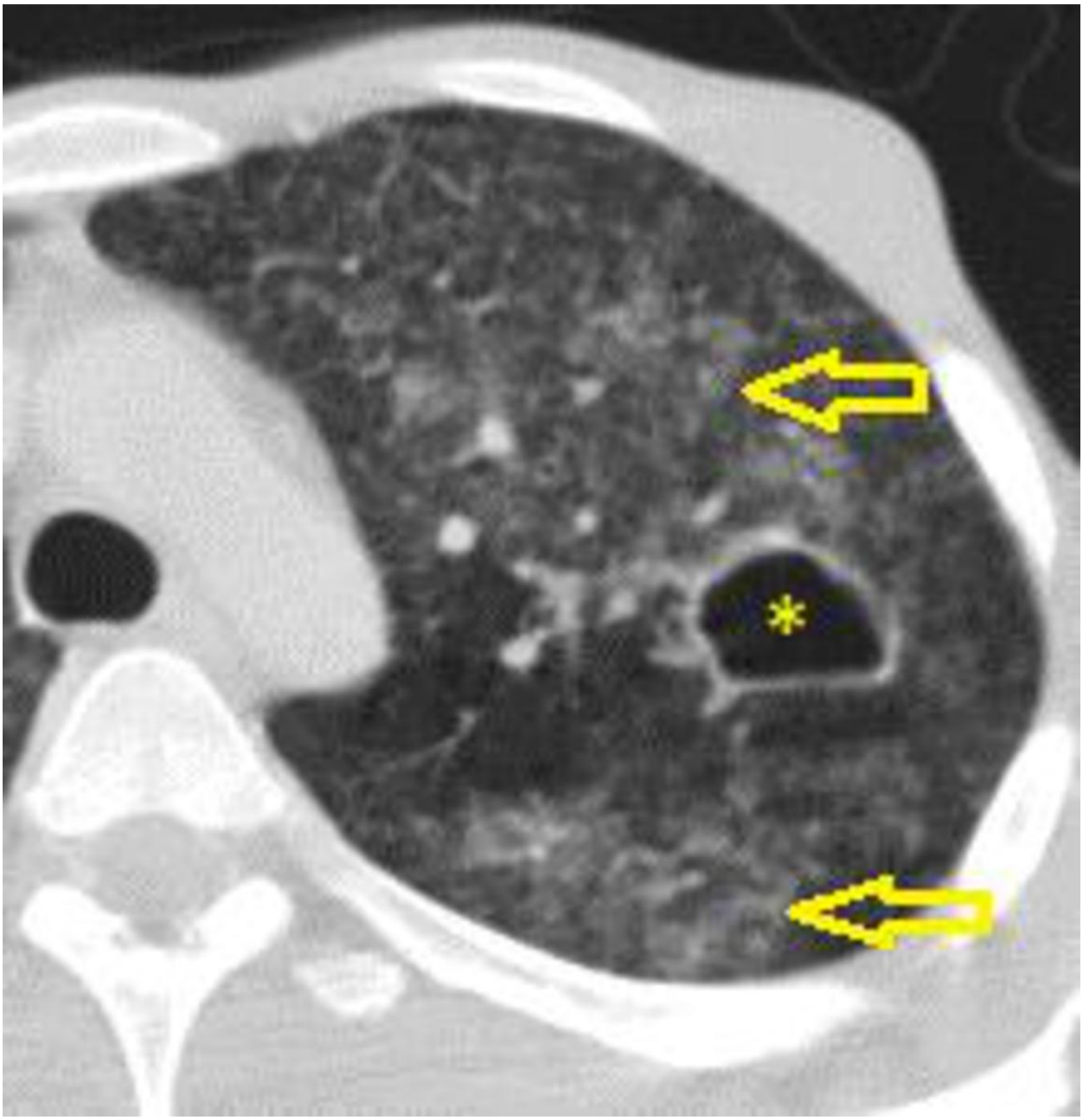

Fig. 14: Thoracic CT of a 25-year-old male patient demonstrates multiple centrilobular coalescing nodules suggesting active infection (arrows). It is also visible in this slice a thin walled cavity in the upper left lobe (*).

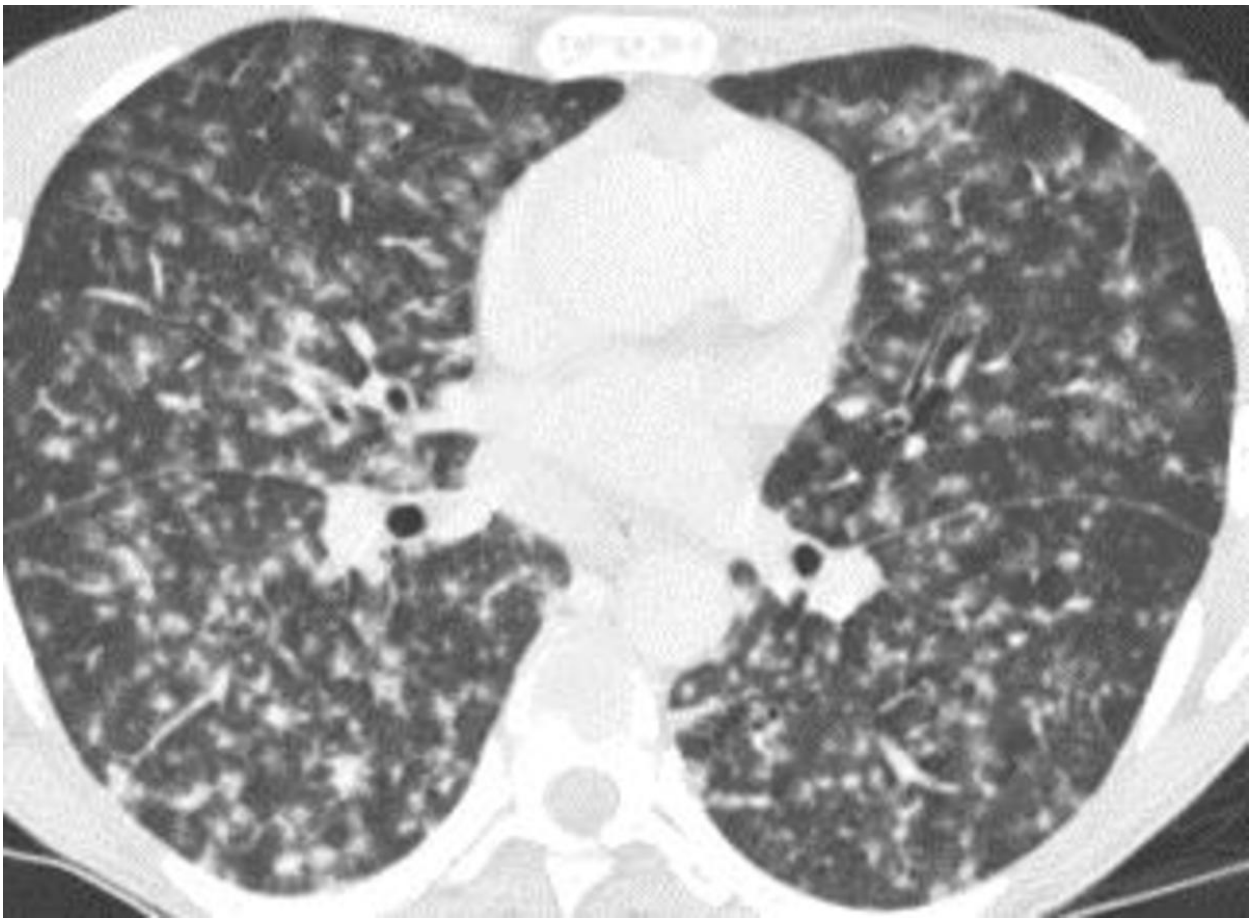

Fig. 15: Thoracic CT of a 46 year-old HIV positive woman demonstrates multiple well defined micronodules with a random distribution. This is a typical finding of miliary tuberculosis.

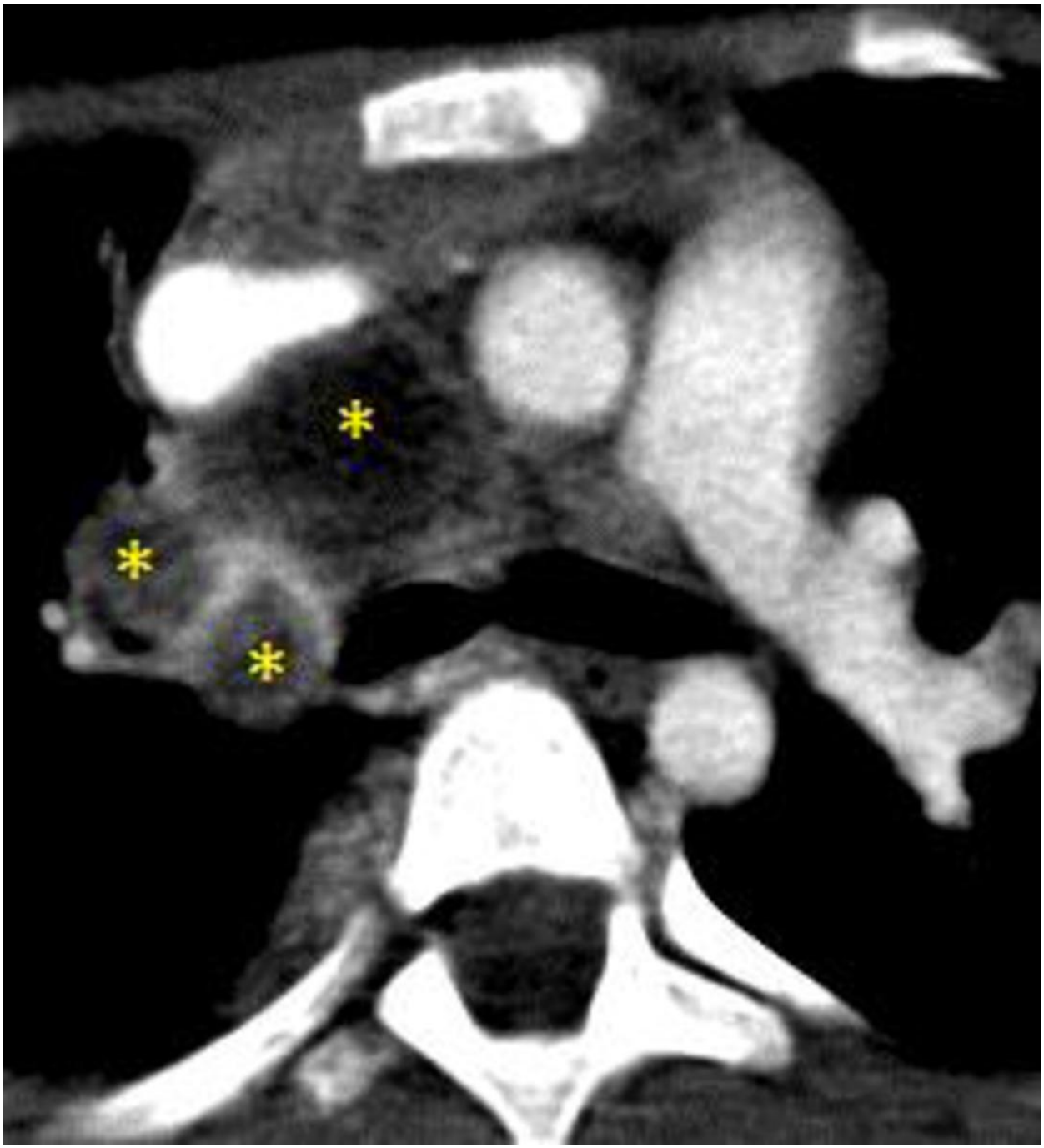

Fig. 16: Thoracic CT of a 6 year-old girl demonstrates multiple mediastinal lymphadenopathies (*). Enlarged nodes have rim enhancement and central hypoenhancing areas of necrosis.

Fig. 17: Pelvic CT of a 33 year-old female patient demonstrates involvement of the ovaries and fallopian tubes with hydrosalpinges (arrow). A small amount of free peritoneal fluid in the pelvis is also present (*). O-right ovary, U-uterus.

Fig. 18: Pelvic ultrasound of a 19 year-old female patient with genito-urinary tuberculosis. The image shows a tubo-ovarian abscess (dimensions: 7,7x3,4cm) appearing as a hypoechoic mass adjacent to the uterus.

Fig. 19: Axial FSE T1 -weighted image (a) and sagittal FSE T2-weighted image (b) of a spinal MRI of a 6 year-old girl with spinal involvement. The images demonstrate spondylodiscitis involving mainly the vertebral body of T10 and extending to the T10-T11 intervertebral disc, which collapsed. It is also visible a paravertebral mass at this level, with extension into the spinal canal.

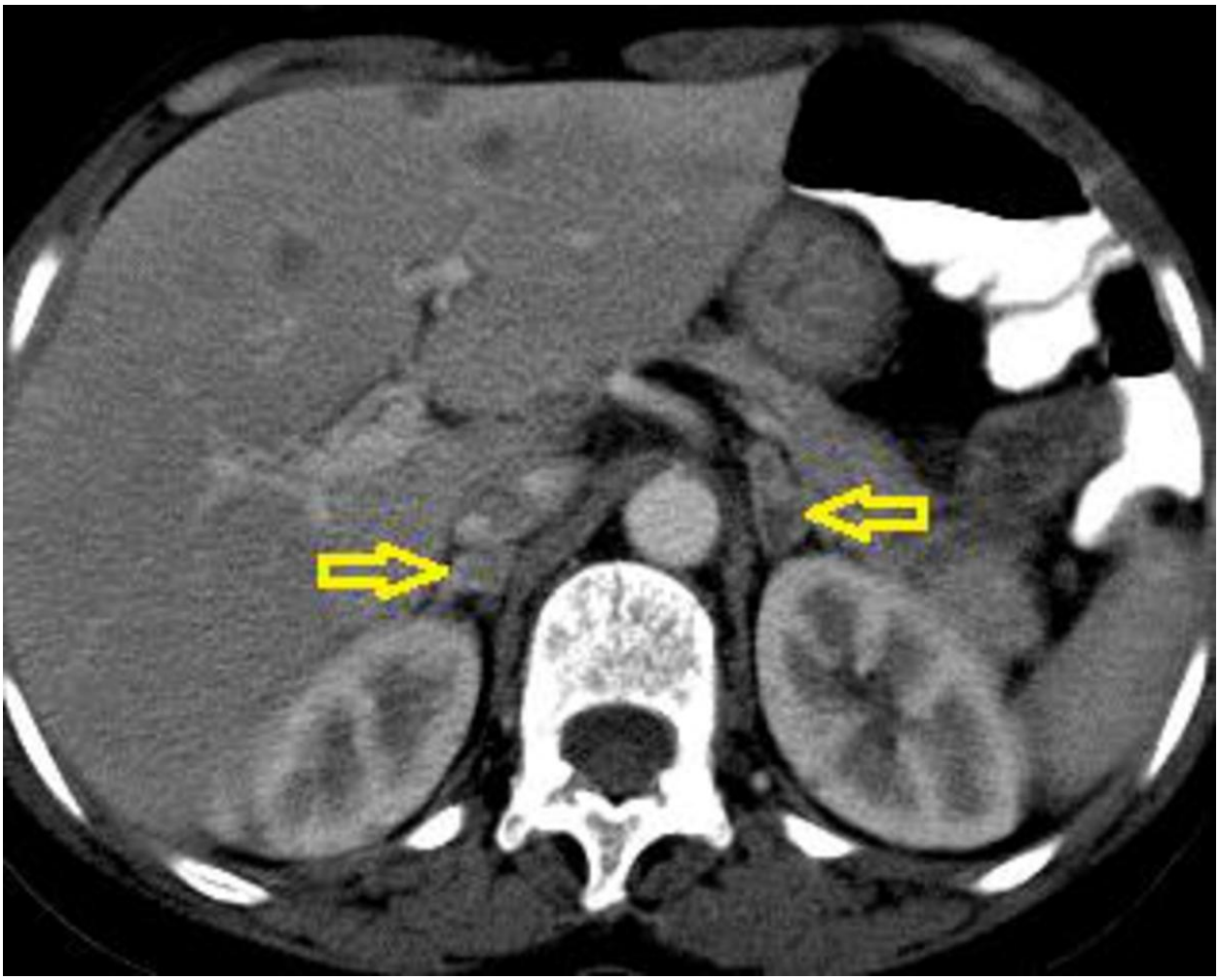

Fig. 20: Abdominal contrast enhanced CT of a 61 year-old HIV positive woman demonstrates bilateral involvement of the adrenal glands (arrows), appearing as bilateral masses with rim enhancement and central areas of necrosis. Three hepatic abscesses are also seen in this section.

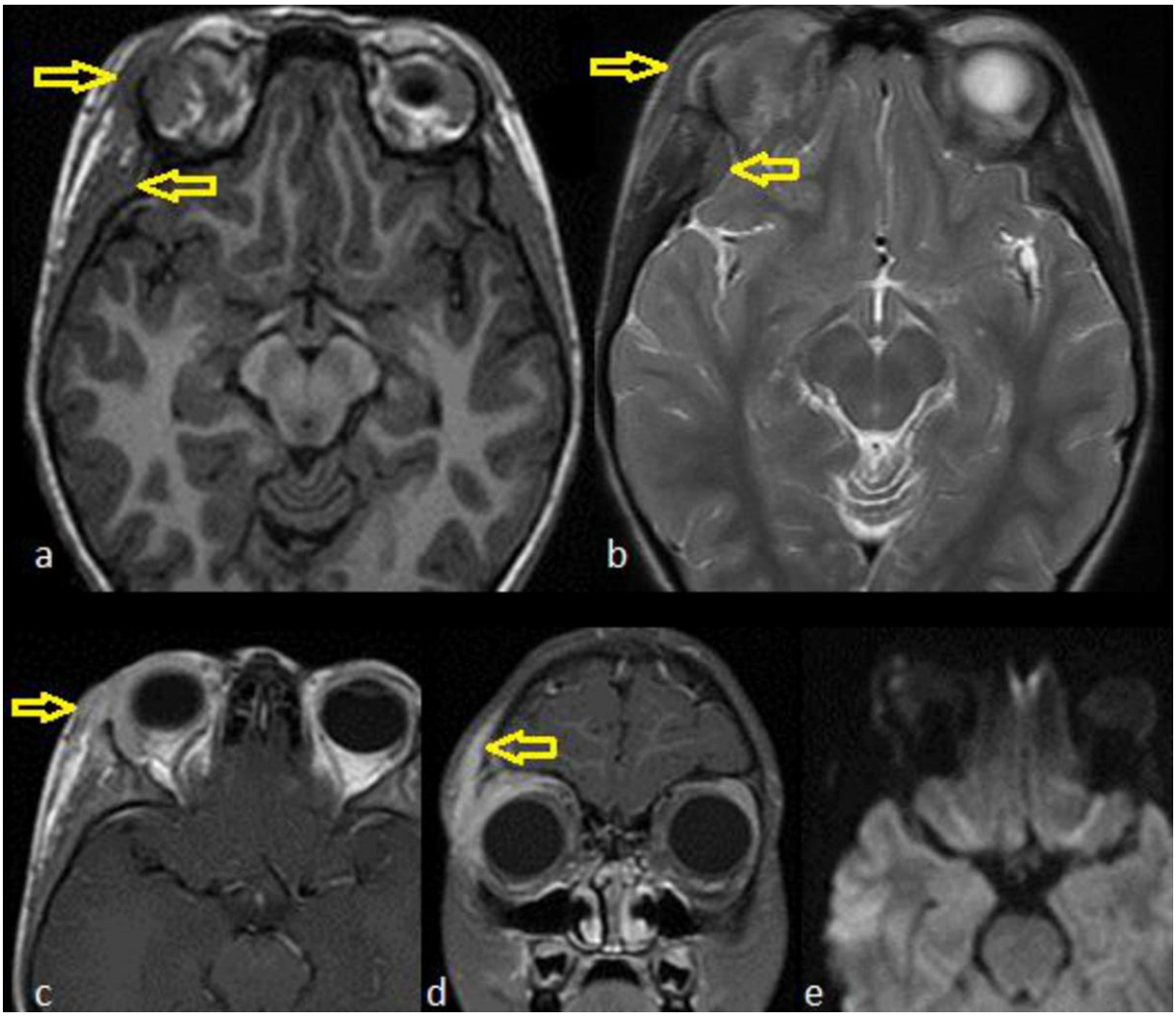

Fig. 21: Axial 3D SPGR T1-weighted image (a), axial FSE T2-weighted image (b), gadolinium enhanced axial SE T1-weighted image (c), gadolinium enhanced coronal SE T1-weighted image (d) and axial diffusion-weighted image (e) of a cranioencephalic MRI of a 6 year-old girl with orbital tuberculosis. The images demonstrate a space occupying lesion in the lateral wall of the right orbit, which displaces medially the ocular globe (a, b) and has contrast enhancement after gadolinium administration (c). The lesion has an intra-orbital component and extra-orbital extension with malar and cranial basis involvement (d). The lesion has no significant diffusion restriction (e).

Conclusion

Determining the correct diagnosis of abdominal tuberculosis remains challenging and requires a high suspicion index. The clinical and imaging features are unspecific and may mimic many different diseases. Even though, obtaining a definite diagnosis is crucial, as untreated disease has a high mortality rate. Although there are no pathognomonic imaging findings, features that suggest abdominal tuberculosis include thickening of the terminal ileum, cecum and ileocecal valve, smooth peritoneal thickening, misty mesentery with necrotic enlarged lymph nodes and free or loculated ascites with debris and septa. Additional thoracic findings may be helpful, raising the suspicion of tuberculosis. For definitive diagnosis of abdominal tuberculosis microbiological or histological proof should be obtained.

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Personal Information