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Abdominal Imaging

Ultrasound in abdominal tuberculosis

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Abstract
Background: The present study was done to emphasize the importance of ultrasound (US) and US-guided fine-needle aspiration biopsy (FNAB) in the diagnosis of abdominal tuberculosis.
Methods: Sixty-six proven cases of abdominal tuberculosis were selected for this study. The diagnosis was based on clinical features, US observations, FNAB, operative findings, and responses to appropriate antitubercular treatment. The US findings were interpreted with regard to the involvement of lymph nodes, intestine, peritoneum, solid viscera, and abdominal abscesses. Patients with disease limited to the musculoskeletal and genitourinary systems were not included in the study.
Results: Peritoneal tuberculosis was the most common form, of the "wet" ascitic type. Ascites was clear in 19 patients and complex in 17. Tuberculous lymphadenopathy was seen in 37 patients. There was a predilection of periportal, peripancreatic, and mesenteric locations compared with the degree of retroperitoneal involvement. Calcification and heterogeneous echotexture were seen in seven cases. FNAB confirmed the diagnosis of tubercular lymphadenopathy in 19 patients. Intestinal disease was seen in 14 patients. Hepatic or splenic involvement was seen as diffuse organomegaly; less commonly, focal lesions were seen.
Conclusion: This combination of US findings in proper clinical settings are diagnostic of tuberculosis. FNAB confirms the diagnosis in lymphadenopathy, abscesses, and focal lesions of the viscera.

Key words: Abdomen—Ultrasound—Tuberculosis—Fine-needle aspiration biopsy—Lymph nodes—Ascites.

Abdominal tuberculosis (TB), a disease with worldwide distribution, manifests diverse clinical pictures, protean profiles, protracted course, and complications [1]. The gastrointestinal tract, lymphatic system, peritoneum, and solid viscera are subject to different degrees of involvement, alone, in combination, or in association with extra-abdominal disease. In the past, radiologic evaluation was confined largely to barium studies, but these studies alone have been of limited usefulness in detecting and locating the full range of abdominal disease. The importance of reaching the correct diagnosis, however, is formidable because untreated abdominal TB carries a 50% mortality rate [2]. Laparotomy, even though an adequate tool for diagnosis, should be avoided, if possible, and even those patients requiring surgery benefit from preoperative antitubercular chemotherapy [3].

Computed tomography and ultrasound (US) offer the advantage of examining the range of abdominal involvement in a single examination. US is a readily available, noninvasive, flexible, cross-sectional modality for imaging the abdomen and pelvis and an ideal guidance technique for exact placement of the biopsy needle [4]. It also permits the monitoring of responses to therapy.

We present the spectrum of US findings of abdominal TB and discuss the role of fine-needle aspiration biopsy (FNAB) in the diagnosis of this disease.

Materials and methods

The clinical records and US scans of 66 patients with abdominal TB were analyzed retrospectively. Barium studies were done in 20 patients who had bowel abnormalities on US or symptoms suggestive of gastrointestinal involvement.

The diagnosis was confirmed by US-guided FNAB of abdominal lesions ($n = 16$), FNAB of peripheral lymph nodes as alternative sites ($n = 6$), peritoneal biopsy ($n = 4$), and at surgery ($n = 2$). In the remaining 38 patients, the diagnosis of TB was based on clinical suspicion, analysis of aspirated ascitic fluid, raised erythrocyte sedimentation rate, and radiologic investigations. This diagnosis was supported by documented responses to antitubercular treatment.

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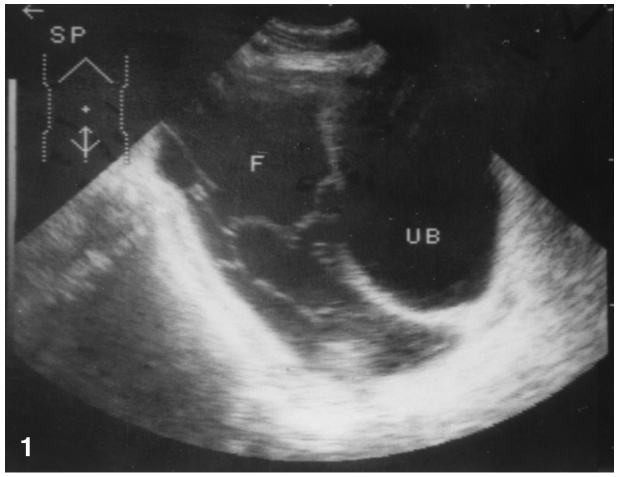
Table 1. Ultrasound patterns of ascites

Nature of ascites	*n* patients[a]	%
Clear fluid	19	53.0
Septae or membranes	13	36.0
Membranes, septae, and debris	2	5.5
Floating debris	2	5.5

[a] $N = 36$ patients



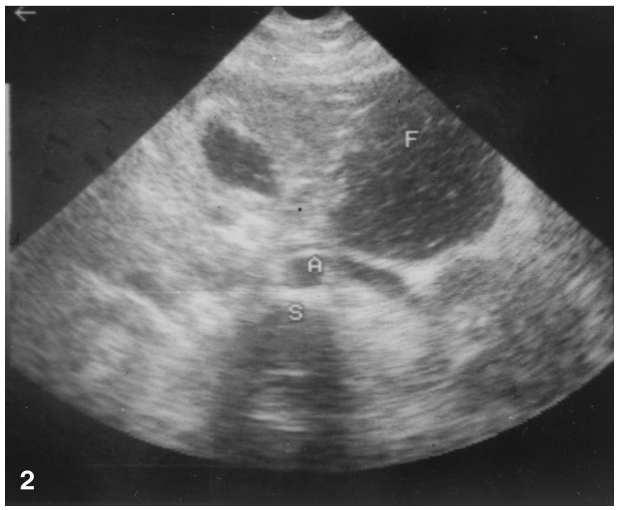


Fig. 1. Longitudinal scan of lower abdomen shows ascites with multiple interlacing septae.

Fig. 2. Transverse scan of the mid-abdomen displays ascitic fluid with internal echogenic debris. *A* aorta, *F* fluid.

The US scans were interpreted for:

1. Lymph node involvement: site (periportal, peripancreatic, mesenteric, or retroperitoneal) and characteristics (homogeneous appearance, hypoechoic central region with peripherally located echogenic regions, or calcification)
2. Intestinal involvement: bowel wall thickening if the wall thickness in transverse sections measured more than 5 mm in the nondistended gut and 3 mm in the distended gut, atypical target configuration, or distended fluid-filled bowel loops showing increased or no peristalsis
3. Peritoneal involvement: ascites (free or loculated, clear or complex; complex ascites was indicated by membranes, septae, or debris) and peritoneal or omental thickening
4. Presence of abdominal abscesses
5. Visceral involvement: homogeneous organomegaly, focal lesion, or calcified foci

Table 2. Associated sonographic findings in tubercular ascites

Associated findings	*n* patients
Lymphadenopathy	12
Intestinal disease	5
Omental thickening	2
Heptomegaly	1
Splenomegaly	4
Calcified foci in liver	1
Pleural effusion	4
Pericardial effusion	1

Results

Patients' ages ranged from 5 years to 60 years. Most were in the third decade of life. Most patients had insidious onset of disease, with duration of symptoms varying from 1 week to 2 years. The most common presenting symptoms were abdominal pain (77%) followed by fever (62%) and anorexia (33%).

TB peritonitis was the most common manifestation of abdominal disease on sonography. It was seen in 38 patients (57%) and manifested as ascites in 36. Several ascitic patterns were identified (Table 1). The most common pattern of ascites was clear fluid in 19 patients. Complex ascites was seen in 17 patients (Figs. 1, 2).

The amount of ascitic fluid was variable. Ascites was free in most cases. Loculated ascites was seen in four patients. In addition to ascites, there were several associated US findings in 25 patients (69%) as detailed in Table 2. Thickened omentum was seen in two patients (Fig. 3). Although ascites was the most common presentation of TB peritonitis, mesenteric abscesses were seen in two cases. Both patients showed an irregular sonolucent area with internal echoes on US, just to the right of the umbilicus in one patient and near the right kidney in the other. Aspiration revealed pus with caseating TB pathology in both cases.

Fig. 3. Transverse scan at the umbilical region demonstrates an echogenic thickened omentum (*curved arrows*). Free fluid is also present (*straight arrow*).

Table 3. Associated sonographic findings in tubercular lymphadenopathy

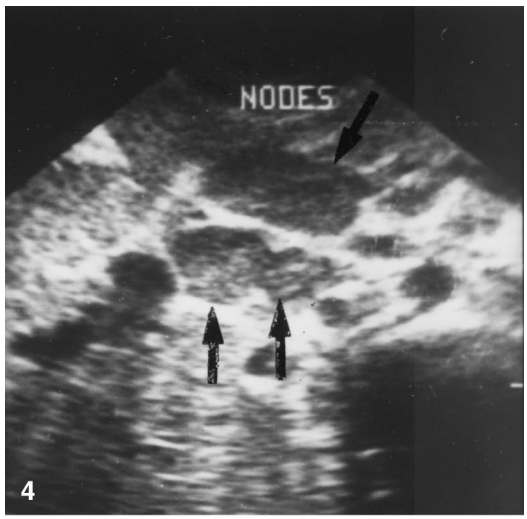
Associated findings	*n* patients
Ascites	12
Intestinal involvement	7
Hepatomegaly	5
Splenomegaly	2
Splenomegaly with focal lesions	1
Pleural effusion	2

Tubercular lymphadenopathy

Thirty-seven patients (56%) had TB abdominal lymphadenopathy. Of these, 20 patients (54%) had associated findings, as detailed in Table 3.

Enlarged nodes were found mainly in the periportal, peripancreatic (Fig. 4), mesenteric (Fig. 5), and upper para-aortic (Fig. 6A) regions. In 27 patients (72.9%), more than one compartment was involved. Of 10 patients who had unicompartmental lymphadenopathy, nine (90%) had periportal or mesenteric lymphadenopathy. The retroperitoneal involvement was mainly of the upper para-aortic group; only two of 15 patients had lymphadenopathy extending up to the iliac groups. The lymph nodes were hypoechoic in most cases; nodes with a hypoechoic central region and peripherally located echogenic regions were seen in five patients. Calcification was demonstrated in two cases (Fig. 7).

Barium studies confirmed the US detected abnormal bowel pattern in seven patients and defined the exact site and extent of bowel involvement. In two patients, barium studies suggested the presence of lymphadenopathy due to extrinsic impression caused on the stomach or bowel (Fig. 6B).



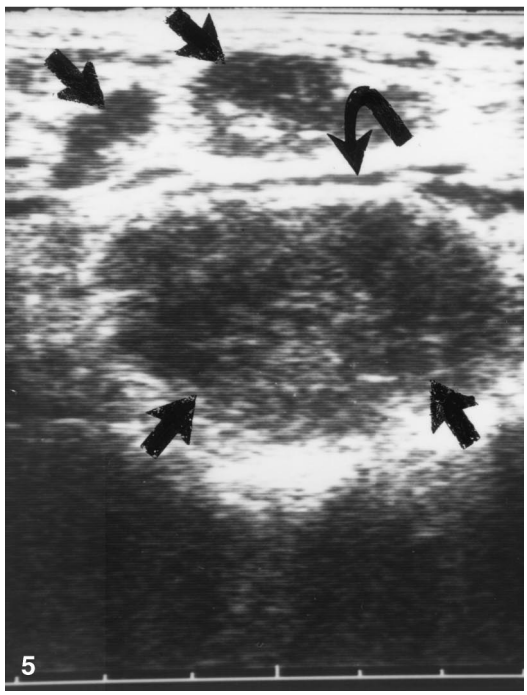


Fig. 4. Enlarged periportal and peripancreatic lymph nodes (*arrows*).

Fig. 5. Sagittal scan demonstrates enlarged, caseating, mesenteric nodal masses (*straight arrows*) surrounding the superior mesenteric artery (*curved arrow*).

Intestinal tuberculosis

Involvement of the gastrointestinal tract was seen in 14 patients. Thirteen patients had associated peritoneal or lymph nodal involvement. In 12 patients, intestinal involvement was suspected on US and confirmed by barium studies (Fig. 8A,B). Of the two patients in whom US failed to detect bowel involvement, one had ascites and the other had lymphadenopathy.

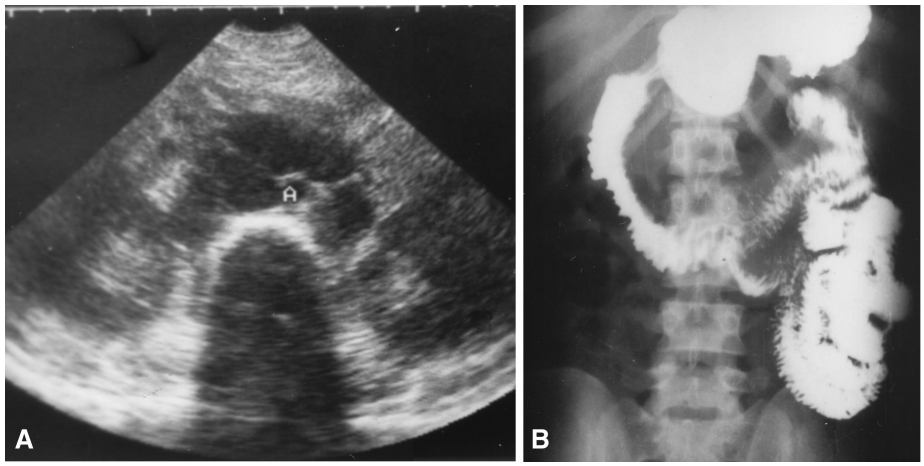


Fig. 6. A Transverse scan of the abdomen shows multiple, enlarged, hypoechoic peripancreatic and paraaortic lymph nodes. **B** Barium study of the same patient reveals an impression on the medial aspect of the duodenal loop.

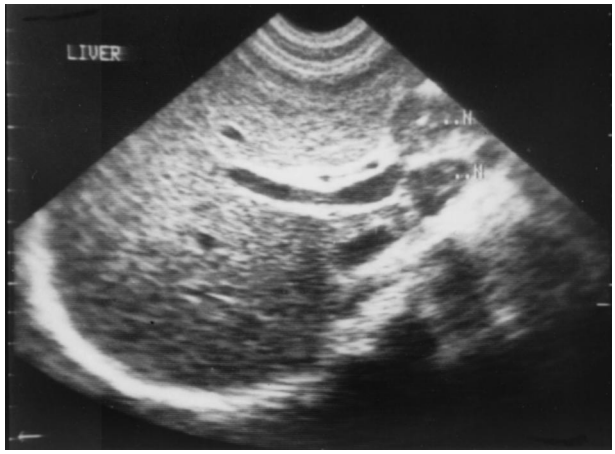


Fig. 7. Transverse scan at the level of the porta hepatis shows enlarged periportal nodes with specks of calcification. *N* node

Hepatic tuberculosis

Hepatic involvement was seen in seven patients (Table 4). Of these, six patients had associated peritoneal or nodal disease.

In a patient with fever of unknown origin for 3 months, a heteroechoic area measuring 8.5 × 6.7 cm was seen in the right lobe of the liver (Fig. 9) Aspiration revealed caseous necrotic material, and improvement was seen after antitubercular treatment.

Splenic involvement

Splenomegaly was seen in five patients. All had associated peritoneal, nodal, or hepatic involvement. One of these patients had multiple hypoechoic focal lesions (Fig. 10). This patient turned out to be positive for the human immunodeficiency virus.

Discussion

Abdominal TB is a disease with protean clinical manifestations. Conventional barium studies, although good for the evaluation of intestinal TB, do not generally provide an indication of extralumenal disease. US and computed tomography are singularly informative in this category of patients. Both modalities have the same ability to detect ascites [5]. However, computed tomography is more accurate than US in detecting the thickening of bowel wall and in delineating the mucosal thickening and lymph node enlargement. But it fails to show multiple, thin, interlacing septa in most patients with tubercular ascites, especially in the subdiaphragmatic and pelvic regions [6]. Its other disadvantages compared with US include limited availability and high cost, especially in developing countries, and its ionizing radiation. US is a simple, readily available, and economical method for the diagnosis of abdominal TB, although it is less accurate due to the disturbance of the US window by bowel gases [5].

Peritoneal TB is the most common form of abdominal TB [7]. It was seen in 38 patients (57%), 36 of whom had ascites that was clear in 19 and complex in 17. Two patients had mesenteric abscesses. These abscesses result from extensive caseation of large masses of lymph nodes [8]. Three forms of TB peritonitis are described:

1. The “wet” type is characterized by ascites that may be free or loculated
2. The “fibrotic fixed” type is seen as large omental masses and matted loops of bowel and mesentry
3. The “plastic” or “dry” type is characterized by caseous nodules, fibrous peritoneal reaction, and dense adhesions [9, 10]

Combinations of these forms are also found [8].

Tubercular peritonitis should be considered when US shows ascites: complex, loculated, or accompanied by hepatosplenomegaly, omental cake, bowel adhesion,

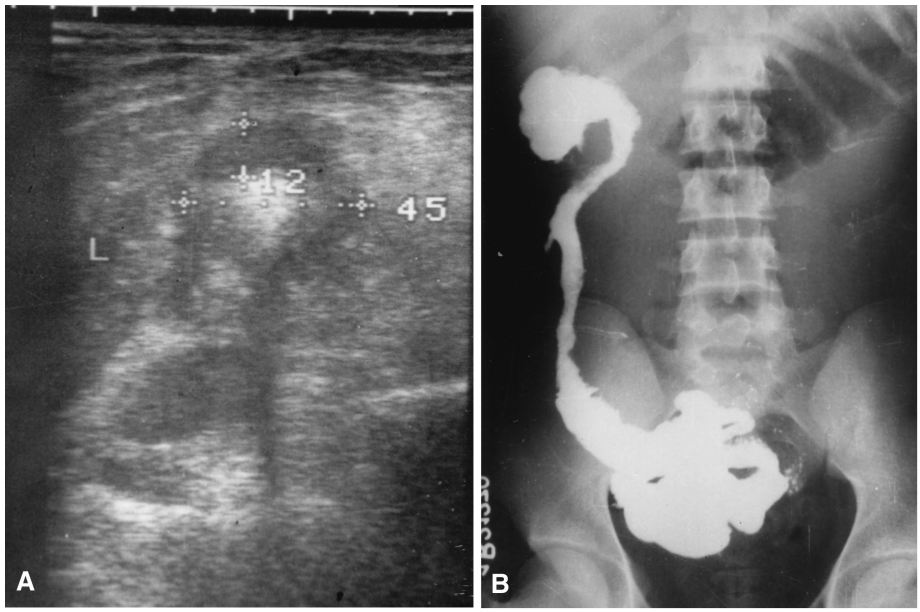


Fig. 8. A Atypical target configuration in the subhepatic region. *L* liver. **B** Barium meal follow-through study reveals stricture of the distal ileum, cecum, and ascending colon, with a deformed ileocecal angle suggestive of TB.

Table 4. Findings of hepatic tuberculosis in seven patients

Sonographic findings	*n* patients
Hepatomegaly with	
Normal hepatic echogenicity	4
Increased hepatic echogenicity	1
Focal lesion	1
Calcified foci in liver	1

Fig. 9. Heteroechoic mass in the right lobe of the liver in a patient with fever of unknown origin. Aspiration revealed caseous necrotic material.

lymphadenopathy, and bowel wall thickening, and an appropriate history and clinical presentation [11, 12].

Abdominal lymphadenopathy was the second most common manifestation of TB on US in this study and was present in 37 patients. There was a predilection and relative severity of the adenopathy in the periportal, peripancreatic, and mesenteric locations compared with the degree of retroperitoneal involvement. A gradient of retroperitoneal involvement most severe in the upper abdomen was also noted. Similar observations have been made in previous studies [9, 13, 14], and perhaps this distribution reflects the lymphatic drainage of sites in the small bowel and liver that had been seeded hematogenously but may not have developed frank, clinically apparent infection. Iliac, lumbar, and lower abdominal node groups are less commonly involved because they drain into the lower extremities, pelvic viscera, and distal colon, areas less likely to be affected by hematogenous TB dissemination, except when infection is overwhelming.

The lymph nodes were hypoechoic in most cases. Calcification or heterogeneous echotexture before treatment are strongly suggestive of TB [14]. Lymph node masses, even when large, do not cause obstruction of the biliary ducts, ureters, or bowel. This noninvasiveness was also seen in our study [13, 15]. Lymph node appearances may not always be valuable in differentiating benign from malignant disease, although ancillary US findings may be suggestive of TB [16]. Guided aspiration biopsies establish the diagnosis in most cases [17]. With therapy, lymph nodes were reduced in an irregular manner.

Gastrointestinal TB was found in 14 patients, and 92.8% had associated peritoneal or nodal involvement.

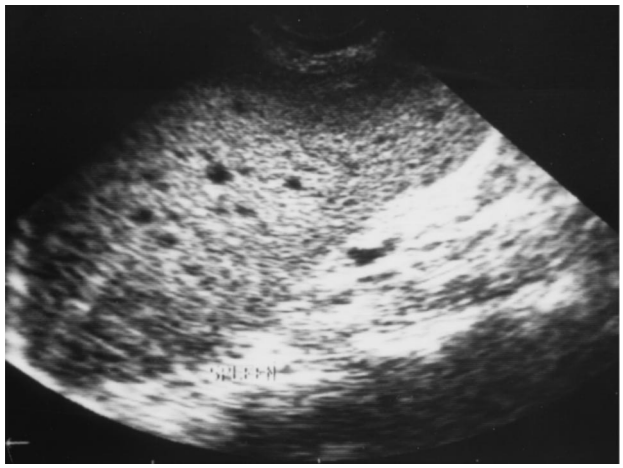


Fig. 10. Ultrasound of spleen shows multiple, well-defined hypoechoic lesions.

Intestinal involvement was suspected on US in 85.7%. The mild wall thickening of small bowel may be overlooked, and it is difficult to distinguish the individual loops when they are adhered together [12]. Although computed tomography is an important imaging modality in demonstrating lumenal changes, barium studies are essential for further characterizing the nature of bowel pathology [13, 18].

TB of the liver or spleen is uncommon, as are the focal macronodular or pseudotumor forms. Hepatomegaly was seen in six patients. Enlarged liver may show normal echogenicity; sometimes increased echogenicity is seen [19]. The macronodular form has been described as a hypo- or hyperechoic, poorly defined, or well-marginated mass. Due to the difficulty in differentiating this from tumoral disease, percutaneous biopsy under US guidance is mandatory in these cases. [20, 21]. Macronodular TB of the spleen is seen as multiple hypoechoic nodules throughout the spleen [20, 22], as in one case in the present study.

US-guided FNAB offers a safe and accurate method of achieving a diagnosis of TB in patients with radiologically demonstrable lesions, especially those involving lymph nodes and the spleen [17]. The yield from bowel FNAB is low, likely due to the presence of desmoplastic reaction.

In conclusion, US is a useful imaging modality for diagnosis and follow-up in patients clinically suspected of having abdominal TB. Although an individual finding may be of limited diagnostic value, the combination of multiple findings and the proper clinical setting can help in the diagnosis. Further, US-guided FNAB is of considerable help in the diagnosis of tubercular lymphadenitis, mesenteric abscesses, and focal lesions in viscera.

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