

# Computerized Tomography Features of Abdominal Tuberculosis

Kobkun Muangsomboon, M.D.\*, Chayanit Thepchana, M.D.\*, Phakphoom Thiravit, M.D.\*, Sorranart Muangsomboon, M.D.\*\*

\*Department of Radiology, \*\*Department of Pathology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.

## ABSTRACT

**Objective:** To describe CT findings of abdominal tuberculosis (TB) because CT has the ability to demonstrate changes in the abdomen and is increasingly used for primary evaluation of abdominal conditions.

**Methods:** The abdominal CT images of 33 patients with proven abdominal TB in Siriraj Hospital from January 2005 to December 2009 were retrospectively reviewed. The CT findings of ascites, peritoneum, lymph node, gastrointestinal and visceral organ involvement were evaluated.

**Results:** The peritoneal and lymph node involvement were the most common features (78.8% of each finding). Peritonitis with ascites (wet type) was more common than dry type. Most of the patients with lymph node involvement had multiple groups (96.2%) and the most common location was mesenteric region. The gastrointestinal tract involvement was likely to be the combination of large bowel and small bowel diseases and the most common feature was bowel wall thickening (88.2%). The solid organ involvement was found about 20.4% which was always the part of multiple organs involvement or disseminated disease. The lymph node involvement in the immunocompromised group was statistically significantly different when compared with the non-immunocompromised group. ( $p < 0.001$ )

**Conclusion:** CT scan is a reliable imaging modality to demonstrate abnormality in the abdominal cavity. The common features in the patients with abdominal tuberculosis include the combination of peritoneal, lymph nodes and multiple organs involvement. Diagnosis of abdominal tuberculosis is sometimes difficult to rely on CT features, so interpretation of images with the clinical and laboratory data could be a valuable tool in the diagnosis of abdominal tuberculosis, especially in patients with non-specific abdominal symptoms. Early and accurate diagnosis leads to an effective therapy and good prognosis with decrease of mortality rates.

**Keywords:** Computed tomography, abdominal tuberculosis

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## INTRODUCTION

Abdominal tuberculosis is an important disease in Thailand. It is increasingly found in developed countries, mainly in patients with AIDS/HIV infection and in other groups of immunosuppressed population. The disease may involve any system in the body in which involvement in the abdomen can mimic many conditions, including malignancy such as lymphoma or carcinomatosis peritonei, inflammatory bowel disease, and other infectious diseases. Early and accurate diagnosis of abdominal TB leads to an effective therapy and good survival rates. On the contrary, untreated or delayed treat-

ment leads to high mortality rates. Therefore it is necessary to early recognize the disease then initiate treatment for this curable disease.

Abdominal TB may present in varying imaging features depending upon the involved organs. Nowadays, CT offers the unique ability to image the entire abdominal structures within a single examination and is widely available. It is therefore important to be familiar with the CT appearances and complications of the disease. This retrospective study describes the CT features of abdominal TB with pathologically proven cases.

## MATERIALS AND METHODS

The retrospective study was approved by our institutional review board. Between January 2005 and December 2009, the patients with proven abdominal TB who had undergone CT scans of the abdomen as part of their diagnostic work up, were included in the study. The

Correspondence to: Kobkun Muangsomboon

E-mail: [Kmuangsomboon@yahoo.com](mailto:Kmuangsomboon@yahoo.com)

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scans were reviewed by one abdominal radiologist. All abdominal CT studies were performed by using 64 MDCT (Lightspeed; GE or Somatom; Siemens).

The diagnosis was established on the basis of at least one of the following criteria:

a) The histological evidence of caseating granuloma.

b) The histological demonstration of acid fast bacilli in the lesion or ascitic fluid.

c) The growth of mycobacterium tuberculosis on culture of the tissue or ascitic fluid.

d) Satisfactory therapeutic response to anti-TB drug in patients with clinical and radiological suspicion of abdominal tuberculosis without pathologic evidence.

The case records were analyzed according to age, gender, immune status, history of pulmonary TB, clinical presentation and CT findings. The patients were divided into 2 subgroups consisting of the immunocompromised and the immunocompetent subgroups.

The CT findings were reviewed and classified for:

(1) The pattern of peritoneal involvement: location and characteristic of involvement, peritoneal thickening, nodularity or mass formation (omental cake) and with or without presence of ascites:

- the quantity of ascites was classified into minimal, moderate and marked ascites, in which "minimal" was defined as thin fluid lined along the perihepatic, perisplenic space or in pelvic cavity, "marked" was defined as globalized fluid resulting in centralization of bowel and "moderate" when the finding did not meet the criteria of minimal or marked ascites. (Fig 1)

- the density characteristic of ascites fluid was classified in 3 levels; less than 10 hounsfield units (HU), 10-20 HU and more than 20 HU.

(2) The pattern of lymph node involvement (size  $\geq 1$  cm. in short axis): location, number (single or matted), necrosis and calcification.

(3) The pattern of gastrointestinal tract involvement: location and its characteristics (wall thickening, stenosis, obstruction, perforation or fistula).

(4) The pattern of solid organ involvement: location (liver, spleen, kidney and adrenal gland), enlargement, abscess and calcification.

The statistical analysis was done by using SPSS program for frequency, mean, percentage. The Pearson Chi-square test and Fisher exact test were also analyzed with the statistical significance ( $p < 0.05$ ).

## RESULTS

The patient's cohorts were 33 patients, composed of 20 males and 13 females. The range of age was 20-79 years old, with the mean age about 46.12 years. The majority of the patients had HIV infection which accounted for 69.70%. In this cohort, none of the patients was on immunosuppressive drug or steroid. The patients with pulmonary tuberculosis were 63.64% and the combination of HIV infection and pulmonary TB was found in 15/33 cases (Table 1). The most common clinical presentation

**TABLE 1.** Immune status and active pulmonary tuberculosis of the patients.

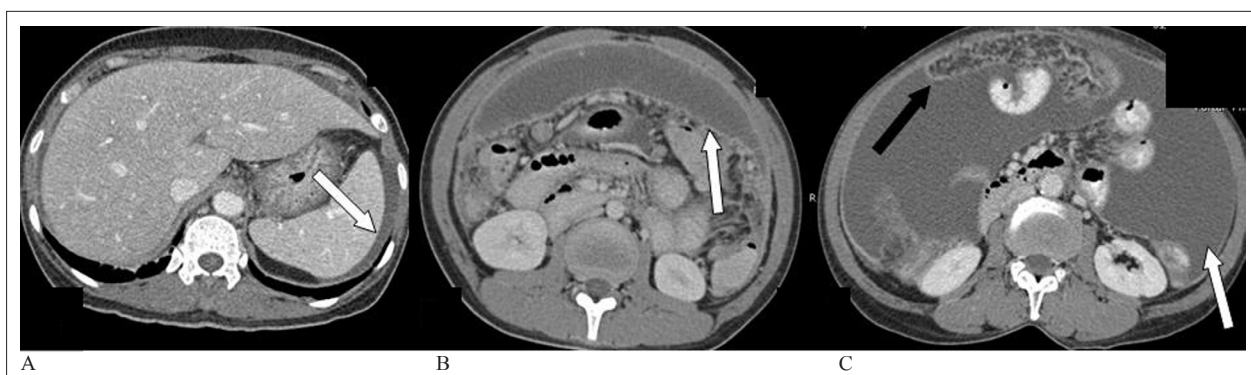
Active pulmonary TB	Unknown	HIV Positive	Negative	Total
Positive	2	15	4	21 (63.64%)
Negative	3	8	1	12 (36.36%)
Total	5 (15.15%)	23 (69.70%)	5 (15.15%)	33

was abdominal pain which accounted for 20/33 cases (60.6%). Other symptoms were fever, abdominal mass, weight loss and one patient presented with high grade bowel obstruction. In this study, 22 patients had the evidence of abdominal tuberculosis by the histological evidence of caseating granuloma or demonstrable acid fast bacilli in the tissue or ascitic fluid (criteria a or b), 16 patients had the evidence of positive mycobacterium tuberculosis on culture (criteria c) and 9 patients had positive tests of both histology and culture. Four other patients had no records of positive histopathology results or culture and had satisfactory therapeutic response to anti-TB drugs. The sites of abdominal involvement have been shown in Table 2 in which the most common sites were peritoneal and lymph node involvement.

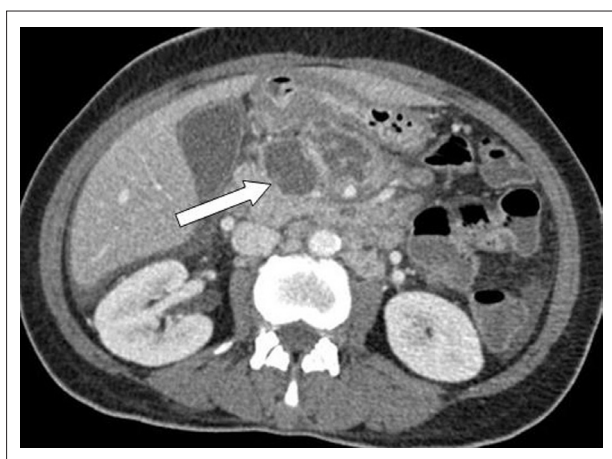
In 26 patients with peritoneal involvement, the CT analysis of the pattern of the peritoneal involvement was classified as "wet peritonitis" when ascites were present and as "dry peritonitis" when ascites were absent. The wet type was more common than the "dry" type (88.46% and 11.54%, respectively). The density of ascites was measured 6-33 HU in range (mean 16.1 H.U.)

**TABLE 2.** CT features in abdominal tuberculosis patients.

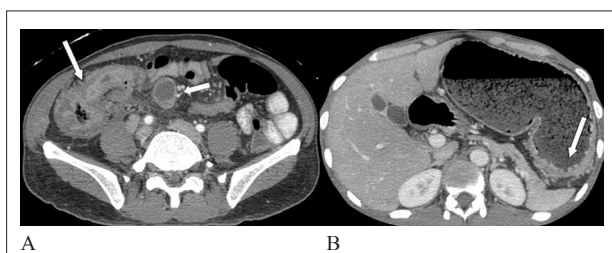
CT findings	No. patients	Percent
<b>Peritoneal involvement</b>	<b>26/33 (N=33)</b>	<b>78.8%</b>
No ascites (dry type)	3/26	
Presented ascites (wet type)	23/26	
density of ascites		
Less than 10 HU	4 / 23	
10-20 HU	15 / 23	
More than 20 HU	4 / 23	
<b>Lymph node involvement</b>	<b>26/33 (N=33)</b>	<b>78.8%</b>
Mesenteric group	24/26	
Para-aortic group	21/26	
Ileo-cecal group	9/26	
Porta hepatic group	8/26	
Iliac group	11/26	
<b>Solid organs</b>	<b>22/33 (N=33)</b>	<b>66.7%</b>
Liver	15/22	
Spleen	14/22	
Kidney	9/22	
Adrenal gland	2/22	
<b>Gastrointestinal tract</b>	<b>17/33 (N=33)</b>	<b>51.5%</b>
Terminal ileum	12/17	
Small bowel	6 / 17	
Ileo-cecal valve and cecum	9/17	
Colon	4/17	



**Fig 1.** Axial images of the contrast enhanced CT (CECT) demonstrated ascites (white arrow). A) Minimal ascites seen as thin fluid layer at perisplenic space. B) Moderate amount of ascites. C) Marked ascites seen as centralization of bowel loop and peritoneal thickening (reticular pattern) of omentum (black arrow).



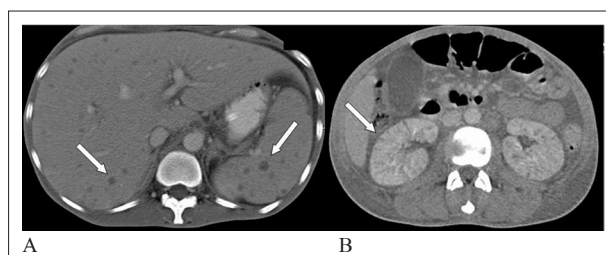
**Fig 2.** Axial image of the CECT demonstrated matted nodes with central necrosis of the mesenteric group (arrow).



**Fig 3.** Axial images of the CECT demonstrated bowel wall thickening. A) Bowel wall thickening of terminal ileum (long arrow) and necrotic node (short arrow). B) Bowel wall thickening at splenic flexure (arrow) causing colonic obstruction (dilated proximal colon) and possibly mimic CA colon.

The pattern of peritoneal disease revealed peritoneal thickening in 25/26 cases; 96.2% (Fig 1C). This pattern was more common than peritoneal nodule (5/26 cases; 19.2%) and omental cake: plaque or mass like lesion (2 cases; 7.7%). The location of disease was found to be generalized in the abdominal cavity and the common locations were paracolic region (80.8%) and omentum (61.5%).

The lymph node involvement was detected in 26/33 cases (78.8%). Twenty five of 26 patients (96.2%) had multiple groups of node involvement. Localized or



**Fig 4.** Axial images of the CECT demonstrated solid organ involvement in abdominal tuberculosis. A) Hepatosplenomegaly and multiple low density lesions or small abscesses. B) Striated nephrogram or inhomogeneous enhancement with micro-abscesses of both kidneys from tuberculous infection.

regional adenopathy was seen in only 1/26 case (3.8%) involving the mesenteric region.

Lymph node enlargement was seen in all patients with nodal involvement (100%) which was mostly matted appearance. Central necrosis was found in 22/26 cases (Fig 2) and calcification was found in only one case. The most common location of the lymph node involvement was mesenteric group, 92.3% followed by para-aortic group, 80.8% and iliac group, 42.3%.

The gastrointestinal tract disease was noted in 17/33 cases (51.5%). The location of disease involvement has been described in Table 2. The majority of the cases had the combination of small bowel and large bowel diseases accounting for 9/17 cases, 52.9%, followed by isolated small bowel involvement (8/17, 47.1%). The terminal ileum was the most common location of gastrointestinal tract disease (12/17; 70.6%). No isolated stomach or isolated large bowel disease was shown.

The gastrointestinal tract disease revealed wall thickening in 15/17 cases (88.2%) (Fig 3), obstruction in 4/17 cases (23.5%) and one patient with jejunal perforation.

The solid organ disease occurred in 22/33 cases (66.7%). The liver and spleen involvement could be seen as organomegaly or focal/multifocal hypodensity lesions (Fig 4A). The adrenal gland showed enlargement in one patient. Renal involvement was seen as multifocal hypodensity lesions (Fig 4B). The combination of the solid organ diseases was seen in 12/22 cases (54.5%) involved



**TABLE 3.** Abdominal TB features on CT in immunocompromised (HIV/AIDS) and immunocompetent patients.

CT features	HIV		P values
	Positive	Negative	
Peritoneum involvement	73.9%	80.0%	1.000
Lymph node involvement	95.7%	20.0%	.001
Gastrointestinal tract involvement	60.9%	20.0%	.153
Solid organs involvement	73.9%	60.0%	.606

in varying combinations. The isolated solid organ involvement without other features was not found in this study.

## DISCUSSION

Causative organisms for abdominal TB are usually mycobacterium tuberculosis or mycobacterium avium – intracellulare, the latter being more common in immunocompromised patients.<sup>1</sup> Abdominal TB is usually caused by injection of the organism in infected sputum or contaminated food. The mycobacterium tuberculosis organism causes caseation necrosis in the intestine, followed by spreading to mesenteric lymph nodes. In this study, two of the most common findings were peritoneal and lymph node involvement, seen in 26/33 cases (78.8%) each. The combination of CT features such as lymphadenopathy, peritoneal, gastrointestinal tract or solid organ involvement was seen in 30/33 (90.9%) cases. Only 3 patients had isolated CT findings, two of which had isolated peritoneal involvement and another one had isolated lymph node involvement.

Peritonitis was more likely to be wet type than dry type and the volume of ascites was small. Ascites in abdominal TB can be transudate ascites due to an early stage of immune reaction or complicated ascites (fluid with septation or debris) due to a late stage of immune reaction or cell mediated immunity.<sup>2</sup> Ultrasound (US) is a good modality to evaluate the complex nature of ascites whereas it is difficult to demonstrate by CT.<sup>3</sup> However, CT is useful in determining the density of the ascitic fluid, especially high density ascites which are presumably due to the complex nature of the fluid. The high density of the fluid has been reported to be specific for TB<sup>4,5</sup> whereas another<sup>6</sup> suggested that it was not a reliable factor and can overlap with peritoneal carcinomatosis or other abdominal inflammatory processes. This study showed variability of ascitic fluid density with a range of 6-33 HU. We divided the range of density into 3 subgroups, consisting of density less than 10 HU, 10-20 HU, and more than 20 HU. The most common subgroup was 10-20 HU (61.5%), which meant that the majority of ascites in abdominal tuberculosis, were not clear fluid. Mesenteric disease is an important and common manifestation of early stage abdominal TB. The mesentery is initially thickened with a few discrete lymph nodes interspersed within it and, the later stage of mesenteric disease represents irregular inflammatory masses of caseating lymph nodes.<sup>7</sup> CT offers the distinct advantage of demonstrating these features better than US because the bowel gas may alter visualization of the mesentery on US.

In this study, the abdominal lymphadenopathies were found in 78.8% of cases which commonly involved the mesenteric region, followed by para-aortic and iliac regions and mostly occurred in multiple groups. These results are similar to the previous study in which the lymphadenopathies involved mesenteric, portal and peripancreatic sites reflecting the lymphatic drainage of the small bowel.<sup>8</sup> The lymph node characteristics, are usually matted together with hypodense center or central necrosis, probably due to caseation, and many occasionally contain calcification.<sup>9,10</sup> Although central necrosis with rim enhancement of lymph node is not pathognomonic, it is a useful sign and readily seen in the current generation of CT scanners. Our study found central necrotic nodes about 84.6% and calcific node in only one patient (3.8%).

The most common sites of gastrointestinal tract TB are terminal ileum and cecum.<sup>11-14</sup> Gastrointestinal tract TB may be ulcerative type, hyperplastic type or a combination of the two. The ileo-cecal TB is often hyperplastic type.<sup>15</sup> In the early stage of the disease, circumferential wall thickening of the cecum and terminal ileum and a few regional nodes are seen. In later stages of the disease, the ileocecal valve and adjacent medial wall of the cecum are predominantly and symmetrically thickened. However, these changes are nonspecific and may also be seen in cecal carcinoma, Crohn's disease, lymphoma and amebiasis. In advanced ileocecal disease, there are gross wall thickening, adherent small bowel loops, large regional lymph nodes and mesenteric thickening together forming a complex mass of varied density, which are characteristic of CT appearance of TB. In this study, we also found the terminal ileum as a common site with wall thickening. One patient had jejunal perforation. There was no case of isolated colonic, gastric and duodenal TB in this study which had been documented as rare entities. Barium examination is one of the best modalities to evaluate mucosal change of the bowel, although evaluation of extramucosal disease is limited. Thus, CT is valuable in evaluating directly the extramucosal component of the disease.

Visceral TB is rarely seen in isolation, but more frequently in parts of multi-organs or disseminated disease.<sup>2,16-18</sup> Liver and spleen are the mainly involved organs and the patterns can occur in the form of micro abscesses in miliary TB, which is represented by CT as diffuse low density focal lesions or in the form of larger abscesses. This study found visceral TB in 22/33 cases (66.7%) similar to other studies<sup>19,20</sup> and the common feature was organomegaly and small abscess (63.6%). No calcified granuloma was visible.

In this study, the authors tried to describe the difference of CT features in immunocompromised and immunocompetent patients. We had only HIV/AIDS infection patients in the immunocompromised group. We found that the lymph node involvement in the immunocompromised group was more common than the immunocompetent group ( $P < 0.05$ ) which was statistically significant whereas the peritoneal, gastrointestinal tract and solid organ involvement showed no significant difference. (Table 3)

In addition, we found pulmonary TB in 21/33 cases (63.64%) and the combination of TB and HIV/

AIDS was found in 15/33 cases (45.5%). The limitation of this study was the difference in number of patients in the two subgroups. We found abdominal TB in the immunocompromised patients more than immunocompetent patients, although this might reflect the association between abdominal TB and immune status.

## CONCLUSION

CT scan is a reliable imaging modality to evaluate abdominal tuberculosis and to demonstrate the variety of abnormal findings in the whole abdomen. The common features in the patients with abdominal tuberculosis include the combination of peritoneal and lymph nodes involvement, solid organs involvement and gastrointestinal tract involvement, respectively. The radiologist may suspect abdominal TB in patients with systemic illness and abdominal symptoms when there is evidence of peritoneal disease, lymph node or several organs involvement. Although there is no only one characteristic CT feature to diagnose the disease, interpretation of CT images along with clinical and laboratory data can be a valuable tool to make the diagnosis of abdominal tuberculosis especially in immunocompromised patients. Last, early and accurate diagnosis leads to an effective therapy and good prognosis with decrease of mortality rates.

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