

## ORIGINAL RESEARCH

# Spectrum of Findings of Tuberculous Peritonitis on CT Imaging

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## ABSTRACT

**Background:** Diagnosing abdominal tuberculosis is still a big problem because of lack of clinical symptoms and signs. Early and precise diagnosis leads to successful therapy and a high chance of survival. Therefore, the study is conducted to find the spectrum of findings in tuberculous peritonitis patients in New Delhi, India.

**Materials and Methods:** An observational cross-sectional descriptive study was done at ABVIMS and associated Dr. RML Hospital in New Delhi at the Department of Radio Diagnosis. The investigation lasted 30 months, from January 2021 to June 2023. Ultrasound imaging of the abdomen was done followed by Dual phase CT acquisition using Siemens somatom drive 256 slice CT. The data were collected from a total of 44 study participants.

**Results:** Half of them 22 (50%) were males. The mean age with SD (standard deviation) of the study population was 42.09 (18.40) years. Mantoux test was positive in 25 (56.8%). On ultrasound examinations, most of the study participants had ascites with septations 19 (43.2%). Uniform and smooth thickening and enhancement of the peritoneal lining was the most commonly observed CT finding at 43 (97.7%), followed by ascites at 42 (94.4%).

**Conclusion:** CT imaging offers an easy and early diagnosis of tuberculous peritonitis. Enhancement of peritoneal lining and ascites were the common findings of tuberculous peritonitis on CT imaging.

**Key words:** Tuberculous peritonitis, ultrasound, computed tomography, peritoneal thickening, ascites

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## Introduction

Tuberculous peritonitis is an uncommon form of tuberculosis (TB) that affects around 4% of all tuberculosis patients [1]. Risk factors for tuberculous peritonitis include renal failure, cirrhosis, alcoholism, steroids, type 2 diabetes, intravenous drug usage, malignancy, and AIDS [2]. The introduction of antituberculosis chemotherapy, combined with socioeconomic advancement, reduced the incidence of all tuberculosis types [3]. Though abdominal tuberculosis continues to be a serious public health issue. The cases of the illness have recently increased in places where it was previously rare. Increased migration and travel, as well as a rise in the number of people living with HIV who are vulnerable to opportunistic infections, are partly to blame for this. Evidence of a rise in the prevalence of extrapulmonary TB has been accumulating. [4]. The peritoneum, mesenteric lymph nodes, and the digestive tract may be affected by abdominal TB. Intersections between these categories have also been

considered on occasion. Peritoneum is a common site for extrapulmonary location of tuberculosis [5]. HIV patients and those on dialysis for the management of chronic renal failure are also more susceptible to get TBP[6]. This disease's diagnosis continues to provide considerable hurdles. This is owing, in part, to a lack of pathognomonic clinical signs that might normally aid in pursuing the diagnosis when suspicion exists, as well as the poor yield of routinely used laboratory investigations. Detection of Mycobacterias is challenging, and therefore laparoscopy is typically required for management [7]. Early and precise diagnosis leads to successful therapy and a high chance of survival. A significant mortality risk might arise from delayed treatment. Therefore, it is essential to diagnose the ailment quickly and start treatment for this treatable condition. It is crucial to be know the range of CT scan images and appearances observed in TB peritonitis given the extensive use of CT as an imaging modality and the benefits of identifying alterations in the whole of abdomen[8]. In

underdeveloped nations, particularly India, there has been a paucity of study on CT findings in TB peritonitis. So, this current research was conducted with the aims and objectives of describing the spectrum of CT imaging features in tuberculous peritonitis patients in New Delhi, India.

### Materials and methods

**Study setting:** An observational descriptive cross-sectional study was carried out at ABVIMS and associated Dr. RML Hospital in New Delhi at the Department of Radio Diagnosis. The investigation lasted 30 months, from January 2021 to June 2023.

**Study participants:** The study participants included in the present study were referred from various clinical departments for CT evaluation. Inclusion criteria of the study participants were those with clinical suspiciousness of peritoneal involvement and abdominal tuberculosis based on clinical, laboratory or X-ray findings. Exclusion criteria included those patients who had no clinical signs of tuberculosis and patients with acute and chronic kidney failure with creatinine levels more than 3 mg/dl.

**Study procedure:** Ultrasound imaging of the abdomen was done followed by Dual phase CT acquisition (A non-contrast scan and a single-phase post contrast scan acquired 35-40 seconds after intravenous contrast injection) using Siemens somatom drive 256 slice CT. Patients with associated chest complaints were also subjected to CT chest imaging. Imaging findings were correlated with clinical and laboratory investigations and compared with cytology/histopathology findings wherever possible.

**Sample size:** The most frequent feature in CT was ascites in TB peritonitis. It was found in 45% of abdominal tuberculosis patients in similar research conducted by Singh et al. [9] in the year 2019. The sample size calculations were done using the equation, formula,  $n = Z\alpha^2 p q / d^2$ ,  $n$  represents the sample size,  $Z\alpha$  represents the value of the standard normal variate whose value is 1.96 at 95% CI (confidence interval) is 1.96, and  $d$  is the error (absolute). Considering the absolute error of 11%, the sample size came to be 40. When 10% non-response rate is also taken into account, the final sample size came to be 44.

**Ethical issues:** The data were collected from the patients after getting permission from the IEC (Institutional Ethical Committee). Written informed consent was obtained from patients or their guardians in case of patients with age less than 18 years.

**Statistical analysis:** The IBM SPSS software version 24 was used for the statistical analysis. For qualitative variables, numbers and percentages were computed. For quantitative data, mean along with standard deviation (SD), or median with inter-quartile range (IQR) were determined.

### Results

The data was obtained from 44 research participants. Half of them 22 were males. The mean age of the research participants was 42.09 years with SD of 18.40 years. The median (IQR) was 38.50 (27.25-60.75) years, with the minimum and maximum ages being 11 and 76 years, respectively, with a range of 65 years. The majority of research participants, 18 (40.9%), were between the ages of 20 and 40. Table 1 gives the data about the age distribution of the research participants.

**Table 1: Age distribution of study participants.**

S.No	Age category	Number	Percentage
1	≤ 20 years	4	9.1
2	21 - ≤ 40 years	18	40.9
3	41 - ≤ 60 years	11	25.0
4	≥ 61 years	11	25.0

Among 44 study participants, 12 (27.3%) were housewives, 11 (25%) were students, 10 (22.7%) were clerks, 6 (13.6%) were labourers, and 5 (11.4%) were unemployed.

### Clinical features

Abdominal pain was the most common clinical feature reported by 36 (81.8%) patients followed by weight loss in 35 (79.5%). Fever and abdominal distension were seen in 23 (52.3%) and 22 (50%) patients respectively. The clinical features present in the study participants are illustrated in Figure 1. The mean (SD) of ascitic ADA was found to be 31.95 (19.88) U/mL. The median (IQR) was 30 (18.5-38.5) U/mL, and the minimum and the maximum values

were found to be 18.5 and 38.5 U/mL respectively with a range of 20 U/mL. The mean (SD) serum ESR among the study participants was found to be 38.14 (24.14). The median (IQR) age was 34 (20-55.75) years, and the minimum and the maximum values were found to be 6 and 110 respectively with a range of 104. Among 44 study participants, 25 (56.8%) tested positive for Mantoux test, and the remaining 19 (43.2%) tested negative for the test. The data is illustrated in Figure 2.

**Ultrasound examination findings**

On ultrasound examinations, most of the study participants had ascites with septations 19 (43.2%), followed by ascites with septations and mesenteric

necrotic lymph nodes 11 (25%). Table 2 represents the USG (ultrasonogram) examination findings observed in the study participants.

**Table 2: Ultrasound examination findings among the study participants.**

S.No	Ultrasound findings	Number	Percentage
1	Ascites with septations	20	45.5
2	Ascites with septations and mesenteric necrotic lymph nodes	11	25.0
3	Ascites with septations and mesenteric necrotic lymph nodes, omental thickening, and raised vascularity	7	15.8
4	Ascites with septations and echogenic mesentery	4	9.1
5	Ascites with septations and mesenteric necrotic lymph nodes, echogenic mesentery	1	2.3
6	Echogenic mesentery	1	2.3

**CT imaging features**

The CT scan imaging features among the study participants are given in Table 3 and Figures 1-5. Uniform and smooth thickening and enhancement of the peritoneal lining was the most commonly observed CT finding at 43 (97.7%), followed by ascites at 42 (94.4%).

**Associated comorbidities**

The most associated comorbidity among the study participants was pulmonary tuberculosis 14 (31.8%), while 8 (18.2%) was undergoing chronic dialysis, 7 (15.9%) were associated with HIV, and 2 (4.5%) had liver cirrhosis.

**Table 3: CT imaging findings among the study participants.**

S.No	CT imaging findings	Number*	Percentage*
1	Uniform and smooth thickening and enhancement of the peritoneal lining	43	97.7
2	Ascites	42	94.4
3	Abdominal necrotic lymphadenopathy	33	75.0
4	Mesenteric thickening with crowded vascular bundles	32	72.7
5	Thickened and smudged pattern of omentum	19	43.2
6	Sclerosing mesenteric mass	5	11.4
7	Cocoon formation	2	4.5

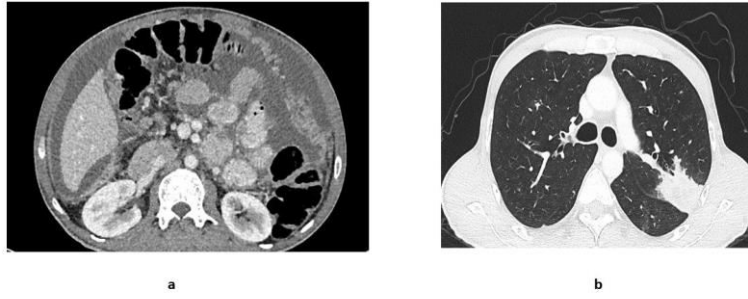
Note: \*Numbers are not mutually exclusive

**Efficacy of USG and CT in detecting tuberculous peritonitis**

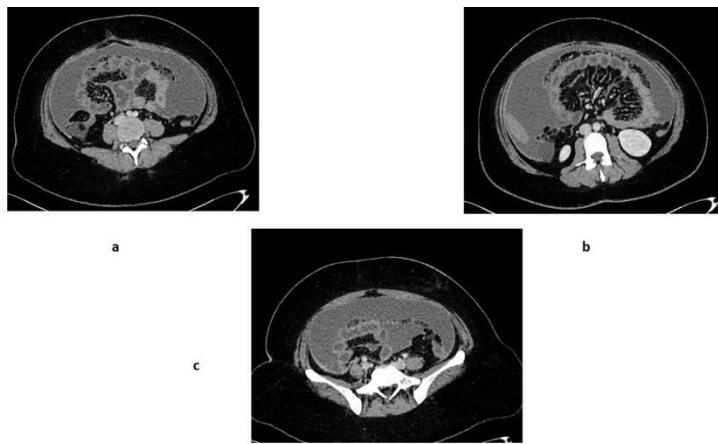
Ultrasound was able to detect 43 out of 44 tuberculous peritonitis cases and therefore the efficacy of USG in detecting tuberculous peritonitis was 97.7% among the study participants. CT imaging was able to detect all 44 cases of tuberculous peritonitis, and therefore its efficacy in detecting tuberculous peritonitis was 100% among the study participants.



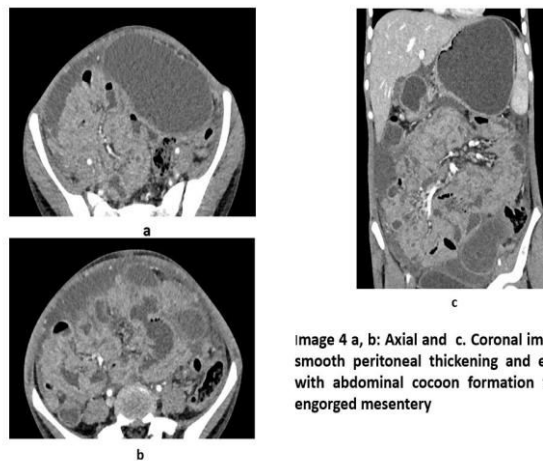
IMAGE 1 a. Axial postcontrast image showing ascites with congested mesentery b. Axial postcontrast image showing ascites with multiple necrotic lymph nodes and congested mesentery c. Axial post contrast image showing ascites and smooth nodular thickening of the peritoneum



**IMAGE 2 a.** Axial postcontrast image showing ascites, smooth thickening and enhancement of the peritoneum, necrotic lymph nodes and congested mesentery **b.** Axial image of the lung window of the same patient showing air space consolidation in the left lung suggestive of pulmonary involvement



**Image 3 a ,b ,c:** Axial post contrast imaging showing ascites, smooth nodular thickening and enhancement of peritoneum with omental caking and congested mesentery.



**image 4 a, b:** Axial and **c.** Coronal images of a patient showing smooth peritoneal thickening and enhancement with ascites with abdominal cocoon formation with omental caking and engorged mesentery

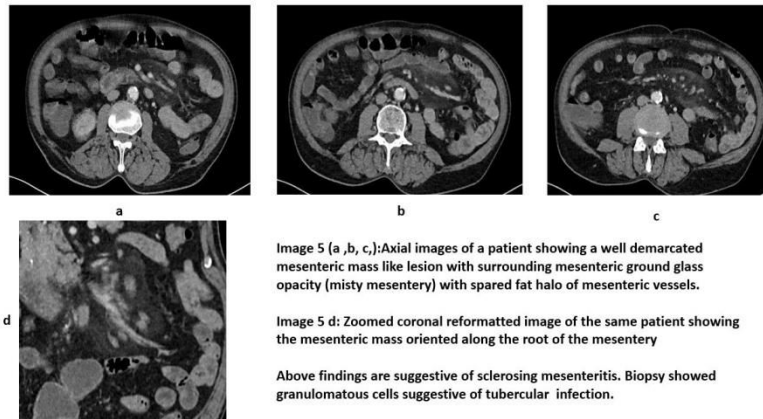


Image 5 (a ,b, c):Axial images of a patient showing a well demarcated mesenteric mass like lesion with surrounding mesenteric ground glass opacity (misty mesentery) with spared fat halo of mesenteric vessels.

Image 5 d: Zoomed coronal reformatting image of the same patient showing the mesenteric mass oriented along the root of the mesentery

Above findings are suggestive of sclerosing mesenteritis. Biopsy showed granulomatous cells suggestive of tubercular infection.

## Discussion

The lymphatic spread from the initial lesion sites or haematogenous dissemination from a distant region (typically the lung) distinguishes the mesenteric lymph node rupture that leads to tuberculous peritonitis. The genitourinary infection seldom spreads directly. Immunodeficiency, malignancy, alcoholism, intravenous drug usage, type 2 diabetes, and steroid therapy increase the risk of the illness [2]. Ascites, changes in general health, and fever are the most common clinical signs. This dominance is recorded in nearly every series in the literature [10, 11]. Abdominal discomfort was reported by 81.8% of patients in the current research, followed by weight loss and fever in 79.5% and 52.3%, respectively. Because of its varied clinical presentations and equivocal features in laboratory investigations, tuberculous peritonitis is difficult to diagnose. A correct diagnosis of tuberculous peritonitis is critical because prompt and proper treatment resulted in a favourable prognosis [3]. Due to its ease of use and low cost, ultrasound is an essential diagnostic tool for peritoneal TB. Even in the absence of ascites, it is critical to identify peritoneal abnormalities. Although histological proof is required for a specific diagnosis, several peritoneal abnormalities have a high diagnostic value, particularly in endemic locations. The most common differential diagnosis is peritoneal carcinomatosis. Ultrasonography can assist in guiding peritoneal biopsy in cases where the big omentum is significantly thicker than normal or if there are peritoneal nodules larger than 1 cm, preventing the need for a more invasive laparoscopy [12]. The big omentum, small bowel mesentery, and parietal peritoneum are only a few of the peritoneal structures that might sustain injury [13]. Ascites, which accounts for 97.7% of cases in our sample, is the most common condition, according to several studies [14, 15]. It's frequently divided into septas. Only when there is ascites do they show up on ultrasound as linear straight septa. It's possible that ascites is absent at the start of the illness especially in dry kinds [13]. In certain situations, a thorough examination of the peritoneal structures reveal worrisome pathologies in the mesentery, big omentum, or outer peritoneal layer.

The extensive omentum's involvement is very indicative of tuberculous peritonitis. The most reported variant in the literature [16], nodular heterogeneous omental thickening, was identified in 32.1% of this present study. Nodules are often described as hypoechoic hypertrophic of lymphoid types. Caseous necrosis might make them appear anechoic on occasion. Peritoneal carcinomatosis, in our experience, has less of this feature [17]. The mesentery's involvement is likewise quite obvious. Its prevalence has been shown in several research [18] to vary from 22% to 68%. It results in repeated hypoechoic and enlargement of the abdominal peritoneum, which surrounds the loops, and is what causes small bowel agglutination. Adnexal involvement resembling an ovarian malignant tumour has been documented often in the literature [19]. CT scanning is essential non-intrusive imaging method for determining the severity of illness. TB peritonitis is classified into three different types: "wet" with loculated or free ascites, "dry" or "plastic" with fibrous response, thick adhesions, and caseous nodules, and "fibrotic fixed" because of matted loops of intestine, and rarely loculated ascites. On CT, however, there is significant overlap between the three groups. Because ascites can involve different parts of the peritoneum, larger omentum along with small intestinal mesentery, and ascites, the varied peritoneal radiological findings, larger omentum, ascites, and small intestinal mesentery should be discussed individually [20]. When immune response occurs in the early transudate stage or when cell-mediated immunity is late, ascites in tuberculous peritonitis can be clear or high density when the fluid becomes complicated with plenty of protein and cellular components. 30% to 100% of patients had free or loculated ascites, according to one study [21]. The high density of the fluid, according to some writers [22], is unique to peritoneal TB, whereas other authors [23] argue that it cannot be a reliable marker and it can also overlap with the findings of peritoneal carcinomatosis. This prevented us from measuring the ascitic fluid's density in our study participants. About 94.4% of the research subjects had ascites. In our study, the dry TB peritonitis type was absent due to its

uncommonness and the relatively small number of individuals in our investigation. Delicate fibrinous threads in the ascites, confined ascites, along with caseous or hardened lymph nodes which are strongly suggestive of tuberculous peritonitis under the correct clinical conditions[24]. Our patients had no septation or fibrinous threads. CT, unlike ultrasonography, has difficulty demonstrating the intricate structure of the ascites. The omentum is involved in three ways: nodular, caked (soft tissue replacement), and smudged (infiltration with ill-defined lesions) [23]. The smeared type was detected in 43.2% of our research subjects. Mesenteric disease is a frequent and fatal complication of early-stage peritoneal TB. Mesenteric abnormalities include mesenteric thickness caused by oedema, lymphadenopathy, and fat accumulation. CT has the specific benefit of revealing these characteristics in up to 98% of instances [23]. Nodular lesions and mesenteric thickening are the most prevalent mesenteric alterations. In 72.7% of the research individuals, we discovered congested vascular bundles. The frequent laparoscopic abnormalities in tuberculous peritonitis include thicker peritoneum with adhesions and small nodules, whereas up to 80% of patients have enhanced thickened and smooth peritoneum on CT[25]. Peritoneum demonstrated a unique sort of increased and smooth uniform thickening (97.7%) in our investigation. The symptoms of tuberculous peritonitis vary. CT imaging consistently reveals the full spectrum of results. Though no CT characteristic is indicative of illness, CT results when evaluated in conjunction with laboratory and clinical data can be an important diagnostic tool in the management and treatment of abdominal or peritoneal TB. Free ascites, larger adhesions with congested vascular bundle inside mesentery, a smeared pattern of involvement of omentum, smooth, and uniform thickening of the peritoneal lining are all the symptoms of tuberculous peritonitis in patients.

### Conclusion

We found the mean (SD) age of the study participants to be 42.09 (18.40) years. The most prevalent symptom was abdominal discomfort, and the mean (SD) of ascitic ADA was 31.95 (19.88) U/mL. Most of the study participants (43.2%) had ascites on ultrasonography exams. The most frequent CT observation was uniform and smooth thickening and enhancement of the peritoneal lining (43 (97.7%)), followed by ascites (42 (94.4%)).

**Data availability statement:** The datasets used for analysis are available from the authors on request.

**Conflict of interest:** Nil

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