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CT Imaging of Abdominal Tuberculosis: The Tip of the Iceberg with Much Beneath the Surface

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ABSTRACT

The abdomen is the most common site of extrapulmonary tuberculosis. Abdominal tuberculosis still attains demonous proportions in size & nature in the developing world despite measures taken for prophylaxis & directed therapy. It has shown a recent resurgence in the West because of AIDS epidemics and migratory fluxes. Diagnosis of extrapulmonary tuberculosis is often arduous as it can simulate numerous other disease entities. Multislice spiral computed tomography has the ability to precisely demonstrate changes in the bowel, lymph nodes, peritoneum, mesentery and solid organs in a single examination and is widely available. Thus it is important for the radiologists to be acquainted with its various imaging features which frequently lead to a diagnostic dilemma. Imaging findings of abdominal TB are not pathognomonic, but may be highly evocative if considered in simultaneity with proper clinical findings. In this paper, we will illustrate & describe imaging features of abdominal tuberculosis in an immunocompetent population and its complications.

KEYWORDS : Extrapulmonary tuberculosis, Computed tomography, immonocompetent

BACKGROUND- Tuberculosis (TB) has been declared are emerging global emergency by the World Health Organisation and is the most important communicable disease worldwide. Lungs are the primary involved organs and it has a known propensity to disseminate from the primary site. The prevalence of extra-pulmonary tuberculosis seems to be rising, particularly due to increasing prevalence of acquired immunodeficiency syndrome.(AIDS).[1,2] Abdomen is involved in 11% of patients with extrapulmonary tuberculosis.[3] Though potentially curable, abdominal tuberculosis continues to be a major cause of morbidity and mortality in India.

Early administration of chemotherapy in abdominal tuberculosis is important as it can give convincing results. Positive response to therapy, itself helps in diagnosis[4] and prevents the development of complications, which subsequently may require surgery. Diagnosis of extrapulmonary tuberculosis remains a challenge even to the most experienced physician as it may affect practically any intracavitary organ, presenting with non-specific signs and symptoms, delaying the diagnosis.A high index of suspicion specially in high risk population therefore needs to be sustained for an early diagnosis and timely treatment, as untreated disease has a high mortality rate.

A plain radiograph of the chest is important in diagnosis, as abdominal involvement complicates pulmonary tuberculosis in 6% - 38% of patients.[5] Computed tomography (CT) has been found to be very advantageous in abdominal tuberculosis. CT scan is reported to be superior to ultrasonography for showing high-density ascites, caseous necrosis of lymph nodes (as low attenuation necrotic centers and thick enhancing inflammatory rims) and mesenteric involvement, as bowel gas may restrain visualization of the mesentery on sonography.

With reduced scanning time with the modern CT machines , less motion artifacts and single breath-hold acquisition is possible,which improves vascular contrast enhancement. Multiplanar reconstructions can then be carried out in any desired plane, these having the same resolution as the axial image.[6] Also three-dimensional imaging is possible using Volume Rendering techniques- Maximum Intensity Projection (MIP), and Virtual Endoscopy.[7]

MATERIAL AND METHODS

Over a period of 2 yrs, (Between September 2014 and July 2016) 100 consecutive patients suspicious of abdominal Koch's on CXR, USG and Barium studies and clinical signs were evaluated by dedicated abdominal CT scan. MRI study was only done in cases of complications for evaluation of the retroperitoneum especially psoas abscess. The study group comprised of 60 male and 40 female patients, with age range of 14 to 45 years (mean age 26 years). The scans were independently reviewed by 2 radiologists and any discord in findings was concluded by combine review of the scans and a concordance reached. The diagnosis was established on the basis of at least one of the following criteria:

Histological evidence of caseating granuloma.

- Increased LDH & ADA levels in the ascitic fluid or positive PCR tests.
- Growth of mycobacterium tuberculosis on culture of tissue or ascitic fluid.
- Satisfactory therapeutic response to chemotherapy in patients with clinical, radiological and operative evidence of abdominal tuberculosis.
- Since abdominal tuberculosis is paucibacillary, the yield of organisms is low and characteristic histological changes are taken as diagnostic.

Immunocompromised and AIDS/HIV patients were excluded from our study as they virtue separate discussions. Genitourinary TB was also excluded except in those cases with co-existing abdominal lymphadenopathy.

Non-contrast and contrast enhanced CT examination of patients were carried out using Siemens Somatom Emotion 16 slice MSCT scanner. Scanning was done with collimation of 5mm reconstructed at 1.5mm intervals following intravenous administration of 100-120 ml of non-ionic contrast (300 mg I/ml at 2.5 ml/sec). Gastrointestinal tract was distended using oral contrasts and air/water given per rectally.

RESULTS

Low grade fever (65%), abdominal pain (60%) and weight loss (50%) had higher prevalence than other signs and symptoms. The disease can present at any age but was seen most commonly in young adults. Out of 100 patients of abdominal TB, lymphadenopathy was the most common manifestation on computed tomography,noted in 90 patients (90%) followed by intestinal involvement in 58 patients(58%). Tubercular peritonitis was seen in 55patients (55%).Associated hepatosplenomegaly was noted in 24 patients(24%)

TUBERCULAR LYMPHADENOPATHY

Lymphadenopathy was the most common manifestation of abdominal tuberculosis in our study, noted in 90% of patients. The size of lymphnodes varied from 0.6 mm – 2.5 cms (short axis).Enlarged lymph nodes were noted most commonly in the mesenteric, porta hepatis, peripancreatic, upper para- aortic region and the omentum. There was a striking tendency for the involvement of mesenteric & peripancreatic lymph nodes to accompany & usually surpass the extent of retroperitoneal involvement. The spectrum of lymphadenopathy encountered in our study included (1) increased number of normal sized nodes, (2) randomly distributed mildly enlarged nodes, (3) localized cluster of enlarged nodes and (4) large conglomerate masses.

At contrast enhanced CT, 60 cases (66.7%) had typical peripheral enhancement with central nonenhancing areas . This pattern reflected significant central liquefactive or caseous necrosis and perinodal highly vascular inflammatory reaction (Fig-1). Though not pathognomonic, the pattern of peripheral rim enhancement, could be highly suggestive of tuberculosis in an appropriate clinical

setting. Relatively homogeneous confluent, discrete and calcified lymph nodes also noted.

TABLE1: PATTERN OF LYMPH NODE INVOLVEMENT

	Number of cases	Percentage
Peripheral enhancement with central necrosis	60	66.67
Relatively homogenous, confluent	20	22.22
Relatively homogenous, discrete	10	11.11

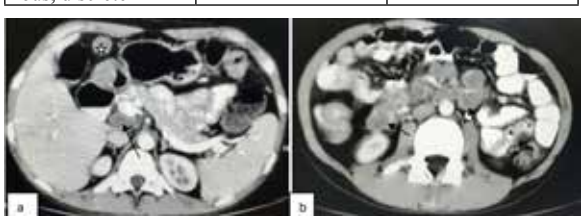

Fig-1 CECT abdomen showing enlarged peripancreatic (arrow in a) and omental lymph nodes (*) and mesenteric lymph nodes (arrows in b) with central necrosis.

DISCUSSION

Lymph node involvement may be the only sign of the disease. 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. The commonest route of transmission 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 transmission.The presence of nodal calcification in the absence of a known primary tumour in patients from endemic areas suggest a tubercular etiology.[8]

Similar pattern of lymphadenopathy however also encompasses other disease entities malignant adenopathy, Whipple disease, lymphoma following radiotherapy.[9]

INTESTINAL TUBERCULOSIS

Ileocecal region was the most common site involved in the gastrointestinal tract in our study seen in 58 patients (58 %). Ileocecal region involvement was seen in the form of bowel wall thickening, gaping and thickened ileocecal valve, pulled up cecum, regional lymphadenopathy and pericecal fat stranding (Fig-2). Though Intestinal involvement is present in in 80-90% of patients, radiologic alterations are seen only in 50% of cases. The number of cases found in our institution supported this prevalence.

Fig-2 CECT scan showing pronounced ileocaecal thickening (a,b,c) (white arrows). Associated mesenteric lymphadenopathy is also noted in (b) (black arrows).

Fig-3 Coronal MPR of CT abdomen shows marked circumferential thickening of the caecum which was diagnosed on imaging studies initially as a caecal mass but on histopathology turned out to be profound tuberculous involvement of the caecum simulating a mass.(hypertrophic form with pseudomass formation).

DISCUSSION

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 routes from a distant source of infection.[10]

At CT, the extensive involvement of ileocecal region with marked thickening, heterogeneous enhancement, pulled up cecum, thickened and gaping ileocecal valve, pericecal fat stranding and regional lymphadenopathy with some showing rim enhancement, as seen in 58 of our cases are uncommon in diseases other than TB.

Perforation and fistulas are the most frequent gastrointestinal complications of tuberculosis, with incidence of 7.6%, the small bowel and colon are the most common sites.[11] Other complications include vascular complications, intussuception and obstruction of the small bowel (Fig-4).[12]Ano-rectal tuberculosis can present as strictures and fistula-in-ano(Fig-5).

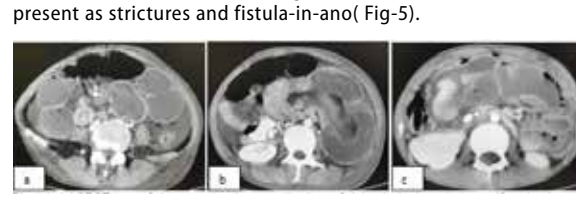

Fig-4 Axial CECT scan of abdomen showing complications of abdominal tuberculosis manifested as intestinal obstruction(a) intussuception(b) and cocoon formation with small bowel dilatation (c).

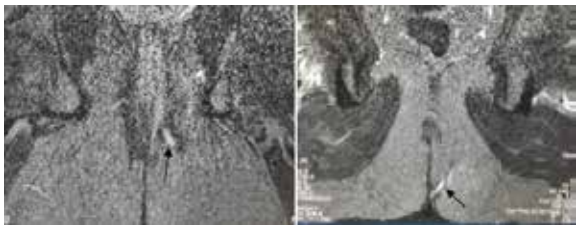

Fig-5 STIR MRI image shows evidence of fistula in ano (arrow) secondary to tuberculosis.

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

TUBERCULAR PERITONITIS

Tubercular peritonitis was seen in 55 patients. Peritoneal involvement with ascites (wet peritonitis) noted in 44 patients (80%). This was seen either as free ascites or loculated within a diffusely thickened enhancing peritoneal thickening (Fig-6). The rest of the cases showed peritoneal, mesenteric or omental thickening /fat stranding or nodularity but no ascites (dry peritonitis)

TABLE2: CT FEATURES IN TUBERCULAR PERITONITIS

	Number of cases	Percentage
Ascites , free	32	58.18
Ascites , loculated	12	21.82
Ascites with diffuse peritoneal thickening	30	54.54
Only peritoneal thickening	11	20
Omentalinfiltration/ nodules/fat stranding	32	58.18
Associated bowel thickening	20	36.36
Any associated organomegaly	24	43.63
Any associated pleural effusion	14	25.45

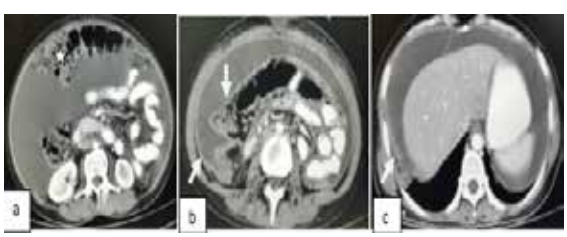

Fig-6 Axial CECT scan of abdomen showing marked ascites as free fluid (a) with omental nodules (*)and loculated ascites with diffusely enhancing peritoneal thickening (arrows in b) . There is evidence of nodular peritoneal thickening in (arrow in c) along the right perihepatic space.

DISCUSSION

Although there is a considerable superimposition of presentation patterns, peritoneal tuberculosis is classically classified into three types according to its macroscopic aspects, namely: dry, wet and fibrous types [13-16]. The wet type (Fig-6) presents primarily either as free or loculated ascites, associated or not with diffuse and smooth peritoneal thickening; in the dry type, there is a predominance of peritoneal and mesenteric thickening with caseous nodules, lymph nodes enlargement and fibrinous adhesions; on its turn, the fibrous type is characterized by remarkable omental thickening and entanglement of bowel loops clinically resembling a mass, occasionally with loculated ascites and that may be similar to peritoneal carcinomatosis[17].

Free or loculated ascites may be present in 30-100% of cases, and the tomographic density is variable (20-45 HU), depending on the phase of the disease.

The omentum may be altered in up to 80% of cases, appearing as diffuse infiltration, nodule, and omental cake (Fig-6 a, b & c) . Diffuse densification is most commonly found , while the omental cake pattern, characterized by omental fat thickening and densification, is less frequently seen, occurring in 20% of cases, but it is most typically found in peritoneal carcinomatosis, in up to 40% of cases[17].

Mesenteric disease is a common abnormality that may be observed at CT as early as at the initial stages of peritoneal tuberculosis, in up to 98% of cases[14], ranging from a mild involvement (linear striations, vascular engorgement, star-shaped appearance, fat densification) to a more extensive involvement (diffuse infiltration of the mesenteric leaves).Thick striations with vascular engorgement constitute the most common finding (65% of cases), followed by the nodular pattern (29%)[17].

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

SOLID ORGAN DISEASE

At our institution, 24 patients showed typical manifestations of hepatosplenic disease,appearing as liver and splenic enlargement and multiple abscesses of variable size (Fig-7).

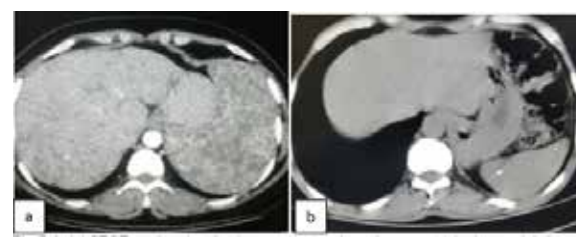

Fig-7 Axial CECT section showing hepatosplenic micro-abscesses (a) in the arterial phase which persisted on the venous phase and two healed calcified granulomas in spleen (b).

DISCUSSION

Visceral TB is rarely seen in isolation and is more frequently part of multifocal or disseminated disease. The most common presentation is a nonspecific hepatosplenomegaly, which occurs due to a fine miliary infiltration of the parenchyma. Hepatosplenic tuberculosis has two type of presentations, namely, military and macronodular.The miliary form is associated with hematogenous dissemination and hence the diffuse involvement of the liver.Often the only feature of visceral TB is organomegaly with calcified granuloma visible in the late stage disease or after healing. Macronodular form of hepatosplenic tuberculosis is an uncommon form of tuberculosis.

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.

A normal chest radiograph cannot exclude the possibility of abdominal tuberculosis while finding of active or healed tuberculous lesions on chest X-ray only support the diagnosis of abdominal tuberculosis. Ultrasound is capable of imaging the entire abdomen in single examination but is affected by bowel gas and obesity thus making it less accurate in detecting bowel wall thickening, tubercular lymphadenopathy and peritoneal disease.[18]

ASSOCIATED FINDINGS:

Thoracic findings

In literature review only 15% of patients with abdominal tuberculosis have evidence of pulmonary disease. In our institution, 28% of the cases of abdominal tuberculosis had associated thoracic findings.

Genitourinary tuberculosis

We observed genitourinary involvement in our institution in 2 male and 22 female patients, involving bladder and fallopian tubes respectively. The kidneys are often primary sites involved for genitourinary

tuberculosis in litrerature, being achieved by haematogenous route. Ureters and bladder may be involved by descent infection. Female genital tuberculosis involved fallopian tubes in upto 90% of cases with formation of tubo-ovarian abscesses (Fig-8).

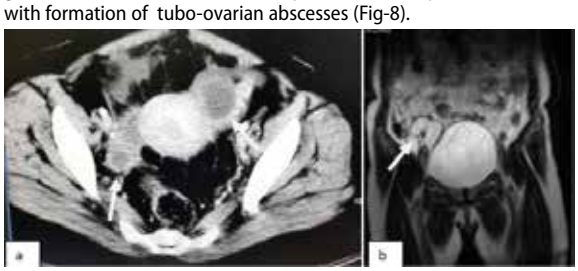

Fig-8 Axial CECT section showing b/l tubo-ovarian mass

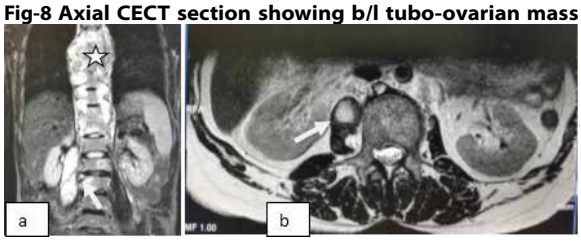

Fig-9 Coronal T2W MRI and axial T2W showing right sided psoas abscess (Tubercular) (arrows). Associated changes of tubercular spondylodiscitis and paravertebral abscesses are noted at a more superior level (*) in (a)

Other findings

Last but not the least, central nervous system involvement needed to be considered in our study, due to its endemicity in kumaon region and its clinical relevance. Tuberculous meningitis was the most common manifestation of neurotuberculosis. Parenchymal disease noted with or without meningitis and manifested as either solitary or multiple tuberculomas.

CONCLUSION

A high clinical index of suspicion and judicious use of diagnostic procedures can certainly help in timely diagnosis and treatment and thus reduce the mortality of this curable but potentially lethal disease.[19] It is concluded that multislice spiral CT is the modality of choice to demonstrate the entire spectrum of manifestations seen in patients of abdominal TB. Although no single CT feature is diagnostic of the disease, CT findings, interpreted in the light of proper clinical settings and laboratory data can be a valuable tool in the diagnosis of abdominal tuberculosis.Additional thoracic findings may be useful, raising the suspicion of tuberculosis.For the definitive diagnosis of abdominal tuberculosis microbiological or histological proof should be obtained.

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