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CT Appearances in Treated Abdominal Tuberculosis: A Radiologist's Dilemma

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Abstract

Objective To study the CT appearances of the abdomen after completion of antitubercular therapy (ATT) in adult patients.

Methods Multidetector CT scan abdomen was done in 20 adults within 1 month of completing ATT. CT appearances were compared with pretreatment scans which were available in 7 cases.

Results We found that residual ileocecal wall thickening and enhancement was significant ($p < 0.05$) after treatment in cases of ileocecal tuberculosis (TB). Mild decrease in wall thickness and diameter of the involved dilated small bowel loops was seen. Numerous large, matted nodes with necrosis persisted in the mesentery and retroperitoneum in treated TB, but reduction in the size of nodes was appreciated.

Conclusion Our results help to fill the vacuum in the database of CT appearances in treated abdominal TB. Persistence of bowel changes and lymph nodes should not be mistaken for recurrence of TB or residual disease.

Keywords
- Ileocecal tuberculosis
- Multidetector CT Scan
- Antitubercular therapy (ATT)
- treated abdominal TB

Introduction

Patients who have completed antitubercular therapy (ATT) for abdominal tuberculosis (TB) may present for CT scan of the abdomen several months or years later for various abdominal complaints. Their CT scan may show ileocecal wall-thickening with irregularity of walls, contracted cecum, enhancement of walls of cecum and/terminal ileum, pulled-up ileocecal junction, large noncalcified, matted or necrotic lymph nodes, hypodense lesions in the liver/and spleen, partial strictures in jejunum/ileum, etc. It is very difficult to decide whether these lesions are the cause of the patient's presenting problems or represent healed TB.

It is also possible that due to the presence of these changes, an occult cause of abdominal complaints, that is, some new disease entity, is overlooked. This may create problems in the management of patients. Such patients may be restarted on ATT or may even undergo unnecessary bowel surgery like resection and anastomosis. Subsequent postoperative complications may lead to a lifelong dilemma, irrespective of whether the surgery was actually required.

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Although there are innumerable studies in literature on sonographic[1–3] and CT appearances[1,4,5] in abdominal TB, there is paucity of literature regarding CT appearances in healed abdominal TB,[6–10] and it is mostly anecdotal. Ma et al[11] have explored the roles of CT enterography and gastrointestinal ultrasound in the evaluation of ATT response to intestinal TB retrospectively.

The purpose of this prospective study is to create a database of CT appearances of the abdomen after completion of ATT.

Methods

An observational pilot study was performed in the Department of Radio Diagnosis, University College of Medical Sciences and Guru Teg Bahadur Hospital, Delhi, from December 2013 to March 2015 among 20 adult patients who had completed a course of ATT for abdominal TB. These patients were deemed to have been completely treated for abdominal TB by the physicians. Medical records were perused during this period to select those patients who had positive findings on CT and/or sonography before ATT had been started. Cases with genitourinary tract TB were excluded from the study.

Definitive tissue diagnosis in the form of caseating granulomas in mesenteric nodes on fine needle aspiration cytology or on diagnostic laparoscopy was the basis of starting ATT in all the cases.

As much as 80% (16 out of 20) of cases had taken a 6-month course of ATT (category I—isoniazid [5 mg/kg], rifampicin [10 mg/kg], pyrazinamide [25 mg/kg], and ethambutol [15 mg/kg]), while a 9-month course of the same drugs was received in 20% (4 out of 20) cases. The acquisition of CT scan abdomen was done within 1 month of completing ATT in all the cases. After clearance from the Institutional Ethics Committee and written informed consent obtained from all the individual participants of the study, the patients underwent a noncontrast and contrast-enhanced CT scan (CECT) of the abdomen on a 64 slice Multidetector CT scanner (Somatom Definition AS – Siemens AG, Germany). CT appearances of the ileocecal region and other bowel changes, lymph node status, peritoneal changes, and solid organ involvement were recorded.

Patients were fasting for 6 hours and were encouraged to drink 1.5 to 2.0 L of 2.5% mannitol solution over 45 to 60 minutes. CECT scan of the abdomen was performed after injection of 80 to 100 mL nonionic water-soluble iodinated contrast (300 mgI/mL) was injected intravenously (IV) at 3 mL/sec. Scanning was done after a delay of 50 seconds. Axial scans were taken at appropriate kV and mAs and slice thickness of 5.0 mm. Thin axial reconstructions of slice thickness 1.0 to 3.0 mm and multiplanar reconstructions were done in the coronal, sagittal, and oblique planes.

Three appropriate axial sections for measurement of the bowel wall thickness and attenuation were selected subjectively while scrolling the axial CT images on the workstation. The maximum bowel wall thickness and attenuation was measured in the three representative axial scans, and their mean was calculated. The average wall thickness and attenuation was also taken as a mean value of three selected axial sections. Cursors were used to measure the wall thickness, and pixel lens was used for estimating the attenuation values.

CT findings were compared with previous (pretreatment) CT scans in 7 patients. All 20 cases of treated abdominal TB were followed-up clinically till the end of the study period (15 months).

Statistical Analysis

All the CT scan findings were converted into a computer-based spreadsheet. Descriptive statistics were used and reported as percentages. Posttreatment observations were compared in cases with and without ileocecal involvement, using Wilcoxon signed ranks test at 5% level of significance.

Results

Age of the patients ranged from 18 to 47 years. The mean age being 29.55 years. As much as 75% of cases (15 out of 20) in our study were males and 25% were females. All the cases were asymptomatic at the time of CT scan. On enquiry, we found there was a past history of abdominal pain, anorexia, weight loss, fever, and abdominal distension—the most common clinical symptoms for which the patients received ATT. Symptoms had been present for an average duration of 2 to 4 weeks before ATT was started.

Before starting ATT, all 20 cases had undergone abdominal sonography. Seven cases with ileocecal involvement on sonography had also undergone abdominal CT scan.

The CT findings of the ileocecal region of bowel after completing ATT are shown in ►**Tables 1** and **2**. The CT appearances of abdominal lymph nodes in these 20 cases on CT scan are listed in ►**Table 3**.

Cecum was high in position in 65% (13 out of 20) cases after ATT, but it was normally positioned in the right iliac fossa (RIF) in 35% (7 out of 20) cases. Cecum was well-distended in more than 70% cases in our study.

Maximum cecal wall thickness was in the normal range (< 3.0 mm) in 60% cases of treated abdominal TB. As much as 80% patients had an average cecal wall thickness of 1.0 to 3.0 mm.

Cecal wall thickening was found to be asymmetrical after completing ATT but no cecal wall calcification or fatty attenuation was seen in any case of treated abdominal TB. Pericecal fat stranding was seen in 4 out of 20 cases.

In 90% cases, the terminal ileal luminal diameter was normal after completing ATT.

In 70% cases of treated abdominal TB, maximum terminal ileal wall thickness was normal, while in 30% cases, it was increased. In 85% cases of treated abdominal TB, the average terminal ileal wall thickness was normal. Other bowel findings in treated abdominal TB included partial strictures in 2 cases, segmental dilatation and wall thickening in a loop of distal ileum in 3 cases, and enteroliths in 2 cases.

Peritoneal changes like combination of patchy peritoneal thickening/mesenteric fat stranding/nodularity/hypervascularity and omental stranding/hypervascularity/nodules

Table 1 Bowel CT parameters in treated abdominal TB

S. no.	Bowel CT parameters	Treated cases of TB ($n = 20$)		With pre-ATT ileocecal involvement ($n = 7$)	Without pre-ATT ileocecal involvement ($n = 13$)
		Mean	Range	Range	Range
1.	Cecal lumen diameter		2.7–5.5cm	3.5–5.5 cm	2.7–5.3 cm
2.	Maximum cecal wall thickness	3.1 mm	1.2–8.0 mm	2.0–6.0 mm	1.2–3.2 mm
3.	Average cecal wall thickness		0.9–5.0 mm	1.8–5.0 mm	0.9–2.7 mm
4.	Maximum cecal wall enhancement	64 HU	41–111 HU	41–102 HU	42–111 HU
5.	Average cecal wall enhancement	46 HU	30–92 HU	30–92 HU	31–90 HU
6.	Terminal ileal lumen diameter	1.9 cm	0.9–3.5 cm	1.3–3.5 cm	0.9–2.0 cm
7.	Maximum terminal ileal wall thickness	2.9 mm	0.7–8.4 mm	1.2–8.4 mm	0.7–5.2 mm
8.	Average terminal ileal wall thickness		0.5–5.5 mm	0.9–5.5 mm	0.5–2.8 mm
9.	Maximum terminal ileal wall enhancement	72 HU	42–119 HU	42–119 HU	44–99 HU
10.	Average terminal ileal wall enhancement	59 HU	32–100 HU	32–100 HU	32–82 HU

Abbreviations: ATT, antitubercular therapy; TB, tuberculosis.

Table 2 Distribution of bowel CT parameters in treated TB

S. no.	CT bowel parameter	With pre-ATT ileocecal involvement ($n = 7$)	Without pre-ATT ileocecal involvement ($n = 13$)
1.	Position of cecum and ileocecal junction		
	Normal	3	4
	High	4	9
2.	Maximum cecal wall thickness > 3.0 mm	6	2
3.	Average cecal wall thickness > 3.0 mm	4	0
4.	Ileocecal junction thickening	3	2
5.	Terminal ileal wall thickness high, i.e., > 5.0 mm	4	2
6.	Average terminal ileal wall thickness high > 5.0 mm	2	0

Abbreviations: ATT, antitubercular therapy; TB, tuberculosis.

were noted in 50% cases of treated cases of abdominal TB. Ascites was seen in 2 cases.

Solid organ involvement was seen in the form of two small subcentimetric, rounded, ill-defined, hypodense lesions in liver and spleen and mild hepatosplenomegaly in a total of 4 cases.

Follow-Up

The period of clinical follow up ranged from 1.5 to 15 months in our study. In 17 out of 20 cases, follow-up was possible for 3 to 15 months. All the 20 cases remained asymptomatic in the follow-up period with no complaints of abdominal pain, fever, vomiting, anorexia, weight loss, etc. No new complaints were reported. In fact, a few cases reported weight gain.

Statistical Analysis

The average and maximum cecal wall thickness, maximum wall enhancement and average attenuation values of cecal wall were significantly higher in cases with pre-ATT ileocecal involvement ($p < 0.05$). No significant difference was observed in cecal luminal diameter in treated TB cases with and without pre-ATT ileocecal involvement ($p > 0.05$).

The maximum terminal ileal luminal diameter, the maximum terminal ileum wall thickness and the average wall thickness in treated abdominal TB was significantly higher in cases with pre-ATT ileocecal involvement ($p < 0.05$). No significant difference was observed in the maximum or average postcontrast terminal ileal wall attenuation in treated abdominal TB cases, with and without ileocecal involvement ($p > 0.05$).

Discussion

The rationale of this study was to create a database of the CT abdomen appearances in patients of abdominal TB, who have been declared adequately treated by a qualified medical practitioner, so that changes of treated tubercular infection are not confused with recent disease.

Table 3 Lymph nodal status in treated abdominal TB

Lymph nodal region	Mesenteric	RIF	Periportal	Retroperitoneal
Number of patients	20	10	6	14
Number of lymph nodes	2–36	1–6	1–4	3–34
Short axis diameter (mm)	4.0–21.0	3.6–9.4	6.0–33.8	3.0–25.0
Maximum dimension (mm) of largest node	4.2–33.0	5.5–15.0	8.6–38.8	
Number of patients with matted lymph nodes	10	2	2	5
Number of cases with homogenous contrast enhancement	13	7	4	8
Number of cases with heterogenous contrast enhancement	4	3	2	0
Number of cases with both homogenous and heterogenous enhancement	3	0	0	2
Number of cases with central hypodensity and peripheral rim enhancement	6	2	1	4
Postcontrast attenuation (HU)	21–150	22–155	41–103	33–128
Number of cases with lymph nodes showing calcification	3	0	0	2

Abbreviations: RIF, right iliac fossa; TB, tuberculosis.

To the best of our knowledge, this is the first prospective study to objectively assess various bowel wall and nodal parameters in treated cases of abdominal TB.

CT Features of Bowel in Treated TB

Distension of terminal ileum and cecum was fair/optimal after administration of 1 to 1.5 L of oral mannitol. In 3 out of 7 cases with ileocecal TB, cecum and ileocecal junction were normally positioned in the RIF after completing ATT, while in 4 cases, they were high in position on abdominal CECT scan. There was no change in the position of the cecum and ileocecal junction after completing ATT in all the seven cases.

The cecum and ileocecal junction were high in position in 69% (9 out of 13) cases of treated TB, having no ileocecal involvement before starting ATT and in 57% (4 out of 7) cases having ileocecal involvement before starting ATT. Thus, the normal cecum can have a variable position in the right flank of abdomen, and its high position in the RIF does not distinguish between healed or active ileocecal TB.

After completing ATT, the maximum cecal wall thickness was increased on CT scan ($>$ or $=$ 3.0 mm) in 85.7% (6 out of 7) treated cases of ileocecal TB and also in 2 out of 13 cases with no pre ATT ileocecal wall thickening. Probably in these latter two cases (who had not undergone a CT scan prior to starting ATT), cecal wall thickening was not well-delineated or missed on sonography prior to starting ATT.

The maximum cecal wall thickness (2.0–6.0 mm) was significantly higher in treated cases of TB with pre ATT ileocecal involvement ($p < 0.05$) than those having no ileocecal involvement (1.2–3.2 mm) before starting ATT. Similarly, the average cecal wall thickness (1.8–5.0 mm) with pre ATT ileocecal involvement was also significantly higher in treated cases of TB ($p < 0.05$) than those having no pre-ATT ileocecal involvement (0.9–2.7mm). So, in our study, it was observed that the maximum and average cecal wall thickness can be increased in treated abdominal TB. Ma et al also found thickened bowel wall in 13/18 patients after ATT.[11]

With regard to the maximum post contrast cecal wall attenuation and the average cecal wall attenuation in treated abdominal TB, there was no significant difference in the range of attenuation values ($p > 0.05$) in cases with and without pre-ATT ileocecal involvement (range 41–111 Hounsfield units [HU] and 30–92 HU, respectively). Hence, it appears that marked wall enhancement persists in the ileocecal region after completion of ATT. As all these cases remained asymptomatic for 15 months after completing ATT, contrast enhancement in the ileocecal region after completing ATT may not suggest active TB. Ma et al also opined that abnormal bowel wall contrast enhancement persisted in 4/14 patients after ATT, although HU have not been mentioned in their article.[11]

Although TB is a benign disease, cecal wall thickening was found to be asymmetrical in treated abdominal TB, probably because there is unsynchronized healing of the bowel wall in ulcerative, hypertrophic, and ulcerohypertrophic types of TB.[11] Pericecal fat stranding, present in 20% cases, apparently does not indicate active inflammation.

In 3 out of 7 cases of treated TB, with ileocecal junction thickening prior to starting ATT, ileocecal junction wall thickening was persistent (►**Fig. 1**). However, it was also seen in two more cases without pre-ATT ileocecal thickening. These were probably missed on previous sonography studies or may be the thickening was apparent due to suboptimal distension of the ileocecal junction on CT scan.

As far as terminal ileal luminal diameter is concerned, in 2 cases with ileocecal involvement, the maximum terminal ileal lumen diameter was increased, that is, 3.5 cm. In these cases, the dilatation was present on CT scan prior to starting ATT also (►**Fig. 1**).

In this study, the range of maximum terminal ileal wall thickness was 0.7 mm to 8.4 mm with a mean of 2.9 mm. Maximum terminal ileal wall thickness ranged from 1.2 mm to 8.4 mm in cases with ileocecal involvement. No comparative data are available for treated abdominal TB. On CT, the

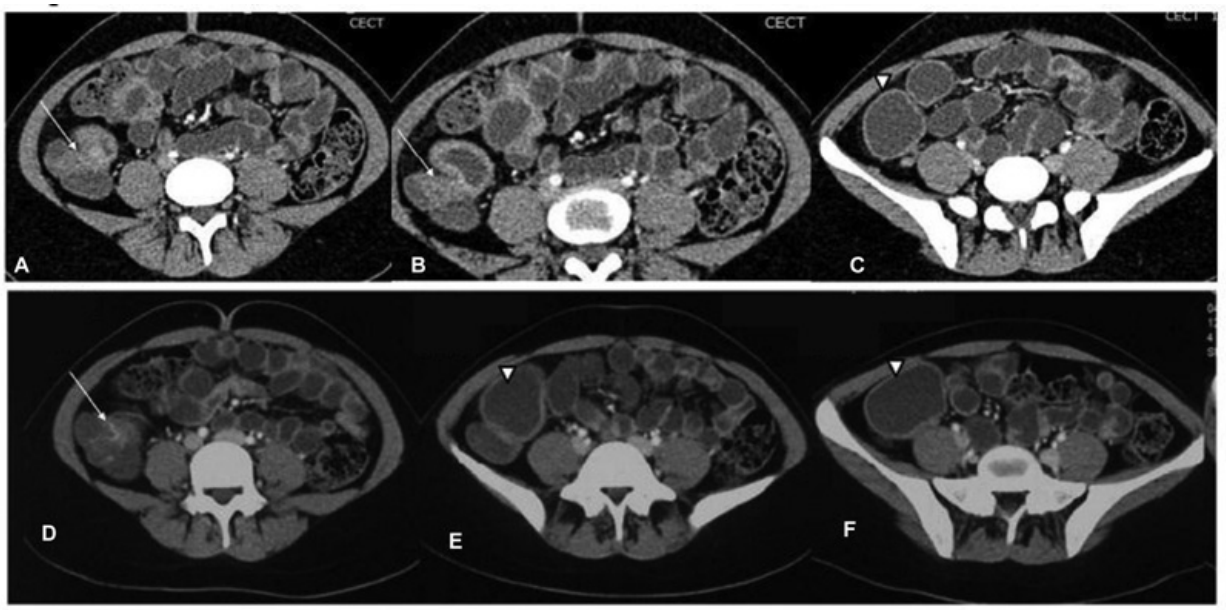

Fig. 1 (**A–C**) Axial postcontrast CT scan images show marked thickening and enhancement of the ileocecal junction (arrow in **A** and **B**) with terminal ileum dilatation (arrowhead in **c**) before starting antitubercular therapy (ATT). **(D–F)** 20 days after completing ATT, although the ileocecal thickening and enhancement reduced considerably (arrow in **D**), the dilatation of the terminal ileum persisted (arrowhead in **E** and **F**).

normal small bowel wall thickness measures 2 to 3 mm; a wall thicker than 4 mm is considered abnormal except in the terminal ileum, where 5 mm is considered the upper limit of normal.[4] The maximum terminal ileal wall thickness was $\geq$ 5.0 mm in six treated abdominal TB cases. Among these, four cases had pre-ATT ileocecal involvement, and terminal ileum was thickened prior to starting ATT (►**Fig. 2**). In two cases, the terminal ileal wall thickening may have been overlooked on sonography and no pre-ATT CT scan was available for review. Bowel distension was adequate in these two cases, hence collapsed bowel was not responsible for a fallacious impression of wall thickening. The maximum and average terminal ileal wall thickness were as high as 8.0 mm and 5.5 mm, respectively, in treated abdominal TB. On statistical analysis, the maximum and the average terminal ileal wall thickness was significantly higher in treated cases of abdominal tuberculosis with pre-ATT ileocecal involvement ($p < 0.05$).

Wall enhancement in the ileocecal junction region ranged from 30 to 99 HU after ATT. The maximum and the average postcontrast terminal ileal wall attenuation in treated abdominal TB ranged between 32 HU to 119 HU and showed no significant difference in cases with and without ileocecal involvement ($p < 0.05$; ►**Fig. 2**). No studies regarding CT attenuation values for bowel wall in TB are available in literature.

Dilatation of a long distal ileal segment and presence of enterolith within it was also seen after completion of ATT, although the patients were asymptomatic (►**Fig. 3**).

Lymph Nodal Status on CT Scan in Cases Representing Healed Tuberculosis

As many as 12 out of 20, that is, 60% cases of abdominal TB in our study had only lymphadenopathy on sonography when

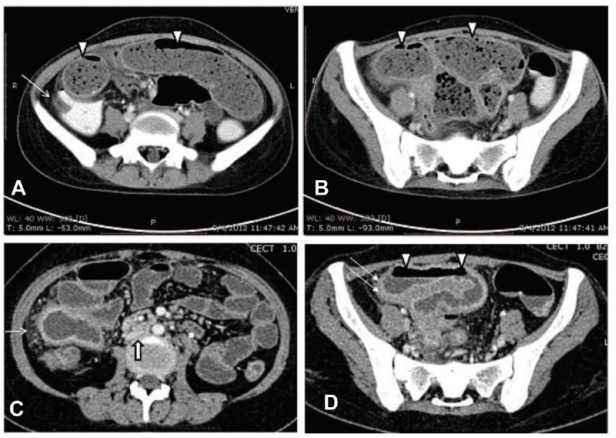

Fig. 2 (**A, B**) A 25-year-old female showing ileocecal junction thickening (arrow) and causing proximal small bowel obstruction (small bowel feces sign—arrowheads) before antitubercular therapy (ATT) was started (**C, D**) Marked enhancement (110 HU) and persistent wall thickening (6.0 mm) of the terminal ileal segment (double arrows) with adjacent mesenteric soft-tissue nodularity (single arrow) 15 days after completing ATT in the same case. Subcentimetric residual retroperitoneal lymphadenopathy (thick arrow in **C**) is also noted. The small bowel feces sign has disappeared.

ATT was started. After ATT completion, nodes were seen in mesentery (►**Fig. 4**), including RIF, periportal region and retroperitoneal region, with size ranging from as small as 3.6 mm to as large as 33.8 mm in short axis diameter (►**Fig. 5**).

Mesenteric lymph nodes persisted in all cases of treated abdominal TB. As much as 70% cases showed presence of retroperitoneal nodes. Thus, all cases with retroperitoneal nodes had mesenteric nodes as well. RIF nodes were noted in 50% cases, whereas periportal nodes were noted in 30% treated cases. Discrete as well as matted nodes were noted

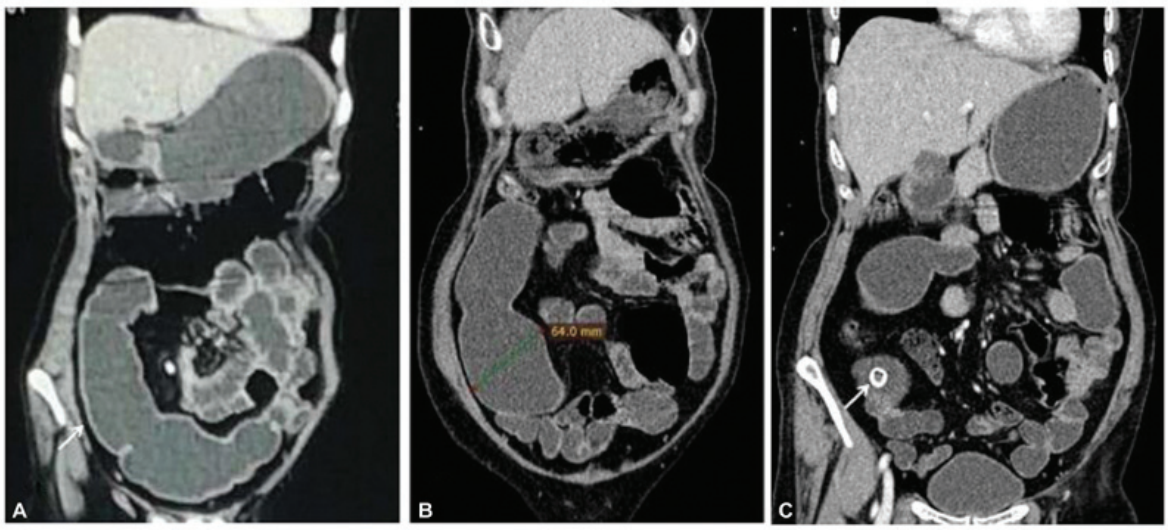

Fig. 3 (**A**) Coronal reformatted postcontrast CT image showing a long dilated distal ileal segment (arrow) prior to starting antitubercular therapy (ATT). (**B**) shows the same case with persistence of dilated distal ileal segment (maximum diameter of 6.4 cm) after ATT completion along with (**C**) enterolith (arrow) in distal ileum.

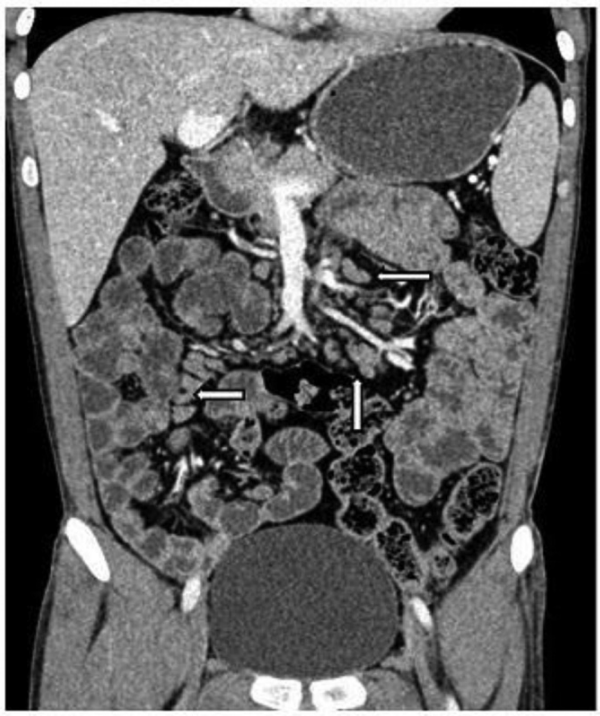

Fig. 4 Coronal reformatted postcontrast CT showing numerous discrete and matted homogeneously enhancing (arrows) subcentimetric mesenteric nodes.

showing homogeneous, heterogeneous, or peripheral rim enhancement with central hypodensity; having attenuation values between 21HU to 114HU and very few showed calcification. As these cases were also asymptomatic in the follow up period of our study, it appears that presence of large, necrotic, enhancing or matted nodes does not indicate active TB. Ma et al observed that necrotic nodes persisted after ATT, but there was a significant decrease in enlarged mesenteric nodes.[11]

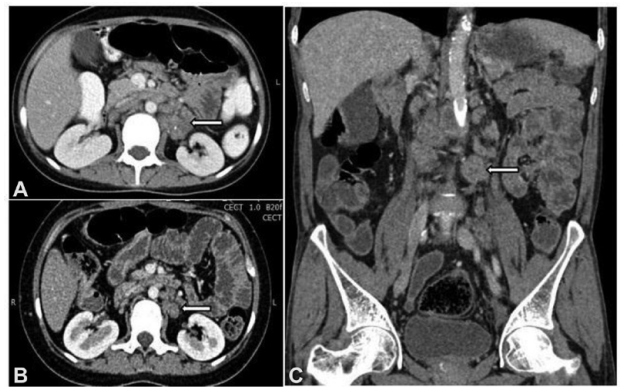

Fig. 5 (**A**) Axial postcontrast CT scan images prior to starting antitubercular therapy (ATT) shows matted, retroperitoneal lymphadenopathy (arrow). (**B**) Axial contrast-enhanced CT (CECT) shows reduction in their size (arrow) 1 month after completing ATT. (**C**) Coronal reconstruction of the same shows persistence of enlarged retroperitoneal nodes (arrow) after treatment.

Limitation

A limitation of our study was that an objective assessment of bowel and lymph nodes was not possible in 7 cases in which pre- treatment and post-treatment CT scan films were available, as cases were not stored in the hard disc memory and no CDs of the CT were available.

Conclusion

In treated ileocecal TB, ileocecal wall thickening and enhancement may persist on CECT abdomen. Distal ileal wall thickening, enhancement, luminal dilatation, partial strictures, and enteroliths may also persist following successful treatment of tubercular abdomen. Numerous, discrete or large matted nodes showing central necrosis/heterogeneous/homogeneous postcontrast enhancement can be seen in treated abdominal TB. Presence of these features in the abdominal CT scan of a

patient with treated abdominal TB should not be confused with active TB and should not prevent the treating physicians from considering an alternative clinical diagnosis. The decision whether to reinstitute ATT should be based on clinical correlation.

Conflic of Interest
None declared.

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