



## CT FEATURES OF DIFFERENT TYPES OF BOWEL WALL THICKENINGS

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**ABSTRACT** **Background and aims:** Conditions that are neoplastic, inflammatory, infectious, or ischemic can thicken the small or large gut wall. The various patterns of bowel thickening and the associated pericolic changes can be evaluated to pinpoint the underlying diagnosis. This article discusses a bunch of cases with bowel tuberculosis, infectious enterocolitis, Crohn's disease, ulcerative colitis, lymphoma and adenocarcinoma to differentiate between different bowel wall thickenings we get in our day-to-day practice and help reach a definitive diagnosis. **Materials and methods:** We selected 20 cases presenting with bowel wall thickening for computed tomography (CT) evaluation in our department with due permission from the institution's ethical committee, who were evaluated, and logical conclusions were drawn. The machine used during the study was a 256-slice CT machine (Phillips Brilliance iCT, Phillips Healthcare) with a dual head power injector (Sino Power-D). The patients were taken up for colonoscopy and biopsy sample was taken and the HPE findings were correlated with the imaging features. **Results:** The thickening of the bowel wall can be classified as focal, segmental or diffuse. Focal, irregular and asymmetrical bowel wall thickening usually suggests a malignancy. However, a disproportionately severe pericolic fat stranding points towards inflammation was found. Ischemic, inflammatory, or infectious conditions usually cause a segmental or diffuse pattern of bowel wall thickening. **Conclusion:** Tumours usually cause focal bowel wall thickening. Besides cancer, inflammatory disorders can also thicken segmental or widespread gut walls. Knowledge of the disease-specific nuances can help arrive at a logical diagnosis.

**KEYWORDS :** Ileocecal tuberculosis; lymphoma; inflammatory bowel; segmental; focal; diffuse.

### INTRODUCTION

A wide variety of bowel diseases are common in Northeast India, of which tuberculosis is an important cause. In Northeast India, there are 497 cases of tuberculosis for every 100,000 people, according to the National Family Health Survey (NHFS) IV.<sup>1</sup> The abdomen is involved in 11% of patients with extrapulmonary tuberculosis.<sup>2</sup> Other causes are inflammatory bowel disease, malignancies, infections, ischemic bowel diseases, etc. The number of new cases of colon cancer per year in the Northeast in 2020 was 1127, while that of rectal cancer was 1106.<sup>3</sup>

A myriad of different features is seen in bowel pathologies that are essential to help differentiate and categorize the diagnosis, more importantly, to distinguish the benign causes from malignant ones. To precisely diagnose the condition under research, familiarity with the different presentations and patterns of various causes of bowel pathologies seen in day-to-day practice must be familiar. An accurate and timely diagnosis goes a long way in timely and proper patient management, which ultimately is the need of the hour in any clinical situation. Since no similar study has been done in this part of the country, the author aims to standardize a simplified approach to the thickening of small and large bowel walls detected on computed tomography (CT) of the abdomen.

This current paper aims to help form a simplified algorithm for bowel wall thickening detected on CT and to differentiate between malignant and benign causes of bowel wall thickening.

Computed tomography can identify intestinal wall anomalies, which can be investigated by classifying attenuation changes in the intestinal wall and using morphologic features revealed by barium examinations. Essential features to look for are enhancement pattern, length of involvement, degree of mural thickening, patency of the mesenteric vessels, mesenteric changes and lumen contents. The mucosa is the most enhancing layer of the bowel and can be seen as a separate layer. In contrast, the less vascular submucosa is rarely seen as a separate layer unless it is oedematous, hemorrhagic, or infiltrated by fat.<sup>4</sup> These characteristics describe the typical enhancement pattern of the bowel wall.

### MATERIALS AND METHODS

A hospital-based prospective observational study was conducted in the department of Radiodiagnosis, Guwahati Medical College and Hospital (GMCH), from October 2021 to September 2022. Only the referred patient from other Departments of GMCH for CT abdomen

will be included, including those with bowel wall thickening on CT and known or follow-up cases of bowel diseases.

Patients who were unwilling to be participants in the study and who have high serum creatinine are excluded from this study.

Patients falling in the inclusion mentioned above criteria will be identified. The participating patient will be evaluated with a 256-slice CT machine (Phillips Brilliance iCT, Phillips Healthcare) with a dual head power injector (Sino Power-D). Informed consent was obtained in written form before enrollment for the study, and due clearance was obtained from the institutional Ethical Committee of GMCH. The patients were subsequently taken up for colonoscopy and biopsy sample was taken and the HPE findings were correlated with the imaging features. The data which was extracted was analyzed with Microsoft Excel software.

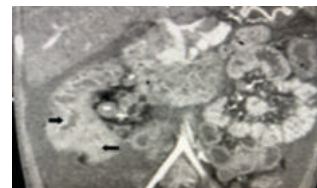
### RESULTS

In an analysis of the 20 patients evaluated during the study, we found that most patients belonged to the male gender (75%). Of the 20 patients evaluated, most were in the 30-40 age group (33%), followed by those in the 50-60 age group (29%).

On analyzing the nature of the pathology, 85% of the cases were benign, with 15% being in the malignant group. In our investigation, we found that ileocecal tuberculosis (TB) was the most common cause of intestinal wall thickening (44%), followed by infective enterocolitis (2%), inflammatory bowel disease (17%), and malignancy (15%).

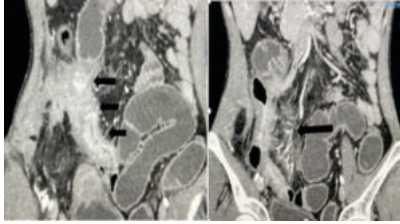
The most common attenuation pattern of the bowel wall thickening seen was heterogeneous (57%), while the most common pattern of involvement was diffuse (60%), followed by segmental (27%) and focal (13%). Most of the diseases affected the small bowel (80%).

The present study was used to obtain some quintessential pathological findings on CT scans as follows:

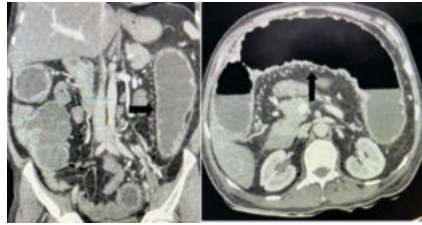


**Figure 1** A case of ileocecal tuberculosis showing asymmetric,

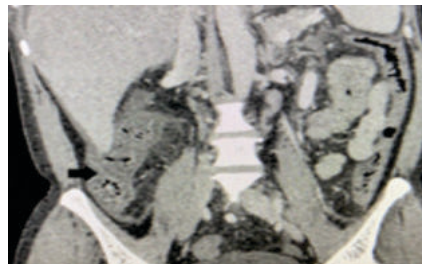
homogeneously enhancing wall thickening involving the cecum, ileocecal (IC) junction and terminal ileum (arrow). The cecum is pulled up, away from the right iliac fossa (RIF) (arrow). HPE revealed tubercular etiology of the bowel thickening.



**Figure 2** A case of Crohn's disease shows the asymmetric, stratified pattern of wall thickening involving the terminal ileum and cecum and part of ascending colon (arrows on the left). There is engorgement of the vasa recta noted, giving a comb sign (arrow on the right). There is also pericolic fat stranding seen. On HPE, it was found to be a case of Crohn's disease.



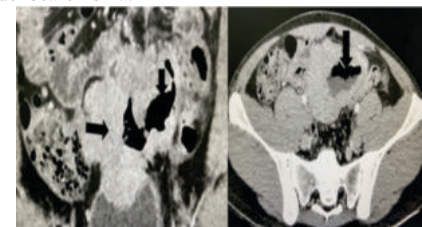
**Figure 3** A case of ulcerative colitis showing diffuse symmetrical involvement of sigmoid, descending, transverse and ascending colon without any skip areas (yellow arrows). There are lots of haustrations and dilatation of the involved bowel loops (lead pipe appearance). On HPE, the features were suggestive of ulcerative colitis.



**Figure 4** A case of infectious colitis showing a long segment wall thickening noted involving the cecum and ascending colon (arrow-mark) with extensive pericolic fat stranding. HPE showed normal crypt architecture and a primarily acute, or polymorphonuclear cell, inflammatory infiltrate in the lamina propria, both of which were suggestive of an infectious cause of the thickening.



**Figure 5** Adenocarcinoma showing focal, irregular, asymmetrical, polypoidal, heterogeneously enhancing wall thickening involving the descending colon causing gross luminal narrowing (red arrow). HPE revealed adenocarcinoma.



**Figure 6** A case of lymphoma showing asymmetric, homogeneously

enhancing bowel wall thickening (arrow) and aneurysmal dilatation (arrow) without any signs of obstruction; a systematic approach for evaluation of bowel wall thickening. HPE features were suggestive of diffuse B- cell type lymphoma.

## DISCUSSION

In a study by Mathew et al.,<sup>5</sup> they found that the majority belonged to the 21- 40 yrs age group, comparable to our study, where the most commonly affected age group was 30-40 years. Patel et al.,<sup>6</sup> found that males showed a high predisposition for the disease, which corroborated with the findings of our study, where the majority of the affected belonged to the male gender.

The most common cause of bowel wall thickening in the study by Mathew et al.,<sup>5</sup> was infective. In contrast, in our study, ileocecal TB was the most familiar pathology, followed by other infective causes. The most common enhancement pattern was found to be heterogeneous by Patel et al.,<sup>6</sup> similar to our study, where we saw that majority of the bowel wall thickening exhibited a heterogeneous pattern. Patel et al.,<sup>6</sup> found the prevalent pattern of involvement to be focal (82.3 %), whereas our study showed a greater incidence of diffuse bowel involvement. Various authors have reported average bowel wall thickness, as shown on the CT in **Table 1**.

### Different patterns of bowel wall enhancement

These attenuation patterns include black, white, and grey, the water halo sign, and the fat halo sign. The white pattern uniformly affects the bulk of the expanded intestinal wall, signifying intense contrast material amplification. If the intestinal wall enhancement in the same scan is equal to or greater than the venous opacification enhancement, they must be categorized as the white attenuation pattern. This pattern is frequently associated with diagnosing vascular disorders and idiopathic inflammatory bowel diseases.

The description of the grey pattern includes a narrow augmentation, a thicker intestinal wall, and uniform attenuation comparable to more muscle. This pattern is used to differentiate between benign and malignant tumours, even though it is the least specific of the patterns and should be used in conjunction with morphological data.

The water halo indication denotes stratification inside a thickened intestinal wall of two or three continuously thickened layers that are symmetrically thickened. Idiopathic inflammatory bowel diseases, vascular issues, viral diseases, and radiation damage are common diagnoses for this symptom.

The three-layered target sign of thickened bowel, known as the "fat halo sign", has a fatty attenuation in the middle or "submucosal" layer. Idiopathic inflammatory bowel diseases of the colon and Crohn's disease of the small intestine are common diagnoses with this symptom.

### Ileocaecal tuberculosis

The most prevalent type of gastrointestinal tuberculosis, which is the third most prevalent type of extrapulmonary tuberculosis, is ileocecal tuberculosis. Three morphological types of ileocecal tuberculosis are known: ulcerative, hypertrophic and ulcerohypertrophic. It is characterized by eccentric wall thickening or mass-like lesions. The ileocecal valve has thickened asymmetrically. (**Figure 1**) Additional features are necrotic lymph nodes, peritonitis, hepatosplenic and thoracic dissemination.

### Crohn's disease

Idiopathic inflammatory bowel illness Crohn's disease, commonly known as regional enteritis, is characterized by widespread discontinuous gastrointestinal tract inflammation. The terminal ileum and proximal colon are most frequently impacted.<sup>7</sup> There are many extraintestinal diseases. The bowel wall has transmural involvement.<sup>8</sup> It is characterized by asymmetric involvement because the mesenteric border is preferentially infiltrated. (**Figure 2**) There is a stratified pattern of bowel enhancement. There are skip lesions noted. Additional features include submucosal fatty proliferation, homogeneously enhancing small lymph nodes, engorged vasa recta (comb sign), creeping fat, luminal complications (strictures, dilatations, and cancer) and extraluminal complications (fistula, abscess, and perforation or toxic megacolon).

### Ulcerative colitis

The other aspect of Inflammatory bowel disease (IBD), which is

ulcerative colitis (UC), primarily affects the colon and manifests extraintestinal. The rectum is the commonest site involved.<sup>9</sup> It is limited to mucosa and submucosa.<sup>8</sup> It is characterized by continuous and symmetric bowel wall involvement. In long-standing cases, there are lots of haustrations characterized by the lead pipe appearance of the colon. (Figure 3)

**Infectious enterocolitis**

Infectious enterocolitis is a colon inflammation brought on by bacterial, viral, fungal, or parasitic infections. With adjacent fat stranding that is proportionally more severe than the wall thickening, segmental or focal wall thickening is seen. (Figure 4).

**Bowel Ischemia**

Ischemic bowel disease encompasses a wide range of illnesses with various clinical and radiologic symptoms, ranging from localized transitory ischemia to catastrophic gastrointestinal tract necrosis. Thromboembolism, nonocclusive causes, intestinal blockage, neoplasms, vasculitis, abdominal inflammatory disorders, trauma, chemotherapy, radiation, and corrosive injury are some of the main causes of insufficient blood flow to the gut. The CT findings include thickening of the bowel wall, whether or not the target sign is present, intramural pneumatosis, mesenteric or portal venous gas, and mesenteric arterial or venous thromboembolism. Various CT abnormalities include thicker bowel walls with significant enhancement, engorged mesenteric veins, mesenteric oedema, bowel obstruction, and infarction of other abdominal organs.

**Adenocarcinoma of bowel**

Prevalent cancer causes significant morbidity and mortality in colorectal cancer. The most typical type of colorectal cancer is colon adenocarcinoma. Adenocarcinoma frequently appears on CT as a distinct soft tissue mass constricting the intestinal lumen. It may also appear as an apple-core defect with focal thickening of the intestinal wall and luminal constriction. Adenocarcinoma frequently appears on CT as a distinct soft tissue mass constricting the intestinal lumen. It may also appear as an apple-core defect with focal thickening of the intestinal wall and luminal constriction. The wall thickening is heterogeneously enhanced with mild pericolic fat stranding. (Figure 5) CT imaging makes it simple to see primary adenocarcinoma complications such as blockage, perforation, and fistula. On a CT scan, the tumour's local expansion can be seen as an extracolic mass or a simple thickening and pericolic fat infiltration.

The disappearance of fat planes between the colon and surrounding organs is another sign of extracolic expansion. The primary organ affected by metastases from colorectal cancer is the liver. Lungs, adrenal glands, and bones are a few additional locations where colon cancer metastasizes frequently.

**Lymphoma of bowel**

The findings of primary small bowel lymphoma include the absence of palpable superficial lymph nodes, a normal chest radiograph without mediastinal or hilar adenopathy, a primary tumour mass centred in the small bowel with the appropriate draining lymph node involvement, the absence of hepatic or splenic lesions and a normal white blood cell count. On CT, a segmental wall thickening was noted with or without aneurysmal dilatation of the lumen. The wall thickening is homogeneously enhancing, asymmetrical and circumferential. (Figure 6) Aneurysmal dilatation occurs due to the replacement of the muscular by a tumour or infiltration of the myenteric nerve plexus.<sup>10</sup>

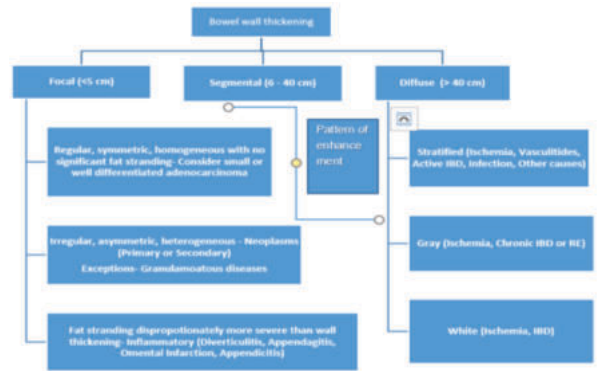
**Table 1** Normal bowel wall thickness

Normal limits of bowel wall thickness <sup>11-16</sup>		
Luminal distension	Collapsed	Well distended
Small bowel	< 3mm	< 3mm
Large bowel	Up to 5 mm	1 to 2 mm

There are numerous causes of bowel wall thickening, which can be categorized based on the length of bowel wall involvement, as shown in Table 2.

**Table 2** Causes of bowel wall thickening based on length of involvement<sup>11</sup>

<5 cm (Focal)	6-40 cm (Segmental)	> 40 cm (Diffuse)
1. Adenocarcinoma	1. Ischemia 2. Infection 3. Crohn's disease 4. Lymphoma	1. Infectious enterocolitis 2. Ulcerative colitis



**Flow Chart 1** Algorithm for evaluation of bowel wall thickening

**Limitations**

There were a few inevitable limitations in the conduct of this research, like the small sample size and the fact that it is not a multicentric study. However, our research findings corroborated sufficiently with previous studies.

**CONCLUSION**

Bowel wall thickening can be diffuse or focal and segmental. The degree and symmetry of focal thickening and perienteric abnormalities aid in reducing the range of possible diagnoses. In heterogeneous and asymmetric focal thickening cases, malignancy can be suspected, whereas benign conditions and well-differentiated tumours may cause symmetric regular and homogeneous thickening. A mismatch between the amount of fat stranding and the degree of wall thickening indicates inflammatory conditions. Benign conditions, except lymphoma, usually cause segmental or diffuse bowel thickenings. Common causes include ischaemia and inflammatory and infectious conditions. The attenuation pattern helps in gauging between the various. With increasing age, malignant causes become more prevalent. However, still, there is significant overlap in CT imaging findings of different non-neoplastic bowel conditions.

**REFERENCES**

- Mazumdar S, Satyanarayana S, Pai M. Self-reported tuberculosis in India: evidence from NFHS-4. *BMJ Glob Health* [Internet]. 2019;4(3):e001371. Available from: <https://gh.bmj.com/content/bmjgh/4/3/e001371.full.pdf>
- Rathi P, Gambhire P. Abdominal Tuberculosis. *The Journal of the Association of Physicians of India* 2016 Feb;64:49-58.
- Desai RK, Tagliabue JR, Wegryn SA, Einstein DM. CT evaluation of wall thickening in the alimentary tract. *Radiographics* 1991;11:771-783. doi:10.1148/radiographics.11.5.1947313.
- Sugi MD, Menias CO, Lubner MG, Bhalla S, Mellnick VM, Kwon MH, et al. CT findings of acute small-bowel entities. *RadioGraphics* 2018 Sep;38(5):1352-69.
- Mathew JR, A Parthasarathi, BT Deepthi, U Harsha. Intestinal bowel wall thickening analysis on MDCT: a retrospective study. *Asian Journal of Medical Radiological Research* 2020 Jul 5;8(1):106-9.
- Kalpesh K. Patel, Mayur V. Khandhedhia, Vishalkumar H. Bhardava. Characterization of bowel lesions with multi-detector CT scan. *International Journal of Contemporary Medicine Surgery and Radiology*. 2018;3(3):C136-C142.
- Kumar V, Abbas AK, Aster JC. Robbins and cotran pathologic basis of disease e-book. 10th ed. [place of publication]: Elsevier; 2020. P. [page number. .].
- Roggeveen MJ, Tismenetsky M, Shapiro R. Ulcerative Colitis. *RadioGraphics* 2006 May;26(3):947-51.
- Ghai S, Pattison J, Ghai S, O'Malley ME, Khalili K, Stephens M. Primary gastrointestinal lymphoma: spectrum of imaging findings with pathologic correlation. *RadioGraphics* 2007 Sep;27(5):1371-88.
- Paulsen SR, Huprich JE, Fletcher JG, Booya F, Young BM, Fidler JL, et al. CT enterography as a diagnostic tool in evaluating small bowel disorders: review of clinical experience with over 700 cases. *RadioGraphics* 2006 May;26(3):641-57.
- Macari M, Megibow AJ, Balthazar EJ. A pattern approach to the abnormal small bowel: observations at MDCT and CT Enterography. *American Journal of Roentgenology* 2007 May;188(5):1344-55.
- Macari M, Balthazar EJ. CT of bowel wall thickening. *American Journal of Roentgenology* 2001 May;176(5):1105-16.
- Wiesner W, Khurana B, Ji H, Ros RP. CT of acute bowel ischemia. *Radiology* 2003 Mar;226(3):635-50.
- Wittenberg J, Harisinghani MG, Jhaveri K, Varghese J, Mueller PR. Algorithmic approach to CT diagnosis of the abnormal bowel wall. *RadioGraphics* 2002 Sep;22(5):1093-107.
- Horton KM, Corl FM, Fishman EK. CT evaluation of the colon: inflammatory disease. *RadioGraphics* 2000 Mar;20(2):399-418.
- Fisher JK. Abnormal colonic wall thickening on computed tomography. *Journal of Computer Assisted Tomography* 1983 Feb;7(1):90-7.