

Characterization of Bowel wall thickening with CT Scan

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Abstract

Introduction: Computed tomography demonstrates intestinal wall abnormalities that can be analysed by categorizing attenuation changes in the intestinal wall and transposing morphologic characteristics learned from barium studies. These attenuation patterns include white, gray, water halo sign, fat halo sign, and black. **Materials and Methods:** This is a prospective and observational study conducted in the Department of Radiology, Subbaiah Institute of Medical Sciences, Shivamogga among 65 patients. The phrase "colonic wall thickening" was scanned and the CT reports in which abdominal CT was taken and reported between January 2019 to September 2019. Inclusion Criteria: Patients clinical presentation of bowel, mesentery and related pathologies arising from duodenum to rectum were selected for this study and underwent Multidetector CT scan. Diagnosis was confirmed by following up patient with USG or CT, Other radiological and non-radiological investigation and/or surgery and histopathology. Exclusion Criteria: Patients had heart failure, hypoalbuminemia, and nephrotic syndrome that could affect colon wall thickness. **Results:** Among the 65 patients included in the study, 1 (1.5%) had congenital lesions, 27 (41.5%) had infective and inflammatory lesions, 3 (4.6%) had ischemic bowel conditions, 31 (47.6%) had neoplastic lesions of bowel and 3 (4.6%) had miscellaneous bowel conditions. Out of 65 cases lesion of bowel, 33 cases showed asymmetrical bowel wall thickening. Out of 65 cases of bowel, 34 showed focal bowel wall thickening (<10 cm) and 8 showed segmental bowel wall thickening (>10 cm). Out of 65 cases of lesions, 12 (66.67%) cases showed segmental (>10 cm) bowel wall thickening. **Conclusion:** Careful analysis of characteristics of lesions on CT scan helps to narrow down the differential diagnosis. Thus, multidetector CT scan is "The imaging modality of choice" for characterization of bowel lesions.

Keywords: Computed tomography, Inflammatory bowel disease, Bowel wall thickness.

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Introduction

Computed tomography (CT) is increasingly being used as a screening technique for patients with symptoms of intestinal disease because of (a) growing confidence in CT in general as a problem solver, especially for many gastrointestinal disorders; (b) a wide margin of clinical diagnostic error in the differentiation of intestinal from other abdominal diseases; (c) its potential for providing information for a comprehensive diagnosis and staging of abdominal neoplasms; and (d) its wide availability and ease of performance. Predictably, CT will uncover abnormalities in patients with or without symptoms referable to the intestinal tract. [1] A wide spectrum of intestinal wall morphologic and enhancement abnormalities can be seen with bowel disorders. Once an abnormality is detected, the radiologist needs a systematic approach for determining the specific cause of the intestinal abnormality. [2] In this article, an organizational framework is proposed that distills both enhancement and morphologic observations for refining CT interpretation of both small and large intestinal diseases. The proposed approach is based on alternative attenuation values of the bowel wall. [3] The spectrum of these mural attenuation patterns includes white (avid contrast material enhancement), gray, water halo sign, fat halo sign, and black (pneumatosis). Differentiating these patterns, sometimes supplemented by geographic and morphologic bowel wall features, will considerably narrow the diagnostic possibilities, particularly in the differentiation of benign from

malignant disease. [4] Many patients with bowel wall abnormalities present with acute, subacute, or chronic gastrointestinal symptoms, some patients may have nonspecific abdominal complaints or none at all. Therefore, the CT imaging technique applied in the overwhelming proportion of patients is a conventional one. In a few cases, the CT technique will prospectively be specifically tailored to the suspected diagnosis. [5] The tailored examination could include use of arterial as well as portal venous phase contrast material enhancement, delayed scans, decubitus positioning, or an enema. Although these refinements might retrospectively contribute additional clues in some cases, their routine incorporation is impractical, particularly with the scant patient history, physical observations, or laboratory information ordinarily available. [6] Because many bowel wall observations may be very subtle, use of thin-section, high-volume, rapid-bolus scanning technique with state-of-the-art CT technology is important in discriminating intestinal abnormalities. Intravenous administration of contrast material is often preferable, and in most cases critical, for discovering certain bowel wall abnormalities that otherwise may be inapparent or very subtle. Because administration of oral contrast material is usually routine, the bowel wall is invariably assessed in the presence of positive luminal contrast material. However, nonopaque fluid distention may reveal luminally oriented features possibly obscured by the oral contrast material. [7]

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Material Method

This is a Prospective and observational study conducted in the Department of Radiology, Subbaiah Institute of Medical Sciences, Shivamogga among 70 patients. The phrase "colonic wall thickening" was scanned and the CT reports in which abdominal CT was taken and reported between January 2019 to September 2019.

Inclusion Criteria

Patients clinical presentation of bowel, mesentery and related pathologies arising from duodenum to rectum were selected for this study and underwent Multidetector CT scan. Diagnosis was confirmed by following up patient with USG or CT, Other radiological and non-radiological investigation and/or surgery and histopathology.

Exclusion Criteria

Patients had heart failure, hypoalbuminemia, and nephrotic syndrome that could affect colon wall thickness.

Statistical Analysis

Descriptive analyses were conducted to give information about the general characteristics of the study groups. Data of continuous variables were expressed as n (%). $p < 0.05$ was considered statistically significant. Calculations were made using SPSS software version.

Results

In our study, the most of the patients the age group of 41-60 years i.e., 33 out of 65 (50.7%), followed by 21-40 years, i.e., 21 out of 65 (32.3%) in Table 1.

Table 1: Distribution of different age groups of patients

Age in years	No. of patients	Percentage
1-20	9	13.8
21-40	21	32.3
41-60	33	50.7
>61	2	3.0
Total	65	100

Table 2: Distribution of gender

Gender	No. of patients	Percentage
Male	44	67.6
Female	21	32.3
Total	65	100

In table 2, maximum number of patients were male 44 (67.6%) and female 21 (32.3%) in our study.

Table 3: Distribution of bowel lesion of the patients

Lesion	No. of patients	Percentage
Congenital lesions	1	1.5
Infective and inflammatory lesions	27	41.5
Ischemic bowel conditions	3	4.6
Neoplastic lesions of bowel	31	47.6
Miscellaneous bowel conditions	3	4.6

In table 3, among the 65 patients included in the study, 1(1.5%) had congenital lesions, 27 (41.5%) had infective and inflammatory lesions, 3 (4.6%) had ischemic bowel conditions, 31(47.6%) had neoplastic lesions of bowel and 3 (4.6%) had miscellaneous bowel conditions.

Table 4: Degree of wall thickening

	Degree of wall thickening	
	Mild (< 1.5 cm)	Marked (>1.5 cm)
Malignant	7	26
Characinoid	2	1
Lymphoma	1	1
Colitis (inflammatory or infectious)	3	1
Ileocecal infective or inflammatory lesions	12	7
Ischemic	2	2
Diverticulitis	1	1
Total	28	37

In table 4, out of 65 cases lesion, colitis (infective/ inflammatory bowel lesions) was 3 cases showed mild (<1.5 cm) bowel wall thickening.

Table 5: Symmetry of wall thickening

	Symmetry of wall thickening	
	Symmetrical	Asymmetrical
Malignant	6	33
Characinoid	1	1
Lymphoma	1	0
Colitis (inflammatory or infectious)	2	1
Ileocecal infective or inflammatory lesions	11	4
Ischemic	1	2
Diverticulitis	1	1
Total	23	42

In table 5, out of 65 cases of lesion of bowel, 33 cases showed asymmetrical bowel wall thickening.

Table 6: Length of involved segment

	Length of involved segment		
	Focal	Segmental	Diffuse
Malignant	34	8	0
Characinoid	1	0	0
Lymphoma	0	1	0
Colitis (inflammatory or infectious)	1	3	1

Ileocecal infective or inflammatory lesions	1	8	0
Ischemic	0	3	2
Diverticulitis	1	0	1
Total	38	23	4

In table 6, out of 65 cases of bowel, 34 showed focal bowel wall thickening (<10 cm) and 8 showed segmental bowel wall thickening (>10 cm). Out of 65 cases of lesions, 12 (66.67%) cases showed segmental (>10 cm) bowel wall thickening.

Table 7: Post-contrast enhancement pattern

	Post-contrast enhancement pattern			
	Homogeneous	Heterogeneous	Layered enhancement	Reduced enhancement
Malignant	19	29	0	0
Characinoid	1	0	0	0
Lymphoma	2	0	0	0
Colitis (inflammatory or infectious)	1	0	3	0
Ileocecal infective or inflammatory lesions	2	1	5	0
Ischemic	1	0	0	1
Diverticulitis	0	1	0	0
Total	26	31	7	1

In table 7, out of 65 cases of bowel lesion, 29 showed heterogeneous pattern of post contrast enhancement while 19 showed homogeneous pattern of post contrast enhancement.

Discussion

With the development of multidetector computed tomography scanners (MDCT), computed tomography became an important tool in the detection and characterisation of bowel abnormalities. This technology makes possible the acquisition of isotropic data and affords the capability of performing high-resolution multiplanar reconstructions. [8] In particular, CT enterography acquired after luminal distention through the administration of high volumes of neutral contrast material (1500-2,000 ml of water, water-methylcellulose solution, polyethylene glycol electrolyte solution or low-concentration barium) is helpful in displaying the thickness and mural enhancement of the small bowel wall. [9] Adequate preparation and distention of the bowel lumen is, however, not always possible in the acute setting. In addition, wall abnormalities of the small and large bowel may be incidentally detected in asymptomatic patients or in patients with nonspecific complaints. For these, the CT imaging technique applied in a significant proportion of patients is a conventional one and radiologists should have a high level of suspicion in the detection and interpretation of bowel wall abnormalities. [10]

Thickening of the bowel wall

Thickening of the bowel wall may be caused by several pathologic conditions or be a normal variant. When thickening of the bowel wall is identified on CT, several imaging features must be assessed in order to narrow the differential diagnosis: length of involvement, degree of thickening, symmetric versus asymmetric involvement, pattern of attenuation and perienteric abnormalities. Each of these features may have a different significance according to the acute or chronic onset of clinical symptoms and will be further discussed in an algorithm approach. [11]

Focal thickening of the bowel wall

Thickening of the bowel wall is considered focal when it extends less than 5 cm. Focal thickening may be caused by tumours or by inflammatory conditions, and distinguishing between the two conditions should be attempted. In addition to the clinical presentation, analysis of the wall symmetry, degree of thickening and perienteric abnormalities provides additional information for the correct diagnosis. In the setting of focal wall thickening three main scenarios may occur: (1) asymmetric focal thickening, (2) symmetric focal thickening and (3) perienteric abnormalities (fat stranding) disproportionately greater than the degree of wall thickening. [12]

Asymmetric focal thickening of the bowel wall-Asymmetric thickening of the bowel wall corresponds to different degrees of

eccentric thickening around the circumference of the involved segment and is typically caused by neoplasms. Malignant tumours of the gastrointestinal tract are more common in the stomach and colon and are less frequent in the small bowel, where they tend to occur at the proximal segments. Neoplasms have a chronic onset and may present as an eccentric focal mass or, more commonly, as a circumferential asymmetric thickening, usually greater than 3 cm in thickness. [13] Symmetric focal thickening of the bowel wall- Circumferential and symmetric thickenings of the bowel wall are features usually attributed to benign conditions such as inflammatory, infections, bowel oedema and ischaemia. However, neoplasms such as well-differentiated or small adenocarcinomas may also display symmetric and homogeneous thickening of the bowel wall and should be considered specially when the thickened bowel has a focal extension and no significant perienteric fat stranding is seen. [14]

Diverticulitis

Diverticulae are sacculations of the mucosa and submucosa through the muscularis of the bowel wall, which are more common in the descending and the sigmoid colon. Diverticulitis occurs when the neck of a diverticulum becomes occluded, resulting in microperforation and pericolonic inflammation. CT findings of acute diverticulitis include inflamed diverticula in combination with pericolonic fat stranding, which is more severe than the mild focal thickening of the adjacent bowel wall. Engorgement of the mesenteric vessels ("centipede" sign) and the presence of fluid at the base of the sigmoid mesentery ("comma sign") are two indicative signs of the inflammatory process. [15]

Bowel ischaemia

Thickening of the bowel wall is the most common but least specific CT sign of bowel ischaemia. The extent of involvement, degree of thickness and pattern of attenuation of the ischaemic bowel vary according to three main factors: (1) pathogenesis of the ischaemia (arterial-occlusive, veno-occlusive or hypoperfusion); (2) severity of the ischaemia (transient ischaemia of the mucosa and/or submucosa versus transmural bowel wall necrosis); (3) superimposed haemorrhage or infection. [16] Although bowel wall thickening is a common finding in cases of bowel ischaemia, the ischaemic bowel wall may also appear paper thin, particularly in cases of acute arterial occlusion. When the ischaemic bowel wall is thickened, it may present with one or more of the three above-mentioned attenuation patterns referred. The stratified pattern of attenuation may be an early finding of bowel ischaemia. This results from oedema of the submucosa and hyperaemia or hyperperfusion of the mucosa and/or muscularis propria. This finding should be judged in the clinical

context and associated imaging findings of bowel ischaemia, such as occlusion of the mesenteric artery or vein, bowel dilatation, engorgement of the mesenteric veins, and mesenteric oedema and ascites. Intestinal pneumatosis and gas in the mesenteric or portal veins are indicative of severe ischaemia and are usually associated with the thinning rather than thickening of the small bowel wall due to bowel wall necrosis. [17]

Inflammatory bowel disease

Bowel wall thickening with a stratified pattern may be also seen in both ulcerative colitis (UC) and Crohn's disease, indicating acute, active disease.[27] Crohn's disease may occur in any part of the gastrointestinal tract but predominantly affects the small bowel, particularly the ileum and right colon. CT signs favouring Crohn's disease include discontinuous involvement of the bowel wall ("skip areas"), prominent vasa recta ("comb sign") and signs of transmural inflammation such as fistulas and abscesses, and proliferation of the fat along the mesenteric border of the bowel.[18]

Infectious enteritis or colitis and pseudomembranous colitis

In most cases of infectious enteritis, the small bowel wall appears normal or mildly thickened. By contrast, infectious colitis typically manifests with significant wall thickening, which may demonstrate either homogeneous enhancement or a striated pattern due to intramural oedema. Stranding of the pericolic fat and ascites are also commonly seen. Although the affected portion of the colon may suggest a specific organism, there is a considerable overlap of the appearances. Thus, laboratory studies are needed to achieve a definitive diagnosis.[19]

Conclusion

Thickening of small and large bowel wall is seen in variety of conditions. No single characteristic is highly specific for differentiation between benign and malignant lesions. Careful analysis of characteristic of lesions on CT scan including degree of bowel wall thickening, symmetrical or asymmetrical thickening, length of bowel wall thickening, pattern of bowel wall enhancement and location of the lesion help to narrow down the differential diagnosis. Thus, multidetector CT scan is "The imaging modality of choice" for characterization of bowel lesions.

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