Section: Anatomy

Original Research Article

FROM DIAGNOSIS TO TREATMENT: ENHANCING PRECISION IN CT ANALYSIS OF BOWEL WALL THICKNING

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Received : *30/11/2023*
Received in revised form : *07/01/2024*
Accepted : *24/01/2024*

Keywords:
CT, MDCT, Abdominal Wall Thickni.

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DOI: 10.47009/jamp.2024.6.1.120

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2024; 6 (1); 603-606

Abstract

Background: Abnormalities in the intestinal wall can be detected using computed tomography (CT) by analyzing changes in attenuation and applying morphologic characteristics learned from barium studies. These changes in attenuation can be categorized into white, gray, water halo sign, fat halo sign, and black. **Aim:** Assessment of CT images with abdominal wall thickening. **Material & Methods:** This prospective study involved 65 patients abdominal CT reports with colonic wall thickening. Patients with clinical presentations of bowel, mesentery, and related pathologies from the duodenum to the rectum were included in the study and underwent Multidetector CT scans. Diagnosis was confirmed through follow-up with ultrasound or CT, as well as other radiological and non-radiological investigations, surgery, and histopathology. **Results:** Out of the 65 patients included in the study, 1 had congenital lesions, 27 had infective and inflammatory lesions, 3 had ischemic bowel conditions, 31 had neoplastic lesions of the bowel, and 3 had miscellaneous bowel conditions. Among the cases with bowel lesions, 3 cases showed mild (<1.5 cm) bowel wall thickening, indicating colitis (infective/inflammatory bowel lesions). Additionally, 33 cases exhibited asymmetrical bowel wall thickening, while 34 cases showed focal bowel wall thickening (<10 cm), and 8 cases showed segmental bowel wall thickening (>10 cm). **Conclusion:** Careful analysis of lesion characteristics on CT scans can help narrow down the differential diagnosis. Therefore, multidetector CT scan is the preferred imaging modality for characterizing bowel conditions.

INTRODUCTION

Computed tomography (CT) is increasingly being utilized as a screening method for patients exhibiting symptoms of intestinal disease due to several factors. Firstly, there is a growing confidence in CT as an effective problem-solving tool, particularly for various gastrointestinal disorders. Secondly, there is a significant margin of error in clinically diagnosing intestinal diseases as opposed to other abdominal conditions, making CT a valuable tool in differentiation. Additionally, CT has the potential to provide comprehensive diagnostic and staging information for abdominal neoplasms. Lastly, CT is widely available and easy to perform, making it accessible for use in screening. As expected, CT scans will reveal abnormalities in both symptomatic and asymptomatic patients with intestinal tract issues. A wide range of morphologic and enhancement abnormalities in the intestinal wall can be observed in cases of bowel disorders. Once an abnormality is detected, radiologists require a systematic approach to determine the specific cause of the intestinal abnormality. This article proposes an organizational framework that incorporates both enhancement and morphologic observations to enhance CT interpretation for small and large intestinal diseases. The proposed approach is based on alternative attenuation values of the bowel wall. These attenuation patterns include white (avid contrast material enhancement), gray, water halo sign, fat halo sign, and black (pneumatosis). By differentiating these patterns, along with geographic and morphologic bowel wall features, the diagnostic possibilities can be significantly narrowed down, particularly in distinguishing between benign and malignant diseases. Many patients with bowel wall abnormalities present with acute, subacute, or chronic gastrointestinal symptoms. However, some patients may have nonspecific abdominal complaints or no symptoms at all. Therefore, the conventional CT imaging technique is applied to the majority of patients. In a few cases, the CT

technique may be specifically tailored to the suspected diagnosis.

The customized examination may involve the utilization of arterial and portal venous phase contrast material enhancement, delayed scans, decubitus positioning, or an enema. While these enhancements may provide additional clues in certain cases, their routine implementation is not practical, especially considering the limited patient history, physical observations, or laboratory information typically available.[6] Given that many observations of bowel wall abnormalities can be quite subtle, it is crucial to employ a thin-section, high-volume, rapid-bolus scanning technique using state-of-the-art CT technology to accurately differentiate intestinal abnormalities. Intravenous administration of contrast material is often preferred and, in most cases, essential for detecting certain bowel wall abnormalities that may otherwise go unnoticed or be very subtle. Although oral contrast material administration is typically standard, the presence of nonopaque fluid distention may reveal features oriented towards the lumen that could potentially be obscured by the oral contrast material.[7]

MATERIALS AND METHODS

This prospective study was conducted at the Department of Radiodiagnosis, Bhagwan Mahavir Institute of Medical Sciences, Pawapuri. The study was approved by institutional research and ethical committee. An informed and written consent was obtained from all the subjects prior to the commencement of study.

The analysed cases of colonic wall thickening through CT reports and a total of 65 subjects were enrolled in the study.

Inclusion Criteria

Patients who presented with clinical symptoms related to bowel, mesentery, and pathologies from the duodenum to the rectum were selected for this study. These patients underwent Multidetector CT scan. The diagnosis was confirmed by further investigations such as USG or CT, as well as other radiological and non-radiological examinations, surgery, and histopathology.

Exclusion Criteria

Patients with heart failure, hypoalbuminemia, and nephrotic syndrome, which could potentially affect colon wall thickness, were excluded from the study.

Statistical Analysis

The data was tabulated in Microsoft excel sheet and evaluated for statistical analysis using SPSS software.

RESULTS

Our study revealed that the majority of patients fell within the age group of 41-60 years, accounting for 33 out of 65 patients (50.7%). The second largest age group was 21-40 years, with 21 out of 65 patients (32.3%), as shown in. [Table 1]

Table 2 displayed the gender distribution of the patients in our study. Among the total number of patients, 44 (67.6%) were male and 21 (32.3%) were female. [Table 2]

In Table 3, we categorized the 65 patients included in the study based on the type of bowel lesions they had. Out of the total, 1 patient (1.5%) had congenital lesions, 27 patients (41.5%) had infective and inflammatory lesions, 3 patients (4.6%) had ischemic bowel conditions, 31 patients (47.6%) had neoplastic lesions of the bowel, and 3 patients (4.6%) had miscellaneous bowel conditions. [Table 3]

Table 4 provided information on the specific type of lesion observed in the 65 cases. Among these cases, 3 showed mild (<1.5 cm) bowel wall thickening, indicating colitis (infective/inflammatory bowel lesions). [Table 4]

In Table 5, we found that out of the 65 cases of bowel lesions, 33 cases exhibited asymmetrical bowel wall thickening. [Table 5]

Table 6 presented the extent of bowel wall thickening in the 65 cases. Among them, 34 cases showed focal bowel wall thickening (<10 cm) and 8 cases showed segmental bowel wall thickening (>10 cm). Additionally, 12 cases (66.67%) displayed segmental (>10 cm) bowel wall thickening out of the total 65 cases of lesions. [Table 6]

Lastly, Table 7 demonstrated the pattern of post-contrast enhancement in the 65 cases of bowel lesions. Among these cases, 29 showed a heterogeneous pattern of enhancement, while 19 showed a homogeneous pattern of enhancement. [Table 7]

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

ISSN (O): 2687-5365; ISSN (P): 2753-6556

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

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

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

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

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 inflammatorylesions	2	1	5	0
Ischemic	1	0	0	1
Diverticulitis	0	1	0	0
Total	26	31	7	1

DISCUSSION

The advent of multidetector computed tomography scanners (MDCT) has made computed tomography an essential tool for detecting and characterizing bowel abnormalities. This technology allows for the acquisition of isotropic data and enables high-resolution multiplanar reconstructions.[8] Specifically, CT enterography, is useful for visualizing the thickness and enhancement of the small bowel wall.[9] In acute cases, and in wall abnormalities of small and large bowel radiologists using conventional CT should maintain a high level of suspicion for detecting and interpreting bowel wall abnormalities.[10]

Bowel wall thickening can be caused by various pathological conditions or may be a normal variation. Usage of several imaging features of CT is advised in these cases depending on the acute or chronic onset of clinical symptoms.[11] Focal thickening of the bowel wall can be caused by either tumors or inflammatory conditions, and it is important to differentiate between the two.[12]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Asymmetric focal thickening of the bowel wall is typically caused by neoplasms, with malignant tumors being more common in the stomach and colon and less frequent in the small bowel. Neoplasms often present as an eccentric focal mass or a circumferential asymmetric thickening, usually greater than 3 cm in thickness.[13-14]

Diverticulae are mucosal and submucosal layers bulging pockets and are more commonly found in the descending and sigmoid colon. In cases of acute diverticulitis, CT scans can reveal inflamed diverticula along with inflammation and swelling of the fat surrounding the colon.[15]

Detection of Bowel ischemia on CT is not specific to the condition. The extent, thickness, and attenuation pattern of the ischemic bowel can vary. The stratified pattern of attenuation, which results from submucosal edema and hyperemia or hyperperfusion of the mucosa and/or muscularis propria, can be an early indication of bowel ischemia. However, this finding should be interpreted in conjunction with the clinical context. Severe ischemia is often characterized by intestinal pneumatosis and the presence of gas in the mesenteric or portal veins. In these cases, the small bowel wall tends to thin due to bowel wall necrosis rather than thickening.[16-17]

Both ulcerative colitis (UC) and Crohn's disease can cause bowel wall thickening with a stratified pattern, indicating active disease. While Crohn's disease can affect any part of the gastrointestinal tract, it primarily affects the small bowel, specifically the ileum and right colon. CT scans can show signs that suggest Crohn's disease, such as skip areas where the bowel wall is not continuously involved, a comb sign indicating prominent vasa recta, and evidence of transmural inflammation like fistulas, abscesses, and fat proliferation along the mesenteric border of the bowel.[18]

In cases of infectious enteritis, the small bowel wall usually appears normal or slightly thickened. However, infectious colitis often presents with significant wall thickening, which can show either uniform enhancement or a striated pattern caused by intramural edema. Stranding of the pericolic fat and ascites are frequently observed as well. While the affected part of the colon may indicate a particular organism, there is a significant overlap in appearances. Therefore, laboratory studies are necessary to establish a definitive diagnosis.[19]

CONCLUSION

In various conditions, the thickening of the small and large bowel wall can be observed. There is no specific characteristic that can definitively differentiate between benign and malignant lesions. However, a thorough analysis of the characteristics of the lesions on a CT scan, such as the degree of bowel wall thickening, whether it is symmetrical or asymmetrical, the length of the thickening, the pattern of bowel wall enhancement, and the location of the lesion, can help narrow down the potential diagnoses. Therefore, multidetector CT scan is considered the preferred imaging modality for characterizing bowel lesions.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556