

TO DETERMINE THE CHARACTERISTICS OF BOWEL WALL THICKENING BY THE USE OF CT SCAN IMAGING

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Abstract

Background: A research using computed tomography (CT) in patients with bowel diseases has the potential to reveal the presence of bowel wall thickening accompanied by atypical morphology and enhancement. The identification of these patterns may facilitate a more accurate distinction between benign lesions and malignant ones. **Aim:** To determine the characteristics of bowel wall thickening by the use of CT scan imaging. **Materials and Methods:** This research is a prospective and observational investigation carried out within the Department of Radiology, including a total of 80 patients. The term "bowel wall thickening" was identified and documented in the abdominal CT reports that were examined. This research focused on patients who presented with clinical manifestations of bowel, mesentery, and associated diseases spanning from the duodenum to the rectum. These patients were subjected to Multidetector CT scan as part of the investigation. The diagnosis was established by doing a patient follow-up using ultrasound (USG) or computed tomography (CT), together with other radiological and non-radiological investigations, as well as surgical procedures and histopathological examination. **Results:** Among 80 patients, 35 individuals (43.75%) presented with infective and inflammatory lesions, 4 individuals (5%) had ischemic bowel conditions, 41 individuals (51.25%) displayed neoplastic lesions of the colon. 27 cases of malignancy showed marked wall thickening (>1.5 cm). 59 patients exhibited focal wall thickening involving less than 10 cm, whereas 20 cases had segmental bowel thickening involving 10 - 30 cm. Among the cases, post contrast enhancement pattern showed, 48 cases of grey attenuation, 17 water target sign, 5 white attenuation and 1 each of fat target sign and pnematosis (gas). **Conclusion:** We concluded that the use of multidetector CT scan is considered the preferred imaging modality for the purpose of characterising bowel lesions.

INTRODUCTION

Multidetector Computed Tomography (MDCT) has emerged as the predominant and pivotal imaging modality for the comprehensive evaluation of abdominal complaints. The utilisation of computed tomography (CT) as a screening modality for individuals displaying symptoms of bowel disease has witnessed a notable rise. This can be attributed to several factors. Firstly, there is an increasing trust in CT as an effective problem-solving tool, particularly in the context of various gastrointestinal disorders. Secondly, there exists a significant margin of error in clinical diagnosis when distinguishing between bowel and other abdominal

diseases. Thirdly, CT has the potential to furnish valuable information for a comprehensive diagnosis and staging of abdominal neoplasms. Lastly, the widespread availability and ease of performing CT scans have contributed to its growing popularity in this context. As expected, computed tomography (CT) scans will detect anomalies in individuals, regardless of whether they exhibit symptoms related to the digestive tract.^[1]

When interpreting CT scans of the abdomen and pelvis, attention is often directed on the peritoneal cavity, the mesentery, and the parenchymal organs.^[2,3] Bowel wall thickening is a frequently seen observation on abdominal CT scans, lacking specificity, and may be attributed to several

underlying causes such as inflammation, infection, ischemia, and neoplastic processes. Colonoscopy is often performed as a further invasive study in cases where bowel wall thickening is seen. Nevertheless, the clinical significance of bowel wall thickening in relation to the presenting symptoms is sometimes ambiguous.^[4-6] A limited number of research have been conducted to investigate the etiology for bowel wall thickening and its association with future endoscopic results. Bowel pathologies may manifest as a diverse range of abnormalities in the morphology and enhancement of the bowel wall. Upon the detection of an abnormality, it is essential for the radiologist to use a methodical approach in order to ascertain the precise etiology of the bowel abnormality.^[7] Combining enhancing and morphologic observation improve the interpretation of computed tomography (CT) scans for diagnosing disorders in both the small and large intestines. The suggested methodology relies on using various attenuation values of the bowel wall.^[8] The range of these mural attenuation patterns comprises white (avid contrast material enhancement), gray, water halo sign, fat halo sign, and black (pneumatosis). The distinction of these patterns, sometimes accompanied by topographical and morphologic characteristics of the gut wall, may significantly limit the range of potential diagnoses, especially when distinguishing between benign and malignant conditions.^[9] A considerable number of individuals exhibiting anomalies in the gut wall manifest acute, subacute, or chronic symptoms related to the gastrointestinal system. However, it is worth noting that some people may have nonspecific abdominal symptoms or be asymptomatic. Hence, the predominant CT imaging method used in the majority of patients is a traditional approach. In some instances, the CT approach may be customised to align with the anticipated diagnosis.^[10] The customised examination may include the use of arterial and portal venous phase contrast material augmentation, delayed scans, decubitus posture, or an enema. While it is possible that these modifications may provide extra insights in some circumstances when looking back, their regular implementation is not feasible, especially given the limited patient history, physical observations, and laboratory information typically accessible.^[11] The use of a thin-section, high-volume, rapid-bolus scanning approach with CT is crucial in distinguishing bowel anomalies in cases where intestine wall findings are inconspicuous in nature. The intravenous infusion of contrast material is often favoured and, in many instances, essential for the detection of certain bowel wall anomalies that would otherwise remain unnoticed or exhibit minimal manifestations. The assessment of the bowel wall is consistently performed when positive luminal contrast material is administered, since it is typically a standard procedure. Nevertheless, the bowel distention while using nonopaque fluid has the potential to expose features that are orientated

towards the lumen, which may have been hidden by the oral contrast material.^[12]

MATERIALS AND METHODS

This research is a prospective and observational investigation carried out within the Department of Radiology, including a total of 80 patients. The term "bowel wall thickening" was identified and documented in the abdominal CT reports that were examined.

Inclusion Criteria

This research focused on patients who presented with clinical manifestations of bowel, mesentery, and associated diseases spanning from the duodenum to the rectum. These patients were subjected to Multidetector CT scan as part of the investigation. The diagnosis was established by doing a patient follow-up using ultrasound (USG) or computed tomography (CT), together with other radiological and non-radiological investigations, as well as surgical procedures and histopathological examination.

Exclusion Criteria

The patients with heart failure, hypoalbuminemia, and nephrotic syndrome were excluded from this study as these conditions may have an impact on the thickness of the bowel wall.

Statistical Analysis

Descriptive analyses were performed in order to provide an overview of the key features pertaining to the research groups. The data pertaining to continuous variables were represented as n (%). A p-value less than 0.05 was deemed to be statistically significant. The calculations were performed using version 25.0 of the SPSS programme.

RESULTS

In the present research, a majority of the patients belonged to the age range of 40-60 years, namely 40 out of 80 individuals, accounting for 50% of the total sample. This was followed by the age group of 20-40 years, with 25 out of 80 patients, or 31.25% of the sample, as shown in Table 1. In our research, the majority of patients were male, with a total of 54 individuals (67.5%), while the remaining 26 patients (32.5%) were female [Table 1].

Table 2 presents the distribution of various types of bowel diseases among the 80 patients who were included in the research. Among these patients, 35 individuals (43.75%) presented with infective and inflammatory lesions, 4 individuals (5%) had ischemic bowel conditions, 41 individuals (51.25%) displayed neoplastic lesions of the bowel. [Table 2].

Table 3 presents the findings of 80 instances of lesion, with malignancy being the predominant etiology showing marked wall thickening. Table 4 presents data on 80 instances of bowel lesions, revealing that 47 of these cases had asymmetrical thickening of the bowel wall.

Table 5 presents the findings of a study including 80 instances of bowel lesions. Among these patients, 59 exhibited focal bowel wall thickening involving less than 10 cm, whereas 20 cases had segmental intestine wall thickening involving 10 - 30 cm.

Table 6 presents the findings of post contrast enhancement patterns. Among these cases, 48 exhibited grey attenuation, 17 had water target sign, 5 had white attenuation and 1 each had fat target sign and pneumatosis (gas).

Table 1: Age and gender of the patients

Age in years	Number	Percentage
Below 20	11	13.75
20-40	25	31.25
40-60	40	50
Above 60	4	5
Gender		
Male	54	67.5
Female	26	32.5

Table 2: Distribution of bowel lesion of the patients

Lesion	No. of patients	Percentage
Infective and inflammatory lesions	35	43.75
Ischemic bowel conditions	4	5
Neoplastic lesions of bowel	41	51.25

Table 3: Degree of wall thickening

	Degree of wall thickening	
	Mild (< 1.5 cm)	Marked (>1.5 cm)
Malignant	8	27
Carcinoid	3	1
Lymphoma	1	1
Colitis (inflammatory or infectious)	6	1
Ileocecal infective or inflammatory lesions	15	9
Ischemic	3	1
Diverticulitis	3	1
Total	39	41

Table 4: Symmetry of wall thickening

	Symmetry of wall thickening	
	Symmetrical	Asymmetrical
Malignant	4	31
Carcinoid	1	3
Lymphoma	2	0
Colitis (inflammatory or infectious)	5	2
Ileocecal infective or inflammatory lesions	17	7
Ischemic	3	1
Diverticulitis	1	3
Total	33	47

Table 5: Length of involved segment

	Length of involved segment		
	Focal	Segmental	Diffuse
Malignant	30	5	0
Carcinoid	4	0	0
Lymphoma	0	2	0
Colitis (inflammatory or infectious)	1	5	1
Ileocecal infective or inflammatory lesions	20	4	0
Ischemic	0	4	0
Diverticulitis	4	0	0
Total	59	20	1

Table 6: Post-contrast enhancement pattern

	Post-contrast enhancement pattern				
	White	Grey	Target Water	Target Fat	Gas
Malignant	2	33	0	0	0
Lymphoma	0	2	0	0	0
Colitis (inflammatory or infectious)	3	0	3	1	0
Ileocecal infective or inflammatory lesions	0	10	14	0	0
Ischemic	0	3	0	0	1
Total	5	48	17	1	1

DISCUSSION

Typically, the thickness of the small bowel wall ranges from 1 to 2 mm when the lumen is adequately distended, with minor fluctuations based on the extent of luminal distension. Certain authors have established a range of 2-3 mm as the maximum acceptable measurement for the normal thickness of the small bowel wall, whereas a threshold of 3 mm has been identified as the top limit for the normal thickness of the colonic wall. Bowel wall thickening may occur due to submucosal oedema, bleeding, or neoplastic invasion.^[13]

The advent of multidetector computed tomography scanners (MDCT) has significantly contributed to the use of computed tomography as a valuable modality for identifying and characterising disorders in the gastrointestinal tract. This method enables the collection of isotropic data and provides the possibility to do high-resolution multiplanar reconstructions.^[14] Specifically, computed tomography (CT) enterography, which involves the use of large amounts of neutral contrast material (such as water, water methylcellulose solution, polyethylene glycol electrolyte solution, or low-concentration barium) to distend the bowel lumen, is a valuable technique for visualising the thickness and enhancement of the small bowel wall.^[15] In the acute environment, achieving sufficient preparation and distention of the bowel lumen may not always be feasible. Furthermore, incidental findings of wall anomalies in the small and large intestine might be seen in asymptomatic individuals or in patients presenting with vague symptoms. In a substantial number of patients, the prevailing CT imaging approach used is a conventional one, necessitating radiologists to possess a heightened degree of suspicion when identifying and interpreting anomalies in the gut wall.^[16]

The thickening of the gut wall may arise from many pathological disorders. When encountering thickening of the bowel wall on CT, it is necessary to evaluate many imaging characteristics to limit down the potential causes. These include the length of the affected area, the extent of thickening, whether the involvement is symmetric or asymmetric, the pattern of attenuation, and any abnormalities in the surrounding tissue. The relevance of each of these qualities may vary depending on whether the clinical symptoms have an acute or chronic start. Focal thickening of the bowel wall is defined as an extension of less than 10 cm. Focal thickening may arise due to the presence of tumours or inflammatory diseases, and it is important to make an effort to differentiate between these two situations. Furthermore, the examination of wall symmetry, extent of thickness, and perienteric anomalies offers further insights for accurate diagnosis, in conjunction with the clinical presentation. Within the context of focal wall thickening, there are three primary scenarios that

may arise: (1) asymmetric focal thickening, (2) symmetric focal thickening, and (3) perienteric abnormalities (specifically, fat stranding) that exhibit a degree of prominence that surpasses the level of wall thickening.^[18]

The presence of asymmetric thickening in the gut wall indicates varying degrees of eccentric thickening throughout the diameter of the affected segment, often attributed to neoplasms. Malignant neoplasms affecting the gastrointestinal system have a higher incidence in the stomach and colon, whereas their occurrence in the small intestine is comparatively less frequent. Notably, within the small bowel, these tumours tend to manifest mostly in the proximal segments. Neoplasms often exhibit a prolonged initiation period and may manifest as either a central mass with an eccentric distribution or, more frequently, as an asymmetric thickening that surrounds the affected area, typically exceeding a thickness of 3 cm.^[19] Circumferential and symmetric thickenings of the bowel wall are often associated with benign diseases, including inflammatory processes, infections, intestine edoema, and ischemia. Nevertheless, it is important to note that neoplasms, such as well-differentiated or tiny adenocarcinomas, may also exhibit symmetrical and uniform thickening of the bowel wall. This should be taken into consideration, particularly when the thickened intestine shows focal expansion and there is no noticeable perienteric fat stranding.^[20]

Diverticulae refer to pouch-like protrusions that develop in the mucosa and submucosa layers of the bowel wall, especially in the descending and sigmoid colon. Diverticulitis is a condition characterised by the occlusion of the neck of a diverticulum, leading to the occurrence of microperforation and subsequent inflammation in the surrounding colonic area. The computed tomography (CT) findings of acute diverticulitis consist of inflammatory diverticula together with pericolonic fat stranding. Two signs that indicate the presence of an inflammatory disease are the engorgement of the mesenteric arteries, also known as the "centipede" sign, and the presence of fluid at the base of the sigmoid mesentery, referred to as the "comma sign".^[21]

The most prevalent but least distinctive computed tomography (CT) finding of bowel ischemia is the thickening of the gut wall. The level of involvement, degree of thickness, and pattern of attenuation of the ischemic bowel exhibit variations based on three primary factors: The factors that contribute to the development of ischaemia include the type of occlusion (arterial-occlusive, veno-occlusive, or hypoperfusion), the extent of the ischaemia (ranging from transitory ischaemia of the mucosa and/or submucosa to transmural gut wall necrosis), and the presence of additional complications such as haemorrhage or infection.^[22] While bowel wall thickening is often seen in instances of bowel ischaemia, it is worth noting that the ischemic bowel

wall may also have a thin appearance, especially in situations of abrupt arterial occlusion. When the gut wall experiences thickening due to ischemia, it might manifest with one or more of the three aforementioned types of attenuation. The presence of a stratified pattern of attenuation might potentially indicate the first manifestation of bowel ischemia. This phenomenon arises due to the accumulation of fluid in the submucosal layer, accompanied by an increased blood flow or excessive perfusion in the mucosal and/or muscularis propria layers. The evaluation of this discovery necessitates an assessment within the clinical framework, taking into account the accompanying imaging observations related to bowel ischemia. These observations may include the obstruction of the mesenteric artery or vein, bowel dilatation, engorgement of the mesenteric veins, as well as mesenteric oedema and ascites. The presence of bowel pneumatosis and gas in the mesenteric or portal veins is a reliable indicator of severe ischemia. Typically, these conditions are accompanied by a weakening of the small intestine wall rather than thickening, which is attributed to the occurrence of bowel wall necrosis.^[23]

Bowel wall thickening characterised by a stratified pattern is seen in both ulcerative colitis (UC) and Crohn's disease, suggesting the presence of acute and active illness.^[23] Crohn's disease has the potential to manifest in all segments of the gastrointestinal system, however it mostly affects the small intestine, with a specific emphasis on the ileum and right colon. Computed tomography (CT) findings that indicate a preference for Crohn's disease consist of non-continuous participation of the intestine wall, notable vasa recta (referred to as the "comb sign"), indications of inflammation that extends through the whole wall of the bowel such as fistulas and abscesses, and an increase in the growth of fat along the mesenteric border of the bowel.^[24]

In the majority of instances involving infectious enteritis, the wall of the small intestine often has a normal appearance or displays a little thickening. In contrast, viral colitis often presents with notable thickening of the bowel wall, which may exhibit either uniform enhancement or a striated pattern caused by intramural oedema. The presence of pericolic fat stranding and ascites is often seen. While the segment of the colon that is impacted may indicate a particular organism, there exists a significant degree of similarity in their visual characteristics. Therefore, it is essential to conduct laboratory investigations in order to establish a conclusive diagnosis.^[25]

CONCLUSION

The thickening of the wall of the small and large bowel is seen in a range of medical disorders. There is no one trait that exhibits a high level of specificity in distinguishing between benign and malignant

tumours. Thorough examination of the features of lesions seen on CT scans, such as the extent of bowel wall thickening, whether it is symmetrical or asymmetrical, the length of the thickened bowel wall, the pattern of bowel wall enhancement, and the specific location of the lesion, aids in the process of refining the differential diagnosis. Therefore, the use of multidetector CT scan is considered the preferred imaging modality for the purpose of characterising bowel lesions.

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