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Accuracy of Computed Tomography (CT) in categorising bowel wall lesions as Benign or Malignant.

Radiology

KEYWORDS: Bowel wall thickening, Computed tomography, Accuracy'

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ABSTRACT

Computed tomography (CT) has become a routine investigation for evaluation of alimentary tract disease because of its speed, accuracy and cross sectional imaging capabilities. The various criteria that allows one to differentiate normal variants and abnormal conditions are attenuation values, enhancement patterns, thickness, symmetry and length of bowel wall thickening and associated perienteric abnormalities. At many centers, CT has almost totally replaced conventional radiography as a screening technique for most acute abdominal processes and the new multidetector-array CT scanners provide even greater opportunities for detection and characterization of abdominal pathologic conditions.

Aims and Objectives:

1. To study and identify various CT characteristics like attenuation values, enhancement patterns, thickness, symmetry and length of thickened bowel wall and usefulness of these CT characteristics in categorizing various lesions as benign or malignant.

2. To compare the imaging diagnoses with histopathological reports and thus to study the diagnostic accuracy of CT.

3. To compare the results with other studies of the past and to establish the efficacy of CT in evaluation of Bowel wall thickening.

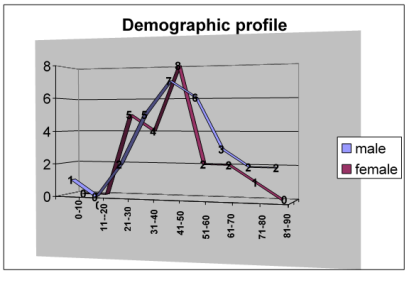
Materials and Methods:

The prospective study was carried out on 50 patients who underwent computed tomographic evaluation of the abdomen based on clinical suspicions or post sonographic and barium evaluation suspecting bowel wall lesions, in our department between September 2015 to June 2016. No selection bias was exercised on the basis of age or gender. The final diagnosis in each case was confirmed by cytology or histopathology and compared with the imaging characteristics. The results were analysed, studied and compared with similar studies of the past.

The studies were performed on Brilliance-16 slice CT scanner from PHILIPS with the patient lying supine and keeping both his upper extremities extended over his head. 750 ml of oral contrast material was administered 45 minutes prior to the examination to opacify the bowel loops. Another 250ml of oral contrast was given to the patient just before the start of the examination for the proper distension of stomach. All patients also received a 80mL injection of non ionic iodinated contrast material, through an antecubital vein at a rate of 3 mL/sec.

Observation and Analysis

Our study consisted of 50 patients, the youngest being of 07years and the oldest being, 85years. The age and gender wise distribution of the patients included in the study was as follows.



Various CT Characteristics noticed in different patients in our study are tabulated in the following tables.

Table 1: Pattern of Attenuation.

	White	Gray	Black	Water Halo	Fat Halo	Heterogeneous
Benign/ Inflammatory	3	4	0	4	0	3
Malignant	0	15	1	2	0	18
Total=50	3	19	1	6	0	21

Table 2: Bowel wall thickness

	Mild(<2cms)	Marked(>2cms)
Benign/Inflammatory	12	2
Malignant	15	21
Total = 50	27	23

Table 3: Extent/Length of the lesion

	Focal (<10cms)	Segmental (10-30cms)	Diffuse (>30cms)
Benign/Infl.	3	1	10
Malignant	29	3	4
Total= 50	32	4	14

Table 4: Symmetry of lesion

	Symmetrical	Asymmetrical
Benign/Inflammatory	12	2
Malignant	9	27
Total = 50	21	29

Table 5: Associated CT findings

	Ulceration	Cavitation	Necrosis	Fat stranding
Benign/Inflammatory	4	0	1	8
Malignant	20	3	11	11

Table 6: Diagnosis given on CT :

Malignant	Adenocarcinoma	27	Total=37
	Metastatic involvement	4	
	lymphoma	2	
	GIST/leiomyosarcoma	2	
	Squamous cell carcinoma	1	
	Scirrhous carcinoma	1	
Benign	Tuberculosis	4	Total=13
	lipoma	1	
	Ulcerative colitis	1	
	Non specific colitis	7	

Final Diagnosis: The confirmation of the diagnosis in all cases were made by cytology and/or histopathology except in case of lipoma where the homogeneous fatty attenuation within the bowel wall was classical of a benign lipoma.

Table 6: Final Diagnosis (Malignant)

Adenocarcinoma	23	63.89%
Metastatic involvement	5	13.89%
lymphoma	4	11.11%
GIST/leiomyosarcoma	2	5.56%
Squamous cell carcinoma	1	2.78%
Scirrhous carcinoma	1	2.78%

Table 7: Final diagnosis (Benign)

Tuberculosis	3	21.43%
Lipoma	1	7.14%
Ulcerative colitis	1	7.14%
Non specific colitis	6	42.86%
Typhlitis	1	7.14%
Brunner's gland hyperplasia	1	7.14%
Gastritis	1	7.14%

Table 8: Sensitivity and specificity of various CT characteristics for labelling a lesion as malignant in our study.

Serial number	CT Characteristic	Sensitivity	Specificity
1	Heterogeneous pattern of enhancement	57%	79%
2	Marked bowel wall thickening (>2cms)	58%	86%
3	Asymmetric bowel wall thickening	86%	75%
4	Focal/segmental bowel involvement	96%	40%

Discussion: Our study consisted of 50 patients, the youngest being of 07years and the oldest being, 85years. The peak age incidence was in the 41-50 years of age group with 15 subjects falling in this age group (7 males and 8 females). There were total of 36 malignant bowel wall lesions and 14 benign cases of bowel wall thickening. Adenocarcinoma was the commonest malignant cause of bowel wall thickening, constituting 23(63.89%) of the cases, while in the benign cases it was the non specific colitis and then the tuberculous involvement of the bowel wall in 6(42.86%) and 3(21.43%) cases out of 14 respectively.

Figure1: Barium meal and CT study of a patient with adenocarcinoma of stomach. Double contrast barium meal study shows, mucosal irregularity with luminal narrowing of the pyloric antrum and canal. On CT, there is focal, marked bowel wall thickening, showing heterogeneous attenuation, with associated perigastric necrotic nodes.

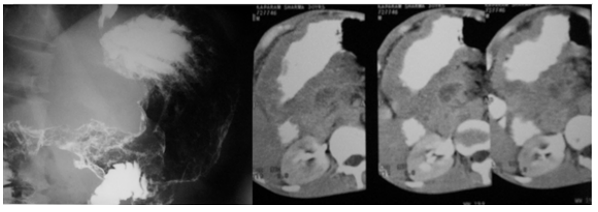
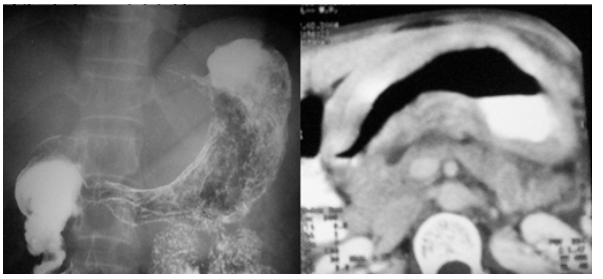


Figure 2: Barium meal study showing architectural distortion in the area gastricae pattern, with associated luminal narrowing and decreased volume of stomach. Corresponding CT images in the same patient shows wall thickening involving the body, pyloric antrum and pyloric canal portion of stomach, with homogeneous enhancement (grey attenuation) in a known case of linitus plastic due to scirrhous cell carcinoma.

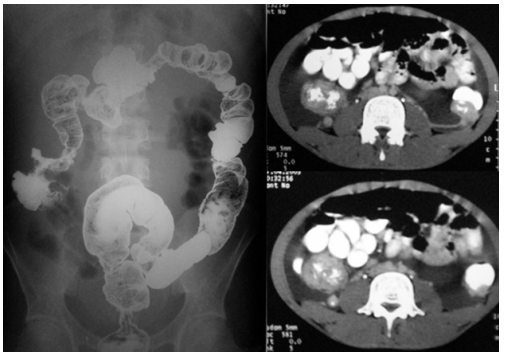


One of the important parameter differentiating between a malignant or a benign cause of bowel thickening, with high specificity, was its attenuation characteristics after contrast enhancement.

White attenuation, meaning enhancement of bowel wall, that is either equal or greater than that of venous opacification in the same scan, was seen in three cases of inflammatory pathology and none of the malignant lesion showed this type of intense attenuation, thus making it 100% specific for the benign lesions[1-6].

The specificity and sensitivity of water halo attenuation, which is a terminology used to indicate stratification within a thickened bowel wall that consists of either two or three continuous, symmetrically thickened layers. in predicting the benignity of the lesion was again highly specific with a specificity of 94% but the sensitivity of the pattern was at dismissal 29% [7-10].

Figure 3: Barium enema study showing multiple areas of luminal narrowing giving classical apple core appearance in the sigmoid, transverse and proximal ascending colon. On CT, there are multiple areas of focal, circumferential bowel wall thickening showing heterogeneous enhancement with associated free fluid in paracolic gutters. The final diagnosis turned out to be signet cell adenocarcinoma.



The heterogeneous enhancement pattern was seen in total 21 cases out of which in 18(85.71%) cases, the cause of bowel wall thickening was malignant, thereby making this attenuation pattern a specific marker for the malignant lesions, with specificity of 79%, however, the gray attenuation pattern is neither a specific nor a sensitive marker showing a sensitivity of 58% and a specificity of 71%.

Black attenuation, which represents air within the bowel wall, was an unusual feature being noticed in one case of diabetic patient with pneumatosis coli [11-13].

Another parameter showing positive test of significance at p value of 0.05 was the total thickness of bowel wall lesion, with lesion more than 2 cms was considered as the one showing marked bowel wall thickening and those less than 2 cms were considered as ones with mild thickening. Twelve (85.71%) cases out of total 14 benign pathologies were having mild bowel wall thickening and 21(58.33%) out of 36 malignant causes showed marked bowel wall thickening. Conversely, of the total 23 cases showing marked wall thickening, 21(91.3%) were malignant, however, out of the total 27 cases with mild bowel wall thickening only 12(44.44%) cases were benign, and

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15(55.56%) cases were that of malignant etiology.

Extent of involvement of the bowel wall showed 81% sensitivity for the malignant lesion while sensitivity of diffuse involvement of bowel for the benign lesion turned out to be 71%. Comparing the results in the test of significance at the p value of 0.05 turned out to be insignificant. That means the association of diffuse involvement of the bowel wall with benign lesion could be by chance and hence the null's hypothesis remains [14-17].

The test of significance taking into account the results of the symmetry of involvement of the lesion turn out to be positive and also the sensitivity of the symmetry of the lesion for predicting a lesion as benign was 86%, with specificity of 75% and a positive predictive value of 57%.

Apart from the above findings, malignant lesions also showed various positive associated findings of ulceration, necrosis, ligament involvement and signs of bowel obstruction with high specificities.

Some of the malignant lesions like lymphoma were showing features of the benign lesions in the form of striated enhancement pattern, but they also showed some areas of incomplete white attenuation and heterogeneous pattern as documented in various other studies. Also taking into account various other parameters the doubts regarding their benign nature were ruled out. Similarly, one of the benign lesions of brunner gland hyperplasia involving the second part of the duodenum also showed some of the features attributed to the malignant lesions like, heterogeneous attenuation pattern, marked wall thickening and the focal involvement of the bowel wall and was wrongly given a diagnosis of malignant lesion in our study [18-21].

On taking into account three attributes i.e. heterogeneous attenuation pattern, asymmetrical involvement of bowel wall and marked thickening, the sensitivity and specificity of CT increased to 91.67% and 80%.

It was observed that in our study, 12(85.71%) out of total 14 cases were correctly diagnosed as benign on CT. One of the cases of 23 yr old male patient with bowel wall involvement at multiple sites, with free fluid in abdomen with probable diagnosis of tuberculosis on CT turned out to be signet cell carcinoma, a subtype of adenocarcinoma, known for their synchronous involvement of the bowel wall at young age.

Also out of the total 36 malignant cases, 34(94.44%) cases were correctly diagnosed on CT. One of the cases whose probable diagnosis on CT was kept as duodenal malignancy turned out to be brunner's gland hyperplasia, and another case of abnormal thickening of the pyloric wall of the stomach, thought to be malignant, turned out to be gastritis.

Hence CT showed a sensitivity of 94.44% and specificity of 86% in differentiating between a benign and malignant etiology of abnormal bowel wall thickening, which was similar to the conclusion reached by Erik K, Insko et al in their studies. As in our study, the sensitivity and specificity of thickness of the lesion of more than 2 cms in terming the lesion as malignant in the study conducted by Erik K. Insko et al was 50% and 88% respectively similar to our study.

Overall sensitivity and specificity of CT in differentiating benign from malignant bowel wall lesion.

Differentiation of abnormal bowel wall thickening on CT	Erik K. Insko et al		Present study	
	Sensitivity	Specificity	Sensitivity	Specificity
	93%	88%	94.44%	86%

Conclusion: We conclude that computed tomography has high sensitivity and specificity in characterization of bowel wall lesions and has the potential to displace other imaging modalities in Bowel Imaging. The combination of heterogeneous pattern of enhancement, focal/segmental bowel wall involvement, marked bowel wall thickening and asymmetrical lesion leads to high specificity to label a lesion as malignant. Radiologists should be aware of these CT criteria for better differentiation of benign lesions from potentially malignant lesions that warrant further diagnostic evaluation/ intervention.

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