



Original Research Article

Role of multi-detector CT in staging of Colorectal carcinoma – A correlative study

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Abstract

Aim: To study the CT characteristics of wall thickening in case of benign and malignant lesions of the colon and rectum, to evaluate the role of MDCT in pre-operative tumour staging of colorectal malignancies and to evaluate the effectiveness of MDCT in differentiating benign and malignant colorectal lesions.

Material and methods: It was correlative study done on patients with wall thickening involving the colon and rectum on CT were included. CT was performed using 16 slice SIEMENS SOMATRON Emotion CT scanner. CT findings were finally correlated with histopathology.

Results: Patients with complaints of loose stools, vomiting, weight loss, constipation, bleeding PR, abdominal pain were evaluated by CT scan and which showed findings that were highly suggestive findings of malignancy like bowel wall thickening, presence of lymph nodes, peri-colic fat stranding, infiltration of adjacent viscera and presence of metastases.

Conclusion: MDCT is an excellent modality in the diagnosis and differentiation of benign and malignant lesions of the colon and rectum. MDCT is also useful in the staging of malignant lesions which helps in proper planning of surgery and further management of the patient.

Key words

Colorectal carcinoma, MDCT in staging colorectal malignancy, Colonic Malignancy, CT in rectal carcinoma, CT in bleeding PR.

Introduction

CT is an increasingly useful technique in the evaluation of intestinal disease, allowing the evaluation of bowel disease as well as extra-

intestinal disease [1]. CT also provides an excellent assessment of the perienteric abnormalities that frequently accompany bowel disease (adenopathy, ascites, fat stranding, presence of abscesses and fistulas) and

improves specificity in diagnosis [2]. Thickening of the bowel wall is the commonly identified abnormality on CT in cases of colorectal lesions [3]. The differential diagnosis for bowel wall thickening is wide. Once a bowel wall thickening is detected, its radiologic features are analysed by using criteria specific to CT imaging. It is important to define the wall thickening as focal, segmental, or diffusely affecting an entire intestinal segment. CT features include degree of thickening of intestinal wall, symmetry of involvement, smooth versus irregular or lobulated inner or outer contour, and pattern of enhancement. Associated findings such as axillary lymphadenopathy, lymphadenopathy, distal metastases, adjacent mesenteric inflammatory response, phlegmon, or abscess are additional important features that are helpful in the differential diagnosis.

One study showed the CT characteristics of bowel wall thickening based on pattern of attenuation and enhancement; degree, symmetry, and extent of thickening; and associated abnormalities [4]. They concluded that the association of several abnormal parameters will lead to a correct diagnosis or will narrow the differential diagnosis in most cases. When confusing or overlapping CT parameters are encountered or uncertainties persist, barium examinations should be liberally used as complementary diagnostic studies.

Colorectal cancer is the third most common cancer in men and the second in women worldwide. The age adjusted incidence rates of colorectal cancer in all the Indian cancer registries are very close to the lowest rates in the world. However population based time trend studies show a rising trend in the incidence of colorectal carcinoma in India [5].

The prognosis of patients with colorectal carcinoma is dependent on the stage of disease

at the time of diagnosis. The depth of wall invasion and the presence of lymph node and distant metastases are the major factors that influence prognosis. Detection of colorectal carcinoma before the malignancy has invaded into or extended through the muscularis propria and before lymph node metastases have occurred offers the best prognosis for the patient and the option of more limited surgery. Accurate preoperative staging is essential for the planning of optimal therapy [6]. Hence this study was an attempt to characterize wall thickening in patients with colorectal lesions as either benign or malignant based on the pattern of attenuation; degree of thickening; symmetric versus asymmetric thickening; focal, segmental, or diffuse involvement; and associated perienteric abnormalities. The study also aimed at evaluating the role of CT in the tumor staging of malignant lesions. The CT findings are finally correlated with histopathological findings.

Materials and methods

In this study, patients with wall thickening involving the colon and rectum on CT were included. CT was performed using 16 slice SIEMENS SOMATRON Emotion CT scanner. All patients were placed in the supine position on the CT table, and a rectal tube was inserted. Room air was gently insufflated into the colon to get adequate colonic distension. CT acquisitions were performed in the arterial phase (start delay of 25-35 seconds) and in the portal venous phase (start delay of 50-70 seconds) with a section width of 5 mm. When wall thickening is identified, it is characterized using the following criteria. (**Figures – 1A, 1B, 2A, 2B, 2C, 3A, 3B, 4A, 4B**)

- Location
- Attenuation
 - Homogenous
 - Heterogenous stratified
 - Heterogenous mixed

- Degree of wall thickening
 - Mild (<2 cm)
 - Marked (>2 cm)
- Symmetric versus asymmetric wall thickening
- Focal, segmental or diffuse wall thickening
- Presence of lymph nodes
- Presence of peri-colonic fat stranding
- Infiltration of adjacent viscera
- Presence of metastasis
- Staging in cases of suspected malignancy.

Inclusion criteria

- All age groups and both sexes.
- Patients with wall thickening involving the colon and rectum.
- Patients in whom histopathological findings are available for correlation.

Exclusion criteria

- Patients with lesions involving the anal canal.
- Patients in whom histo-pathological findings are not available for correlation.

Results

In this study, 45 patients with bowel wall thickening involving the colon and rectum on CT were observed. Of these 28 (62.2%) were males while 17 (37.7%) were females. Of the 45 patients with colorectal lesions 36 lesions (80%) were diagnosed as malignant and 9 lesions (20%) were diagnosed as benign on histopathology. Loose stool (44.4%) was the commonest symptom in patients with inflammatory /infective disease of the colon followed by vomiting (22.2%). There was involvement of the entire length of the caecum, ascending colon, transverse colon, descending colon and sigmoid colon in 11.1% of the cases and involvement of the entire length of the

rectum in 22.2% of the cases. In patients with malignant lesions of the colon the commonest presenting complaint was abdominal pain (41.6%) followed by bleeding per rectum (27.7%) and constipation (13.8%). Both rectum and sigmoid colon were involved in 10 cases (27.7%) followed by the sigmoid colon alone (13.8%). Five lesions showed involvement of the sigmoid colon (13.8%) and one lesion showed involvement of both the rectum and the transverse colon (2.7%).

Pattern of attenuation

Of the 45 cases with thickening of the bowel wall on CT 16 cases (35.5%) had a heterogenous mixed attenuation. 28 cases (62.2%) had homogenous attenuation and 1 case (2.2%) had heterogenous stratified attenuation on CT. (**Table – 1**)

Of the 9 benign cases, 8 cases (88.90%) had homogenous attenuation and 1 case (11.10%) had heterogenous stratified attenuation. Of the 36 malignant cases 16 cases (44.4%) had heterogenous mixed attenuation and 20 cases (55.5%) had homogenous attenuation on CT.

Degree of bowel wall thickening

Of the 45 cases 23 cases (51.1%) had mild wall thickening and 22 cases (48.9%) had marked wall thickening on CT. (**Table – 2**)

Of the 23 cases with mid wall thickening, 8 were benign and 15 were malignant. Of the 22 cases with marked wall thickening, 21 were malignant and one was benign. Of the 25 cases with asymmetric wall thickening 24 were malignant and 1 was benign. Eight of the cases with symmetric wall thickening were benign. (**Table – 3**)

Involvement of lymph nodes in malignant lesion

Enlarged lymph nodes were present in 25 cases

(69.4%) and absent in 11 cases (30.5%).

Involvement of lymph nodes in benign lesions

Enlarged lymph nodes were present in 1 case (11%) and absent in 8 cases (89%).

Presence of pericolic fat stranding in benign lesions

Pericolic fat stranding was seen in majority of benign lesions (88.8%).

Presence of pericolic fat stranding in malignant lesions

Pericolic fat stranding was present in 26 cases (72.2%) and absent in 10 cases (27.7%) with malignant lesions of the bowel.

Invasion of adjacent viscera in malignant lesions

Of the 36 malignant colorectal lesions there was involvement of the adjacent viscera in 12 cases. There was no involvement of the viscera in the remaining 24 cases.

Sites of visceral involvement in malignant lesions

There was infiltration of the bladder in 4 cases (33%), infiltration of the uterus/ ovaries and duodenum in the other 3 cases.

Presence of metastasis in malignant lesions

Of the 36 malignant cases metastases was seen in 15 cases (42%). There was no evidence of metastases in 21 cases (58%).

Sites of metastases in case of malignant lesions

Of the 15 cases with metastases, liver metastases was seen in 7 cases (46%), lung metastases was seen in 1 case (7%), adrenal metastases in 1 case (7%), bone metastases in 1 case (7%), omental deposits in 2 cases (18%) and peritoneal deposits in 3 cases.

Role of CT In staging of malignant lesion

Of the 36 malignant lesions 20 lesions were staged as T1 and T2, 8 lesions were staged as T3 and 8 lesions were staged as T4 based on histopathology.

Of the 20 cases staged as T1 and T2 on histopathology, CT correctly staged 18 cases (90.0%). Over staging was done in 2 cases. Of the 8 cases staged as T3, CT correctly staged 7 cases (87.5%). Under staging was done in 1 case. All the 8 cases staged as T4 on histopathology were correctly staged on CT. (**Table – 4**)

Of the 36 malignant lesions 20 lesions were staged as T1 and T2, 8 lesions were staged as T3 and 8 lesions were staged as T4 based on histopathology.

Figure - 1A: CT- Carcinoma sigmoid colon with heterogenously enhancing enlarged right sided iliac group of nodes.

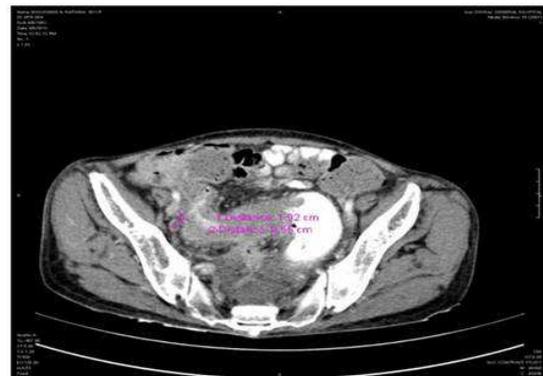


Figure - 1B: CT- Carcinoma sigmoid colon with loss of fat plane at few places between tumor and right adnexa with dilatation of proximal large bowel.



(Above two figures 1A & 1B CECT showing irregular circumferential wall thickening with shouldering and luminal narrowing of sigmoid colon. There is heterogeneously post contrast enhancement with peri lesional fat invasion adherent right adnexa within the lesion. This is a T4 lesion.)

Figure - 2A: Axial CECT showing irregular circumferential wall thickening involving rectum with meso rectal fascial thickening and enlarged loco regional enlarged lymph nodes. This is a T4 lesion.



Figure - 2B: CT- Thickening of wall and contracted caecum, peri caecal fat stranding with involvement of ileo caecal valve



Figure - 2C: CT- Caecum is pulled upwards with obtuse angle of ileocaecal junction with dilated distal ileal loops.

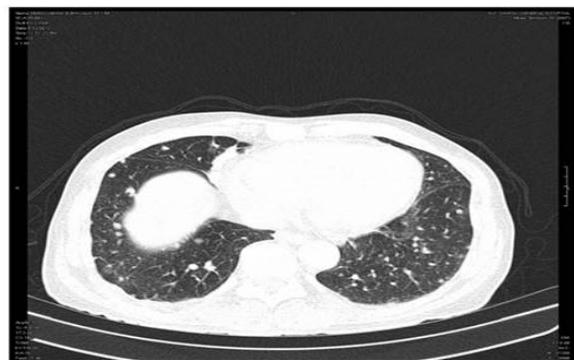


(Above three figures 2A, 2B, 2C) axial CECT are showing ileocaecal tuberculosis.)

Figure - 3A: CT- Carcinoma rectum and anal canal showing multiple hypodense lesions with subtle peripheral post contrast enhancement suggesting multiple liver metastasis.



Figure - 3B: CT- Carcinoma rectum and anal canal with multiple lung metastasis.



(Above two figures 3A, 3B CECT showing multiple liver metastasis in both lobes and lung metastasis on mediastinal and lung window cuts.)

Figure - 4A: CT- Narrowing of lumen with gross thickening of walls involving descending and sigmoid colon with surrounding fat stranding.

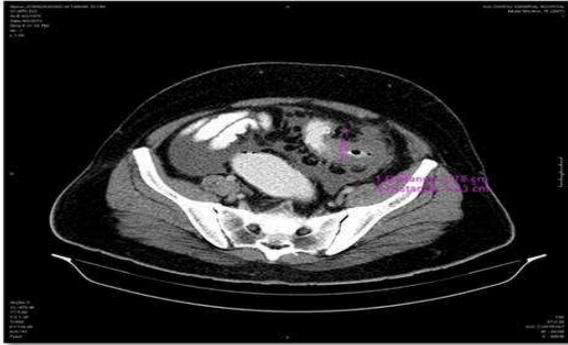
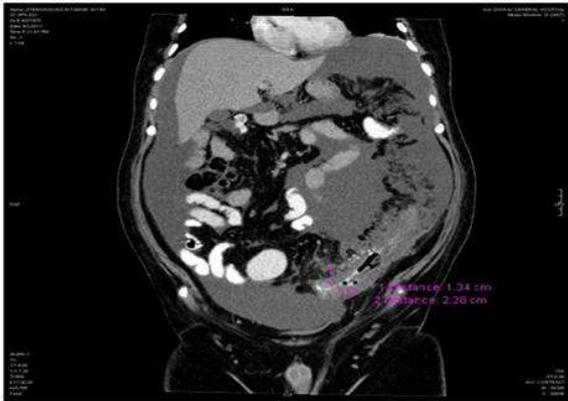


Figure - 4B: CT- Gross ascites with peritoneal mucosal thickening with possible peritoneal metastasis.



(Above two figures 4A, 4B - Axial and coronal CECT showing involvement of descending and sigmoid colon with narrowing of lumen, gross ascites with peritoneal mucosal thickening.)

Discussion

This was a hospital based correlative study to describe the role of MDCT in the evaluation of colorectal lesions. In our study 45 patients with wall thickening involving the region of the colon and rectum were studied. Out of these 45 patients, 28 were males and 17 were females.

The age group commonly affected were those in the age group of 61-70 years (31.1%). Among the 45 cases, 36 cases were histopathologically proved to be malignant and 9 cases were proved to be benign.

Loose stools were the commonest symptom in patients with benign lesions of the colon. Abdominal pain was the commonest symptom in patients with malignant lesions of the colon and rectum. Bleeding per rectum was the second most common symptom in these patients.

Most of the patients with benign lesions of the colon had involvement of the caecum. Rectum along with sigmoid colon was the commonest site for malignant lesions (27.7%).

Attenuation of bowel wall

Among the 9 benign cases, 8 cases (88.90%) had homogenous attenuation and 1 case (11.10%) had heterogenous stratified attenuation. Of the 36 malignant cases 16 cases (35.5%) had heterogenous mixed attenuation and 20 cases (44.4%) had homogenous attenuation on CT. This is in agreement with one study which showed that homogenous attenuation is a feature of benign disease (inflammatory/infective) [4, 7, 8, 9, 10]. 1 case with inflammatory disease of the colon had heterogenous stratified attenuation (target appearance). This was in agreement with the study done by Jorge ahuhalli [11] who described that the target sign is a feature of benign disease seen in cases of ischemic colitis, inflammatory colitis and infectious colitis.

Degree of bowel wall thickening

Mild wall thickening was seen in majority of benign lesions of the colon (88.8%). Of 36 malignant lesions marked wall thickening was seen in 21 cases (58.3%). This is in agreement with the study which described that mild wall

thickening is a feature of inflammatory and infective lesions of colon and marked wall thickening is a feature of malignant lesions of colon such as adenocarcinoma [4, 12, 13].

Symmetric versus asymmetric wall thickening

Symmetric wall thickening was seen in 88.8% of all benign lesions. Asymmetric wall thickening was seen in 24 cases (66.7%).

Lymph nodes

Both benign and malignant lesions had multiple enlarged lymph nodes in approximately 69% of the cases. Hence according to our study presence of enlarged lymph nodes in patients with colonic wall thickening has no role in differentiating benign and malignant lesions of the colon. However one study had described that hypo-attenuating bulky lymphadenopathy is a supportive finding in patients with lymphoma of colon [2]. One study had described that low attenuation lymph nodes with a rim of contrast enhancement or calcified lymph nodes should alert one to the possibility of tuberculosis [4].

Fat Stranding

Majority of benign lesions (88.8%) had evidence of pericolic fat stranding. Pericolic fat stranding was present in 26 cases (72.2%) of malignancy. Pericolic fat stranding was absent in 10 cases (27.7%) of malignancy. Filippone, et al. [6] in their study have found that pericolic fat stranding adjacent to a malignant lesion is a feature of invasion of pericolic fat and hence is a feature of T3 lesions. However it is not a reliable criteria and may result in overstaging of lesions as T3. Pereira JM, et al. [14] have described that pericolic fat stranding is a common finding seen in inflammatory conditions of the colon.

Infiltration of adjacent viscera

Infiltration of the adjacent structures was seen in 12 cases (33.3%) of malignancy. Infiltration of the bladder was seen in 4 cases (33.3%).

Infiltration of the duodenum was seen in the other 3 cases. Infiltration of adjacent structures is highly suggestive of malignancy.

Distant metastases

Distant metastases were seen in 21 cases (58%) of malignancy. Liver metastases was seen in 7 cases (19.4%), lung metastases was seen in 1 case (2.7%), peritoneal metastases in 1 case (2.7%). Both lung and liver were involved in 1 case (2.7%). Karahan, et al. [12] in their study have described that liver is the predominant organ to be involved with metastases from colorectal cancer.

Role of CT in differentiating benign and malignant lesions

Among the 37 lesions identified as malignancy on CT, histopathology confirmed malignancy in 36 cases. 1 case diagnosed as malignancy on CT was confirmed as inflammatory on histopathology. Hence in our study CT had a sensitivity of 100%, specificity of 88.90%, and positive predictive value of 97.30% and a negative predictive value of 100% in the diagnosis of malignant lesions.

All the cases diagnosed as benign on CT were confirmed as benign on histopathology. 1 case diagnosed as malignant on CT was confirmed as inflammatory on histopathology. Hence in our study CT had a sensitivity of 88.90%, specificity of 100%, and positive predictive value of 100% and a negative predictive value of 97.30% in the diagnosis of benign lesions. Hence CT is an excellent modality in differentiating benign and malignant lesions of the colon and rectum.

Role of CT in staging of malignant lesions

Among the 20 cases staged as T1 and T2 on histopathology, CT correctly staged 18 cases (90%). Over staging was done in 2 cases. This was due to inflammatory reaction at the edge of the tumour which produces a nodular margin.

Filippone, et al. [6] in their study on staging of colorectal carcinoma using MDCT, were able to stage 93% of the lesions as T1 and T2 correctly. In our study 7 cases (87.5%) were correctly staged as T3. Understaging was done in 1 case. Filippone, et al. [6] were able to correctly stage 90% of the cases as T3 lesions. All cases with T4 lesions were correctly staged in our study. Filippone, et al. [6] were able to correctly stage 98% of the lesions as T4.

Conclusion

MDCT is an excellent modality in the diagnosis and differentiation of benign and malignant lesions of the colon and rectum, since it has the advantage of providing thinner sections, faster acquisition and multi planar reformatted images. MDCT is also useful in the staging of malignant lesions which helps in proper planning of surgery and further management of the patient.

MDCT with its axial and reformatted images is useful tool to differentiate early colorectal carcinoma and advanced cancer. Besides identifying the lesion MDCT provides further information regarding pericolic abnormalities associated with the lesion, presence of lymph nodes, infiltration of adjacent viscera and the presence of distant metastases.

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Table – 1: Pattern of attenuation.

			Histopathology		Total
			Adenocarcinoma	Inflammatory/ Infective	
Attenuation of Bowel Wall	Homogenous attenuation	Count	20	8	28
			44.4%	17.7%	62.2%
	Heterogenous mixed attenuation	Count	16	0	16
			35.5%	0	35.5%
	Heterogenous stratified attenuation	Count	0	1	1
			0	2.2%	2.2%
Total		Count	36	9	45
			80%	20%	100%

Table – 2: Degree of bowel wall thickening.

			Histopathology		Total
			Adenocarcinoma	Inflammatory/ Infective	
Bowel wall thickening	Mild thickening	Count	15	8	23
			33.3%	17.7%	51.1%
	Marked thickening	Count	21	1	22
			46.6%	2.2%	48.8%
Total		Count	36	9	45
			80%	20%	100%

Table – 3: Role of CT in diagnosis and differentiation of benign and malignant lesions.

			Histopathology		Total
			Adenocarcinoma	Inflammatory/ Infective	
CT impression	Malignant	Count	36	1	37
			97.3%	2.7%	51.1%
	Benign	Count	0	8	8
			0%	100%	48.8%
Total		Count	36	9	45
			80%	20%	100%

Table – 4: CT in the staging of malignant lesions.

			Staging on Histopathology			Total
			T1 and T2	T3	T4	
CT staging	T1 and T2	Count	18	1	0	19
			50%	2.7%	0	52.7%
	T3	Count	2	7	0	9
			5.5%	19.4	0	25%
	T4	Count	0	0	8	8
			0	0	22.2%	22.2%
Total		Count	20	8	8	36
			55.5%	22.2%	22.2%	100%

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