

Role of CT Colonography in the Evaluation of Colorectal Carcinoma

Sabari Arasu P¹, Arun Kumar S², Kaviyaryas T³, Dhivya R⁴, Sangeetha Devi P.S⁵

¹Assistant Professor, Department of Radiodiagnosis, KMCH Institute Of Health Sciences And Research, Coimbatore, ²Professor, Department of Radiodiagnosis, KMCH Institute Of Health Sciences And Research, Coimbatore, ³Senior Resident, Department of Radiodiagnosis, KMCH Institute Of Health Sciences And Research, Coimbatore, ⁴Consultant Pulmonologist, Shanthi Social Services Medical Center, Coimbatore, ⁵Consultant Paediatrician, Coimbatore.

Abstract

Background: Colorectal carcinoma is one of the commonest diseases in the adult. The advancement in the technology of CT scan has offered CT colonography which explores the colonic luminal pathology. The present study is done to evaluate the role of CT colonography in colorectal carcinoma. **Subjects and Methods:** The prospective study was carried out in the Department of Radiodiagnosis and Imaging, Sir Sunderlal Hospital, Institute of Medical Sciences, Banaras Hindu University, Varanasi, over a period of 24 months. A total of 162 patients with colorectal carcinoma were selected and the disease characterization was studied using CT colonography. CT was carried out with GE (General Electric) Light speed VCT 64 slice MDCT machine. **Results:** The study group comprises of 106 male and 56 female patients. Highest numbers of cases (25%) were in the 6th decade of life. The commonest presenting complaints were bleeding per rectum and constipation. The rectum being the most frequently involved colonic segment in 38% of cases. Focal, asymmetric, marked (>2 cm) wall thickening of colon with heterogeneous (mixed) attenuation pattern was seen commonly. Majority of the cases presented with periserosal fat invasion and internal iliac nodal group involvement. Liver is the commonest organ for distant metastasis. Four cases of malignant solitary sigmoid colon polyps and two cases of malignant rectal polyps were also identified. **Conclusion:** CT colonography is effective in characterisation of the malignant colorectal growth and identifying adenomatous polyps thus can be effectively used for the early detection, staging and screening of colorectal malignancy.

Keywords: CT Colonography, Virtual colonoscopy, Colorectal carcinoma, Polyp.

Corresponding Author: Dr. Arun Kumar S, MBBS, MD. Professor, Department of Radiodiagnosis, KMCH Institute of Health Sciences and Research, 99, Avanashi Road, Coimbatore – 641014.

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Introduction

Colon is one of the largest segments of gastrointestinal tract. Right half is wider and straighter than the left half which is less wide and has a little tortuous course before it terminates as anal verge. Colon can be affected by infective, inflammatory and neoplastic diseases. Colonic carcinoma is one of the commonest diseases in the adult which present clinically as bleeding per rectum or malena resulting in iron deficiency anaemia, which sometimes may be the chief clinical symptom.

The diagnostic tools available for colonic study are occult blood estimation in stool, colonoscopy, barium enema and computed tomography (CT). The advancement in the technology of CT scan has offered CT colonography or virtual colonoscopy which explores the colonic luminal pathology at desired segment. Numbers of references are available in the medical literature at international level regarding the usefulness of CT colonography with their drawbacks and pitfalls. But CT colonography has not evolved as a primary imaging modality of colorectal pathologies. The present study is done to evaluate the role of CT colonography in colorectal carcinoma.

Subjects and Methods

The prospective study was carried out in the Department of Radiodiagnosis and Imaging, Sir Sunderlal Hospital, Institute of Medical Sciences, Banaras Hindu University, Varanasi, over a period of 24 months after obtaining approval from the Institutional Ethical Committee.

A total of 162 patients (age range 10-80 years; mean 48 years) with colorectal carcinoma were selected and the disease characterization was studied using CT colonography. Inclusion criteria – histopathologically proven cases of colorectal carcinoma. Exclusion criteria – inflammatory colon pathologies like tuberculosis, Crohn's disease etc.

CT was carried out with GE (General Electric) Light speed VCT 64 slice MDCT machine and adw 4.4 version advantage workstation. Following technical parameters were adopted for each scan: Collimation - 64 x 0.6 mm, Gantry rotation time - 0.6 s, Tube voltage - 120 kV, Effective tube current -335 mAs, Table feed - 55 mm per tube rotation, Pitch - 0.984

To prepare for CT colonography, the patient is put on a low residual diet for 48 hours prior to examination. A clear liquid diet is prescribed 24 hours prior to the study and adequate hydration is recommended. Cathartics (Dulcolax 10 mg) are given on the day before the examination. All patients ingested 4 L of polyethylene

glycol electrolyte solution (peglec), which was initiated at 6 pm on the day before the examination, for cleansing the large bowel.

Patient was put supine on CT table. For virtual Colonoscopic examination colonic distension with room air is done by placing a 16 G rectal tube, and approximately 50 to 70 puffs (2000 ml) of room air was administered with an insufflation bulb or until the patient experiences fullness or mild discomfort. In the supine position a scout image of the abdomen and pelvis is acquired. A complete and full column of gas from the rectum to the caecum should be obtained. Additional gas may be administered at this stage if the colon is not distended adequately. The patient was then scanned in the supine position on MDCT machine using the CT protocol described earlier.

Once the scan has been performed in the supine position, the patient is placed in the prone position, and another scout image is obtained. Additional gas usually is administered in the prone position to maintain adequate colonic distention. The full technique of scan is repeated in the prone position also. Occasionally, limited rescanning is performed with the patient in a decubitus position if there is excess fluid or poor distention of the colon despite these maneuvers. Antispasmodic agent hyoscinebutylbromide (20 mg) was occasionally used to prevent unwanted colonic collapse and spasm, a problem mostly encountered in the sigmoid colon. If needed, intravenous injection of 60-80 ml of iodinated contrast agent (Omnipaque 300) was given through an 18 G needle placed preferably in the antecubital vein, at the rate of 3-4 ml per second. CT was then performed in the portal venous phase (start delay of 60 sec). After the procedure, the patients were observed for about 1-2 hours for any delayed reactions.

Images were processed on adw 4.4 version advantage workstation. Multi planar reconstruction (MPR) was done and the reconstructed images include sagittal, coronal and oblique 2D reformatted, and virtual colonoscopy images. The evaluation is done using both supine and prone acquisition images for assessing the mobility of the lesion. Virtual colonoscopy 3D endoluminal view was studied using specialized 'navigation' software of the workstation. Viewing includes antegrade (caecum to rectum) and retrograde (rectum to caecum) in both supine and prone acquisitions using manual or cine review technique.

Results

A total of 162 patients were included in the study of which 106 were male and 56 were female with mean age of 47.84. Highest numbers of cases (25%) were in the 6th decade of life.

The commonest presenting complaint seen in anorectal and rectal carcinoma patients were bleeding per rectum and constipation. 36.36% of anorectal cases and 31.81% of rectal cases presented with bleeding per rectum while 33.33% of rectal cases and 19.44% of anorectal cases presented with constipation.

Abdominal pain, abdominal distension, mass in the abdomen, loss of weight and appetite etc., were also noted

in patients with sigmoid, descending, transverse and ascending colon cancer.

The rectum being the most frequently involved colonic segment in 62 (38%) cases, followed by sigmoid colon in 42 (25%) and anorectum in 40 (24%) cases.[Table 1].

Imaging features of colorectal carcinoma in CT colonography:

Focal area of wall thickening was seen commonly and it was <10 cm in 140 (86.41%) colorectal cancer cases; while segmental wall thickening (10-30 cm in length) was noted in 22 (13.58%) cases.

Asymmetric or eccentric bowel wall thickening was seen in 98 (60.49%) colorectal cancer cases, and symmetric circumferential wall thickening was seen in 64 (39.50%) cases of carcinoma colon [Figure 1].

Degree of wall thickening was marked (>2 cm) in 136 (83.95%) cases, and was mild (< 2 cm) in 26 (16.04 %) cases of colorectal carcinoma.

The most common attenuation pattern of thickened bowel wall in colorectal carcinoma was heterogeneous (mixed) in 98 (60.49%) cases followed by homogenous pattern in 50 (30.86%) cases and heterogeneous (stratified) pattern in 14 (8.64%) cases.[Table 2].

Periserosal fat invasion is the most common tumour presentation seen in 67.90 % of cases, followed by adjacent organ invasion in 29.63 % of cases. Tumour limiting to muscularispropria is seen only in 2.47 % cases.[Table 3].

The internal iliac group of lymph nodes (pararectal, perirectal, obturator and internal iliac nodes) were most commonly involved and seen in 78 (48%) cases. External iliac and para aortic nodes were involved in 54 (33.3%) cases, followed by mesenteric nodes in 48 (29.6%) cases.

Internal iliac nodal group were predominantly involved in anorectal diseases (85%), and in rectal diseases (68.75%). The external iliac and para aortic nodal groups were predominantly involved in pathologies of sigmoid colon seen in (54.54%); while mesenteric, pericolonic and para colic nodes were predominantly involved in the diseases of descending (83.33%), transverse (75%) and ascending colon (73.33%). Inguinal nodes were significantly involved in anorectal disease and in some cases of rectum and sigmoid colon. This distribution of lymph nodes follows the lymphatic drainage of the colonic segments involved.

Distant metastases were seen more frequently in descending colon cancer followed by sigmoid colon and rectal carcinoma. The hepatic metastasis was noted in 33.33% of descending colon carcinoma, 13.63% of sigmoid colon carcinoma and 13.33% of ascending colon carcinoma. Lung, peritoneum and bone were other organs involved in the descending order of frequency.

Four cases of malignant solitary sigmoid colon polyps were noted on virtual colonoscopy examination. These were solitary and pedunculated, both measuring >10 mm in maximum length, with short stalk. Surface appeared smooth without any irregularity, and showed homogenous attenuation pattern without any focal necrosis or calcification. No evidence of any pericolonic fat stranding or significant lymphadenopathy noted. Polyps showed no mobility on both supine and prone studies of virtual

colonoscopy examination. Histopathologically it was proven to be malignant.

Table 1: Involvement of different colonic segments in male and female

Site distribution	Male	Female	Total cases
	No. of cases	No. of cases	
Anorectum	20	20	40
Rectum	44	18	62
Sigmoid colon	18	24	42
Descending colon	10	2	12
Transverse colon	2	6	8
Ascending colon	24	6	30

Table 2: Imaging findings in cases of carcinoma colon.

Wall thickening	No. of cases	Percentage
Extent:		
Focal	140	86.41%
Segmental	22	13.58%
Symmetry:		
Circumferential	64	39.50%
Eccentric	98	60.49%
Degree:		
Mild	26	16.04%
Marked	136	83.95%
Attenuation pattern:		
Homogenous	50	30.86%
Heterogeneous (mixed)	98	60.49%
Heterogeneous (stratified)	14	8.64%

Table 3: Extent of tumour invasion in CT

Diseased segment	Tumour invasion in CT				
	Muscularispropria	Periserosal	Adjacent organs	Lymph node	Metastases
	No. of cases	No. of cases	No. of cases	No. of cases	No. of cases
Anorectum	0	28	10	26	4
Rectum	2	40	16	40	10
Sigmoid	2	16	10	28	8
Descending	0	8	2	8	4
Transverse	0	6	2	6	0
Ascending	0	12	8	20	4
Total	4	110	48	128	30
Percentage	2.47%	67.90%	29.63%	79.01%	18.51%

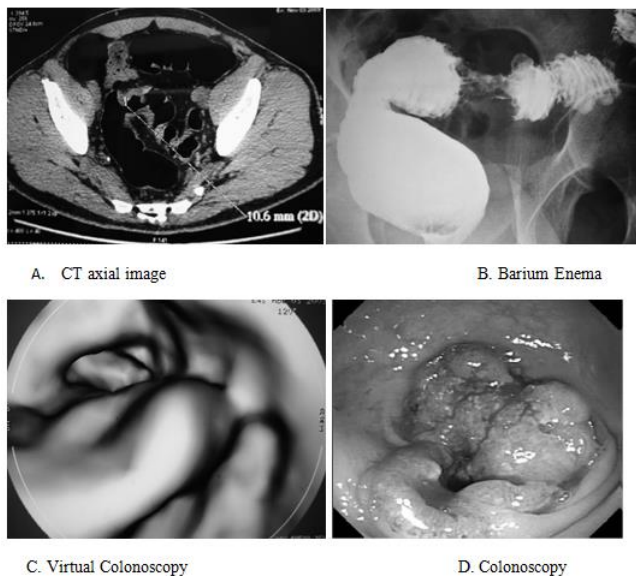


Figure 1: 60 yr old male presented with complaints of difficulty in passing stools and bleeding per rectum. A. Barium enema shows an annular lesion with mucosal irregularity causing luminal narrowing of the sigmoid colon. B. Axial CT scan image shows focal circumferential wall thickening without adjacent periserosal fat invasion. C. Virtual colonoscopy image shows mucosal irregularity with significant luminal narrowing. D. Conventional colonoscopy image shows mass lesion obstructing the lumen which could not be crossed by colonoscope.

Two cases of malignant rectal polyps [Figure 2] were observed, and was solitary and sessile with broad base, and measuring <10 mm in maximum length. The surface of the

polyp showed irregularity without any ulceration. The attenuation pattern was homogenous without any focal necrosis or calcification.

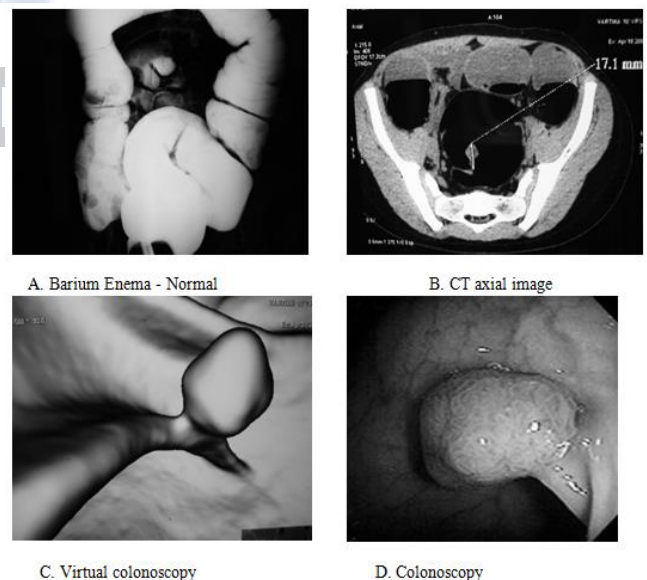


Figure 2: 10 yr old female presented with the complaints of bleeding per rectum. A. Barium enema shows normal appearance of colonic loops. B. Axial CT image shows a solitary pedunculated polyp from the right lateral wall of sigmoid colon. C. Virtual colonoscopy image shows pedunculated polyp with smooth surface protruding into the lumen. D. Conventional colonoscopy image shows the polypoidal lesion.

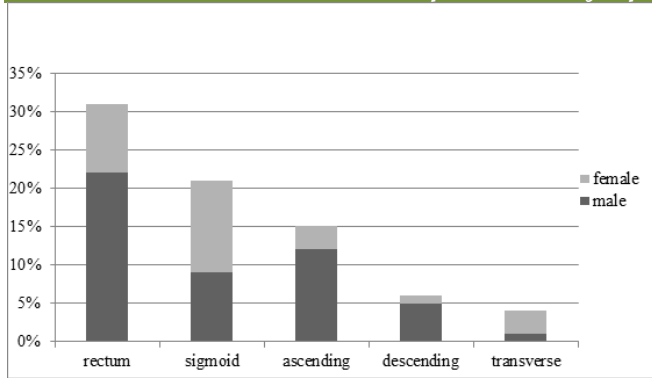


Figure 3: Disease distribution in different colon segments

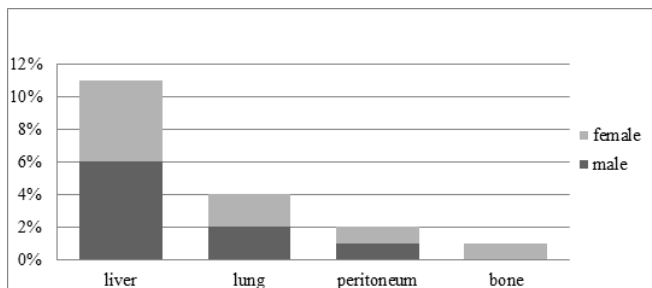


Figure 4: Distribution of metastasis.

Discussion

Colorectal carcinoma is the third most common cancer in the males and second most common cancer in females.^[1] The incidence and mortality rates are rapidly increasing in the developing countries.^[2] Majority of the cases are adenocarcinoma, which in most instances arises from an adenomatous polyp.^[3] Ahnen et al described that the incidence of colorectal cancer rises sharply after the age of 40 years.^[4] In our study also the mean age was 47 years, with 64 percent of the cases above 40 years of age. Males constituted 63% and females were 37% in our study.

Levin et al reported that malena and constipation were the predominant complaints of the patients with rectal cancer, while abdominal pain and other complaints such as weakness, nausea, vomiting and abdominal mass were predominant in cancers of left and right colon.^[5] Similar observations have also been observed in present study.

Coates et al reported that within the large intestine, 31% of the cancers are in the rectum and 69% occur in the rest of colon, of which sigmoid constitutes 30%, followed by ascending colon, transverse and descending colon in descending order which was also supported by Ponz et al.^[6,7] Approximately one half of the colon cancers occur in the rectum and sigmoid colon. It has been observed that there has been an increase in right sided lesions as opposed to left sided lesions in the recent years. More distal lesions are found in men than in women. In our study also the distribution of colon cancer [Figure 3] was consistent with their findings as evidenced by:

Rectum - 31%

Sigmoid colon - 21%

Ascending colon – 15%

Descending colon – 6%

Transverse colon – 4%.

The bowel wall thickening can be focal (<10 cm), segmental (10–30 cm), or diffuse (involving most of the small bowel or colon). According to Blumeke et al and Macari et al, most neoplasm of gastrointestinal tract present as focal area of bowel wall thickening.^[8,9] A segmental and diffuse distribution of involvement is usually caused by an inflammatory process such as Crohn's disease, infectious ileitis, radiation enteritis, and ischemia. Other considerations for segmental involvement include intramural hemorrhage and lymphoma.^[10] Our study also showed that 86.41 % of colorectal neoplasm presented with focal wall thickening and only 13.58% of carcinomas presented with segmental distribution.

In the present study, majority of colorectal cancers (60.49 %) presented with asymmetric or eccentric wall thickening, while only 39.50 % of cases presented with symmetric or circumferential thickening, suggesting asymmetry or eccentric wall thickening a definite feature of malignancy.

In general, benign conditions result in mild degree of bowel wall thickening of less than 2 cm, whereas wall thickening greater than 2 cm is usually present in neoplastic conditions (Buckley et al, Balthazar et al).^[11,12] In our study also, most of the colon carcinoma presented with marked (> 2 cm) bowel wall thickening as seen in 83.95 % of cases. Mild wall thickening (< 2 cm) was noted in 16.04 % of cases.

Filippone et al reported that CT was very useful in the preoperative staging of colon cancer, by analyzing the extent of local and adjacent organ invasion, lymph node involvement and distant metastases.^[13] CT colonography improves the accuracy of local staging of colorectal cancer.^[14] Our study also showed that 67.90 % of colon cancers showing periserosal extension, 29.63 % showing adjacent organ invasion, 79.01 % of cases showing lymphatic spread and 18.51 % showing distant metastases.

Morgan et al noted that liver is the most common organ to be involved by metastases found in 20%–40% of colorectal cancer patients.^[15] Lung involvement is seen in 20% of the cases. Less common metastatic sites include adrenal glands, bone, kidney, pancreas, spleen and central nervous system. In our study also, we have found that the distribution of metastases [Figure 4] is in terms with their findings.

Liver – 11%

Lung – 4%

Peritoneum – 2%

Bone – 1%.

Conclusion

CT colonography is effective in characterisation of the malignant colorectal growth and evaluating its local extent, lymphodal and metastatic spread. It has also high accuracy in identifying adenomatous polyps which are precursors to carcinoma, thus can be effectively used for the early detection, staging and screening of colorectal malignancy.

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