

Comparative analysis of colorectal carcinoma staging using operative, histopathology and computed tomography findings

Subhash Chander Singla, Dhawal Kaushal, Harinder Singh Sagoo, Nalini Calton

Department of Radiodiagnosis, Physiology and Pathology, CMC and H, Ludhiana, Punjab, India

ABSTRACT

Background: The staging of colorectal carcinoma using 3 modalities viz operative, histopathology and CT scan has been subject of interest in accurately defining the extent of disease. This retrospective as well as prospective study was carried out at CMC, Ludhiana, Punjab from November 2011 to May 2014. **Aim:** The objective of this study was to assess the usefulness and accuracy of CT scan findings to state the extent and spread of colorectal malignancy and to correlate these findings with histopathological diagnosis. **Method:** A total of 31 biopsy proven patients showing variable bowel wall thickening involving the colon /rectum on CECT (Contrast Enhanced Computed Tomography) were included in the study. The tumours were staged based on the CT scan findings and were compared with the operative and histopathological findings. **Observations:** Rectum was the most common site of involvement followed by the recto-sigmoid involvement. Metastasis was observed in 5 cases out of the 31 malignant cases. Five of the 7 cases were correctly staged as T1 & T2 lesions on CT having a sensitivity of 83.3%, specificity of 92%, and positive predictive value of 71.4% and a negative predictive value of 95.8% in the diagnosis of T1 and T2 lesions. 15 of the 16 cases were correctly staged as T3 lesions. CT had a sensitivity of 88.2%, specificity of 93.8%, and positive predictive value of 93.8% and a negative predictive value of 86.7% in the diagnosis of T3 lesions. All the 8 cases were correctly staged as T4 lesions. CT had a sensitivity of 100%, specificity of 100%, and positive predictive value of 100% and a negative predictive value of 100% in the diagnosis of T4 lesions. **Conclusion:** We conclude that CT scan is an excellent modality in diagnosing malignant lesions of the colon and rectum.

Key words: Colorectal cancer, CECT, histopathological diagnosis

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INTRODUCTION

Colorectal cancer (CRC) is one of the most common malignancies and usually ranks high in incidence and mortality among all malignancies in the Western world.^[1] Carcinoma of the rectum and sigmoid is one of the most sites of gastrointestinal tract malignancy and accounts for 20% of all

gastrointestinal malignancies.^[2,3] The age-adjusted incidence rates of CRCs in all the Indian cancer registries are very close to the lowest rates in the world.^[4]

Imaging in rectal cancer plays a crucial role in optimizing radiotherapy target definition to avoid adjacent vital structures.^[5] The modalities utilized for the evaluation of rectal carcinoma range from digital rectal examination, X-rays, barium enemas, transrectal ultrasounds, and colonoscopies. Due to the limitations of the abovementioned techniques/

Address for correspondence: Dr. Subhash Chander Singla, Department of Radiodiagnosis, Physiology and Pathology, CMC and H, Ludhiana - 141 008, Punjab, India.
E-mail: subhashsingla2@gmail.com

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procedures extent of intraabdominal spread cannot be assessed. Recently, few reports have shown that computed tomography (CT) staging in rectal cancer is quite accurate in estimating the extent of disease and helpful in planning the treatment of rectal cancer.^[6-8] CT is used for staging of rectal carcinomas before treatment, staging recurrent disease, and for detecting the presence of distant metastases after surgery. These days, as a part of presurgical planning, CT is being used for preoperative assessment of the growth and involvement of adjacent structures including the fat and pelvis muscles.

Considering these points, the present study was planned with aims and objectives to assess the extent and spread of colorectal malignancy on CT scan and to correlate the CT findings with histopathological diagnosis.

MATERIALS AND METHODS

This retrospective (1 year) as well as prospective (1½ years) study was carried out at a tertiary hospital in Punjab from November 2011 to May 2014 using (128 slice Philips Ingenuity High-speed CT scan machine). All patients suspected to having CRCs on clinical symptoms were included in the study. A detailed history of altered bowel habits, bleeding per rectum, pain abdomen, loss of appetite, anemia, loss of weight, or obstructive symptoms were obtained from all the patients. A detailed general physical, systemic clinical examination was done in all patients. All patients included in the study underwent basic and specific investigations which included hemoglobin estimation, total leukocyte count, serum creatinine, liver function tests, and levels of carcinoma embryonic antigen (CEA). Rectal biopsy reports of the patients were obtained from the Department of Surgery and Histopathology. Only those patients who underwent biopsy were included in the study. Those patients, in whom the biopsy specimen or the reports were not available due to any reason, were excluded from the study. Radiological imaging for comparison was done for all patients with biopsy confirmed diagnosis of CRC. Chest X-ray was done in all the patients. CT of abdomen and pelvis of all the patients were included. Abdominal ultrasound, CT chest, and magnetic resonance imaging (MRI) findings were included wherever possible. The images were retrieved from data available with picture archiving and communication system (PACS) in the Department of Medical Informatics.

The biopsy findings of type of growth, differentiation, mucosal changes if any along with the operative findings from the surgeons' operative notes, and the resultant tumor node metastasis (TNM) staging was compared with CT findings of colorectal region. These were correlated with MRI images wherever possible or where images were available with

PACS for comparison and radiological interpretation of TNM staging.

The CT findings were staged according to the criteria modified by Zinkin [Table 1]^[9] and modified Duke's criteria [Table 2].^[10]

The results were tabulated and analyzed.

Parameters studied on computed tomography scan

Computed tomography

The primary tumor was visualized and noted for its exact location, measurement, extent, and features. The surrounding structures were also analyzed for the evidence of any metastatic lesions or local tumor spread particularly spread to perirectal fat, pelvic organs, pelvic side wall, bone involvement, enlarged lymph nodes, and distant organs if any.

Operative findings or biopsy

Gross description of the surgically removed specimen was obtained from the surgical notes and surgical findings were scrutinized for relevant information on growth site, size of the affected lesion, pararectal growth if any and abnormal findings in the surgical anatomy of the region dissected.

Lymph nodes involvement on clinical examination or on operative findings was also documented. Wherever laparotomy or pelvic surgery were done information on involvement of liver, adjacent viscera or other visible organs in the surgical field as mentioned in the surgical notes were taken into consideration. The reports of the biopsy were analyzed for the type of tissue, differentiation, and mucosal involvement.

Statistical analysis

All patients who had definite diagnosis as per the defined criteria were included in the study. The data of both the retrospective

Table 1: Staging of computerized tomography findings (modified from Zinkin)

Stage	Description	5-year survival rate %
A	Limited to the bowel wall	83
B	Extension to pericolic fat; no nodes	70
C	Regional lymph node metastases	30
D	Distant metastases (liver, lung, bone)	10

Table 2: Tumor node metastasis/modified dukes classification system

TNM stage	Modified dukes stage	Description
T1N0M0	A	Limited to submucosa
T2N0M	B1	Limited to muscularis propria
T3N0M0	B2	Transmural extension
T2N1M0	C1	T2, enlarged mesenteric nodes
T3N1M0	C2	T3, enlarged mesenteric nodes
T4	C2	Invasion of adjacent organs
Any T, M1	D	Distant metastases present

Modified from the American Joint Committee on Cancer. TNM: Tumor node metastasis

group as well as the prospective group were analyzed using kappa (a measure of inter-rater agreement for categorical scales when there are two raters) test of agreement and an attempt to draw a correlation between different diagnostic modalities was made using SPSS software. All calculations were done using SPSS version 16 (IBM Corporation, 1 New Orchard Road, Armonk, NY 1050Y-1722 USA).

RESULTS

A total of 31 patients showing variable bowel wall thickening involving the colon/rectum on contrast-enhanced CT were included in the study. Most common age group of the patients with colorectal lesions in our study was found to be 61–70 years (38.7%). Males were more commonly affected as compared to females. Altered bowel habit (77.4%) was the most common symptom in patients presenting with carcinoma of the bowel followed by obstructive symptoms and weight loss. Hemoglobin was found to be abnormally low in 11 patients; however, it was normal in 20 patients. The total leukocyte count was abnormal in only 3 patients and rest 28 patients had normal counts. Creatinine values were abnormally high in 6 patients out of total of 31 patients. Only one patient had abnormal liver function test, whereas in the other thirty cases, the liver function was normal. CEA was found to be increased in 19 patients, whereas 11 patients had normal CEA values. Lung lesions were found in one case, while the thirty cases had normal chest X-ray findings. Ultrasound of liver showed space occupying lesions in only two cases suggesting metastasis. The rest had no definitive evidence of metastasis lesions in the liver. Rectum was the most common site of involvement [Figure 1] followed by the recto-sigmoid. Of the 31 cases, focal length of involvement of the bowel was seen in 18 cases, 11 cases had segmental involvement, and 2 cases had diffuse involvement. Presence of enlarged lymph nodes and perirectal/pericolic fat

stranding was seen in 45.2% of the cases and 24 (77%) patients, respectively. Infiltration of adjacent viscera was seen in 5 (16%) malignant lesions. Metastasis was observed in 5 cases out of the 31 malignant cases [Figure 2]. Five of the seven cases were correctly staged as T1 and T2 lesions. CT had a sensitivity of 83.3%, specificity of 92%, and positive predictive value of 71.4% and a negative predictive value of 95.8% in the diagnosis of T1 and T2 lesions. Fifteen of the sixteen cases were correctly staged as T3 lesions. CT had a sensitivity of 88.2%, specificity of 93.8%, and positive predictive value of 93.8% and a negative predictive value of 86.7% in the diagnosis of T3 lesions. All the eight cases were correctly staged as T4 lesions [Figure 3]. CT had a sensitivity of 100%, specificity of 100%, and positive predictive value of 100% and a negative predictive value of 100% in the diagnosis of T4 lesions.

DISCUSSION

Balthazar *et al.*, 1988,^[11] and Okizuka *et al.*, 1995,^[12] reported the age groups (in years) in their studies ranging from 34 to 92 and 44 to 86, respectively. Hundt *et al.*, 1999,^[13] and Filippone *et al.*, 2004,^[14] reported the age groups (in years) in their studies to be ranging from 42 to 78 and 37 to 81, respectively. Chamadol *et al.*, 2005,^[15] Smith *et al.*, 2007,^[16] and Hennedige *et al.*, 2010,^[17] reported the age groups (in years) in their studies to be ranging from 28 to 75, 33 to 89, and 29 to 94, respectively. In the present study, the age group ranged from 25 to 80 years. Most of the studies^[11-13,15,17,18] reported male predominance, which was in concordance with the present study where males (20, 65%) were more commonly involved as compared to females (11, 35%). In a study done by Khanbhai *et al.*, 2014, preoperative anemia was observed in 88 (44%) patients with mean hemoglobin levels below the lower limit of normal for that sex, whereas in the present study, anemia was



Figure 1: Axial contrast-enhanced computed tomography section of abdomen showing heterogeneously enhancing asymmetric wall thickening involving the rectum (T2 lesion) marked by arrow



Figure 2: Computed tomography - carcinoma rectum with involvement of prostate (T4) sagittal contrast-enhanced computed tomography sections of abdomen and pelvis showing heterogeneously enhancing wall thickening involving the rectum with loss fat planes between the rectum and prostate suggestive its involvement) marked by arrows

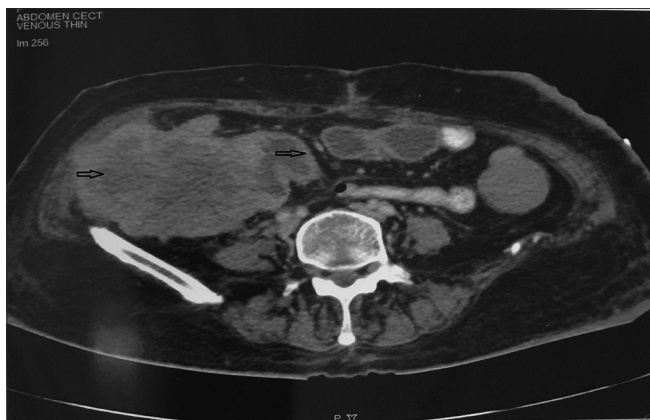


Figure 3: Computed tomography - carcinoma cecum and proximal colon (T4) axial contrast-enhanced computed tomography sections of abdomen showing heterogeneously enhancing mass with necrotic component involving the caecum and ascending colon infiltrating into the pericolic fat and adjacent bowel (T4 lesion) marked by arrows

found in 11 (35%) patients; however, it was normal in twenty patients.^[19] CEA was found to be increased in 19 patients. Wanebo *et al.*, 1978, in a study on patients with Dukes' A, B, C, and D disease demonstrated proportions of increased values of CEA-3%, -25%, -45%, and -65%, respectively.^[20] Rectum was the most common site of involvement in the present study.

A study done by Hennedige *et al.*, 2010, showed rectosigmoid as the most commonly involved site.^[17] Laishram *et al.*, 2010, did a study and also found rectum (53.71%) as the most common site of involvement.^[18] In studies done by Balthazar *et al.*, 1991, and Macari *et al.*, 2001, it was found that focal bowel involvement was a feature of malignancy which was in concordance with our study. Eleven cases had segmental wall thickening which according to their study was seen in benign conditions.^[21,22] Focal bowel wall thickening may be caused by tumors or inflammatory conditions, whereas segmental or diffuse wall thickening can be seen in benign conditions.^[23] In a study done by Chamadol *et al.*, 2005, the sensitivity of detecting enlarged lymph nodes was 92%.^[15] The sensitivity of the nodal detection in studies done by Okizuka *et al.*, 1995, was 60%.^[12] In the present study, enlarged lymph nodes were found in 14 (45%) cases of a total of 31 patients. Pericolic/perirectal fat stranding was present in 24 cases (77%) of bowel malignancies and was absent in 7 cases (23%). Chamadol *et al.*, 2005, in their study found the role of CT in detecting serosal/pericolic fat invasion had a sensitivity of 100%, specificity of 57%, and accuracy of 75% and these have been staged into T3 category. These criteria may not be very reliable and might result in overstaging of lesions.^[15] A study done by Pereira *et al.*, 2004, described that pericolic fat stranding is commonly seen in inflammatory conditions of the colon.^[24] Adjacent organ infiltration was seen in 8 cases (25.8% of total cases); however, the rest of the 23 cases did not show any involvement of viscera which means that the

rate of detection of infiltration was 100% in our study. Zheng *et al.*, 1984, found the involvement of the adjacent visceral organs in 75% patients. Infiltration of adjacent structures is highly suggestive of malignancy.^[25] Liver was found to be the most commonly involved organ in a study done by Horton *et al.*, 2000.^[26] In our study, of the five cases with metastases, only liver metastases was seen in one case, one case showed involvement of lung, one of the cases showed involvement of both lung and liver. Omental metastasis was seen in one case, omental and adrenal metastases in one case. Bony metastasis was not seen in any of the 31 cases. Filippone *et al.*, 2004, in their study were able to stage T1 and T2 correctly in 93% of the cases.^[14] In the present study, of the seven cases staged as T1 and T2 on histopathologically, CT correctly staged five cases (83.3%). Overstaging was done in two cases. Filippone *et al.*, 2004, was able to correctly stage 90% of the cases as T3 lesions.^[14] In our study, 16 cases staged as T3, CT correctly staged 15 cases (93.7%). Understaging was done in 1 case. Filippone *et al.*, 2004, were able to correctly stage 98% of the lesions as T4.^[14] All cases with T4 lesions were correctly staged in our study on CT. A study done by Hennedige *et al.*, 2010, histopathological examination showed that the T-stage of the tumors was T2 in 5 (5%), T3 in 62 (63%), and T4 in 32 (32%) patients.^[17] The overall accuracy of CT for T-stage for the two readers was 45.5% and 60.6% (k is 0.30), respectively.

CONCLUSION

We conclude that multiplanar reformatted imaging obtained in CT scan is an excellent modality in diagnosing malignant lesions of the colon and rectum as it can accurately describe the extent of involvement of primary or secondary lesions. The combined approach of using operative findings, histopathological diagnosis, and radiological images helps in precisely staging the CRC. Multidetector CT with axial and multiplanar images are useful tools to differentiate early colorectal carcinoma and advanced cancer and also provides minute details regarding peri-colic/rectal abnormalities associated with tumor, presence of lymph nodes, infiltration of adjacent viscera as well as the involvement of distant organs.

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Conflicts of interest

There are no conflicts of interest.

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