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Original Article

Radiology Section

Radiological Evaluation of Carcinoma Colon and Comparison with Histopathological Examination: A Cross-sectional Study

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ABSTRACT

Introduction: Colorectal Cancer (CRC) is the fourth most common cancer diagnosed in the world. Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) are useful in pre-operative planning and postoperative follow-up for detecting the presence of distant metastases after surgery.

Aim: To evaluate the role of CT and MRI in diagnosis of CRC by associating the cancer diagnosis and staging by Histopathological Examination (HPE).

Materials and Methods: A cross-sectional observational study was done on 82 subjects with CRC attending the Trichy SRM Medical College and hospital from January 2018 to May 2020. Only those patients who underwent biopsy were included in the study. Biopsy reports of 82 patients were obtained from the Department of Surgery and Histopathology. The staging was done by Tumour Node Metastasis (TNM) staging system. CT, MRI stage, regions involved and HPE reports were considered as outcome variables. Demographic parameters like age, sex were considered as explanatory variables. Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Statistical Package for Social Sciences (SPSS) version 22.0 was used for statistical analysis.

Results: The mean age of the study population was 58.6±14.05 years (range is 22-84 years). Majority (59.76%) were males. Rectum (42.68%) was the most commonly involved site. In staging with biopsy, 32.92% had stage III CRC and 36.59% had stage IV CRC. With CT/MRI staging, 30.4% had stage III CRC and 29.2% had stage IV CRC.

Conclusion: CT/MRI 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 but they are less sensitive as compared to biopsy for cases of CRC involving lymph node and with distant metastasis.

Keywords: Biopsy, Colorectal cancer, Computed tomography, Magnetic resonance imaging

INTRODUCTION

Colorectal Cancer (CRC) is a lethal disease and a relatively common cancer [1,2]. Environmental and genetic factors determine the development of this cancer. It affects the colon and rectum, which are a part of the large intestine. It is also referred to as colon cancer or rectal cancer in short depending on the origin. It can originate either from the colon or the rectum. According to the recent GLOBOCAN statistics (2018), it is the fourth most commonly diagnosed cancer in the world and the third deadliest cancer globally [3-5]. It also accounts for 11% of all cancers diagnosed in the world. It is the third most commonly diagnosed cancer in males and the second in females, with 1.8 million new cases and almost 861,000 deaths in 2018 [3]. The fourth most common cancer globally is colon cancer while rectal cancer ranks as the eighth most common cancer [3].

Annually in the United States, an estimated 1,47,950 new cases of cancer of the large bowel are diagnosed. Out of these, 104,610 are cancer of the colon while the rest are cancer of the rectum. Patients with CRC usually present with symptoms of blood in stools, altered bowel habits, tiredness, weight loss or other symptoms arising due to metastasis. It typically starts as a benign tumour and grows with time to become a carcinoma and metastasise over years. In CRC, radiological imaging plays a vital role in optimising radiotherapy target definition in CRC so as to prevent damage to the adjacent vital structures [6].

In evaluation of colorectal carcinoma, various modalities such as digital rectal examination, colonoscopy, radiological evaluation using x-rays, barium enemas and then transrectal ultrasounds are used [7]. But these methods cannot assess the extent of intra-abdominal spread in CRC. CT staging in CRC has been documented to provide similar accuracy to HPE in staging of cancer [7,8]. Histopathology is a cornerstone in detection and the diagnosis of CRC. Histopathology determines the treatment of cancer and precancer by classifying the diagnostic patterns of cells in tissue sections from biopsy or surgical specimens under the microscope.

The role of CT in staging of carcinoma of rectum is very important. It is employed as a part of staging during diagnosis, for presurgical planning, for staging of recurrence and to detect any distant metastasis after surgery. It is useful in preoperative assessment for determining the extent of growth, involvement of the structures adjacent to the primary tumour like the muscles of pelvis and fat. Presence of metastasis is determined by CT of the chest, abdomen and pelvis.

MRI may be used in certain cases and is often used for rectal lesions to determine its local stage and to facilitate preoperative planning. In primary tumour staging of rectal lesions, the role of rectal MRI is vital in evaluating the involvement of pelvic side wall, anal sphincter complex involvement, for Circumferential Resection Margin (CRM) status, presence of Extra-Mural Venous Invasion (EMVI) besides the tumour morphology, site of the tumour, T and N classification. Radiological imaging (CT and MRI) has been gaining increasing use for pre-treatment staging in the recent times, although not yet accepted as a gold standard. The aim of this study was to evaluate the role of CT and MRI in the assessment of extension and staging of CRC in correlation with histopathologic examination.

MATERIALS AND METHODS

This cross-sectional observational study was done on 82 subjects with CRC. The subjects were selected by convenient sampling. The

sampling frame included the subjects attending the Trichy SRM Medical College and Hospital from January 2018 to May 2020. The study was done after getting approval from Ethical Committee (approval number CMCH & RC/ME-1/2018-IEC NO:063). All patients suspected of having CRCs on examination of clinical symptoms were included in the study after getting the consent. So, the entire sampling frame was included in the study.

A detailed history of altered bowel habits, bleeding per rectum, pain abdomen, loss of appetite, anaemia, 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 haemoglobin estimation, total leukocyte count, serum creatinine, liver function tests, and levels of Carcinoma Embryonic Antigen (CEA). Colorectal biopsy reports of the patients were obtained from the department of surgery and histopathology.

Inclusion criteria: Those patients who underwent biopsy along with all physical, systemic examination and specfic laboratory investigation were included in the study.

Exclusion criteria: Patients without biopsy reports were excluded from the study.

In all cases of CRC confirmed by biopsy, radiological imaging was done. X-ray of the chest was done in all patients. CT findings of abdomen and pelvis were included from all the patients. Wherever possible, findings of the abdominal ultrasound, CT chest and MRI were included. The findings from the biopsy report such as the type of growth, the type of differentiation, changes in the mucosa and other mentioned findings were included besides the intraoperative findings from the notes of the operating surgeon. Then this Tumour Node Metastasis (TNM) staging was matched with the findings from CT and MRI of the colorectal region. Radiological interpretation was done based on the status of the primary tumour (T-stage), the status of lymph node involvement (N-stage), and the status of the distant spread (M-stage).

American Joint Committee on Cancer (AJCC) and the Union for International Cancer Control (UICC) revealed TNM classification by grouping of the tumour, lymph node and metastasis components [9,10]. Akkoca AN et al., in their study used Modified Dukes and TNM classification [11]. Tong GJ et al., in their study compared the eighth version of the AJCC CRC staging to the seventh version [12]. The seventh version of American Joint Committee CRC staging was used as shown in [Table/Fig-1,2] [12].

S. No.	TNM classification characteristics	
1.	**Primary tumour (T):**	
	TX	Primary tumour cannot be assessed
	T0	No evidence of primary tumour
	Tis	Carcinoma in-situ: intraepithelial or invasion of lamina propria
	T1	Tumour invades submucosa
	T2	Tumour invades muscularis propria
	T3	Tumour invades through the muscularis propria into pericolorectal tissues
	T4a	Tumour penetrates to the surface of the visceral peritoneum
	T4b	Tumour directly invades or is adherent to other organs or structures
2.	**Regional lymph nodes (N):**	
	NX	Regional lymph nodes cannot be assessed
	N0	No regional lymph node metastasis
	N1	Metastasis in 1-3 regional lymph nodes
	N1a	Metastasis in one regional lymph node
	N1b	Metastasis in 2-3 regional lymph nodes
	N1c	Tumour deposit(s) in the subserosa, mesentery, or non-peritonealised pericolic or peritectal tissues without regional nodal metastasis
	N2	Metastasis in 4 or more regional lymph nodes
	N2a	Metastasis in 4-6 regional lymph nodes
	N2b	Metastasis in 7 or more regional lymph nodes.
3.	**Distant metastasis (M):**	
	M0	No distant metastasis
	M1	Distant metastasis
	M1a	Metastasis confined to one organ or site (for example: liver, lung, ovary, non-regional node)
	M1b	Metastases in more than one organ/site or the peritoneum

[Table/Fig-1]: TNM classification list- seventh version of American Joint Committee on cancer manual CRC staging [12].
Additional prefixes can be appended to define the TNM stage: c: Clinical assessment data (e.g., cT1b); p: Pathological data; y: Clinical; (yc) or pathological (yp) data following systemic or radiation therapy be it prior to surgery or as a primary treatment; r: Clinical or pathological staging at the time of retreatment or recurrence for disease progression; a: For cancers discovered at autopsy (e.g., aT1) not for cancers known about or suspected prior to death

Stage	T	N	M	Dukes	MAC
0	Tis	N0	M0	-	-
I	T1	N0	M0	A	A
I	T2	N0	M0	A	B1
IIA	T3	N0	M0	B	B2
IIB	T4a	N0	M0	B	B2
IIC	T4b	N0	M0	B	B3
IIIA	T1-2	N1/N1c	M0	C	C2
	T1	N2a	M0	C	C1
IIIB	T3-4a	N1/N1c	M0	C	C2
	T2-3	N2a	M0	C	C1/C2
	T1-2	N2b	M0	C	C1
IIIC	T4a	N2a	M0	C	C2
	T3-4a	N2b	M0	C	C2
	T4b	N1-2	M0	C	C3
IVA	Any T	Any N	M1a	-	-
IVB	Any T	Any N	M1b	-	-

[Table/Fig-2]: TNM staging system-seventh edition of American Joint Committee on cancer manual CRC staging [12].
CRC: Colorectal carcinoma

Computed Tomography

The primary tumour was visualised and noted for its exact location, measurement, extent, and features. The surrounding structures were also analysed for the evidence of any metastatic lesions or local tumour spread particularly spread to perirectal fat, pelvic organs, pelvic side wall, bone involvement, enlarged lymph nodes, and distant organs if any. CT was done with SIEMENS SIGMA 64 slice machine.

Operative Findings or Biopsy

Gross description of the surgically removed specimen was obtained from the surgical notes and surgical findings were scrutinised 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 histopathological reports were analysed for the type of tissue, differentiation and mucosal involvement.

STATISTICAL ANALYSIS

Staging with HPE and staging with CT/MRI were considered as outcome variables. Demographic parameters like age, sex were considered as explanatory variables. Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. IBM SPSS version 22.0 was used for statistical analysis [13].

RESULTS

A total of 82 subjects were included in the final analysis. The age of the study population ranged from 22 to 84 years. Majority (59.76%) were males. CT was done in 65.85% of patients while MRI was done in 34.15% of patients. The most common diagnosis made was primary carcinoma (76.73%) followed by residual/recurrent carcinoma (13.42%). Rectum (42.68%) was the most commonly involved site followed by sigmoid colon (21.95%) [Table/Fig-3].

Parameter	Summary N (%)
Age (Mean±SD) (Years)	58.6±14.05 (22.0-84.0)
Gender	
Males	49 (59.76)
Females	33 (40.24)
Radiological investigation	
CT done	54 (65.85)
MRI done	28 (34.15)
Diagnosis	
1. Primary carcinoma	63 (76.73)
2. Residual/recurrent carcinoma	11 (13.42)
3. Carcinoma with metastasis to liver/peritoneum	3 (3.66)
4. Carcinoma with surrounding mesenteric involvement	1 (1.22)
5. Colocolic intussusception with carcinoma	1 (1.22)
6. Colitis/carcinoma	1 (1.22)
7. Metastatic carcinoma colon	1 (1.22)
8. Nonspecific colitis/carcinoma	1 (1.22)
Mass epicentre	
1. Rectum	35 (42.68)
2. Sigmoid colon	18 (21.95)
3. Ascending colon	7 (8.54)
4. Caecum	7 (8.54)
5. Descending colon	7 (8.54)
6. Hepatic flexure	5 (6.1)
7 Transverse colon	2 (2.44)
8. Anus	1 (1.22)

[Table/Fig-3]: Baseline characteristics of the study population (N=82).

In 29.3%, tumour invaded through muscularis propria into peri-colorectal tissues. About 17.1% had metastasis in seven or more regional lymph nodes while 26.8% had distant metastasis [Table/Fig-4]. In HPE, the most common diagnosis (30.49%) was moderately differentiated adenocarcinoma as shown in [Table/Fig-5]. In staging with biopsy, 32.93% of subjects had stage III CRC and 36.59% of subjects had stage IV CRC [Table/Fig-6]. There was a high concurrence of staging with CT/MRI and by biopsy. Staging with biopsy detected two additional subjects with stage III CRC compared to CT/MRI and six additional subjects with stage IV CRC compared to CT/MRI. Hence, staging with CT/MRI was less sensitive compared to biopsy in cases of CRC with distant metastasis and involvement of lymph nodes. With CT/MRI staging, 23.1% of subjects had stage 0 CRC and 13.4% of subjects had stage II CRC [Table/Fig-7].

Parameter	N (%)
Tumour invades submucosa	6 (7.3)
Tumour invades muscularis propria	12 (14.6)
Tumour invades through the muscularis propria into pericolorectal tissues	24 (29.3)
T3b	2 (2.4)
T3c	2 (2.4)
T3d	1 (1.22)
T4	1 (1.22)
Tumour penetrates to the surface of the visceral peritoneum	14 (17.1)
T4b	5 (6.1)
No regional lymph node metastasis	11 (13.4)
Metastasis in 1-3 regional lymph nodes	22 (26.8)
Metastasis in one regional lymph node	1 (1.22)
Metastasis in 2-3 regional lymph nodes	12 (14.6)
Metastasis in 4 or more regional lymph nodes	9 (1.22)
Metastasis in 4-6 regional lymph nodes	3 (11)
Metastasis in 7 or more regional lymph nodes	14 (17.1)
No distant metastasis	38 (46.3)
Distant metastasis	22 (26.8)
Metastasis confined to one organ or site	10 (1.2)
Metastases in more than one organ/site or the peritoneum	2 (2.4)

[Table/Fig-4]: Summary of TNM in the study population (N=82).

Biopsy report		N (%)
Adenocarcinoma	Moderately differentiated adenocarcinoma	25 (30.49)
	Poorly differentiated adenocarcinoma	20 (19.51)
	Low grade adenocarcinoma	8 (9.76)
	Mucinous adenocarcinoma	3 (3.66)
	Recurrent adenocarcinoma	1 (1.22)
	Adenocarcinoma rectum	2 (2.44)
	Adenocarcinoma transverse colon	1 (1.22)
	Adenocarcinoma ascending colon	1 (1.22)
	Adenocarcinoma rectosigmoid	1 (1.22)
	Intramucosal adenocarcinoma	1 (1.22)
Squamous cell carcinoma	Poorly differentiated squamous cell carcinoma	2 (2.44)
	Anal canal squamous cell carcinoma	1 (1.22)
Metastatic carcinoma	Metastatic carcinoma colon	1 (1.22)
Others	Ischaemic colitis	4 (4.88)
	Chronic non-specific inflammation	2 (2.44)
	Early adenomatous change	1 (1.22)
	Hyperplastic polyp with adenomatous changes	1 (1.22)
	Non-specific inflammation with ulceration	1 (1.22)
	Polyp with adenomatous transformation	1 (1.22)
	Suspicious for lymphoma	1 (1.22)
	Ulceration with inflammatory exudate	4 (4.88)

[Table/Fig-5]: Summary of biopsy report in the study population (N=82).

Parameter	N (%)
0	15 (18.29)
I	2 (2.44)
IIA	5 (6.10)
IIB	3 (3.66)
IIIA	8 (9.76)
IIIB	16 (19.51)
III	3 (3.66)
IVA	28 (34.15)
IVB	2 (2.44)

[Table/Fig-6]: Summary of staging by biopsy (N=82).

Stage	Staging with CT/MRI	Staging with biopsy/HPE
0	19 (23.1%)	15 (18.29%)
I	3 (3.65%)	2 (2.44%)
II	11 (13.4%)	8 (9.76%)
III	25 (30.4%)	27 (32.92%)
IV	24 (29.2%)	30 (36.59%)

[Table/Fig-7]: Comparison of CT/MRI and biopsy findings (N=82).

DISCUSSION

In the present study, there was a high concurrence between staging with the help of CT/MRI and staging with biopsy/HPE as shown in [Table/Fig-7]. Radiological imaging (CT and MRI) has been gaining increasing use for pretreatment staging in the recent times, although not yet accepted as a gold standard. CRC staging affects the extent of surgery, postoperative and follow-up treatment. Accurate staging shows the path in thin line, to keep patients from the side effects of the drug and to avoid the risk of tumour recurrence. Early diagnosis is important.

CRC is a common cancer worldwide that affects both genders and all ages. Majority (59.76%) of the subjects were males. Khougali HS et al., in their study on 163 CRC patients presenting to National Cancer Institute observed that majority were males (53.4%) [14]. Most patients were aged between 40-69 years (58.8%) in their study. In this study the mean age was 58.6±14.05 years similar to that observed in the study by Singla SC et al., [7]. In their study, the age group ranged from 25 to 80 years similar to 22 to 84 years observed in the present study. In this study, CT was done in 54 subjects while MRI was done in 29 subjects.

Rectum was the most common site of involvement followed by the rectosigmoid involvement in the study by Singla SC et al., [7]. In present study, also it was observed that rectum (42.68%) was most commonly involved followed by sigmoid colon (21.95%). Khougali HS et al., in their study also observed that rectum (58.9%) was the most common site of tumour involvement [14]. In this study, 10 subjects (12.2%) had metastasis confined to one organ site while two subjects (2.4%) had metastasis in more than one organ/site or the peritoneum. Overall, 26.8% of present study subjects had distant metastasis. Metastasis was observed in five cases out of the 31 malignant cases in the study by Singla SC et al., [7].

With regards to HPE report, 69.5% of the subjects had adenocarcinoma. Moderately differentiated adenocarcinoma was seen in 30.49% of total subjects while poorly differentiated adenocarcinoma was seen in 19.51%. Poorly differentiated squamous cell carcinoma was seen in 2 (2.44%) subjects while anal canal squamous cell carcinoma was seen in 1 (1.22%) subject. Metastatic carcinoma colon was seen in 1 (1.22%) subject. Khougali HS et al., in their study observed that majority of patients had Grade I adenocarcinoma (50.3%) [14]. In their study, the most common stage of tumour according to Duke's staging was class B (38%) followed by class C (31%).

In the present study with CT/MRI staging, 30.4% of subjects had stage III CRC and 29.2% of subjects had stage IV CRC. In staging with biopsy, 32.93% of subjects had stage III CRC and 36.59% of subjects had stage IV CRC. Staging with biopsy detected two additional subjects with stage III CRC compared to CT/MRI and six additional subjects with stage IV CRC compared to CT/MRI. Hence, staging with CT/MRI was less sensitive compared to biopsy in cases of CRC with distant metastasis and involvement of lymph nodes. In the present study, with CT/MRI staging, 23.1% of subjects had stage 0 CRC and 13.4% of subjects had stage II CRC. It was higher compared to staging with biopsy. In the study by Singla SC et al., the sensitivity of CT was 83.3% while the specificity was 92% in the diagnosis of T1 and T2 lesions [7]. For T3 lesions, the sensitivity was 88.2% and the specificity was 93.8% while for T4 lesions, the sensitivity and specificity was 100%. Nerad E et al., in their systematic review had also observed that in diagnosis of T3-T4 tumours, the sensitivity of CT was high and that use of CT colonography further increased the accuracy [15]. But they also observed that the diagnostic accuracy was low in detection of involvement of nodes.

CT and MRI are widely used in the preoperative assessment to decide the therapeutic strategy. MRI is highly accurate in detection, characterisation, and staging. MRI done preoperatively can help in determining the treatment strategy tailored to the stage of the tumour.

Limitation(s)

In addition to the general limitations of a retrospective study, this study only included colorectal patients from a single institute and thus had a relatively moderate sample size. As assessing the data of CRC with wide geographical area is necessary.

CONCLUSION(S)

It can be concluded from the findings of the present study that CT and MRI are excellent modalities in the diagnosis of malignant lesions of rectum and colon. They have the potential to clearly delineate the extent of involvement of the primary lesion and also the metastasis. Hence, an approach which uses a combination of radiological findings, intraoperative findings and histopathological diagnosis can help in accurately delineating the stage of CRC and its further management. The authors recommend a national, multicentre study to consolidate the findings of this study and provide precise region-specific data.

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