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Original Research Article

Correlation of diagnostic accuracy of computed tomography with magnetic resonance imaging in local staging of carcinoma rectum at tertiary care center

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ABSTRACT

Background: Rectal cancer is third most common cancer related death worldwide. Cross sectional imaging techniques like computed tomography (CT) and magnetic resonance imaging (MRI) play a major role in preoperative staging. En-bloc resection of mesorectum and preoperative neoadjuvant chemoradiotherapy has significant role to reduce postsurgical recurrence.
Methods: A cross-sectional observational study was conducted in the department of radiology, Narayan medical college and hospital Sasaram over a period of 12 months from August 2022 to September 2023. A total of 40 patients with biopsy proved rectal carcinoma were included, Local staging of carcinoma rectum was performed using MRI pelvis, MDCT abdomen and pelvis, the results were analysed and correlated.
Results: The current study is aimed to correlate the diagnostic accuracy of CT with MRI in local staging of carcinoma rectum. Rectal cancer was more common in elderly mostly above 50 years of age. 65% of the cases showed irregular circumferential wall thickening and 35% showed polypoidal growth. On correlating with MRI, CT showed an overall good sensitivity, specificity, and accuracy in diagnosing tumor staging, mesorectal fascia (MRF) involvement and extramural vascular invasion (EMVI). CT can be considered as a reliable imaging modality for local staging of rectal cancer.
Conclusions: MRI and MDCT both are complementary imaging modalities in preoperative staging of rectal cancer. MRI is the best available imaging modality for the local staging of patients and has the potential to play an important role in accurately differentiating which patients should receive preoperative chemoradiation prior to total mesorectal excision. CT can be considered as a reliable imaging modality for assessing local staging of rectal cancer.

Keywords: Circumferential resection margin, MDCT, MRF, EMVI

INTRODUCTION

Rectal cancer is third most common cancer related death worldwide. Cross sectional imaging techniques like CT and MRI play a major role in preoperative staging.[1]

Depth of invasion, number of involved lymph nodes, and involvement of circumferential resection margin (CRM) determines the prognosis of rectal cancer.[2] En-bloc resection of mesorectum and preoperative neoadjuvant chemoradiotherapy has significant role to reduce postsurgical recurrence.[3]

CT is commonly used to assess entire pelvic anatomy and the presence or absence of distant metastasis in colorectal cancer. However, CT has limited soft tissue contrast for local staging. Alternatively, MRI is recommended as a standard imaging modality for preoperative local staging of rectal cancer, with excellent soft tissue contrast and multiplanar capability.[4]

TNM staging is used for rectal cancer staging. T1 tumors are confined to mucosal/submucosal layer, T2 tumors invade muscularis propria, T3 tumors invade mesorectum and T4 tumors extend to visceral peritoneum or surrounding organs.[2] Distinguishing T1 tumor and T2 tumor is not possible on MRI. However, T3 tumors show better results when treated with preoperative chemoradiotherapy and these lesions can be distinguished from T1 and T2 tumors on MRI.[4]

Involvement of MRF determines the need for neoadjuvant chemotherapy or appropriate surgical management. MRF involvement is better seen in MRI, thus MRI plays a major role in preoperative staging of rectal cancer. EMVI is another important prognostic factor in rectal cancer and MRI is the preferred imaging modality in determining EMVI.[5] MRI is the imaging modality of choice in rectal cancer restaging and assessment of chemoradiotherapy response.[5]

With this background, the present study was conducted to correlate CT findings with MRI in local staging in rectal cancer and to evaluate the accuracy of CT in local staging of rectal cancer.

METHODS

This hospital based cross-sectional observational study among 40 patients was conducted at the department of radiodiagnosis Narayan medical college and hospital over a period of 12 months from August 2022 to September 2023. Adult patients were referred to department of radiodiagnosis who were biopsy proved carcinoma rectum for radiological staging. CECT and CE-MRI abdomen were then performed in same cases. Biochemical investigations relevant to the carcinoma rectum were also done. Patients included in the study were-adult patients referred to department of radiodiagnosis with biopsy proved carcinoma rectum for radiological staging. Patients excluded from the study were-patients who had undergone preoperative chemoradiotherapy for carcinoma rectum and patients who had underwent surgery for carcinoma rectum.

A Siemens, Sommatom emotion, 16 slice CT scanner was used, patients were kept nil orally for at least 6 hours and were prepared by bowel cleansing. Plain CT scan of abdomen and pelvis was performed initially followed by injection of 70-100ml of intravenous iodinated contrast agent (ULTRAVIST 370) at the rate of 2 to 3 ml/s using a pressure injector medium.

A Siemens Magnetom Essenza 1.5 Tesla MRI scanner was used and following sequences were taken: T2W oblique sequence with axis perpendicular to the tumor plane, T2W sequence in coronal and sagittal planes, T2W MPR sequence in thin section, Axial T1W and T2W sequence and Axial T2 FAT SATURATED sequence. The data was entered in Microsoft excel sheet and was analysed using appropriate SPSS software (Trial version-21) and findings were correlated.

RESULTS

The present study was a cross-sectional observation study among 40 patients with biopsy proved rectal carcinoma, conducted in the department of radiodiagnosis, Narayan medical college and hospital, local staging of carcinoma rectum was performed using MRI pelvis and MDCT abdomen and pelvis and the results were analysed and correlated.

Gender distribution

Out of 40 patients, 19 (47.5%) were males and 21 (52.5%) were females (Table 1).

Table 1: Distribution of patients according to gender.

Gender distribution	N (%)
Male	19 (47.5)
Female	21 (52.5)
Total	40 (100)

Age distribution

Table 2 shows the age distribution among the study subjects. Maximum subjects were above 50 years of age (77.5%).

Table 2: Distribution of patients according to age.

Age distribution (in years)	N (%)
≤30	1 (2.5)
31-40	2 (5.0)
41-50	6 (15)
>50	31 (77.5)
Total	40 (100)

Morphology of the tumor

Irregular circumferential wall thickening seen in 65% patients, polypoidal mass seen in 35% cases (Table 3).

Table 3: Distribution of patients according to morphology of tumor.

Variables	N (%)
Irregular circumferential	26 (65.0)
Polypoidal	14 (35.0)
Total	40 (100)

Diagnosis of EMVI

On correlating CT with MRI in diagnosing EMVI, CT showed sensitivity of 70%, 100% positive predictive value, 100% specificity, 90.9% negative predictive value and 92.5% accuracy (Table 4).

Table 4: Correlating CT with MRI in diagnosing EMVI.

CT EMVI	MRI EMVI, N (%)		Total, N (%)
	Present	Absent	
Present	7	0	7
Absent	3	30	33
Total	10 (25)	30 (75)	40 (100)
Fisher's exact test	P value		0.0001 significant

There is statistically significant correlation between CT and MRI in diagnosing EMVI with a p=0.0001.

Diagnosis of MRF involvement

On correlating CT with MRI in diagnosing MRF involvement, CT showed sensitivity of 77.7%, specificity of 100%, PPV of 100%, NPV of 93.9% and accuracy of 95%.

Table 5: Correlating CT with MRI in diagnosing MRF involvement.

CT MRF involvement	MRI MRF, N (%)		Total, N (%)
	Present	Absent	
Present	7	0	7
Absent	2	31	33
Total	9 (22.5)	31 (77.5)	40 (100)
Fisher's exact test	P value		0.0001 significant

There is statistically significant correlation between CT and MRI in diagnosing MRF involvement with a p=0.0001.

CT and MRI correlation in staging of rectal carcinoma

T4 tumor stage in CT was seen in 47.5% of our study population, T4 tumor stage in MRI was seen in 42.5% of our study population (Table 6).

Table 6: Correlation of CT with MRI in primary staging (T-stage).

T stage	CT, N (%)	MRI, N (%)	Spearmen correlation value	P value
T1/T2	11 (27.5)	12 (30)	0.941	0.0001
T3	10 (25)	11 (27.5)	0.937	0.0001
T4	19 (47)	17 (42.5)	0.904	0.0001

The current study is aimed to correlate the diagnostic accuracy of CT with MRI in local staging of carcinoma rectum. A total of 40 patients referred to our department from August 2022 to September 2023, after satisfying the inclusion and exclusion criteria were evaluated. Patients with clinical suspicion of carcinoma rectum underwent biopsy and diagnosed to have carcinoma rectum. These patients were evaluated using CECT abdomen and pelvis and MRI pelvis for radiological staging.

In our study we found 52.5% (21 cases) were females and 47.5% (19 cases) were males, suggesting almost equal distribution among males and females and rectal cancer was more common in elderly and about 77.5% of the patients were above 50 years of age.

All the cases included in our study who underwent colonoscopy and biopsy for histopathological diagnosis showed adenocarcinoma of rectum. In assessment of morphology of rectal tumors, 65% of the cases showed irregular circumferential wall (Figure 2) thickening and 35% of the cases showed polypoidal growth (Figure 1).

MRF (Figure 4) involvement determines the management of rectal cancer. If MRF is not involved, the patient may undergo total mesorectal excision, and if MRF is involved, neoadjuvant chemotherapy is the treatment of choice. So, assessment of MRF is significant while evaluating local staging of rectal cancer using MDCT and MRI. In our study, 15% involvement of MRF seen in MDCT and 22.5% MRF involvement seen in MRI. In correlation with MRI, MDCT showed sensitivity of 77.7%, specificity of 100%, PPV of 100%, NPV of 93.9% and accuracy of 95%.

The most important prognostic factor for rectal cancer is EMVI (Figure 3), which is associated with poor survival rate and high risk of local recurrence and distant metastasis. In our study MDCT showed 12.5% EMVI and MRI showed 25% EMVI. In correlation with MRI, MDCT showed sensitivity of 70%, specificity of 100%, PPV of 100%, NPV of 90.9% and accuracy of 92.5%. On correlating with MRI, CT showed an overall good sensitivity, specificity, and accuracy in diagnosing tumor staging, MRF involvement and EMVI. CT can be considered as a reliable imaging modality for local staging of rectal cancer.

Figure 1: Axial CECT of endophytic polypoidal growth.

Figure 2: Axial CECT showing irregular circumferential wall thickening of rectum.

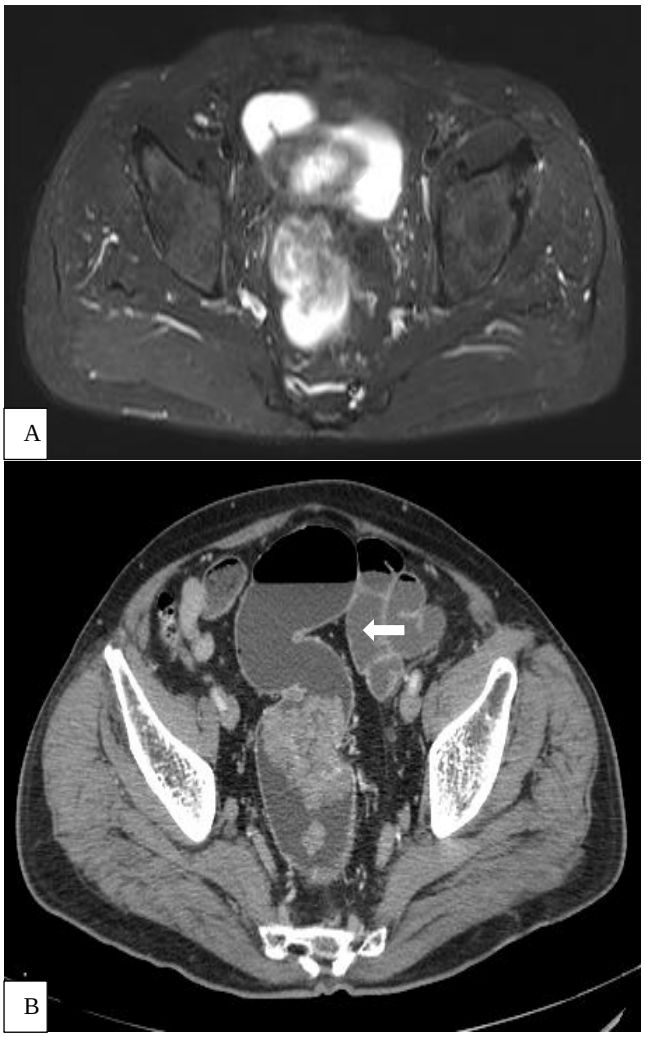

Figure 3 (A and B): Axial MRI and CECT images shows EMVI.

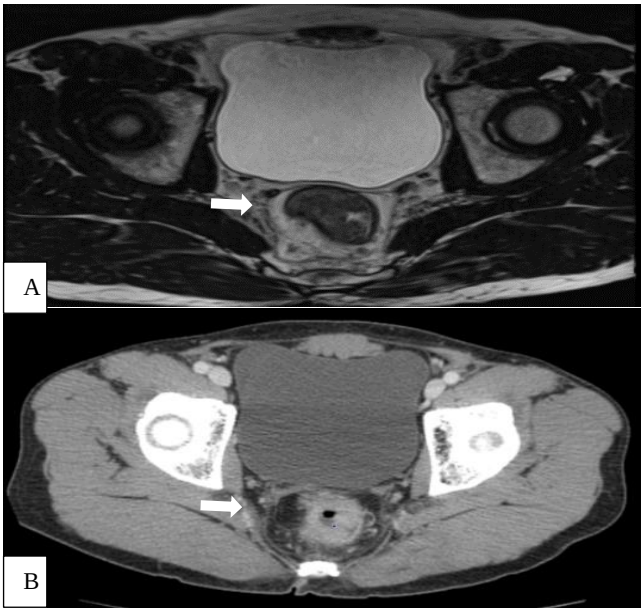

Figure 4 (A and B): Axial MRI and CECT images showing MRF thickening in anterior aspect.

DISCUSSION

The incidence of rectal cancers has been increasing following industrialisation and economic development. Adenocarcinoma comprises vast majority of rectal cancers. There are multiple risk factors are related to rectal cancer including: Obesity (especially in men), low fibre and high fat and animal protein diet, family history of benign/malignant colorectal tumours, history of endometrial/breast cancer, pelvic irradiation and colonic adenoma, inflammatory bowel disease (IBD) (Chronic colitis and Crohn disease).[6] The prognosis of colorectal cancer is determined by CRM that provides information on the margin resection status for TME and influences local recurrence and therapy plan. EMV, a feature that influences prognosis, extra-mesorectal nodes that can impact therapy planning.[7]

Contrast-enhanced CT is the current main modality used for preoperative local staging in colon cancer. However, due to limited soft-tissue contrast, its performance for staging primary tumor (T stage) or detecting extramural extension is generally dissatisfactory.[8] MRI plays an essential role in staging and predicting the prognosis of patients with rectal cancer because its excellent soft tissue contrast augments its ability to stage tumors and accurately predict clear CRM before radical surgery.[9]

Preoperative (neoadjuvant) chemotherapy is effective in a number of advanced gastrointestinal cancers, including rectal cancer, and has shown promising results in the first trials on locally advanced colon cancer. Preoperative imaging is essential in identifying patients with locally advanced colon cancer at high risk of relapse and therefore candidates for neoadjuvant therapy.[10]

Specific imaging features of tumour aggressiveness proven to predict outcomes such as magnetic resonance (MR)-CRM and MR presence of EMVI should also be taken into consideration when treatment decisions are made in order to reduce risks of both local and distant failure in rectal cancer patients.[11]

CT has a good sensitivity for the detection of colon cancers with tumor invasion beyond the bowel wall. However, detecting nodal involvement using CT is unreliable.[12] High-resolution MRI enables differentiation of partial versus full submucosal invasion with 89% accuracy when tested prospectively in patients with ERC (Early rectal carcinoma).[13] MRI has advantage over CT to assess local recurrence and tumor response to chemoradiotherapy.

EMVI, which is intravenous tumor extension beyond the rectal wall on histopathology, is a predictor for worse prognosis. T2-weighted images (T2WI) demonstrate EMVI as a nodular-, bead-, or worm-shaped structure of intermediate T2 signal with irregular margins that arises from the primary tumor. Compared with MRI, the role of CT in assessing EMVI is limited because of its lower contrast resolution. However, CT can be an alternative to assess EMVI in patients who have a contraindication to MRI or who are unable to undergo MRI due to claustrophobia. On CT, EMVI is often seen as a heterogeneously enhancing, serpentine cord-like structure connecting veins with the irregular, contiguous margins of the primary tumor.[14]

MRI at 3 T can accurately delineates the MRF involvement, which is one of the main decision points in planning treatment. The MRF is an important barrier to the radial spread of tumors, which also forms the plane of dissection in total mesorectal excision. High-resolution MRI has the ability to detect involvement of the surgical CRM. CRM involvement has been defined as tumor within 1 mm of the MRF. Total mesorectal excision is currently the reference standard for surgical treatment of rectal cancer, and it involves resection of the rectum and mesorectum with an intact MRF.[15]

MRI is clearly the best available radiologic modality for the local staging of patients with rectal cancer, and has the potential to play an important role in accurately distinguishing which patients should receive preoperative chemoradiation prior to total mesorectal excision. Alternatively, while MDCT is quite limited in local staging, both should be considered primary modalities when performing preoperative distant staging.[4]

Limitations

The study was conducted in a single hospital with a small sample size, also, patients included in this study belonged mostly to the same region. So, the results may not represent the whole community.

CONCLUSION

MRI and MDCT both are complementary imaging modalities in preoperative staging of rectal cancer. MRI is the best available imaging modality for the local staging of patients with rectal cancer, and has the potential to play an important role in accurately differentiating which patients should receive preoperative chemoradiation prior to total mesorectal excision. CT can be considered as a reliable imaging modality for assessing local staging of rectal cancer and for patients with MRI contraindications.

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