International Surgery Journal
Tanjum T et al. Int Surg J. 2024 Oct;11(10):1615-1621
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: https://dx.doi.org/10.18203/2349-2902.isj20242760

Original Research Article

Observation of magnetic resonance imaging of pelvis and post operative findings in cases of rectal carcinoma

Tasmia Tanjum[1]*, M. Sarower Islam[2], Papri Saha[3], Ahmed Imran[4], Ratan Chandra Bhowmik[5], S. M. Ferdous Jahan Begum Sharmin[6], Mohammad Sabidur Rahman[7], M. Altaf Hossain[2]

[1]Department of Radiology and Imaging, Sir Salimullah Medical College Mitford Hospital, Dhaka, Bangladesh
[2]Department of Medical Gastroenterology, Sheikh Russel National Gastroliver Institute and Hospital, Dhaka, Bangladesh
[3]Department of Radiology and Imaging, Sylhet MAG Osmani Medical College Hospital, Sylhet, Bangladesh
[4]Department of Radiology and Imaging, Dhaka Medical College Hospital, Dhaka, Bangladesh
[5]Department of Gastroenterology, Sylhet MAG Osmani Medical College Hospital, Sylhet, Bangladesh.
[6]Department of Obstetrics and Gynaecology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh
[7]Department of Medicine, Bangabandhu Sheikh Mujib Medical College, Faridpur, Bangladesh

Received: 24 July 2024
Revised: 01 September 2024
Accepted: 02 September 2024

***Correspondence:**
Dr. Tasmia Tanjum,
E-mail: tanjumtasmia17@gmail.com

ABSTRACT

Background: Colorectal carcinoma, the most common malignancy within the gastrointestinal tract, ranks second in cancer-related fatalities across Western Europe and the United States, with approximately one quarter of cases located in the rectum. The purpose of this study was to evaluate magnetic resonance imaging (MRI) findings and analyze postoperative outcomes in the pelvic region of patients diagnosed with rectal carcinoma. The aim of this study was to observe MRI findings and postoperative outcomes in the pelvic region of patients diagnosed with rectal carcinoma.
Methods: This cross-sectional study at Dhaka medical college hospital spanned 24 months from July 2021 to June 2023, involving 90 patients with provisional rectal carcinoma diagnoses. Patients underwent MRI using the Hitachi Echelon 1.5 T MR system™ for assessment of lesion site, tumor characteristics, lymph node involvement, and local organ status. Histopathological evaluation followed the WHO grading system and AJCC TNM classification, 8th edition. Statistical analysis was conducted using SPSS version 23.0 with significance set at $p<0.05$.
Results: In 90 patients with rectal carcinoma, common comorbidities included diabetes (30%) and hypertension (23.3%). MRI showed mid-rectal tumors (47.8%), mainly hypointense on T1WI (81.1%) and hyperintense on T2WI (96.7%). Tumor staging identified T2 in 36.7% and lymph node involvement (N0) in 50.0%. About 38.9% patients were found in T2 staging and 53.3% patients in N0 group identified by histopathology.
Conclusions: MRI findings in rectal carcinoma correlate well with histopathology, underscoring MRI's clinical utility and suggesting potential for enhancing diagnostic accuracy in future research.

Keywords: MRI, Rectal carcinoma, Pelvic imaging, Histopathological evaluation, AJCC TNM classification

INTRODUCTION

Colorectal carcinoma stands as the most common malignancy within the gastrointestinal tract and ranks second in terms of cancer-related fatalities across Western Europe and the United States.[1] Approximately one quarter of colorectal cancers are located in the rectum.[2] The prevalence of rectal cancer increases

significantly in the elderly population, with an incidence more than ten times higher in individuals over 65 years. Tumor staging and surgical resection are the most critical prognostic factors for disease-free and overall survival in rectal carcinoma. Therefore, preoperative imaging modalities for accurate staging according to the international TNM system are essential for effective management.[1]

The rectum marks the endpoint of the large intestine, beginning where the sigmoid colon meets and extending to the anal sphincter complex where the levator ani muscle attaches to its muscular layer.[3] According to guidelines from the European society for medical oncology (ESMO), rigid rectoscopy defines cancer location as <5 cm from anal verge as low, 5-10 cm as mid, and 10-15 cm as high rectal cancer.[4] MRI, especially T2-weighted sequences, provides optimal visualization of the rectal wall anatomy, distinguishing its three layers in clinical settings.[5]

Rectal carcinoma is typically diagnosed by sigmoidoscopy or colonoscopy with biopsy. The role of imaging is crucial in confirming the extent of disease and providing an accurate preoperative roadmap of the tumor and its relationship to important anatomical structures. Current surgical treatment of choice for rectal carcinoma is total mesorectal excision (TME) and sphincter-sparing surgery. For this type of surgery and also for neoadjuvant therapy, accurate T staging is required.

The development of MRI for medical inquiry has resulted in a significant advance in diagnosis, particularly in terms of avoiding possible fatal ionizing radiation exposure. Three-dimensional T2-weighted MRI is not routinely recommended but may be useful for assessing response to neoadjuvant therapy. T1-weighted imaging with a wider field of view may help in assessment of the common iliac and lower para-aortic nodes or incidental findings in the pelvis (with the same concept of FSE T2-weighted MRI with a large field of view) and especially the bones. MRI also helps the radiologist to identify the prognostic subgroups that may need neoadjuvant therapies according to the risk of local recurrence and treatment failure.[2]

Blomqvist et al found MRI predicts tumor-free lateral resection margins exceeding 1 mm in rectal cancer specimens.[6] Brown et al used thin-section MRI to accurately stage tumors, especially T3 tumors, crucial for treatment planning.[7] Prognosis in rectal carcinoma depends on tumor infiltration into the mesorectum and achieving negative circumferential resection margins (CRMs).[8] MRI accurately predicts CRM involvement, guiding neoadjuvant therapy planning and assessing resection margins and sphincter invasion.[9]

Precise preoperative staging refines surgical techniques and optimizes neoadjuvant chemoradiotherapy in rectal carcinoma.

MRI has shown high spatial resolution coronal imaging to accurately depict structures like levator muscles, sphincter complex, and the intersphincteric plane, crucial for staging and surgical planning in low rectal tumors.[10] The purpose of this study was to evaluate MRI findings and analyze postoperative outcomes in the pelvic region of patients diagnosed with rectal carcinoma.

Aim

The aim of this study was to observe MRI findings and postoperative outcomes in the pelvic region of patients diagnosed with rectal carcinoma.

METHODS

This cross-sectional study was conducted at the department of radiology and imaging, Dhaka medical college hospital (DMCH) over a 24-month period from July 2021 to June 2023. The study population comprised 90 patients provisionally diagnosed with rectal carcinoma who attended the department of radiology and imaging at DMCH, followed by histopathological evaluation.

Inclusion criteria

Patients clinically suspected of rectal carcinoma and referred for MRI of the pelvis. Patients provisionally diagnosed with rectal carcinoma during reporting at the radiology and imaging department were included.

Exclusion criteria

Patients who refused to be enrolled in the study. patients with cardiac pacemakers, implantable cardioverter defibrillators, or intracranial aneurysm clips containing ferromagnetic materials, patients with a history of allergy to intravenous contrast media and claustrophobic patients were excluded.

Institutional approval was obtained from the IRB of DMCH, and ethical issues were addressed according to the Helsinki Declaration. Informed written consent was obtained from all participants. Baseline demographic information and medical history were recorded through face-to-face interviews. All patients underwent MRI of the pelvis using a Hitachi Echelon 1.5 T MR System™. MRI variables assessed included the site of the lesion, tumor characteristics, lymph node involvement, and local organ involvement. Histopathological examination was conducted on surgical specimens, with histological grading and pathological staging based on the WHO grading system and AJCC TNM classification, 8th edition. Statistical analyses were carried out using SPSS version 23.0. A $p<0.05$ was considered statistically significant. All information was kept confidential, and only the investigators, regulatory authorities, and the IRB had access. Regular meetings ensured accuracy and consistency in data collection and analysis.

RESULTS

Table 1 shows that the mean age was 49.1±2.5 years, with a range from 19 to 68 years. Almost one third (31.1%) of the patients belonged to the age group of 51-60 years. The sex distribution of the study population indicates that about 55.6% of the patients were male and 44.4% were female, with a male-to-female ratio of 1.25:1. Regarding co-morbidities, 30% of the patients had diabetes mellitus (DM), 23.3% had hypertension (HTN), 10% had anal fissure, 13.3% had hemorrhoids, and 2.2% had chronic kidney disease (CKD). Clinically, 83.3% of the patients presented with per rectal bleeding, 72.2% with alteration of bowel habits, 70% with abdominal pain, 63.3% with weight loss, 53.3% with tenesmus, and 50% with mucous discharge.

Table 2 show that 47.8% of patients had mid rectal tumors, 35.5% had lower rectal tumors, and 16.7% had upper rectal tumors. About 53.3% of patients had circumferential lesions, while 30% had asymmetrical lesions, and 16.7% had irregular lobulated lesions. MRI imaging characteristics indicated that 81.1% of the tumors were hypointense on T1WI, 96.7% were hyperintense on T2WI, and approximately 78.9% showed heteogeneous enhancement.

Table 3 shows that 36.7% of patients were at T2 staging, and in cases of lymph node involvement, about 50% had N0.

Table 4 shows that 38.9% patients were found in T2 staging identified by histopathology.

Table 5 shows that 53.3% patients were found in N0 group, followed by 26.7% in N1b group by histopathology.

Table 6 shows the MRI diagnosis evaluation across various tumor stages compared to histopathological findings. For T2 staging, MRI identified 31 true positive cases, 2 false positive case, 3 false negative cases, and 54 true negative cases, with a significant p value. In T3a evaluation, MRI showed 15 true positive cases, 3 false positive cases, 3 false negative cases, and 69 true negative cases, also with a significant p-value. T3b assessment revealed 11 true positive cases, 2 false positive case, and 76 true negative cases, with a significant p value.

For T3 MRF positive, MRI detected 16 true positive cases and 70 true negative cases, with a significant p value. Finally, in T4a evaluation, MRI identified 8 true positive cases and 80 true negative cases, with a significant p value.

Table 7 shows MRI diagnosis evaluation for lymph node staging (N0, N1a, N1b and N2a) in comparison with histopathological diagnosis. For N0, there were 43 true positive cases, 5 false negative cases, and 40 true negative cases. P value is significant. For N1a, there were 9 true positive cases, 1 false positive case, 1 false negative case, and 79 true negative cases. P value is significant. For N1b, there were 23 true positive cases, 3 false positive cases, and 63 true negative cases. P value is significant. For N2a, there were 8 true positive cases and 80 true negative cases. P value is significant.

Table 1: Demographic and clinical characteristics of the study patients, (n=90).

Variables		N	Percentage (%)
Age (in years)	19-20	2	2.3
	21-30	7	7.7
	31-40	20	22.2
	41-50	18	20
	51-60	28	31.1
	61-68	15	16.7
	Mean±SD	49.1±2.5	
	Range (min-max)	19.0-68.0	
Sex	Male	50	55.6
	Female	40	44.4
Co-morbidities	DM	27	30
	HTN	21	23.3
	Anal fissure	9	10
	Hemorrhoids	12	13.3
	CKD	2	2.2
Clinical presentation	Per rectal bleeding	75	83.3
	Alteration of bowel habit	65	72.2
	Abdominal pain	63	70
	Weight loss	57	63.3
	Tenesmus	48	53.3
	Mucous discharge	45	50

Table 2: MRI findings of the study patients including location, features, and imaging characteristics (n=90).

Variables		N	Percentage (%)
MRI findings (Location of the tumor)	Lower rectal	32	35.5
	Mid rectal	43	47.8
	Upper rectal	15	16.7
Features of tumor	Circumferential	48	53.3
	Asymmetrical	27	30
	Irregular lobulated	15	16.7
T1WI	Isointense	17	18.9
	Hypointense	73	81.1
	Hyperintense	0	0
T2WI	Isointense	3	3.3
	Hypointense	0	0
	Hyperintense	87	96.7
DWI	Restricted	90	100
	Non restricted	0	0
Contrast enhancement pattern	Homogenous	19	21.1
	Heteogenous	71	78.9

Table 3: MRI findings of the study patients (staging) (n=90).

Variables		N	Percentage (%)
rT staging	T1	0	0
	T2	33	36.7
	T3a	18	20
	T3b	12	13.3
	T3 MRF positive	18	20
	T4a	9	10
rLN staging	N0	45	50
	N1a	10	11.1
	N1b	26	28.9
	N2a	9	10

Table 4: T staging by histopathology (n=90).

pT staging	N	Percentage (%)
T1	0	0.0
T2	35	38.9
T3a	18	20.0
T3b	10	11.1
T3 MRF positive	18	20.0
T4a	9	10.0

Table 5: LN staging by histopathology (n=90).

pLN staging	N	Percentage (%)
N0	48	53.3
N1a	10	11.1
N1b	24	26.7
N2a	8	8.9

Table 6: Comparison between histopathological and MRI diagnosis in evaluation for tumor stages (T2, T3a, T3b, T3 MRF positive, T4a) (n=90).

MRI diagnosis		Histopathological diagnosis		Fisher's exact test value	P value
		Positive	**Negative**		
		(n=34)	(n=56)		
T2	Positive (n=33)	31 (True positive)	2 (False positive)	69.91	0.001
	Negative (n=57)	3 (False negative)	54 (True negative)		

Continued.

MRI diagnosis		Histopathological diagnosis	Fisher's exact test value	P value	MRI diagnosis
		Positive	Negative		
T3a		(n=18)	(n=72)	56.41	0.001
	Positive (n=18)	15 (True positive)	3 (False positive)		
	Negative (n=72)	3 (False negative)	69 (True negative)		
T3b		(n=12)	(n=78)	66.81	0.001
	Positive (n=13)	11 (True positive)	2 (False positive)		
	Negative (n=77)	1 (False negative)	76 (True negative)		
T3 MRF positive		(n=18)	(n=72)	66.74	0.001
	Positive (n=18)	16 (True positive)	2 (False positive)		
	Negative (n=72)	2 (False negative)	70 (True negative)		
T4a		(n=9)	(n=81)	69.15	0.001
	Positive (n=9)	8 (True positive)	1 (False positive)		
	Negative (n=81)	1 (False negative)	80 (True negative)		

Table 7: Comparison between histopathological and MRI diagnosis in evaluation for lymph node staging (N0, N1a, N1b, N2a) (n=90).

MRI diagnosis		Histopathological diagnosis		Fisher's exact test value	P value
		Positive	Negative		
N0		(n=48)	(n=42)	64.46	0.001
	Positive (n=45)	43 (True positive)	2 (False positive)		
	Negative (n=45)	5 (False negative)	40 (True negative)		
N1a		(n=10)	(n=80)	70.89	0.001
	Positive (n=10)	9 (True positive)	1 (False positive)		
	Negative (n=80)	1 (False negative)	79 (True negative)		
N1b		(n=24)	(n=66)	71.39	0.001
	Positive (n=26)	23 (True positive)	3 (False positive)		
	Negative (n=64)	1 (False negative)	63 (True negative)		
N2a		(n=9)	(n=81)	69.15	0.001
	Positive (n=9)	8 (True positive)	1 (False positive)		
	Negative (n=81)	1 (False negative)	80 (True negative)		

DISCUSSION

This was a cross-sectional study conducted at the radiology and imaging department of DMCH from November 2021 to April 2023. Patients provisionally diagnosed with rectal carcinoma who came for MRI were screened for eligibility, and 90 patients were eventually enrolled in the study.

In this study, almost one-third (31.1%) of patients belonged to the age group 51-60 years. The mean age was 49.1±2.5 years, with a range from 19 to 68 years. Xu et al reported a mean age of 62.30±10.77 years, with a range of 29 to 89 years.[11]

In this study, 55.6% were male, and 44.4% were female. Yılmaz et al reported 32 male and 24 female patients.[12] Regarding sociodemographic findings, males were predominant, as observed in other countries.

In this study, 30% of patients had DM, followed by 23.3% with HTN, 10% with anal fissure, 13.3% with hemorrhoids, and 1 patient with CKD. Laohawiriyakamol et al reported 28 patients with hypertension and 16 with diabetes mellitus.[13] De Marco et al noted 9.5% with HTN, 10% with DM, and 11% with cardiovascular disease.

In this study, 83.3% had per rectal bleeding, followed by alteration of bowel habit (72.2%), abdominal pain (70%), weight loss (63.3%), tenesmus (53.3%), and mucous discharge (50%).

In this study, 47.8% of patients were found to have mid rectal tumors, followed by 35.5% with lower rectal tumors and 16.7% with upper rectal tumors. Chatterjee et al reported that most tumors were located in the upper (15) and middle third (16) of the rectum, with nine tumors in the lower third. In the current study, 53.3% of patients had circumferential lesions, while the rest had asymmetrical (30%) and irregular lobulated (16.7%) lesions.[14] In this study, 81.1% of tumors were hypointense and 18.9% were isointense on T1WI, with 96.7% being hyperintense and 3.3% isointense on T2WI. About 78.9% had heterogeneous enhancement.

In this study, radiologically, 36.7% of patients were staged as T2, 20% as T3a, 13.3% as T3b, 20% as T3

MRF positive, and 10% as T4a. Regarding lymph node involvement, 50% were N0, 11.1% were N1a, 28.9% were N1b, and 10% were N2a. Yılmaz et al reported that MRI showed tumor stages as T0 (1.8%), T1 (3.6%), T2 (37.5%), T3 (44.6%), and T4 (12.5%). About 62.5% were N negative, and 37.5% were N positive.

In this study, MRI evaluation of T-staging showed significant findings across various stages: T2 and rT2 staged rectal carcinoma were identified in 31 cases (true positive), with 3 cases misclassified as other stages on MRI (false negative) compared to histopathology. Two false positive case was noted, alongside 54 true negative cases. Similarly, for T3a, rT3a staged rectal carcinoma was detected in 15 cases (true positive), with 3 false negative cases. Three false positive cases were identified, and 69 cases were true negative. T3b assessment revealed 11 true positive cases and 2 false positive case, with 76 true negative cases. For T3MRF positive, 16 cases were true positive and 70 were true negative. Finally, rT4a staged rectal carcinoma was found in 8 cases (true positive), alongside 80 true negative cases. All findings reported significant p-values.

In this study, MRI evaluation for lymph node involvement showed significant results across different stages: rN0 assessment revealed 43 cases with no lymph node involvement in both MRI (rN0) and histopathology (pN0) (true positive). Five patients with pN0 were misclassified in other groups by MRI (false negative), and 2 false positives were identified. Forty cases were correctly identified as not having rN0 or pN0 (true negative). For rN1a, 9 patients showed lymph node involvement in both MRI (rN1a) and histopathology (pN1a) (true positive). One false negative case was noted, along with one false positive case. Seventy-nine cases were correctly identified as not having rN1a or pN1a (true negative). rN1b evaluation found 23 true positive cases with one false negative, but 3 false positive cases were identified. Sixty-three cases were correctly identified as not having rN1b or pN1b (true negative). rN2a assessment revealed 8 true positive cases with one false positive and one false negative, alongside 80 true negative cases. All findings reported significant p values.

This study aimed to observe MRI findings and postoperative outcomes in patients with rectal carcinoma. The results demonstrated significant correlations between MRI staging and histopathological outcomes, emphasizing the detailed imaging characteristics of rectal carcinoma, including tumor location, intensity on different MRI sequences, and lymph node involvement. These findings underscore importance of MRI in preop evaluation and accurate staging of rectal carcinoma, which crucial for guiding effective treatment strategies.

Limitations

The study has several limitations: This study was conducted at a single center, which may limit the generalizability of the findings to broader populations. The study spanned a relatively short duration, which may have constrained the depth and breadth of data collection. The study's diagnostic accuracy may have been limited because higher field strengths, like 3.0 T MRI systems, are known to provide better imaging capabilities.

CONCLUSION

In this study, MRI findings of rectal carcinoma demonstrated high comparability with histopathological diagnosis, affirming MRI's role as a sensitive and specific diagnostic modality for assessing the diagnosis and locoregional extension of rectal carcinoma. While histopathology remains the gold standard, our findings underscore the clinical utility of MRI in this context. Future research should focus on validating these results in larger, prospective studies, particularly exploring specific MRI techniques to enhance diagnostic accuracy.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Winter L, Bruhn H, Langrehr J, Neuhaus P, Felix R, Hänninen LE. Magnetic resonance imaging in suspected rectal cancer: determining tumor localization, stage, and sphincter-saving resectability at 3-Tesla-sustained high resolution. Acta Radiol. 2007;48(4):379-87.
2. Liang TY, Anil G, Ang BWL. Imaging paradigms in assessment of rectal carcinoma: loco-regional and distant staging. Cancer Imaging. 2012;12(1):290-303.
3. Salerno G, Sinnatamby C, Branagan G, Daniels IR, Heald RJ, Moran BJ. Defining the rectum: surgically, radiologically and anatomically. Colorectal Dis. 2006;8(3):5-9.
4. Attenberger UI, Winter J, Harder FN, Burkholder I, Dinter D, Kaltschmidt S, et al. Height of Rectal Cancer: A Comparison between Rectoscopic and Different MRI Measurements. Gastroenterol Res Pract. 2020;202:1-7.
5. Engin G, Sharifov R. Magnetic resonance imaging for diagnosis and neoadjuvant treatment evaluation in locally advanced rectal cancer: A pictorial review. World J Clin Oncol. 2017;8(3):214-29.
6. Blomqvist L, Rubio C, Holm T, Machado M, Hindmarsh T. Rectal adenocarcinoma: assessment of tumour involvement of the lateral resection margin by MRI of resected specimen. Br J Radiol. 1999;72(853):18-23.
7. Brown G, Richards CJ, Bourne MW, Newcombe RG, Radcliffe AG, Dallimore NS, et al. Rectal carcinoma: thin-section MR imaging for staging in 28 patients. Radiology. 1999;21:215-222.

8. Horvat N, Carlos Tavares Rocha C, Clemente Oliveira B, Petkovska I, Gollub MJ. MRI of rectal cancer: Tumor staging, imaging techniques, and management. Radiographics. 2019;39(2):367-87.
9. Mulla M, Deb R, Singh R. MRI in T staging of rectal cancer: How effective is it? Indian J Radiol Imaging. 2010;20(2):118-21.
10. Saklani AP, Bae SU, Clayton A, Kim NK. Magnetic resonance imaging in rectal cancer: a surgeon's perspective. World J Gastroenterol. 2014;20(8):2030-41.
11. Xu L, Zhang C, Zhang Z, Qin Q, Sun X. Value of 3 Tesla MRI in the preoperative staging of mid-low rectal cancer and its impact on clinical strategies. Asia-Pacific J Clin Oncol. 2020;16:216–22.
12. Yılmaz EM, Cartı EB, Gök M, Özgün H. Comparison of T and N staging on preoperative magnetic resonance imaging and postoperative histopathologic specimens in rectum cancer. Turk J Colorectal Dis. 2017;27(1):11-5.
13. Laohawiriyakamol S, Worathanmanon S, Tubtawee T, Kanjanapradit K, Sangkhathat S, Pruphetkaew N, et al. Accuracy of high-resolution rectal magnetic resonance imaging restaging with histopathology in locally advanced rectal cancer after neoadjuvant chemoradiotherapy. Asian J Surg. 2021;44:275-9.
14. Chatterjee P, Eapen A, Perakath B, Singh A. Radiologic and pathological correlation of staging of rectal cancer with 3 Tesla magnetic resonance imaging. Can Assoc Radiol J. 2011;62(3):215-22.

Cite this article as: Tanjum T, Islam MS, Saha P, Imran A, Bhowmik RC, Sharmin SMFJB, et al. Observation of magnetic resonance imaging of pelvis and post operative findings in cases of rectal carcinoma. Int Surg J 2024;11:1615-21.