

Diagnostic accuracy of MRI in mesorectal fascial involvement

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ABSTRACT

Introduction: Evaluation of mesorectal fascial involvement in rectal cancer is of prime importance in decision making regarding treatment options.

Objective: To determine diagnostic accuracy of Magnetic Resonance Imaging (MRI) in detection of mesorectal fascia involvement in rectal carcinoma patients using histopathology as gold standard.

Materials & Methods: A comparative study was performed in the Radiology department of Kuwait Teaching Hospital, Peshawar, from January 1, 2021, till December 31, 2021, on 155 patients of rectal carcinoma who had their MRI done for rectal cancer on 0.3T MR Machine. Surgical findings like mesorectal fascial involvement by the tumor, presence/absence of pelvic lymph nodes within 5mm of mesorectal fascia, and staging of the tumor were included as variables. Specimens were sent in formalin to a histopathologist, and findings were considered for comparison. Data were analyzed using SPSS version 23.

Results: Out of 155 patients, 82 patients showed mesorectal fascial involvement whereas 73 patients were Circumferential Resection Margin (CRM) negative. Out of these 73 patients were falsely labeled as CRM positive on MRI, whereas 9 patients were falsely labeled as CRM negative on MRI. Positive predictive value was 91%, with negative predictive value of 88%. Diagnostic accuracy was 89.6%. Sensitivity was 89% whereas specificity was 90.4%.

Conclusion: MRI has high sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy for detection of mesorectal fascial involvement in case of rectal carcinoma taking 5mm as cut off value.

Keywords: Rectal neoplasms; Fascia; Predictive value of tests; Magnetic Resonance Imaging.

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INTRODUCTION

Nowadays colorectal cancer is the third most common cancer in men and second in women worldwide and accounts for about 9% of new cancer causes and 9% of cancer related deaths. Approximately 1 out of 3 of these tumors is rectal cancers. Rectal cancer is the major cause of mortality in USA. Risk factors for rectal cancer include Familial Polyposis Syndrome, Diabetes Mellitus, Obesity, Alcohol and Smoking.¹

The most accurate imaging technique to evaluate Positive Circumferential Resection Margin (pCRM) status before Total Mesorectal Excision (TME) is high resolution Magnetic Resonance Imaging (MRI); however, after long course Chemoradiotherapy (CRT) the accuracy of MRI decreases in determining pCRM involvement. Previously some studies showed moderate accuracy of 64-92% in predicting Mesorectal Fascia (MRF) invasion and 33-45% in predicting CRM involvement with post CRT MRI.²

Clinicians need rectal MRI in case of positive colonoscopy for cancer. Other imaging modalities like endorectal ultrasound and Computed Tomography (CT) have limitations. MRI assesses tumor site and allow accurate rectal cancer staging non-invasively which is important for appropriate treatment strategy. MRI accurately identifies mesorectal fascia infiltration.³

Tumor invasion into mesorectum and the ability to surgically achieve negative CRMs directly affects the prognosis of rectal cancer. The most appropriate treatment for rectal cancer is the TME and use of neoadjuvant CRT for patients with locally advanced rectal cancer.⁴ Rectal Carcinoma accounts for about 65% cases of colorectal cancers, and 98% of these cancers are adenocarcinomas upon histopathology. In recent years a decline has been noted in the incidence of colorectal cancer owing to early diagnosis and better treatment options.^{5,6}

Hence, evaluation of mesorectal fascial involvement in rectal cancer is of prime importance in decision making regarding treatment options. MRI is the only available reliable tool regarding assessment of mesorectal fascial involvement preoperatively.

In this study the diagnostic accuracy of MRI has been evaluated for confirming or negating mesorectal fascia involvement taking its surgical findings and histopathology as gold standard.

MATERIALS & METHODS

This comparative study was performed in the Department of Radiology, Kuwait Teaching Hospital (KTH), Peshawar, for 12 months (1 January 2021 till 31st December 2021). All patients presenting to radiology department for rectal MRI for rectal cancer staging were included in the study. Patients of either sex including all age groups were included. Patients not undergoing surgery were excluded, as were patients who underwent preoperative chemoradiation. Approval of ethical committee of KTH was obtained. Patients were informed about the purpose of the study, its importance, and written informed consent was taken. All MRI scans were performed on 0.3 Tesla MR system with pelvic coil (Toshiba Japan). Routine MR images taken included 2D T₂ FSE images with TR of 2800ms, TE of 101 ms, ET of 17 ms (echo train length), FOV 24 cms, matrix size 572x256, slice thickness 4mm with a gap of 1mm. DWI images were taken with a b value of 1000. FLAIR images were also taken. The images were taken in all three orthogonal planes, i.e., axial, sagittal and coronal. Small FOV high resolution images were taken where necessary. Regarding post-contrast images, 0.12 ml/kg body weight was given and T₁ was taken 17 minutes after contrast administration.

For MR image evaluation, the observer was blinded to histopathological findings. MR images were studied for invasion of mesorectal fascial involvement. Following criteria were followed when labeling a case as CRM positive:

- 1) Signal intensity changes within the fascia
- 2) Obvious extension of tumor through mesorectal fascia
- 3) Tumor within 5mm of fascia
- 4) Metastatic lymph nodes within 5 mm of mesorectal fascia
- 5) Invaded vessel extending through the fascia.

Stage of tumor was also considered. All the above-mentioned findings were compared to surgical findings and histopathological evaluation of the removed specimen.

For histopathological evaluation, the TME specimen after receipt was sent for histopathological evaluation. It was sectioned

transversely at 3-5 mm intervals. The specimen was evaluated for:

- (1) Intactness of the mesorectal fascia
- (2) Extent of tumor and the closest distance of tumor from mesorectal fascia
- (3) Areas with suspicion of extra-mural vascular invasion
- (4) Positive lymph nodes and their distance from mesorectal fascia with clock wise indication of its position.

The data collected were entered in SPSS version 23 and analyzed for descriptive and comparative statistics. Study variables were age; sex, MR findings, surgical findings and lymph node involvement were entered. Means and standard deviations were determined for age of the patients, size of tumor, and its distance from mesorectal fascia. Frequencies and percentages were calculated for different age groups and gender. Diagnostic accuracy was determined in terms sensitivity, specificity, positive predictive value, and negative predictive value for CRM involvement as compared to its histopathological outcomes by a 2x2 table. Gender wise and age wise stratification of rectal cancer staging was also done.

RESULTS

Of 155 patients included in the study, 82 (52.9%) had involvement of the mesorectal fascia, whereas 73 (47.1%) patients were CRM negative. Out of these, 7 (4.5%) patients were falsely labeled as CRM positive on MRI, whereas 9 (5.8%) patients were falsely labeled as CRM negative on MRI.

Sensitivity was 89% whereas specificity was 90.4%. Positive Predictive Value (PPV) was 91%, with Negative Predictive Value (NPV) of 88%. Diagnostic accuracy was 89.6%. Tumor size ranged from 3 mm to 64 mm with Mean and Standard Deviation (SD) of 20.9±16 mm.

Minimum distance of the tumor from circumferential resection margin was 1mm and maximum distance was 14 mm with Mean and SD of 6.13 ± 4.3 mm. Patients' ages ranged from 41-89 years with a Mean and SD of 65.32 +/- 13.15 years.

Overall, the ratio of CRM positive patients increased with increasing age. Calculations were made for different age groups. Overall diagnostic accuracy ranged from 84-94% in different age groups.

Table 1: CRM involvement MRI *CRM Involvement Histopathology* age Cross tabulation

Age Groups (years)	CRM Involvement MRI		CRM Involvement Histopathology		Total
			CRM positive	CRM negative	
41-50	CRM inv MRI	CRM positive	3	1	4
		CRM negative	1	20	21
	Total		4	21	25
51-60	CRM inv MRI	CRM positive	12	0	12
		CRM negative	2	24	26
	Total		14	24	38
61-70	CRM inv MRI	CRM positive	17	3	20
		CRM negative	2	11	13
	Total		19	14	33
71-80	CRM inv MRI	CRM positive	29	3	32
		CRM negative	1	7	8
	Total		30	10	40
81-90	CRM inv MRI	CRM positive	12	0	12
		CRM negative	3	4	7

	Total		15	4	19
Total	CRM inv MRI	CRM positive	73	7	80
		CRM negative	9	66	75
	Total		82	73	155

T staging in different age strata was taken in account which showed increasing incidence of T₄ with increasing age; the 41-50 age group had only one patient in T₄ group with 11 patients in T₃ stage and rest in T_{1&2}; the 51-60 age group had 6 patients in T₄, 13 patients in T₃, 15 in T₂, and 4 patients in stage T₁. The 61-70 years age group showed 14 patients in stage T₄, 14 patients in T₃, 5 patients in T₂ and no patient in T₁ stage. 71-80 years age group shows 16 patients in T₄, 20 in stage T₃, 4 patients in T₂, and no patient in stage T₁. The 81-90 years age group shows 9 patients in T₄ stage, 8 patients in stage T₃, 2 patients in T₂, and no patients in T₁.



Figure 1A: Axial T2 FAT SAT shows a case of rectal adenocarcinoma with diffuse circumferential thickening of rectum with involvement of CRM.



Figure 1B: Sagittal T2 WI shows a case of adenocarcinoma rectum with craniocaudal length of 5 cm at a distance of 4.8 cm from anal verge.



Figure 3C: Axial (Post Contrast) view shows a case of adenocarcinoma rectum with avidly enhancing rectal tumor.

DISCUSSION

Assessment of mesorectal fascial involvement by rectal carcinoma preoperatively is very important regarding management options. It is the most crucial finding taken in consideration when deciding for preoperative chemo radiotherapy.⁷⁻⁹ Preoperative CRT downsizes and downstages the tumor with the result that total mesorectal excision would be possible. MRI has proved to be the best modality for CRM involvement detection.¹⁰ Our study aimed at determining the diagnostic accuracy of MRI for detection of CRM involvement preoperatively taking histopathology as gold standard.

On the whole the diagnostic accuracy of MRI for CRM involvement in our study was 89.6%, sensitivity was 89%, specificity was 90.4%, PPV was 91% and NPV was 88%. A similar study¹¹ found out the specificity for prediction of a clear margin by magnetic resonance imaging to be 92%. Surgical specimens were histopathologically graded as complete or moderate in 80% subjects. Magnetic resonance imaging predicted clear margins in 349 out of 408 patients. At surgery 327 had clear margins.¹¹

It is of utmost importance that the high-resolution magnetic resonance imaging accurately predicts whether the surgical resection margins will be clear or affected by tumor. This technique can be reproduced accurately in multiple centers to predict curative resection and may warn or predict the surgical/oncology team of potential outcome/failure if the surgery goes ahead, thus enabling selection of patients for preoperative treatment.¹²⁻¹⁴

Overall diagnostic accuracy of our study ranged from 84-94% in different age groups. This is comparable to the data published earlier. In recently published studies,^{15,16} it was found that MRI had good accuracy for CRM and should be considered for preoperative rectal cancer staging. The studies also found out that in contrast, lymph node assessment was poor on MRI. A local

study had results similar to our study, but their sample size was much smaller as compared to ours.¹⁷

CONCLUSION

MRI has high sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy for detection

of mesorectal fascial involvement in case of rectal carcinoma taking 5mm as cut off value. MRI can safely be used in preoperative assessment and staging of rectal carcinoma as well as decision making regarding patient management options.

REFERENCES

1. Wang X, Gao Y, Li J, Wu J, Wang B, Ma X, et al. Diagnostic accuracy of endoscopic ultrasound, computed tomography, magnetic resonance imaging, and endorectal ultrasonography for detecting lymph node involvement in patients with rectal cancer. *Medicine (Baltimore)*. 2018 Oct 26;97(43):e12899.
2. Kim KH, Park MJ, Lim JS, Kim NK, Min BS, Ahn JB, et al. Circumferential resection margin positivity after preoperative chemoradiotherapy based on magnetic resonance imaging for locally advanced rectal cancer: implication of boost radiotherapy to the involved mesorectal fascia. *Jpn J Clin Oncol*. 2016 Apr;46(4):316-22.
3. Delli Pizzi A, Basilico R, Cianci R, Seccia B, Timpani M, Tavoletta A, et al. Rectal cancer MRI: protocols, signs and future perspectives radiologists should consider in everyday clinical practice. *Insights Imaging*. 2018 Apr 19;9(4):405-12.
4. Jhaveri KS, Hosseini-Nik H. MRI of rectal cancer: an overview and update on recent advances. *AJR Am J Roentgenol*. 2015 Jul;205(1):W42-55.
5. Hassan TA, Abdel-Rehman HM, Ali HY. Utility of high resolution MRI for pre-operative staging of rectal carcinoma, involvement of the mesorectal fascia and circumferential resection margin. *Egypt J Radiol Nucl Med*. 2016 Dec;47(4):1243-50.
6. Vogelaar I, van Balleegooijen M, Schrag D, Boer R, Winawer SJ, Habbema JDF, et al. How much can current interventions reduce colorectal cancer mortality in the U.S.? Mortality projections for scenarios of risk-factor modification, screening, and treatment. *Cancer*. 2006 Oct 1;107(7):1624-33.
7. Nougaret S, Reinhold C, Mikhael HW, Rouanet P, Bibeau F, Brown G. The use of MR imaging in treatment planning for patients with rectal carcinoma: have you checked the "DISTANCE"? *Radiology*. 2013 Aug;268(2):330-44.
8. Pedersen BG, Moran B, Brown G, Blomqvist L, Fenger-Grøn M, Laurberg S. Reproducibility of depth of extramural tumor spread and distance to circumferential resection margin at rectal MRI: enhancement of clinical guidelines for neoadjuvant therapy. *AJR Am J Roentgenol*. 2011 Dec;197(6):1360-6.
9. MERCURY Study Group. Extramural depth of tumor invasion at thin-section MR in patients with rectal cancer: results of the MERCURY study. *Radiology*. 2007 Apr;243(1):132-9.
10. Ngan SY, Burmeister B, Fisher RJ, Solomon M, Goldstein D, Joseph D, et al. Randomized trial of short-course radiotherapy versus long-course chemoradiation comparing rates of local recurrence in patients with T3 rectal cancer: Trans-Tasman Radiation Oncology Group trial 01.04. *J Clin Oncol*. 2012 Nov 1;30(31):3827-33.
11. MERCURY Study Group. Diagnostic accuracy of preoperative magnetic resonance imaging in predicting curative resection of rectal cancer: prospective observational study. *BMJ*. 2006 Oct 14;333(7572):779.
12. Brown G, Radcliffe AG, Newcombe RG, Dallimore NS, Bourne MW, Williams GT. Preoperative assessment of prognostic factors in rectal cancer using high-resolution magnetic resonance imaging. *Br J Surg*. 2003;90:355-64.
13. Brown G, Richards CJ, Newcombe RG, Dallimore NS, Radcliffe AG, Carey DP, et al. Rectal carcinoma: thin-section MR imaging for staging in 28 patients. *Radiology*. 1999;211:215-22.
14. 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;72:18-23.
15. Al-Sukhni E, Milot L, Fruitman M, Beyene J, Victor JC, Schmocker S, et al. Diagnostic accuracy of MRI for assessment of T category, lymph node metastases, and circumferential resection margin involvement in patients with rectal cancer: a systematic review and meta-analysis. *Ann Surg Oncol*. 2012 Jul;19(7):2212-23.
16. Siegel R, Desantis C, Jemal A. Colorectal cancer statistics, 2014. *CA Cancer J Clin*. 2014 Apr;64(2):104-17.
17. Khan MR, Nawab K, Anjum H, Gul H. Diagnostic accuracy of magnetic resonance imaging in preoperative evaluation of depth of tumor invasion (T staging) and mesorectal fascia involvement in carcinoma rectum. *J Postgrad Med Inst*. 2019;33(2):160-4.