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To determine the diagnostic accuracy of magnetic resonance imaging in detecting rectal cancer, keeping histopathology as a gold standard.

Nasreen Naz[1], Uzma Azmatullah[2], Afaque Ali[3], Majid[4] & Adeel Ahmed[4]

[1]Department of Radiology Dow University Hospital, Karachi-Pakistan.
[2]Department of Radiology and Imaging, Memon Medical Institute, Karachi-Pakistan.
[3]Department of Radiology, Shaukat Khanum Memorial Cancer Hospital and Research Center, Lahore-Pakistan.
[4]Tabba Heart Institute, Karachi-Pakistan.

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Corresponding Author Email: azmat.radiologist@gmail.com
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Abstract

Background: Magnetic Resonance Imaging (MRI) has a premier role in detecting rectal cancer and is considered superior for diagnosing tumour recurrences. It is the modality of choice by which patients with total abdominal perineal (AP) resection can be fully evaluated. This study aimed to evaluate the diagnostic accuracy of MRI in the detection of rectal carcinoma in suspected cases, keeping histopathology as a gold standard.

Methodology: A descriptive cross-sectional study was conducted in the radiology department of Dow University of Health Sciences, Civil Hospital, Karachi, from 19th May to 18th November 2018. A total of 181 patients with a history of bleeding per rectum, altered bowel habits and abdominal pain were included. High-resolution 2D T2-weighted fast spin-echo sequences in the sagittal, axial and coronal planes were taken. Patients were followed for histopathology reports. The diagnostic accuracy of MRI for rectal carcinoma was calculated in terms of diagnostic accuracy, sensitivity, specificity, using histopathology as a gold standard.

Results: There were 63% male and 37% female patients. The mean symptoms duration was 60.61 ± 7.18 weeks. 64.1% were presented with bleeding per rectum, 52.5% with altered bowel habits and 31.5% with abdominal pain. 35.4% of cases were diagnosed positive by MRI, and 43.6% cases through histopathology. Sensitivity, Specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy were 85.9%, 79.5%, 69.6%, 91.2%, and 81.76% respectively.

Conclusion: It was concluded that MRI has 85.9% sensitivity, 79.5% specificity, and 81.76% diagnostic accuracy in detecting rectal cancers proving its reliability in detecting both early and recurrent rectal cancers.

Keywords

Diagnostic Accuracy, Magnetic Resonance Imaging, Rectal Carcinoma, Histopathology.

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Introduction

Colorectal cancer (CRC) is the third leading cause of cancer death worldwide, with its incidence steadily rising[1,2] being 3–4 times more common in developed than in developing nations[1]. Disease burden is attributed to myriad factors comprising genetic, environmental, and dietary factors. Rectal cancer has variance according to the geographical location[3] and is considered a disease of the elderly population; however, the occurrence is not uncommon in the younger age group[4]. The risk of occurrence at a younger age is linked to genetics. Fortunately, there are well-established screening guidelines that allow for the prevention and early detection of CRC[5-7].

CRC is more incident among men than women. Global age-standardized incidence rates per 100,000 of CRC in both sexes is 19.7, in males is 23.6, and in females is 16.3[8], While the age-standardized incidence rate among men is 30.1/100,000 in high-HDI (human development index) nations, it is 8.4 in low-HDI nations (the same statistics for women are 20.9 and 5.9, respectively)[9].

Rectal cancers may be suspected from signs and symptoms or by rectal examination. Colonoscopy and imaging studies help disease evaluation. Histologic tissue examination is required to achieve the diagnosis, followed by a proper staging. Sigmoidoscopy and colonoscopy are two commonly used diagnostic and screening modalities for rectal cancers. Although flexible sigmoidoscopy is an accurate diagnostic method for rectal cancers, colonoscopy is still required to evaluate other parts of the colon for synchronous colonic polyps or tumours found in 4% of patients[10].

Radiological modalities like magnetic resonance imaging, endoscopic ultrasound (EUS)-transrectal or transvaginal, including transrectal ultrasound (TRUS) are used to determine tumour stage and distinguish localized cancers involving the mucosa and submucosa from those involving the muscularis propria or perirectal fat[11,12] MRI is superior to all other imaging tests having an established role in initial tumour staging and also in the evaluation of treatment response and local recurrence[13,14].

MRI staging of rectal cancer can be performed using an endorectal surface coil, gradient coil systems or high-resolution surface coils. Limited study material is available in the local database regarding the full utilization of MRI in diagnosing Rectal Carcinoma. Thus, this study aims to determine the reliability of MRI in achieving an accurate diagnosis of CRC to decide its role for more frequent application of its use in local practices.

Methodology

This descriptive cross-sectional study was conducted at the radiology department of Dow University of Health Sciences, Civil Hospital, Karachi, from 19th May to 18th November 2018. After approval from the institutional ethical review committee, written informed consent was obtained from patients referred to the radiology department with a request for an MRI pelvis to exclude rectal carcinoma.

Non-probability sampling technique was used, and the sample size was calculated with the help of disease prevalence, using the WHO calculator. Total 181 patients of either sex between age 20 to 70 years with a history of bleeding per rectum, altered bowel habits and abdominal pain were included in this study. In contrast, all those patients were excluded from previously operated on for rectal carcinoma, those with a history of chemotherapy, radiotherapy or patients with in-situ metallic implants.

The presence of the following conditions was considered suspicious for rectal carcinoma.

1. The Patients with a history of bleeding per rectum, altered bowel habits and abdominal pain for at least 4 to 6 months
2. On Digital Rectal Examination, there is a palpable mass, confirmed on rigid proctoscopy.

High resolution two-dimensional (2D) T2-weighted fast spin-echo sequences in sagittal, axial and coronal planes taken and slice thickness was 3 mm.

The cranial border of the field of view (FOV) was taken from the lumbar five vertebral body and the caudal border below the anal canal with a range of 240–250-mm. Imaging findings with age, duration of symptoms and lesion size were recorded in a pre-designed proforma. Patients followed for histopathology report.

Statistical analysis was done using SPSS version 22.0. Mean and standard deviation were calculated for quantitative variables like age and duration. The efficiency of MRI for rectal carcinoma was calculated in terms of diagnostic accuracy, sensitivity, specificity, positive predictive values and negative predictive values using histopathology as a gold standard. Effect modifiers like age, gender and duration of symptoms were controlled through stratification.

A post-stratification 2x2 table was generated to calculate diagnostic accuracy, sensitivity, specificity, positive predictive value and negative predictive value.

Results

During this study from 181 patients came for MRI pelvis with a clinical suspicion of CRC. Out of 181 patients, 63% were male, and 37% were female. The mean patient age was 46.88 ± 9.49 years. The mean symptoms duration was 60.61 ± 7.18 weeks. The detailed descriptive statistics of symptom duration are presented in table 1. Among total study patients, 64.1% presented with bleeding per rectum, 52.5% with altered bowel habits and 31.5% with abdominal pain.

Table 1: Demographic characteristics of the enrolled patients.

Characteristics		**(n = 181)**
Age (years)		46.88±9.49
Gender	Male	114(63)
	Female	67(37)
Age according to rectal carcinoma diagnosed by MRI		51.54±9.11
Age according to rectal carcinoma diagnosed by histopathology		51.16±10.29
Symptoms duration		60.61±7.18
Symptoms duration w.r.t. rectal carcinoma diagnosed by MRI		60.28±7.67
Symptoms duration w.r.t. rectal carcinoma diagnosed by histopathology		60.32±7.28
Bleeding Per Rectum		116(64.1)
Altered Bowel Habits		95(52.5)
Abdominal Pain		57(31.5)
Rectal Carcinoma by MRI		64(35.4)
Rectal Carcinoma by Histopathology		79(43.6)

Values are given as n(%) and Mean±SD

In our study, 35.4% of cases were diagnosed positive by MRI and 43.6% cases through histopathology, as presented in table 3. The detailed descriptive statistics of gender, age and symptom duration according to diagnosis by MRI and histopathology are presented in table 2 and 3. Sensitivity, Specificity, Predictive values and diagnostic accuracy of MRI in the detection of rectal carcinoma taking histopathology as gold standard calculated. The results showed that 55 patients were true positive, correctly diagnosed, and 93 patients were true negative, correctly diagnosed. Sensitivity, Specificity, PPV, NPV and accuracy were 85.9%, 79.5%, 69.6%, 91.2%, and 81.76% respectively as presented in table 3. Stratification was done for gender, age and symptom duration and Sensitivity, Specificity, Predictive values and diagnostic accuracy of MRI were computed. Detailed results are presented in table 2.

Table 2: Diagnostic accuracy of MRI taking histopathology as gold standard.

MRI	Histopathology n(%)		
	Positive	**Negative**	**Total**
Positive	55(85.9)	9(14.1)	64
Negative	24(20.5)	93(79.5)	117

Sensitivity-86%; Specificity-80%; Positive Predicted Value-70%; Negative Predicted Value-91%; Overall Diagnostic Accuracy-82%

Table 3: Baseline characteristics and diagnostic accuracy of MRI taking histopathology as gold standard.

Variables		Sensitivity	Specificity	PPV	NPV	Diagnostic accuracy
Age	≤ 50 years	69.20%	83.90%	56.30%	90.10%	80.53%
	> 50 years	97.40%	66.70%	78.70%	95.20%	83.80%
Gender	Male	85%	59.30%	69.90%	78%	72.80%
	Female	100%	96.80%	66.70%	100%	97.01%
Symptoms Duration	≤ 60 weeks	87.90%	77.80%	70.70%	91.30%	81.60%
	> 60 weeks	83.90%	81%	68.40%	91.10%	81.90%

PPV: Positive Predictive Value, NPV: Negative Predictive Value

Discussion

Rectal cancer, a serious malignancy worldwide, is a leading cause of mortality[15]. Many studies on morbidity and mortality caused by CRC have been done. Their objective focused on the earliest possible diagnosis, identifying factors influencing prognosis and predicting outcomes and disease-free survival. Nowadays, it is believed that the distance of the tumour from the mesorectal fascia is the strongest predictor of outcome. The more is distance the tumour from the mesorectal fascia, the better the outcome and prolonged disease-free survival rate, and the lesser the distance of the tumour from the mesorectal fascia, the poorer the prognosis with chances of early recurrence[13]. For this purpose, pre-operative radiological investigations are routinely performed using different radiological modalities to determine the distance of mesorectal fascia from the tumour; amongst them, MRI most accurately allows distance measurements between tumour and mesorectal fascia together with cancer staging[14].

However, the statistical data available regarding MRI results to predict mesorectal fascia as involved or uninvolved is controversial. This study aimed to compare MRI-based radiological findings with histopathological findings as a gold standard. Wieder et al., performed a study to predict tumour-free circumferential resection margin using MRI and confirmed his findings by comparing it with histopathological evaluation of circumferential margin. According to his analysis, MRI accurately predicts the circumferential resection margin with a sensitivity of 100% and specificity of 88%[15]. In our study, we found 85.9% sensitivity, 79.5% specificity, and 81.76% diagnostic accuracy of MRI taking histopathology as a gold standard.

This study suggested that MRI can play a vital role in the early diagnosis of disease and determine the tumour's distance from the mesorectal fascia. Our study results with other studies may be due to different protocols followed by radiologists at different institutes for imaging. The imaging can be compliant or non-compliant[16]. One of the studies shows that compliant imaging predicts the tumour more accurately[17]. In compliant imaging, comparatively fewer sequences of images are taken, which are more accurate than the other imaging techniques, especially when the tumour

invades the mesorectum anteriorly. Suzuki et al., showed that sensitivity and specificity of compliant rectal imaging was 86% and 94%, respectively, when compared with histopathology[18].

Hancock and colleagues showed that the accuracy of MRI to predict mesorectal fascia status is 76%, with sensitivity and specificity of 96.9% and 73.8%, respectively[19]. Rao et al., in their study, claimed that MRI had 88% accuracy in predicting mesorectal fascia involvement by tumour. In contrast, sensitivity, specificity, positive predictive value and negative predictive values in his study were 80%, 90.4%, 70.6% and 94%, respectively[20]. If results from different studies regarding mesorectal fascia status are compared, broad result variation is seen. One reason could be the skills, knowledge and experience of the radiologist.

Videhult et al., found that the accuracy of MRI for mesorectal fascia was 86%, with inter-observer variability of 80% and 100%[21]. He also admits that it is very difficult to distinguish the tumour invading mesorectal fat from the tumour, which is not. MRI has the poor performance to differentiate between the tumour and desmoplastic response. The desmoplastic response is a tissue reaction surrounding the tumour. Often, the tumour is limited to mesorectal fat with the desmoplastic response, which extends to the mesorectal fascia, and MRI occasionally misinterprets it as a positive margin. This is very clear from the studies mentioned above, as the sensitivity of MRI in all studies is lower than specificity.

Conclusion

Our study showed that high-resolution MRI in suspected cases of rectal cancers is quite reliable in early disease detection and inaccurate tumour staging with 85.9% sensitivity, 79.5% specificity, and 81.76% diagnostic accuracy.

The use of MRI as a routine pre-biopsy examination in our local practice should be encouraged in all suspected cases of rectal carcinomas, which might help improve patient survival by reaching a more accurate and timely diagnosis without missing out lesions while reducing mortality and morbidity.

Conflicts of Interest

The authors have declared that no competing interests exist.

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References

1. Rawla P, Sunkara T, Barsouk A. Epidemiology of colorectal cancer: incidence, mortality, survival, and risk factors. Prz Gastroenterol. 2019;14(2):89.
2. Miller KD, Goding Sauer A, Ortiz AP, Fedewa SA, Pinheiro PS, Tortolero-Luna G, Martinez-Tyson D, Jemal A, Siegel RL. Cancer statistics for hispanics/latinos, 2018. CA: Cancer J. Clin. 2018;68(6):425-445.
3. Arnold M, Sierra MS, Laversanne M, Soerjomataram I, Jemal A, Bray F. Global patterns and trends in colorectal cancer incidence and mortality. Gut. 2017;66(4):683-691.
4. Vuik FE, Nieuwenburg SA, Bardou M, Lansdorp-Vogelaar I, Dinis-Ribeiro M, Bento MJ, Zadnik V, Pellisé M, Esteban L, Kaminski MF, Suchanek S. Increasing incidence of colorectal cancer in young adults in Europe over the last 25 years. Gut. 2019;68(10):1820-1826.
5. Calonge N, Petitti DB, DeWitt TG, Gordis L, Gregory KD, Harris R, Kizer KW, LeFevre ML, Loveland-Cherry C, Marion LN, Moyer VA. Routine aspirin or nonsteroidal anti-inflammatory drugs for the primary prevention of colorectal cancer: US Preventive Services Task Force recommendation statement. Ann. Intern. Med. 2007;146(5):361-364.
6. Bibbins-Domingo K, Grossman DC, Curry SJ, Davidson KW, Epling JW, García FA, Gillman MW, Harper DM, Kemper AR, Krist AH, Kurth AE. Screening for colorectal cancer: US Preventive Services Task Force recommendation statement. Jama. 2016;315(23):2564-2575.
7. Wolf AM, Fontham ET, Church TR, Flowers CR, Guerra CE, LaMonte SJ, Etzioni R, McKenna MT,

Oeffinger KC, Shih YC, Walter LC. Colorectal cancer screening for average-risk adults: 2018 guideline update from the American Cancer Society. CA: Cancer J. Clin. 2018;68(4):250-281.

8. Ferlay J, Ervik M, Lam F, Colombet M, Mery L, Piñeros M, Znaor A, Soerjomataram I, Bray F. Global cancer observatory: cancer today. Lyon, FranceIARC 2018;17:1-6.
9. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA: Cancer J. Clin. 2018;68(6):394-424.
10. Cross AJ, Wooldrage K, Robbins EC, Pack K, Brown JP, Hamilton W, Thompson MR, Flashman KG, Halligan S, Thomas-Gibson S, Vance M. Whole-colon investigation vs. flexible sigmoidoscopy for suspected colorectal cancer based on presenting symptoms and signs: a multicentre cohort study. Br. J. Cancer. 2019;120(2):154-164.
11. Ren Y, Ye J, Wang Y, Xiong W, Xu J, He Y, Cai S, Tan M, Yuan Y. The optimal application of transrectal ultrasound in staging of rectal cancer following neoadjuvant therapy: a pragmatic study for accuracy investigation. J. Cancer. 2018;9(5):784.
12. Ortega CD, Perez RO. Role of magnetic resonance imaging in organ-preserving strategies for the management of patients with rectal cancer. Insights into imaging. 2019;10(1):1-6.
13. Santiago I, Figueiredo N, Parés O, Matos C. MRI of rectal cancer—relevant anatomy and staging key points. Insights into Imaging. 2020;11(1):1-21.
14. Cai Z, Xie X, Chen Y, Chen Z, Cao W, Saad KS, Zou Y, Lan P, Wu X. Risk factor analysis for inaccurate pre-operative MRI staging in rectal cancer. BMC cancer. 2020;20(1):1-9.
15. Wieder HA, Rosenberg R, Lordick F, Geinitz H, Beer A, Becker K, Woertler K, Dobritz M, Siewert JR, Rummeny EJ, Stollfuss JC. Rectal cancer: MR imaging before neoadjuvant chemotherapy and radiation therapy for prediction of tumor-free circumferential resection margins and long-term survival. Radiology. 2007;243(3):744-751.
16. Gollins S, West N, Sebag-Montefiore D, Susnerwala S, Falk S, Brown N, Saunders M, Quirke P, Ray R, Parsons P, Griffiths G. A prospective phase II study of pre-operative chemotherapy then short-course radiotherapy for high risk rectal cancer: COPERNICUS. Br. J. Cancer. 2018;119(6):697-706.
17. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2019. CA: Cancer J. Clin. 2019;69(1):7-34.
18. Suzuki C, Torkzad MR, Tanaka S, Palmer G, Lindholm J, Holm T, Blomqvist L. The importance of rectal cancer MRI protocols on iInterpretation accuracy. J. Surg. Oncol. 2008;6(1):1-9.
19. Hancock L, Forde C, Bradbury J, Mortensen N, Gleeson F. Magnetic resonance imaging predicts circumferential resection margin status in patients receiving preoperative chemoradiotherapy for rectal cancer. Colorectal Dis. 2007;9(2):188.
20. Rao SX, Zeng MS, Xu JM, Qin XY, Chen CZ, Li RC, Hou YY. Assessment of T staging and mesorectal fascia status using high-resolution MRI in rectal cancer with rectal distention. World J. Gastroenterol.: WJG. 2007;13(30):4141.
21. Videhult P, Smedh K, Lundin P, Kraaz W. Magnetic resonance imaging for preoperative staging of rectal cancer in clinical practice: high accuracy in predicting circumferential margin with clinical benefit. Colorectal Dis. 2007;9(5):412-419.