

MRI DIAGNOSTIC ACCURACY IN THE DETECTION OF EMVI IN CARCINOMA RECTUM USING HISTOPATHOLOGY AS THE GOLD STANDARD

¹Naheed Khan,²Sidra Saeed, ³Irsa Shuaib, ⁴Mehmood Akhtar Khattak, ⁵Hina Gul

⁶Kalsoom Nawab

^{1,2, 3,4,5-}Department of Radiology Khyber Teaching Hospital Peshawar

ABSTRACT

Background: Extramural Venous Invasion [EMVI] is the intravenous tumor extension beyond the rectal wall in patients with rectal cancer. Being a predictor of a worse prognosis, detection of EMVI is essential to deciding on treatment options

Objective: to determine the diagnostic accuracy of preoperative MRI in detecting extramural vascular invasion in patients with rectal cancer, taking histopathology as the gold standard.

Study design: A Retrospective study.

Place and duration of study: Department of Radiology Khyber Teaching Hospital Peshawar from 05-Feb- 2020 to 05-March 2021

Materials & Methods: 118 patients MRI in Radiology Khyber Teaching Hospital Peshawar for rectal carcinoma from 05-Feb 2020 to 05-March 2021. Patients were examined with a 0.3 Tesla MRI machine using MRI sequences T2WI, T1WI, FLAIR, and DWI. Post-op specimens were sent in formalin for histopathological assessment. Data, including MRI features and Histopathological findings, were assessed with SPSS version 20.

Results: Our study included 118 rectal cancer patients, 55.1% (85) male and 44.9% (70) female. 31-100 in 10-year increases. 31-50 and 41-50 had four instances (3.4%). Twenty (16.9%) patients were between 51 and 60, 22(18.6%) were between 61 and 70, 35 (29.7%) were between 71 and 80, 11 (9.3%) Between 81 and 90, and 22 (18.6%) were between 91 and 100. MRI results found 57 EMVI-positive and 61 negative individuals. 45 (38.1%) patients had EMVI, whereas 73 (61.9%) did not. Cross-tabulation was utilized to analyze MRI's sensitivity, specificity, PPV, and NPV in diagnosing EMVI. MRI was 83.3% sensitive, 69% specific, 60% positive predictive, and 88.3% negative predictive. EMVI correlates with neoplastic mass.

Conclusion: MRI demonstrates high diagnostic accuracy in identifying extramural venous invasion (EMVI) in rectal cancer. With strong sensitivity, specificity, and predictive values, MRI serves as a valuable tool in preoperative staging, aiding in treatment planning and risk stratification.

Keywords: Carcinoma Rectum, Extramural Venous Invasion, MRI, Mesorectal Fascia.

How to Cited this Article : Khan N, Saeed S, Shuaib I, Khattak MA, Gul H, Nawab K. MRI diagnostic accuracy in the detection of EMVI in carcinoma rectum using histopathology as the gold standard. Pak J Adv Med Med Res. 2023;1(2):39-43. [doi:10.69837/pjammr.v1i02.16](https://doi.org/10.69837/pjammr.v1i02.16).

Corresponding Authors: Sidra Saeed

Department of Radiology Khyber Teaching Hospital Peshawar

Email: drsiddrahsaeed233@yahoo.com

<https://orcid.org/0000-0002-2836-7280>

Cell No: +92 347 9527323

Article History

| | | |
|------------|----------|----------|
| Received: | January | 12 2023 |
| Revision: | February | 17, 2023 |
| Accepted: | April | 26, 2023 |
| Published: | July | 05- 2023 |

INTRODUCTION

The United States ranks third in colorectal cancer incidence and mortality [1]. Effective screening, staging, and therapy significantly reduce mortality. Rectal cancer often involves mesorectal invasion and venous malignancies [2]. MRI plays a crucial role in assessing local recurrence and distant metastases, particularly in cases of extramural venous invasion (EMVI), which is associated with poor prognosis. Contrast-enhanced T1-weighted images, intermediate signal intensity on T2-weighted images, and moderate to high signal intensity on diffusion-weighted imaging (DWI) help identify EMVI [3]. MRI is essential in guiding rectal cancer treatment, preoperative evaluation, and surgical planning [4]. Brown et al. established a link between MRI findings and EMVI histology, emphasizing MRI's role in predicting nodal and distant metastases, poor prognosis, and the need for neoadjuvant therapy. The sub mucosal and muscular plexus contribute to anorectic vein drainage [5]. The superior rectal (haemorrhoidal) vein drains into the inferior mesenteric vein, while the inferior vena cava receives blood from the iliac and rectal veins. A significant portion of patients (33.2%) have unidirectional rectal veins, contributing to systemic and portal circulation [6]. MRI can identify tumor invasion into mesorectal fat, with EMVI often presenting as saw-tooth tumors. T2-weighted and post-contrast images frequently reveal beaded or nodular arteries [7]. Smith introduced a five-point MRI evaluation system for EMVI assessment. A smooth, well-defined T2-weighted arterial signal suggests perirectal vascular anomalies, while a score of 0 or 1 typically indicates the absence of EMVI. Approximately 1 in 13 cases show agreement in MRI detection [9]. MRI enables vascular assessment based on count, size, and origin within the rectum [10]. Tumors in the upper rectum and those with prominent arteries have worse prognoses. Chemo radiation and mesorectal resection remain standard treatments for T3 rectal cancer. MRI is instrumental in identifying poor prognostic factors such as EMVI, tumor mucin content, and mesorectal facial (MRF) involvement, aiding in surgical planning and patient selection for neoadjuvant chemo radiotherapy [11]. A cross-sectional study was conducted at Khyber Teaching Hospital, Peshawar, including 118 rectal cancer patients who underwent pelvic MRI. The study recorded patients' age, gender, and clinical histories, with ethical approval obtained. The cohort included 55.1% male (n=85) and 44.9% female (n=70) patients. The age distribution ranged from 31 to 100 years, with 3.4% of cases in the 31-50 and 41-50 age groups, while 16.9% of patients were aged 51-60, and 22 patients fell into higher age brackets. Tesla. The surgery began with antispasmodics. Fat-free T2- T2-weighted FSE pictures (axial, sagittal, coronal) [12].

Bifurcation of the pelvic aorta in the axial plane. The sagittal plane. More than a thousand drunk driving photographs were found. Structure, location, anterior peritoneal reflection, and rectal junction were examined. For MRF, CRM, and EMVI, lymph node invasion was analyzed. Uniform vessel wall thickness, targeted growth, and a shift in tumor signal intensity are EMVI (moderate on T2WI). Here are EMVI's results. Muscle development without lumps and arteries. Being lodged near extramural roadways but revealing no tumors. Med tumors signal poor blood flow. Nodular growth with uneven blood vessels. EMVI 2 3 4. Histology confirms. In pathological EMVI, smooth muscle or RBCs are observed. MRI's sensitivity, specificity, and positive and negative predictive values for EMVI were analyzed in SPSS 24[13].

MATERIALS AND METHODS:

118 patients who had MRI treatment at Department of Radiology Khyber Teaching Hospital Peshawar for rectal cancer between February 2020 and March 2021 were included. Patients were scanned using an MRI scanner with a field strength of 0.3 Tesla utilizing the T2WI, T1WI, FLAIR, and DWI sequences. Specimens collected postoperatively were preserved in formalin before being sent off for histological analysis. SPSS version 20 was used to study the gathered data, which included MRI characteristics and histopathological results.

APPROVAL FORM ETHICS COMMITTEE:

The study received ethical approval from the Ethics Review Committee of Khyber Teaching Hospital, Peshawar under reference number **IRB-890/06/2020**. All Study protocols adhered to institutional and international ethical guidelines. Informed consent was obtained from all participants before enrollment, ensuring confidentiality and compliance with ethical standards.

RESULTS

(18.6%) were between 61 and 70, thirty-five (29.7%) were between 71 and 80, eleven (9.3%) were between 81 and 90, and twenty-two (18.6%) were between 91 and 100. MRI findings identified 57 of 118 individuals as EMVI positive and 61 as negative. Forty-five patients The study included 118 rectal cancer patients,

MRI DIAGNOSTIC ACCURACY IN THE DETECTION OF EMVI....

comprising 85 males (55.1%) and 70 females (44.9%). The age distribution showed that 3.4% of patients were between 31-50 years, 16.9% between 51-60 years, 18.6% between 61-70 years, 29.7% between 71-80 years, 9.3% between 81-90 years, and 18.6% between 91-100 years. MRI detected 57 cases (48.3%) as EMVI-positive and 61 cases (51.7%) as EMVI-negative. However, histopathology confirmed 45 patients (38.1%) as EMVI-positive and 73 patients (61.9%) as EMVI-negative. The diagnostic accuracy of

MRI in detecting EMVI was assessed, yielding a sensitivity of 83.3%, specificity of 69.0%, positive predictive value (PPV) of 60.0%, and negative predictive value (NPV) of 88.3%. MRI findings strongly correlated with histopathological results, demonstrating its clinical reliability in detecting EMVI and guiding preoperative staging and treatment decisions for rectal cancer patients. Table 01: EMVI * Cross-tabulation of HP Data

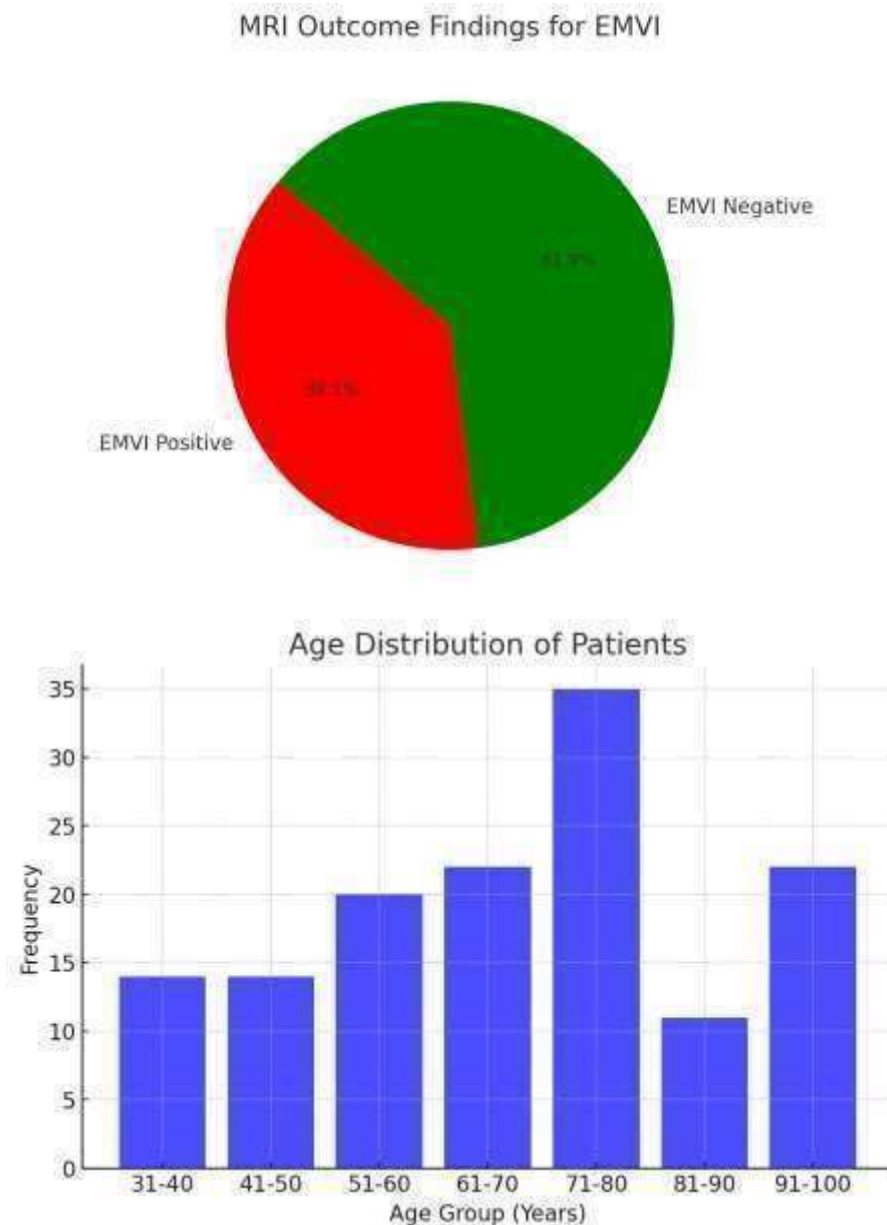


Table 01: Cross-tabulation of MRI-detected EMVI Status with Histopathological Findings

| EMVI Status | HP Negative (n) | HP Positive (n) | Total (n) |
|---------------|-----------------|-----------------|-----------|
| EMVI Negative | 35 | 23 | 58 |
| EMVI Positive | 7 | 53 | 60 |

Table 02: Frequency of Age Group and Percentage.

| Age Group (Years) | Frequency (n) | Percentage (%) | Cumulative Percentage (%) |
|-------------------|---------------|----------------|---------------------------|
| 31-40 | 14 | 3.4 | 3.4 |
| 41-50 | 14 | 3.4 | 6.8 |
| 51-60 | 20 | 16.9 | 23.7 |
| 61-70 | 22 | 18.6 | 42.4 |
| 71-80 | 35 | 29.7 | 72.0 |
| 81-90 | 11 | 9.3 | 81.4 |
| 91-100 | 22 | 18.6 | 100.0 |
| Total | 118 | 100.0 | 100.0 |

Table 03: Frequency of valid Gender wise and Percentage

| Gender | Frequency (n) | Percentage (%) | Valid Percentage (%) | Cumulative Percentage (%) |
|--------|---------------|----------------|----------------------|---------------------------|
| Male | 85 | 55.1 | 55.1 | 55.1 |
| Female | 70 | 44.9 | 44.9 | 100.0 |
| Total | 155 | 100.0 | 100.0 | 100.0 |

DISCUSSION

MRI at baseline helps to determine EMVI in rectal cancer patients since it functions independently as a diagnostic measure for survival rates and local and distant relapses [14]. MRI detects extramural venous invasion (mrEMVI) through its ability to identify irregular varicose veins which show tumor signal intensity beyond the muscularis propria. High-resolution T2-weighted MRI proves to be effective in determining the EMVI-related risk levels of locally advanced rectal cancer per Study by Amy C. Lord et al. [14]. In cases of locally advanced rectal cancer patients doctors use Neoadjuvant chemoradiotherapy (CRT) as a treatment method to lower tumor size [15]. Study in MRI techniques has transformed the diagnostic function so MRI now takes precedence over histopathological assessment for detecting EMVI. MRI proved accurate for detecting EMVI by examining histopathology findings according to the findings of this present Study [16]. The study showed 83% diagnostic accuracy with 81% sensitivity and 90% specificity for EMVI detection using MRI. A retrospective Bahrain study evaluated 82 patients showing MRI determination of 31 EMVI cases which histopathological results agreed with 26 of those diagnoses. The study demonstrated that tumors positive for EMVI most frequently occurred in the 93% of cases located at the middle rectum according to findings

reported by T.H. Kim. The detection capabilities of MRI for identifying EMVI proved useful for survival predictions according to J.S. Bae et al. [17]. This Study conclusions from our study match those reported in this study. Our Study evaluated diffusion-weighted imaging (DWI) as it relates to EMVI detection. DWI turned out to be inadequate for precise EMVI detection despite ongoing Study about its operational effectiveness. Adding DWI sequences did not produce clinically significant diagnostic benefits to tumor characterization and monitoring but reduced the consistency of observer readings. DWI-based EMVI assessment methods require additional Study to perfect their utilization in rectal cancer assessment.

LIMITATIONS

The Study design had two main constraints because it used retrospective data from a single hospital center. The study results may have been affected by interpretation disagreements among MRI readers because the sample size remained small. A further validation of diffusion-weighted imaging (DWI) for EMVI detection needs to occur in larger multicenter Study to determine the method's effectiveness.

FUTURE FINDINGS

Study needs to conduct prospective multi-center studies that use large patient cohorts to fully validate

as a way to create more precise imaging evaluations. Early tumor aggressiveness detection along with treatment response evaluation becomes more accurate when DWI works together with functional biomarkers scans. MRI as a tool for EMVI detection. Study should study how AI-based analysis helps MRI interpretation

Disclaimer: Nil

Conflict of Interest

REFERENCES:

1. Zheng K, Zheng N, Xin C, et al. The prognostic significance of tumor deposit count for colorectal cancer patients after radical surgery. *Gastroenterol Res Pract*. 2020;2020:2052561.
2. 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*. 2013;90(3):355–364.
3. Chand M, Swift RI, Chau I, Heald RJ, Tekkis PP, Brown G. Adjuvant therapy decisions based on magnetic resonance imaging of extramural venous invasion and other prognostic factors in colorectal cancer. *Ann R Coll Surg Engl*. 2014;96(7):543–546.
4. Ale Ali H, Kirsch R, Razaz S, et al. Extramural venous invasion in rectal cancer: an overview of imaging, histopathology, and clinical implications. *Abdom Radiol (NY)*. 2019;44(1):1–10.
5. Santiago I, Figueiredo N, Pares O, Matos C. MRI of rectal cancer—relevant anatomy and staging key points. *Insights Imaging*. 2020;11(1):100.
6. Zhang XY, Wang S, Li XT, et al. MRI of extramural venous invasion in locally advanced rectal cancer: relationship to tumour recurrence and overall survival. *Radiology*. 2018;289(3):677–685.
7. Kapiteijn E, Marijnen CA, Nagtegaal ID, et al. Preoperative radiotherapy combined with total mesorectal excision for resectable rectal cancer. *N Engl J Med*. 2001;345(9):638–646.
8. Lord AC, D'Souza N, Shaw A, et al. MRI-diagnosed tumour deposits and EMVI status have superior prognostic accuracy to current clinical TNM staging in rectal cancer. *Ann Surg*. 2022;276(2):334–344.
9. Kim TH, Woo S, Han S, Suh CH, Vargas HA. The diagnostic performance of MRI for detection of extramural venous invasion in colorectal cancer: a systematic review and meta-analysis of the literature. *AJR Am J Roentgenol*. 2019;213(3):575–585.

Nil Funding Disclosure: Nil

AUTHORS CONTRIBUTION

Concept & Design of Study: Naheed Khan

Drafting: Sidra Saeed, Irsa Shuaib

Data Analysis: Mehmood Akhtar Khattak

Critical Review: Hina Gul and Kalsoom Nawab

Final Approval of version: All Mentioned Authors Approved

10. Bae JS, Kim SH, Hur BY, et al. Prognostic value of MRI in assessing extramural venous invasion in rectal cancer: multi-readers' diagnostic performance. *Eur Radiol*. 2019;29(8):4379–4388.
11. Smith NJ, Barbachano Y, Norman AR, Swift RI, Abulafi AM, Brown G. Prognostic significance of magnetic resonance imaging-detected extramural vascular invasion in rectal cancer. *Br J Surg*. 2008;95(2):229–236.
12. Fornell-Perez R, Vivas-Escalona V, Aranda-Sanchez J, et al. Primary and post-chemoradiotherapy MRI detection of extramural venous invasion in rectal cancer: the role of diffusion-weighted imaging. *Radiol Med*. 2020;125(6):522–530.
13. Siddiqui MRS, Simillis C, Hunter C, et al. A meta-analysis comparing the risk of metastases in patients with rectal cancer and MRI-detected extramural venous invasion (mrEMVI) vs mrEMVI-negative cases. *Br J Cancer*. 2017;116(12):1513–1519.
14. Gu C, Yang X, Zhang X, et al. The prognostic significance of MRI-detected extramural venous invasion, mesorectal extension, and lymph node status in clinical T3 mid-low rectal cancer. *Sci Rep*. 2019;9(1):12523.
15. Beets-Tan RG, Lambregts DMJ, Maas M, et al. Magnetic resonance imaging for clinical management of rectal cancer: updated recommendations. *Lancet Oncol*. 2018;19(9):e403–e412.
16. Nougaret S, Reinhold C, Mikhael HW, et al. The use of MR imaging in treatment planning for patients with rectal carcinoma: have you checked the "DISTANCE"? *Radiology*. 2013;268(2):330–344.
17. Sahakyan MA, Tabouret-Viaud C, Romain B, et al. Role of MRI in rectal cancer: a scientific review. *Colorectal Dis*. 2017;19(9):752–760.



Licensing and Copyright Statement

All articles published in the **Pakistan Journal of Advances in Medicine and Medical Research (PJAMMR)** are licensed under the terms of the **Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC 4.0)**. This license permits non-commercial use, distribution, and reproduction in any medium, provided the original author and source are properly cited. Commercial use of the content is not permitted without prior permission from the **Author(s) 2023** the journal. [This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.](#)