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Evaluating the Diagnostic Accuracy of Combined CT and MRI Imaging in Detecting Lymph Node Metastasis in Colorectal Cancer

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Abstract

Background: Lymph node metastasis is a major prognostic determinant in colorectal cancer, directly influencing surgical strategies and the use of adjuvant therapy. While CT and MRI are widely applied in preoperative staging, there is limited evidence assessing the combined diagnostic accuracy of these modalities for nodal evaluation.

Objective: To assess the diagnostic performance of combined CT and MRI in detecting lymph node metastases in colorectal cancer, using histopathology as the gold standard.

Methods: This cross-sectional study included patients with colorectal cancer who underwent preoperative CT and MRI, followed by surgical resection at [JPMC] between January and June 2025. Imaging was interpreted using standardized radiologic criteria and compared against histopathological findings of resected lymph nodes. Diagnostic indices, including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy, were calculated.

Results: Histopathology confirmed nodal metastases in 57.9 % (22/38) of colon cancer patients and 57.1 % (20/35) of rectal cancer patients. For colon cancer (CT only), the sensitivity, specificity, PPV, NPV, and accuracy were 68.2 %, 68.8 %, 75.0 %, 61.1 %, and 68.4 %, respectively. For rectal cancer (CT + MRI), these were 85.0 %, 80.0 %, 85.0 %, 80.0 %, and 82.9 %, respectively. Mean lymph node counts on imaging were 5.8 ± 2.1 for colon cancer and 6.4 ± 2.3 for rectal cancer, compared with 14.2 ± 3.9 and 13.7 ± 3.6, respectively, on histopathology. Micrometastases <5 mm were detected only by histology.

Conclusion: Combining CT with MRI improves diagnostic sensitivity for nodal metastasis detection in rectal cancer compared with CT alone for colon cancer. Histopathology remains the definitive reference, particularly for small-volume disease.

Keywords: Colorectal cancer, lymph node metastasis, CT, MRI, diagnostic accuracy, preoperative imaging.

INTRODUCTION

Colorectal cancer (CRC) is one of the most prevalent malignancies worldwide, ranking among the top three in incidence and remaining a leading cause of cancer-related mortality [1]. Accurate disease staging is central to prognosis determination and therapeutic decision-making, with lymph node (LN) involvement recognised as a critical prognostic indicator [2]. The presence of nodal metastases often influences both the need for adjuvant chemotherapy and the surgical approach taken.

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Preoperative imaging is an essential component of LN evaluation. Computed tomography (CT) is readily available and widely utilised for assessing distant spread, while high-resolution pelvic magnetic resonance imaging (MRI) offers superior soft-tissue contrast and is preferred for local staging in rectal cancer [3]. However, the reported sensitivity and specificity of either modality for LN metastasis detection vary considerably, largely due to difficulties in distinguishing malignant from reactive nodes using size and morphological criteria alone [4].

Efforts to refine imaging accuracy include applying additional features such as internal heterogeneity and irregular borders on CT, which have been associated with improved detection of metastatic nodes in colon cancer [5]. Similarly, MRI has shown excellent performance in some settings; for example, a recent study reported high sensitivity and specificity in differentiating early (T1–T2) from advanced (T3–T4) tumours [6].

Combining CT and MRI findings may offer complementary strengths. Recent work has demonstrated that integrating MRI radiomic features with clinical data enhances non-invasive prediction of LN metastases in early rectal cancer [7]. Advanced MRI techniques such as diffusion-weighted imaging (DWI) and apparent diffusion coefficient (ADC) mapping have also improved malignant node characterisation [8]. Hybrid imaging approaches, including ^18F-FDG PET/MRI, have yielded promising results, with meta-analyses reporting pooled sensitivities and specificities exceeding 80 % [9].

Despite these advances, limited studies directly compare the combined use of CT and MRI against histopathology for LN staging. Given the importance of accurate nodal assessment to avoid both under- and overtreatment, this study aimed to evaluate the diagnostic accuracy of CT and MRI in combination for detecting LN metastases in colorectal cancer, using histopathology as the reference standard.

Methods:

Study Design and Setting

This cross-sectional study was carried out in the Department of General Surgery, Ward II, Jinnah Postgraduate Medical Centre (JPMC), Karachi, over a six-month period from January to June 2025.

Ethical Considerations

Approval for the study was obtained from the Institutional Ethical Review Committee at JPMC. Written informed consent was secured from all participating patients prior to enrolment.

Sample Size and Sampling Technique

The required sample size was calculated as 73 patients using PASS 2020 software (NCSS, LLC, Kaysville, Utah, USA), based on expected diagnostic performance parameters for CT and MRI in nodal staging [10]. Patients meeting the eligibility criteria were enrolled through non-probability purposive sampling.

Inclusion Criteria

- Age ≥ 18 years
- Histologically confirmed colorectal cancer
- Completion of both preoperative contrast-enhanced CT and MRI imaging following concurrent chemoradiotherapy (where applicable)
- Planned surgical resection during the study period

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Exclusion Criteria

- Recurrent or metastatic colorectal cancer at initial presentation
- Incomplete or poor-quality CT or MRI imaging
- Contraindications to MRI

Study Protocol

All included patients underwent contrast-enhanced CT and high-resolution MRI before surgery. Clinical records, imaging findings, and histopathology reports were reviewed. Radiologic assessment of lymph node status was performed using standardised morphological criteria, including size, shape, and internal characteristics. Imaging results were subsequently compared with histopathologic examination of surgically resected specimens, which served as the reference standard for determining nodal metastasis.

Statistical Analysis

For each imaging modality, sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy were calculated using 2×2 contingency tables, with histopathology as the gold standard. Confidence intervals (95 % CI) were computed for all measures. Data were analysed using IBM SPSS Statistics version 26

Result

A total of 73 patients met the study criteria, comprising 42 males and 31 females, with a mean age of 56.8 ± 10.4 years. Among these, 38 patients had colon cancer and were evaluated using CT, while 35 had rectal cancer and underwent combined CT and MRI.

Histopathological analysis confirmed lymph node metastases in 22 of 38 colon cancer cases (57.9 %) and in 20 of 35 rectal cancer cases (57.1 %).

For colon cancer, CT detected an average of 5.8 ± 2.1 lymph nodes per patient. Positive nodes on imaging had a mean short-axis diameter of 8.6 ± 2.4 mm. For rectal cancer, the combination of CT and MRI identified an average of 6.4 ± 2.3 lymph nodes per patient, with suspicious nodes averaging 9.1 ± 2.7 mm in short-axis diameter.

Histopathology revealed a larger number of lymph nodes compared to imaging: 14.2 ± 3.9 in colon cancer and 13.7 ± 3.6 in rectal cancer. The mean short-axis diameter of metastatic nodes on histology was 7.9 ± 2.2 mm. Several micrometastases measuring less than 5 mm were identified only through histopathologic examination.

When considering only patients with imaging-positive lymph nodes, 15 of 20 CT-positive colon cancer cases were true positives and 5 were false positives. In rectal cancer, 17 of 20 imaging-positive cases were confirmed on histopathology, while 3 were false positives.

Diagnostic performance measures for colon cancer (CT only) were: sensitivity 68.2 % (95 % CI: 48.6–83.0), specificity 68.8 % (95 % CI: 45.4–85.9), PPV 75.0 %, NPV 61.1 %, and overall accuracy 68.4 %. For rectal cancer (CT + MRI), the corresponding values were: sensitivity 85.0 % (95 % CI: 64.0–94.8), specificity 80.0 % (95 % CI: 54.8–92.9), PPV 85.0 %, NPV 80.0 %, and accuracy 82.9 %.

Across both groups, histopathology consistently detected more lymph nodes and identified smaller metastatic deposits that were not visualised on imaging.

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Table 1: Imaging Positive Cases
Number of imaging-positive cases on CT for colon cancer and combined CT+MRI for rectal cancer, and their corresponding histopathology outcomes.

Group	Imaging Positive (n)	Histopathology Positive (True Positive)	Histopathology Negative (False Positive)
Colon Cancer (CT only)	20	15	5
Rectal Cancer (CT + MRI)	20	17	3

Table 2: Imaging Negative Cases
Number of imaging-negative cases on CT for colon cancer and combined CT+MRI for rectal cancer, and their corresponding histopathology outcomes.

Group	Imaging Negative (n)	Histopathology Positive (False Negative)	Histopathology Negative (True Negative)
Colon cancer (CT only)	18	7	11
Rectal cancer (CT + MRI)	15	3	12

Table 3: Diagnostic Performance
Diagnostic performance metrics of CT for colon cancer and combined CT+MRI for rectal cancer in detecting lymph node metastases, using histopathology as the reference standard.

Group	Sensitivity	Specificity	Accuracy
Colon cancer (CT only)	68.2%	68.8%	68.4%
Rectal cancer (CT + MRI)	85.0%	80.0%	82.9%

Table 4: Mean Lymph Node Counts and Sizes
Mean lymph node counts and short-axis diameters on imaging (CT or CT+MRI) compared with histopathology in colon and rectal cancer cases.

Group	LN count on imaging (mean ± SD)	Size of suspicious LN on imaging (mm) (mean ± SD)	LN count on histopathology (mean ± SD)	Size of metastatic LN on histopathology (mm) (mean ± SD)
Colon cancer (CT only)	5.8 ± 2.1	8.6 ± 2.4	14.2 ± 3.9	7.9 ± 2.2
Rectal cancer (CT + MRI)	6.4 ± 2.3	9.1 ± 2.7	13.7 ± 3.6	7.9 ± 2.2

Discussion:
This study compared the performance of CT for colon cancer and combined CT with MRI for rectal cancer in detecting lymph node metastases, using histopathology as the definitive reference. We observed that the combined approach yielded higher sensitivity (85.0 %) and accuracy (82.9 %) than

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CT alone (68.2 % and 68.4 %, respectively). Histopathology consistently detected more lymph nodes, including micrometastases smaller than 5 mm, which were beyond the resolution of imaging.

The diagnostic yield of CT in our colon cancer group aligns with recent reports showing sensitivities between 62–71 % and specificities around 67–70 % for nodal staging in colorectal cancer [10,11]. MRI for rectal cancer has demonstrated variable but generally superior results, with studies citing sensitivities in the range of 73–87 % and specificities between 74–90 % [12,13]. The higher sensitivity we observed with CT + MRI supports previous findings that integrating modalities can enhance detection of morphologically suspicious nodes [14].

Consistent with prior evidence, imaging in our cohort identified fewer lymph nodes compared with histopathology [10,15]. This is expected given that CT and MRI are more likely to visualise larger nodes (>5 mm), whereas histology frequently reveals smaller metastases, including those in morphologically normal-appearing nodes. In our study, the average size of positive nodes on imaging exceeded that found on histology, a difference possibly attributable to tissue shrinkage during processing or the inherent limitations of imaging in identifying microscopic disease [12,15].

From a clinical perspective, precise nodal staging plays a crucial role in determining surgical margins, the extent of lymphadenectomy, and the need for neoadjuvant or adjuvant therapy. In colon cancer, the moderate sensitivity of CT suggests a risk of under-staging and potential undertreatment if imaging is relied upon exclusively. Conversely, the improved performance of CT + MRI in rectal cancer supports its use as part of a comprehensive preoperative work-up, particularly in guiding multidisciplinary treatment planning [13,14]. Nevertheless, histopathology remains essential for confirming nodal involvement and detecting small-volume metastases that could influence prognosis and management.

The present study has limitations that should be considered. The sample size was modest and derived from a single centre, which may limit the generalisability of our findings. Our imaging assessments were based solely on morphological criteria; advanced imaging techniques, such as diffusion-weighted MRI or radiomics-based analysis, were not included, despite evidence suggesting they may enhance diagnostic accuracy [16,17]. Additionally, while histopathology is considered the gold standard, the assessment of micrometastases can still be subject to observer variability.

Future work should focus on larger, multicentre studies and explore the integration of high-resolution MRI, PET/MRI, and artificial intelligence–driven image analysis to improve preoperative nodal staging [16,18]. Overall, our results suggest that combining CT and MRI offers superior accuracy for rectal cancer compared to CT alone in colon cancer, but histopathology remains indispensable for definitive staging.

Conclusion:

In this study, combining CT with MRI improved diagnostic sensitivity, specificity, and overall accuracy for detecting lymph node metastases in rectal cancer compared with the use of CT alone in colon cancer. The multimodality approach provided a more reliable preoperative assessment, which can aid in refining surgical planning and multidisciplinary treatment decisions. However, histopathological examination remains the definitive standard, particularly for identifying micrometastases and other small-volume nodal disease that may be missed on imaging. Further research involving larger, multicentre cohorts and incorporating advanced imaging technologies could enhance the precision of nodal staging in colorectal cancer and contribute to better patient outcomes.

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REFERENCES

1. Sung H, Ferlay J, Siegel RL, et al. Global cancer statistics 2020: GLOBOCAN estimates. CA Cancer J Clin. 2021;71(3):209–249.
2. Beets-Tan RGH, Lambregts DMJ, Maas M, et al. Magnetic resonance imaging for clinical management of rectal cancer. Nat Rev Gastroenterol Hepatol. 2018;15(10):665–676.
3. Dighe S, Purkayastha S, Swift I, et al. Diagnostic precision of CT vs MRI for colorectal cancer nodal staging: a meta-analysis. Radiology. 2017;282(2):345–355.
4. Akinci D, Akhan O, Ozmen MN, et al. Imaging of colorectal carcinoma. Eur J Radiol. 2020;131:109235.
5. Rollvén E, Holm T, Glimelius B, et al. Assessment and diagnostic accuracy of lymph node status to predict stage III colon cancer using CT. Cancer Imaging. 2017;17(1):3.
6. Bompou E, Vassiou A, Baloyiannis I, et al. Comparative evaluation of CT and MRI in the preoperative staging of colon cancer. Sci Rep. 2024;14:68147.
7. Wang Y, Ren J, Dong Y, et al. MRI radiomics with clinical data in evaluating LN metastasis in low T-stage rectal cancer. Front Oncol. 2023;13:1194120.
8. Hunter C, Jeyadevan N, Blake H, et al. MRI Evaluation of Rectal Cancer LN Staging Using ADC. J Magn Reson Imaging. 2023;57(2):435–442.
9. Zhang Y, Liu J, Sun K, et al. Lymph node staging in CRC using 18F-FDG PET/MRI: a meta-analysis. Eur J Med Res. 2023;28(1):1124.
10. Shkurti F, et al. Diagnostic accuracy of CT for lymph node metastases in colorectal cancer: A systematic review and meta-analysis. *Eur J Cancer*. 2023;189:1-12.
11. Rollvén E, et al. CT in nodal staging of colorectal cancer: a meta-analysis. *Eur Radiol*. 2019;29(6):2893-2903.
12. Zhuang Z, et al. MRI for lymph node staging in rectal cancer: systematic review and meta-analysis. *Front Oncol*. 2021;11:709070.
13. Uçar A, et al. Efficacy of high-resolution MRI in preoperative local staging of rectal cancer. *Mol Imaging Radionucl Ther*. 2016;25(1):1-8.
14. Bompou E, et al. Comparative performance of MRI and CT in colon cancer staging: prospective study. *Sci Rep*. 2024;14:68147.
15. Heo SH, et al. Nodal staging of rectal cancer: diagnostic performance of MRI criteria. *World J Gastroenterol*. 2015;21(15):4244-4252.
16. Bedrikovetski S, et al. Artificial intelligence and radiomics in colorectal cancer imaging: a review. *BMC Cancer*. 2021;21:144
17. Jhaveri KS, et al. Diffusion-weighted MRI for preoperative staging of rectal cancer: systematic review and meta-analysis. *AJR Am J Roentgenol*. 2015;205(1):42-53.
18. Ren Y, et al. Diagnostic value of 18F-FDG PET/MRI for lymph node metastases in colorectal cancer: meta-analysis. *Eur J Med Res*. 2023;28:187.