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# Magnetic Resonance Imaging in Differentiation of Gastrointestinal Tuberculosis and Crohn's Disease: Radiological and Histopathological Correlation.

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## Abstract

***Background:*** Distinguishing gastrointestinal tuberculosis (GI TB) from Crohn's disease (CD) remains a significant diagnostic challenge in tuberculosis-endemic regions due to overlapping clinical presentations and radiological features. This study evaluated whether magnetic resonance imaging (MRI) can reliably differentiate between these conditions using histopathological diagnosis as the definitive reference standard. ***Objective:*** To study the role of MRI in distinguishing between GITB and CD based on characteristic imaging findings. ***Methods:*** A prospective cross-sectional study enrolled 40 patients with imaging and clinical findings suggestive of either GI TB or CD. All patients underwent 3-Tesla MRI with comprehensive assessment of 15 imaging features. Histopathological examination provided the reference standard diagnosis. Sensitivity, specificity, predictive values, and interobserver agreement (kappa coefficient) were calculated to determine diagnostic test performance. ***Results:*** Among the 40 study participants, histopathological examination confirmed gastrointestinal tuberculosis (GI Tb) in 28 (70%) cases and Crohn's disease (CD) in 12 (30%) cases. Magnetic resonance imaging diagnosed Gastrointestinal Tuberculosis in 29 (72.5%) patients and Crohn Disease in 11 (27.5%) patients. A substantial agreement was observed between Magnetic resonance imaging -based diagnosis and histopathological findings ($\kappa = 0.695$, $p < 0.001$). Overall, Magnetic resonance imaging demonstrated a diagnostic accuracy of 87.5% (95% confidence interval: 82%–92%) in differentiating gastrointestinal Tuberculosis from Crohn Disease. For the diagnosis of Gastrointestinal Tuberculosis, Magnetic resonance imaging showed a sensitivity of 92.9%, specificity of 75.0%, positive predictive value (PPV) of 89.7%, and negative predictive value (NPV) of 81.8%. For the diagnosis of Crohn Disease, Magnetic resonance imaging demonstrated a sensitivity of 75.0%, specificity of 92.9%, PPV of 81.8%, and NPV of 89.7%. ***Conclusions:*** Analysis of imaging characteristics revealed that necrotic lymphadenopathy, asymmetric bowel wall thickening, and peritoneal involvement were significantly associated with Gastrointestinal Tuberculosis, whereas long-segment bowel involvement, layered mural enhancement, and mesenteric vascular prominence (comb sign) were more frequently observed in Crohn Disease. These findings highlight the value of MRI as a reliable non-invasive modality for differentiating Gastrointestinal Tuberculosis from Crohn Disease, with excellent overall diagnostic performance and substantial concordance with histopathological diagnosis. The specific imaging features identified provide reliable diagnostic markers for clinical decision-making.

**Keywords:** Gastrointestinal Tuberculosis, Crohn Disease, Magnetic Resonance Imaging, Differential Diagnosis, Histopathological Correlation, Diagnostic Accuracy.

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## INTRODUCTION

Gastrointestinal tuberculosis (GI TB) and Crohn's disease (CD) are both chronic granulomatous inflammatory conditions with a marked predilection for the ileocaecal region, and they produce overlapping symptoms such as abdominal pain, diarrhoea, and weight loss.[1] This clinical and anatomical resemblance, together with similar radiological appearances, makes the two conditions difficult to distinguish, a problem that is especially pressing in tuberculosis-endemic regions such as India, where GI TB remains common while CD is increasingly being recognised.[2]

Accurate differentiation matters because the two diseases demand fundamentally different treatment strategies: GI TB responds to conventional anti-tubercular chemotherapy with the potential for complete cure, whereas CD requires long-term immunosuppressive or biologic therapy with no prospect of cure.[3] Misdiagnosis in either direction can lead to inappropriate drug exposure, delayed treatment, and avoidable morbidity, and although tissue histology remains the definitive reference standard, endoscopic biopsy is invasive, carries procedural risk, and is not always accessible in resource-limited settings.[4]

Magnetic resonance imaging offers a non-invasive alternative that can characterise bowel wall architecture, signal changes, and mesenteric findings without ionizing radiation, making it attractive for use in younger patients who may need repeated assessment. However, its comparative diagnostic performance against histopathology in a direct GI TB-versus-CD cohort remains underexplored, particularly in high-prevalence tuberculosis settings.

## AIM OF THE STUDY

This investigation aimed to establish the diagnostic accuracy of MRI-based imaging criteria in differentiating gastrointestinal tuberculosis from Crohn's disease when histopathological findings serve as the reference standard. Secondary objectives included identification of specific imaging features with highest discriminatory value between these conditions.

## MATERIALS AND METHODS

### Study Design and Setting

This prospective cross-sectional diagnostic accuracy study was conducted at Era's Lucknow Medical College & Hospital over a 24-month period (January 2024 to December 2025). The institutional setting represents a tertiary-level teaching hospital serving a tuberculosis-endemic region in northern India, providing clinical context for evaluating imaging performance in populations where both conditions occur with clinically significant prevalence.[5]

### Selection of Participants

**Inclusion criteria**

1. symptomatic patients presenting with imaging findings consistent with chronic bowel wall thickening on ultrasonography (>3 mm in distended state; >5 mm in non-distended state)
2. clinical and imaging features suggesting either gastrointestinal tuberculosis or Crohn's disease
3. availability of histopathological confirmation of diagnosis
4. age range 18–70 years.[6]

**Exclusion criteria**

1. pregnant women (MRI safety considerations)
2. contraindications to magnetic resonance imaging (cardiac pacemakers, ferromagnetic implants, metallic foreign bodies)
3. incomplete or non-diagnostic histopathological examination results.
4. Forty consecutive symptomatic patients meeting selection criteria were enrolled. Diagnosis was established through standard histopathological examination of tissue obtained via clinical care procedures (endoscopic biopsy when available, surgical specimens when clinically indicated, or fine needle aspiration cytology [FNAC] when appropriate).

### Ethical and Consent Framework

This investigation received approval from the Institutional Ethics Committee of Era's Lucknow Medical College & Hospital prior to patient enrolment. Approval for the study was obtained from the Institutional Ethics Committee vide letter No. ECR/717/Ins./U.P./2015/RR-21 dated 10TH May 2024. Informed consent was obtained from all the patients.

### Imaging Acquisition and Analysis

All patients underwent magnetic resonance imaging on a 3-Tesla (3.0T) Siemens Magnetom Vida® system using a standardised enterographic protocol.[4] MRI diagnosis was formulated based on established institutional criteria previously validated in similar populations.[7] Diagnosis of intestinal tuberculosis was assigned when four or more of the following imaging features were demonstrated: (1) ileocaecal region involvement, (2) asymmetric short-segment bowel wall thickening, (3) T2-weighted (T2W) hypointense signal characteristics in the bowel wall, (4) necrotic rim-enhancing lymph nodes, (5) ascites, (6) peritoneal thickening. Conversely, CD diagnosis was established when four or more of these features were identified: (1) long-segment (>15 cm) continuous or near-continuous bowel involvement, (2) skip lesions (areas of normal bowel interspersed within diseased segments), (3) symmetric circumferential bowel wall thickening, (4) T2-weighted hyperintense mural oedema reflecting active inflammation, (5) stratified (target-like) post-contrast enhancement

pattern, (6) comb sign (engorged mesenteric vessels), (7) creeping fat appearance, (8) penetrating complications (fistulae, abscesses).[6]

**Histopathological Reference Standard**

Following MRI imaging, patients underwent diagnostic procedures as clinically indicated. Histopathological examination of obtained tissue provided the definitive reference standard diagnosis. All histology was reviewed by experienced pathologists blinded to MRI results where operationally feasible.

**Statistical Methods**

Data management and analysis utilised Microsoft Excel 2023 software with statistical testing conducted using IBM SPSS Statistics version 21.0. Categorical demographic variables were summarised as frequencies and percentages. Continuous variables were expressed as mean ± standard deviation (SD) with accompanying range, and median with interquartile range (IQR). Diagnostic test performance was quantified using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy. Inter-method agreement between final diagnosis and MRI diagnosis was assessed using kappa coefficient.[8,9] Statistical significance was defined as $p<0.05$.

## RESULTS

**Patient Cohort Characteristics**

The study population comprised 40 symptomatic patients (18 males, 22 females; male-to-female ratio 0.82:1) ranging in age from 22 to 70 years (mean 42.40±15.53 years; median 36 years; interquartile range 30–56.5 years). Age distribution revealed predominance in younger age groups: 31–40 years (30%), 21–30 years (27.5%), 61–70 years (20%), 41–50 years (12.5%), and 51–60 years (10%). Histopathological confirmation established GI TB diagnosis in 28 patients (70%) and CD diagnosis in 12 patients (30%).[10]

Clinical presentation across the cohort demonstrated similar symptomatic patterns: abdominal pain (95%), fever (75%), anaemia (42.5%), vomiting (37.5%), weight loss (35%), and night sweats (35%).[3] Notably, vomiting as a presenting complaint showed statistically significant association with GI TB diagnosis ($p=0.025$), occurring in 89.3% of TB patients compared to 58.3% of CD patients, suggesting potential clinical value as a screening feature in endemic regions.[11]

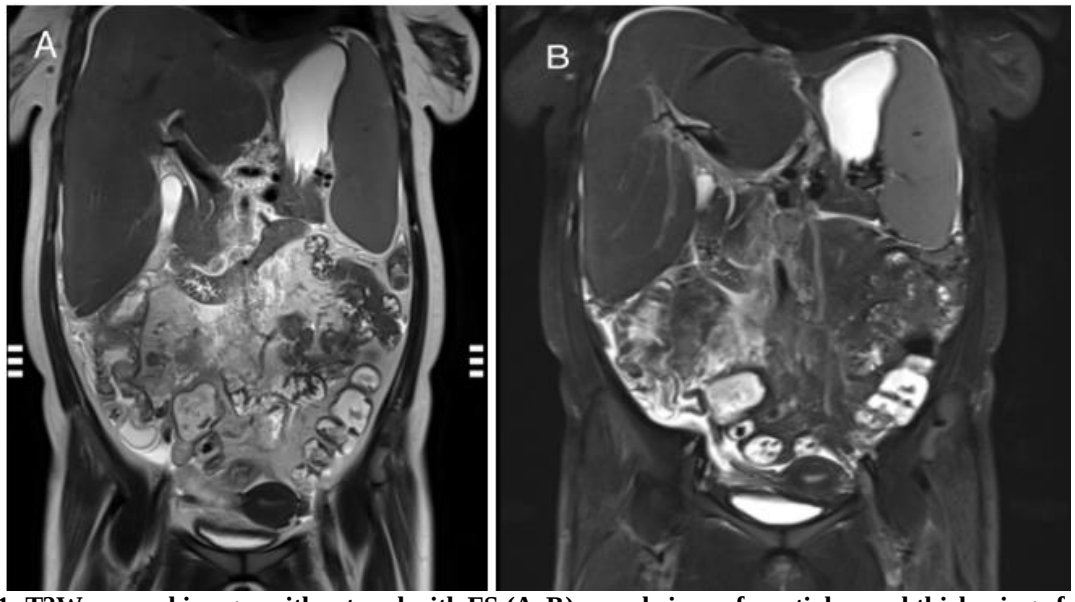



**Figure 1: T2W coronal images without and with FS (A, B) reveal circumferential mural thickening of caecum, ascending colon and ileocecal region in a GI TB patient**

**Imaging Feature Analysis**

Evaluation of 15 distinct MRI features revealed the following frequency distribution across the entire cohort: ileocaecal involvement (65%), necrotic lymph nodes (60%), asymmetric short-segment thickening (55%), ascites (50%), lymphadenopathy (47.5%), peritoneal thickening (47.5%), skip lesions (45%), T2-weighted hypointense bowel wall (42.5%), symmetric circumferential thickening (42.5%), long-segment involvement exceeding 15 cm (40%), stratified target-pattern enhancement (30%), comb sign (27.5%), creeping fat (20%), and penetrating complications (10%).[12]

Statistical comparison of imaging feature frequencies between disease groups revealed features significantly associated with gastrointestinal tuberculosis: ileocaecal involvement (78.6% TB versus 45.5% CD; p=0.006), asymmetric short-segment wall thickening (71.4% versus 16.7%; p=0.001), T2-weighted hypointense signal characteristics (57.1% versus 8.3%; p=0.004), necrotic lymph nodes (78.6% versus 16.7%; p<0.001), ascites (60.7% versus 25.0%; p=0.038), and peritoneal thickening (60.7% versus 16.7%; p=0.011).[13]

Conversely, imaging features significantly associated with Crohn's disease included: long-segment bowel involvement exceeding 15 cm (75.0% CD versus 25.0% TB; p=0.003), T2-weighted hyperintense mural oedema (58.3% versus 25.0%; p=0.043), stratified target-pattern post-contrast enhancement (58.3% versus 17.9%; p=0.010), and comb sign appearance (66.7% versus 10.7%; p<0.001).[14,15]

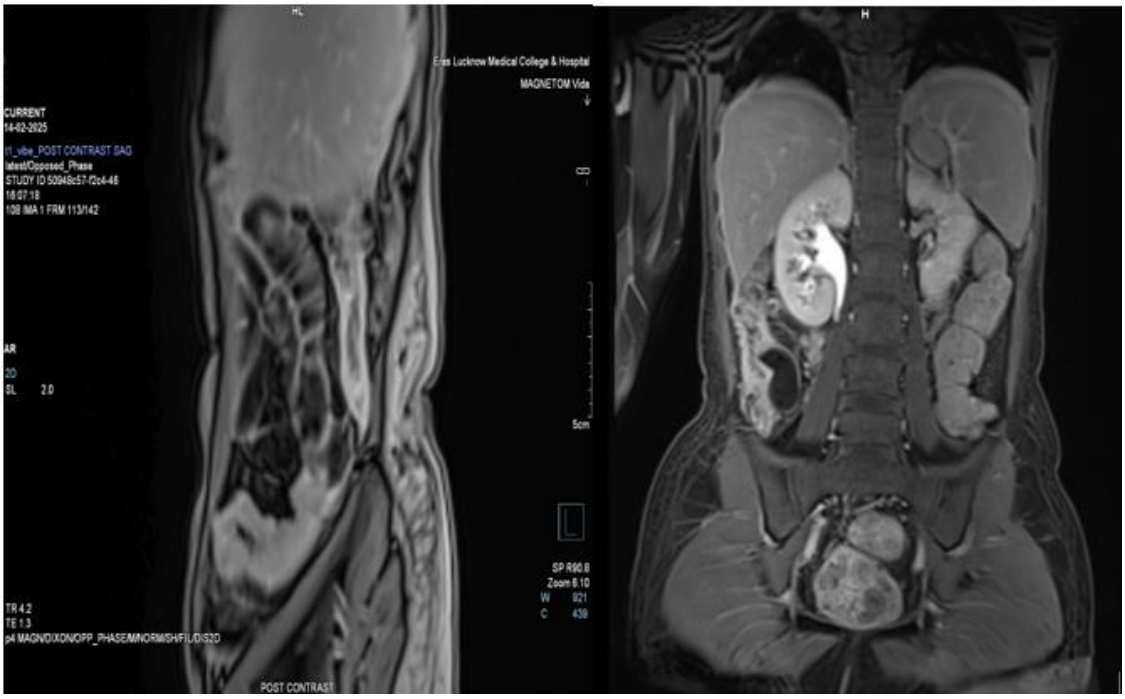



**Figure2: T1 VIBE POST CONTRAST shows INFLAMMATION OF CAECUM**

**Diagnostic Accuracy of MRI**

The overall diagnostic accuracy of MRI in differentiating gastrointestinal tuberculosis from Crohn's disease was 87.5% (35/40 patients correctly classified).[13] For CD diagnosis: sensitivity was 75.0% (9/12 true positives among histopathologically confirmed CD cases), specificity was 92.9% (26/28 true negatives among non-CD cases), positive predictive value was 81.8% (9/11 MRI-positive cases confirmed as true CD), negative predictive value was 89.7% (26/29 MRI-negative cases confirmed as non-CD), and overall accuracy was 87.5%.[8]

For GI TB diagnosis: sensitivity was 92.9% (26/28 true positives among histopathologically confirmed TB cases), specificity was 75.0% (9/12 true negatives among non-TB cases), positive predictive value was 89.7% (26/29 MRI-positive cases confirmed as true TB), negative predictive value was 81.8% (9/11 MRI-negative cases confirmed as non-TB), and overall accuracy was 87.5%.[9] Agreement between MRI-based diagnosis and histopathological reference standard demonstrated substantial concordance ($\kappa$=0.695; p<0.001), indicating that the imaging classification system employed provides reliable diagnostic information exceeding chance agreement.[9,16]

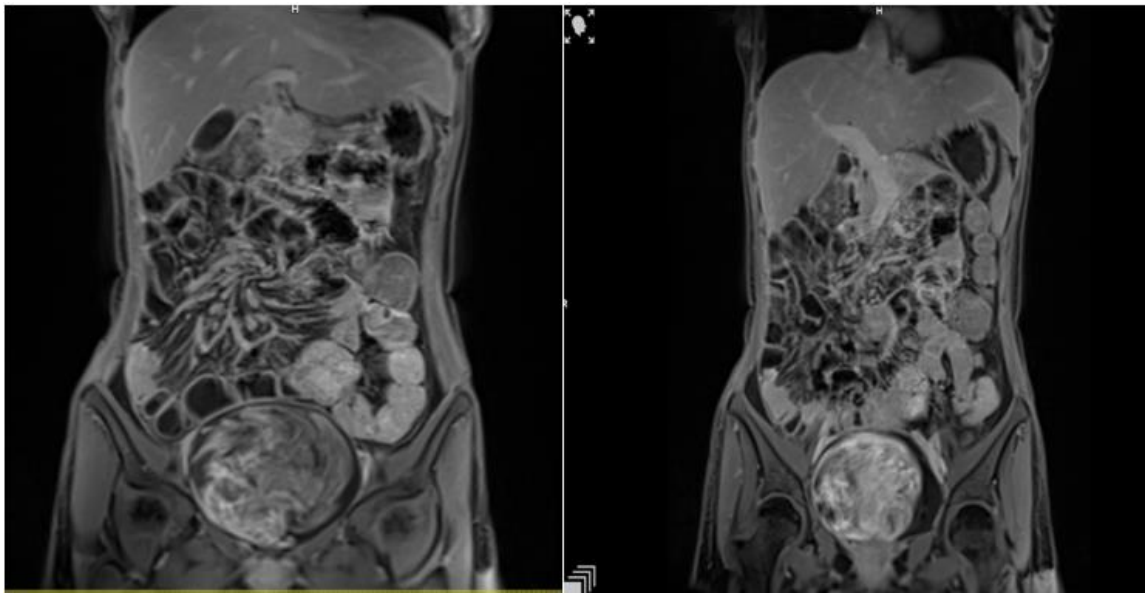


**Figure 3: T1 VIBE DIXON shows COMB'S sign and LYMPHADENOPATHY in a Crohn's disease patient**

**Table 1: Association of MRI Findings with histopathological/FNAC diagnosis**

| Sl. No. | MRI Findings | Crohn's disease (n=12) | | Gastrointestinal tuberculosis (n=28) | | Statistical significance | |
|---|---|---|---|---|---|---|---|
| | | No. | % | No. | % | $\chi^2$ | 'p' |
| 1. | Ileocaecal involvement | 4 | 45.5 | 22 | 78.6 | 7.556 | 0.006 |
| 2. | Asymmetric short segment thickening | 2 | 16.7 | 20 | 71.4 | 10.18 | 0.001 |
| 3. | T2 hypointense bowel wall | 1 | 8.3 | 16 | 57.1 | 8.189 | 0.004 |
| 4. | Lymphadenopathy | 4 | 33.3 | 15 | 53.6 | 1.380 | 0.240 |
| 5. | Necrotic lymph node | 2 | 16.7 | 22 | 78.6 | 13.41 | <0.001 |
| 6. | Ascites | 3 | 25.0 | 17 | 60.7 | 4.286 | 0.038 |
| 7. | Peritoneal thickening | 2 | 16.7 | 17 | 60.7 | 6.535 | 0.011 |
| 8. | Long segment (>15 cm) | 9 | 75.0 | 7 | 25.0 | 8.750 | 0.003 |
| 9. | Skip lesions | 8 | 66.7 | 10 | 35.7 | 3.252 | 0.071 |
| 10. | Symmmetric circumferential thickening | 6 | 50.0 | 11 | 39.3 | 0.395 | 0.530 |
| 11. | T2 hyperintense mural edema | 7 | 58.3 | 7 | 25.0 | 4.103 | 0.043 |
| 12. | Stratified (target) enhancement | 7 | 58.3 | 5 | 17.9 | 6.553 | 0.010 |
| 13. | Comb sign | 8 | 66.7 | 3 | 10.7 | 13.190 | <0.001 |
| 14. | Creeping fat | 3 | 25.0 | 5 | 17.9 | 0.268 | 0.605 |
| 15. | Penetrating complications | 1 | 8.3 | 3 | 10.7 | 0.053 | 0.818 |

**Table 2: Diagnostic efficacy of MRI against Histopathological/FNAC diagnosis of Crohn's disease**

| MRI Diagnosis of Crohn's disease | Histopathological/FNAC diagnosis of Crohn's Disease | | Total |
|---|---|---|---|
| | Positive | Negative | |
| Positive | 9 | 2 | 11 |
| Negative | 3 | 26 | 29 |
| **Total** | **12** | **28** | **40** |

| Sensitivity | Specificity | PPV | NPV | Accuracy |
|---|---|---|---|---|
| 75.0 | 92.9 | 81.8 | 89.7 | 87.5 |
| $\kappa$=0.695; p<0.001 | | | | |

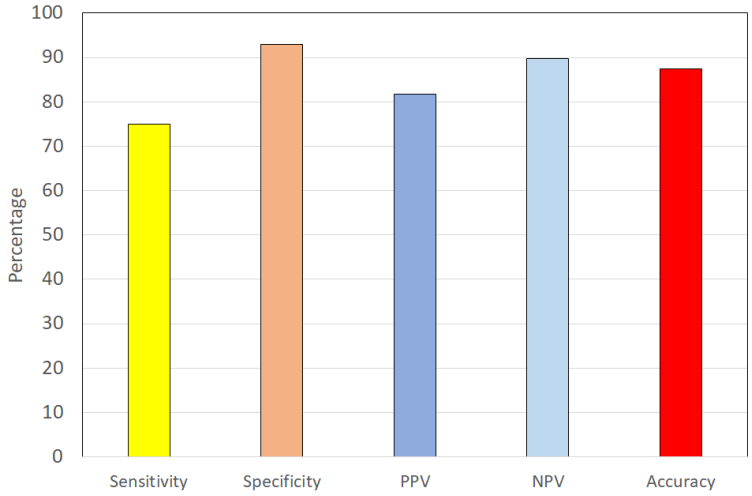



**Figure 1: Diagnostic efficacy of MRI against Histopathological/FNAC for diagnosis of Crohn's disease**

**Table 3: Demographic and Clinical Characteristics of patients (n=40)**

| Sl. No. | Characteristic | Statistic |
|---|---|---|
| 1. | Mean Age ± SD (Range) in years Median age [IQR] | 42.40±15.53 (22-70) 36 [30, 56.5] |
| 2. | Male: Female | 18 (45%):22 (55%) |
| 3. | Presenting complaints | |
| | Abdominal colicky pain | 38 (95.0%) |
| | Fever | 30 (75.0%) |
| | Anemia | 17 (42.5%) |
| | Vomiting | 15 (37.5%) |
| | Weight loss | 14 (35.0%) |
| | Night sweats | 14 (35.0%) |
| 4. | ATT history | 15 (37.5%) |
| 5. | Family history of tuberculosis | 22 (55.0%) |
| 6. | Personal history of tuberculosis | 16 (40.0%) |
| 7. | No history of tuberculosis/contact | 13 (32.5%) |
| 8. | Tobacco use/smoking history | 19 (47.5%) |

## DISCUSSION

This investigation demonstrates that enterographic MRI achieves 87.5% overall diagnostic accuracy in differentiating gastrointestinal tuberculosis from Crohn's disease.[17,18] The complementary diagnostic performance profiles-92.9% sensitivity for TB with 75% specificity, contrasting with 75% sensitivity for CD but 92.9% specificity-reflect distinct patterns that optimise disease-specific detection.[19] These findings suggest MRI could serve as an effective adjunctive diagnostic tool for populations where both conditions occur.[19]

MRI demonstrated excellent sensitivity for diagnosing GI TB (92.9%) and excellent specificity for diagnosing CD (92.9%), indicating strong performance in identifying tuberculosis while minimizing false-positive classification of Crohn's disease. This indicate that MRI-based diagnostic criteria successfully identify tuberculous involvement whilst minimizing false-negative classification, a critical performance characteristic in clinical contexts where missed tuberculosis diagnosis carries substantial morbidity implications.[14] The corresponding specificity of 92.9% for CD recognition minimises erroneous assignment of tuberculosis patients to Crohn's disease diagnoses, thereby reducing inappropriate initiation of immunosuppressive therapy in immunocompromised TB patients.[4]

Among the 15 imaging features evaluated, necrotic lymph node changes emerged as the strongest discriminatory marker, present in 78.6% of GI TB versus merely 16.7% of CD cases ($p<0.001$).[17,20] This finding reflects fundamental pathologic distinction: tuberculosis produces caseating granulomatous inflammation leading to central lymph node necrosis and liquefaction, whereas CD generates non-caseating granulomas without tissue necrosis.[20] This imaging-histology correlation validates our hypothesis that specific MRI signal patterns reflect underlying pathologic differences, enabling non-invasive differentiation between these distinct disease entities.[19]

Asymmetric short-segment bowel wall thickening predominated in GI TB (71.4% versus 16.7% in CD; p=0.001), reflecting the characteristically focal nature of tuberculous inflammation.[13] TB lesions typically produce circumscribed areas of bowel involvement separated by intervening normal or relatively normal segments, yielding asymmetric wall contours. This contrasts fundamentally with CD, which produces transmural inflammation extending across longer bowel segments and creating more uniform circumferential thickening patterns.[15,21-23]

Extensive longitudinal bowel involvement exceeding 15 cm characterised CD patients (75% versus 25% TB; p=0.003). This radiological finding reflects the transmural inflammatory pattern in CD, which produces continuous or near-continuous wall involvement, whereas GI TB characteristically produces focal, segmental areas of inflammation separated by intervening normal bowel.[12,18] The comb sign-representing pathologic hypertrophy of mesenteric vessels supplying inflamed bowel segments-demonstrated strong association with CD (66.7% versus 10.7% in TB; p<0.001).[12,24] This vascular finding reflects the chronic neovascularisation response to sustained transmural inflammation, a pathologic hallmark of CD that distinguishes it from the more focal vascular changes in tuberculous disease.[24,25]

The substantial agreement between MRI classification and histopathological diagnosis (κ=0.695; p<0.001) provides independent validation of our imaging diagnostic approach.[8] This inter-method agreement level, whilst not perfect, considerably exceeds chance agreement and supports the diagnostic utility of the imaging criteria employed in this investigation.[9]

Clinical presentation patterns demonstrated some differentiation: vomiting occurred significantly more frequently in TB patients (89.3%) compared to CD patients (58.3%; p=0.025),[20] potentially reflecting greater frequency of gastric involvement or outlet obstruction from TB lesions. These imaging findings align with established radiological and pathological knowledge of disease-specific features.[1] The diagnostic approach employed-requiring four or more features from a defined set-demonstrated good diagnostic accuracy and could provide practical value in routine clinical settings.[6]

MRI's diagnostic advantage over conventional imaging relates to its unique technical characteristics: (1) multiplanar imaging capability enabling precise assessment of bowel wall layering and stratification patterns, (2) inherent soft tissue contrast superiority optimal for detecting subtle inflammatory changes, (3) absence of ionizing radiation—particularly important in younger patients with potential for serial imaging during therapeutic monitoring, and (4) capacity for functional imaging with diffusion-weighted sequences potentially offering additional pathophysiologic insights.[12,24] These advantages prove particularly relevant in tuberculosis-endemic regions where young patients may require repeated imaging assessments during anti-tubercular therapy to confirm treatment response or investigate inadequate clinical improvement.[7,17]

Certain limitations warrant acknowledgement: this single-institution series involved relatively modest patient numbers, exclusively investigated a TB-endemic population, and relied upon imaging criteria derived from institutional experience rather than multicentre consensus standards.[2] Prospective validation in independent patient cohorts and diverse geographic settings would strengthen confidence in the diagnostic approach proposed.[2].

## CONCLUSION

Magnetic resonance imaging showed excellent diagnostic accuracy (87.5%) for differentiating gastrointestinal tuberculosis from Crohn's disease, with high sensitivity for detecting TB (92.9%), high specificity for detecting CD (92.9%), and substantial agreement with histopathological diagnosis (κ=0.695, p<0.001). Necrotic lymphadenopathy, asymmetric short-segment wall thickening, and peritoneal involvement favoured a diagnosis of GI TB, whereas long-segment involvement, layered mural enhancement, and the comb sign favoured CD. These complementary imaging signatures allow MRI to serve as a reliable, radiation-free adjunct to histopathology, particularly useful for initial triage and for monitoring in tuberculosis-endemic settings where invasive testing is not always feasible. Larger, multicentre studies are needed to validate these imaging criteria before they are adopted into routine diagnostic algorithms. In practice, the take-home message is straightforward: a systematic MRI assessment of these discriminating features can meaningfully narrow the differential between GI TB and CD and guide earlier, more appropriate treatment.

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**Conflict of Interest**

The authors declare no conflicts of interest.

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**Data Availability**

The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request.

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