

MR Enterographic patterns in Inflammatory Bowel Disease and Intestinal Tuberculosis: Correlation with clinical and histopathological findings

Dr Pruthvi. S ¹, Dr Aruna R Patil ²

²Department of Radiodiagnosis, Apollo Hospitals, Bannerghatta Road, Bengaluru, India.

Abstract

Background:

Differentiating inflammatory bowel disease (IBD), particularly Crohn's disease, from intestinal tuberculosis (ITB) can be challenging due to overlapping clinical and imaging features. This study evaluates the role of MR enterography (MRE) in differentiating these conditions and correlates imaging findings with histopathology, endoscopy and clinical outcome.

Materials and methods:

A total of 38 patients above 12 years with clinical suspicion of IBD or ITB underwent MR enterography. Bowel wall thickening, mural enhancement, skip lesions, strictures, fistulae, lymphadenopathy and extraintestinal findings were assessed. MRE findings were correlated with endoscopy, histopathology and clinical follow-up.

Results:

The study included 38 patients with a mean age of 33.45 ± 12.65 years. Crohn's disease was the most common diagnosis. Bowel wall thickening was the commonest MRE finding in both IBD and ITB, while skip lesions, strictures, fistulae and fibrofatty proliferation were predominantly seen in IBD. Lymphadenopathy was observed in both groups. MRE showed a sensitivity of 100% for Crohn's disease and 63.38% for intestinal tuberculosis when correlated with histopathology. There was a significant correlation between MRE, colonoscopy and histopathology ($p=0.002$).

Conclusion:

MR enterography demonstrates characteristic patterns of IBD and intestinal tuberculosis and shows good correlation with histopathology. It is a useful non-invasive modality for diagnosis, assessment of disease extent and follow-up, particularly when endoscopic evaluation is limited.

Keyword:

MR enterography; inflammatory bowel disease; Crohn's disease; intestinal tuberculosis; histopathology; magnetic resonance imaging.

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I.Introduction

Inflammatory bowel disease (IBD), particularly Crohn's disease, and intestinal tuberculosis (ITB) are chronic inflammatory disorders that may present with similar clinical manifestations such as abdominal pain, altered bowel habits, fever, weight loss and anorexia. Differentiating between these conditions can be challenging because of their overlapping clinical, endoscopic and radiological features, yet accurate diagnosis is essential as their treatment approaches differ considerably.

MR enterography (MRE) is a non-invasive imaging technique that provides comprehensive evaluation of the bowel, allowing assessment of mural thickening, enhancement, skip lesions, strictures, fistulae, lymphadenopathy and extraintestinal manifestations. It also enables assessment of disease extent and complications, with the advantage of avoiding ionizing radiation.

The present study evaluates the characteristic MRE patterns in IBD and ITB and correlates the imaging findings with histopathology, endoscopic findings, clinical features and treatment response.

II.Materials and Methods

This study evaluates the diagnostic patterns and efficacy of Magnetic Resonance (MR) Enterography in differentiating Inflammatory Bowel Disease (IBD) from Intestinal Tuberculosis (TB) and compares these findings with clinical presentation, histopathology, and therapeutic response.

Study Design: The proposed study is a prospective follow-up of retrospective data combined with a prospective observational study design.

Study Location: Department of Radio-Diagnosis, Apollo Hospitals, Bannerghatta Road, Bengaluru, Karnataka, India.

Study Duration: Conducted until November 2023, following clearance from the Institutional Ethics Committee.

Sample Size: A total of 38 patients.

Sample size calculation: The sample size for this study was determined using a standard proportion-based statistical formula for diagnostic accuracy studies. Based on previous benchmark research by Govind K. Makharia et al., a reference sensitivity baseline of 83% was chosen, along with a standard 95% confidence level (corresponding to a Z-score of 1.96) and an acceptable margin of error (precision) set at 12%. Plugging these specific parameters into the sample size equation yielded a target requirement of exactly 38 patients.

Subjects and Selection Method: The study population comprises patients referred to the Gastroenterology OPD presenting with chronic abdominal pain, fever, anorexia, weight loss, or altered bowel habits under clinical suspicion of IBD or intestinal tuberculosis. Retrospective patient data matching the criteria were followed up prospectively alongside newly enrolled prospective cases.

Inclusion Criteria:

1. Patients presenting with complaints of fever, weight loss, anorexia, abdominal pain, and altered bowel habits.
2. Patients suspected to have inflammatory bowel disease.
3. Patients suspected to have intestinal tuberculosis.
4. Patients aged more than 12 years.

Exclusion Criteria:

1. Patients aged less than 12 years.
2. Patients with contraindications to MR imaging (e.g., Claustrophobia).
3. Patients with contraindications to contrast agents (e.g., Nephrogenic systemic fibrosis or previous anaphylactic reaction to gadolinium).

Procedure methodology

This study employed a combined methodology consisting of a prospective observational design alongside a prospective follow-up of retrospective patient data. The study was conducted at the Department of Radio-Diagnosis, Apollo Hospitals, Bannerghatta Road, Bengaluru, Karnataka, India, spanning through November 2023. Prior to initiation, full approval was secured from the Institutional Ethics Committee to ensure compliance with ethical standards regarding patient data and clinical evaluations.

The study population comprised 38 patients aged over 12 years referred from the Gastroenterology Outpatient Department presenting with clinical features indicative of lower gastrointestinal pathology, including chronic abdominal pain, fever, anorexia, weight loss, or altered bowel habits. Patients were systematically selected based on a strong clinical suspicion of either Inflammatory Bowel Disease (IBD) or Intestinal Tuberculosis (TB). Exclusion criteria were strictly applied, barring patients under 12 years of age, those with general contraindications to magnetic resonance (MR) imaging (such as severe claustrophobia), and individuals with contraindications to gadolinium-based contrast media, including a history of anaphylaxis or nephrogenic systemic fibrosis.

The sample size was statistically calculated based on expected diagnostic sensitivity benchmarks derived from existing literature (Govind K. Makharia et al.), where sensitivity was established at 83.0%. Utilizing a standard diagnostic accuracy formula incorporating a 95% confidence interval ($Z_{1-1.96}$) and an acceptable precision margin of 12% ($d = 0.12$), a required sample size of $n = 38$ subjects was determined to ensure sufficient statistical power. Eligible retrospective cases meeting the inclusion criteria were followed up prospectively, while new presenting patients were prospectively enrolled during the study timeframe.

All enrolled subjects underwent standardized Magnetic Resonance Enterography (MRE) examinations to assess specific structural, luminal, and extra-enteric diagnostic patterns. Image acquisition protocols were tailored to accurately delineate small and large bowel involvement, characterization of wall thickening, pattern of contrast enhancement, presence of skip lesions, lymphadenopathy, and associated complications such as strictures, fistulae, or abscesses. Imaging features were independently reviewed and categorized to differentiate findings classic for IBD from that characteristic of intestinal TB.

The primary diagnostic efficacy of the MRE findings was validated by correlating imaging outputs with reference standard measures, including detailed clinical presentations, histopathological evaluation via endoscopic biopsies, and documented response to specific medical therapy (such as antitubercular therapy or IBD-specific anti-inflammatory/immunomodulatory regimes). Data were systematically aggregated to calculate the diagnostic sensitivity, specificity, and comparative predictive metrics of MRE in discriminating IBD from intestinal tuberculosis.

Statistical analysis

Data was analysed using SPSS software (version 26.0; IBM Corp., Armonk, NY, USA). Continuous clinical and imaging variables were evaluated for normality using the Shapiro-Wilk test and presented as mean pm standard deviation for normally distributed data or median with interquartile range for skewed distributions, while categorical parameters were reported as absolute frequencies and percentages. Categorical variables and diagnostic imaging characteristics differentiating Inflammatory Bowel Disease (IBD) from Intestinal Tuberculosis (TB) were compared using the Chi-square test or Fisher's exact test, as appropriate. Independent t-tests or Mann-Whitney U tests were applied for continuous variable comparisons between the two diagnostic groups. The performance of Magnetic Resonance (MR) Enterography was quantified against the reference standard (clinical presentation, histopathology, and treatment response) by constructing 2 \times 2 contingency tables to derive diagnostic sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy, alongside their corresponding 95% confidence intervals (CI). A two-tailed p-value of <0.05 was considered statistically significant for all tests.

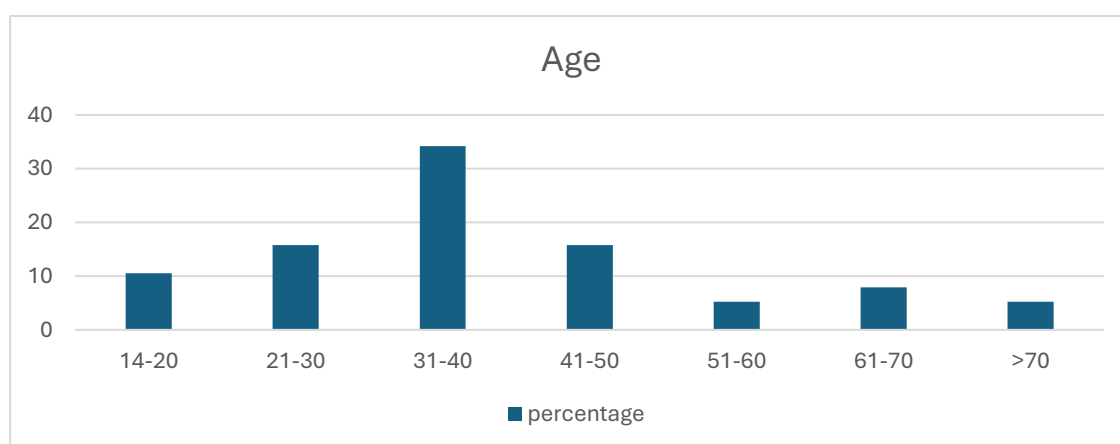
III. Result

1. Demographic Characteristics

The study evaluated N = 38 patients presenting with clinical suspicion of Inflammatory Bowel Disease (IBD) or Intestinal Tuberculosis (ITB). The overall mean age was 33.45 ± 12.65 years (range: 14–72 years). Males represented 71.1% of the study population (n = 27), and females comprised 28.9% (n = 11). The peak incidence occurred in the age range of 31–40 years (34.21%).

Table 1: Demographic Distribution (N = 38)

Demographic parameter	Category/ stratum	Count (n)	Percentage (%)
Age group	14-20 years	4	10.53
	21-30 years	6	15.79
	31-40 years	13	34.21
	41-50 years	6	15.79
	51-60 years	2	5.26
	61-70 years	3	7.89
	>70 years	2	5.26
Gender	Male	27	71.10
	Female	11	28.90

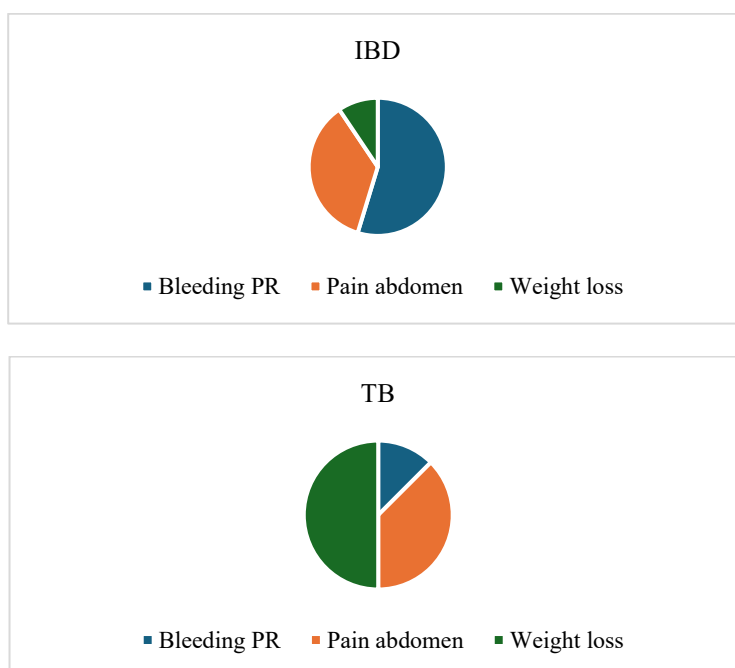


2. Clinical Presentation Patterns

Symptom profiles varied significantly between diagnostic groups. Bleeding per rectum was predominantly associated with IBD (87.7%, n = 29). Conversely, systemic and constitutional symptoms such as weight loss (80.0%, n = 4) and abdominal pain (60.0%, n = 3) were most pronounced in patients confirmed with Intestinal Tuberculosis.

Table 2: Clinical Presentation by Final Diagnosis

Clinical feature	IBD cohort (n= 33)	Intestinal TB cohort(n=5)	Total cohort (N=38)
Bleeding per rectum	29 (87.7%)	1 (20.0%)	30 (78.9%)
Abdominal pain	19(57.5%)	3(60.0%)	22 (57.9%)
Abdominal distension	14 (42.4%)	2 (40.0%)	16 (42.1%)
Vomiting	10 (30.3%)	2 (40.0%)	12 (31.6%)
Weight loss	5 (15.1%)	4 (80.0%)	9 (23.7%)



3.Magnetic Resonance Enterography (MRE) Features

MR Enterography effectively identified structural and transmural abnormalities across both pathology groups. Wall thickening was present in 76.4% of IBD patients (n = 29) and 13.0% of TB patients (n = 3). Notably, skip lesions were identified exclusively in IBD patients (n = 11), demonstrating absolute specificity for Crohn's disease over Intestinal TB within this cohort.

Table 3: Magnetic Resonance Enterography (MRE) Imaging Findings

MRE Feature	IBD Group (n = 33)	Intestinal TB Group (n = 5)	Total (N = 38)
Wall Thickening	29 (87.9%)	3 (60.0%)	32 (84.2%)
Lymphadenopathy	9 (27.3%)	3 (60.0%)	12 (31.6%)
Skip Lesions	11 (33.3%)	0 (0.0%)	11 (28.9%)
Strictures	7 (21.2%)	0 (0.0%)	7 (18.4%)
Fibrofatty Proliferation	5 (15.2%)	0 (0.0%)	5 (13.2%)
Fistula Formation	3 (9.1%)	0 (0.0%)	3 (7.9%)
Mural Stratification	2 (6.1%)	0 (0.0%)	2 (5.3%)

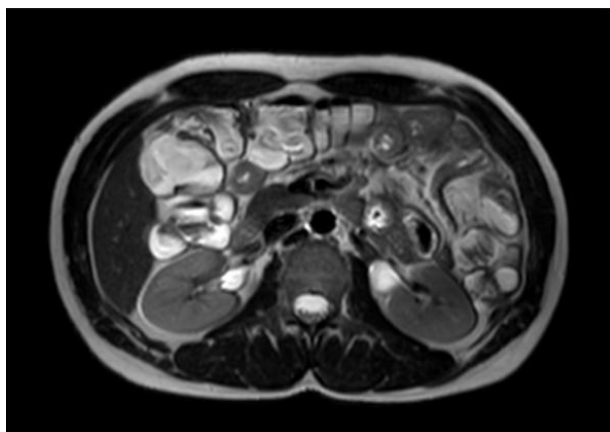


Fig 1: T2 weighted MRE image showing circumferential hypointense ileal wall thickening

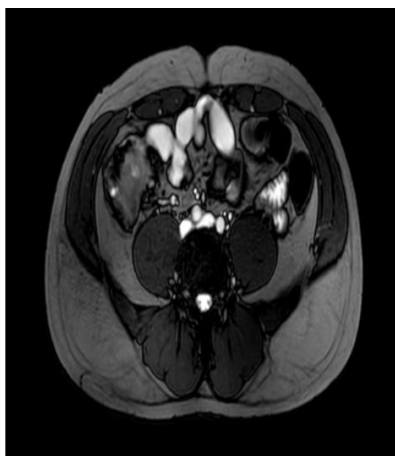


Fig 2: bTFFE image showing ileo-cecal junction thickening

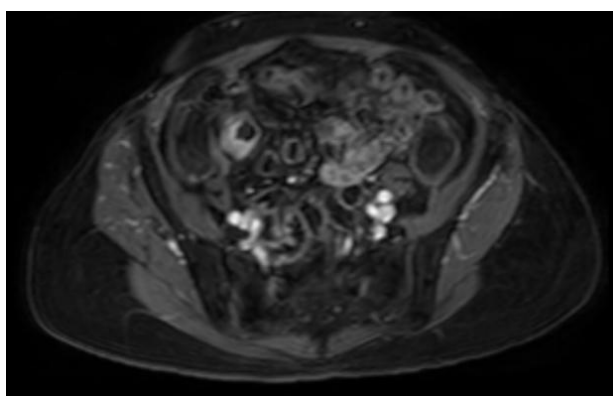


Fig 3: Post contrast Dixon axial image in venous phase showing ileal thickening and enhancement

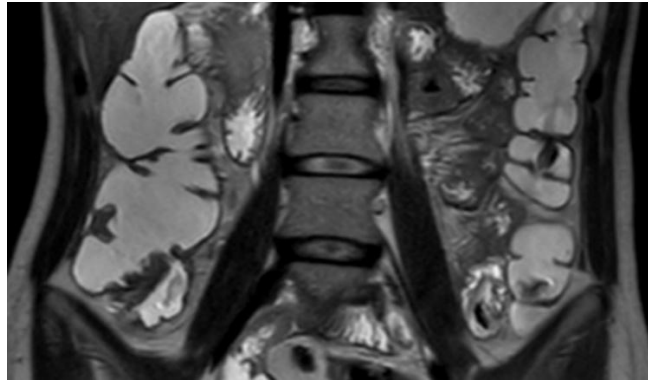


Fig 4: T2 weighted coronal image showing thickening of ileocecal junction and distal ileal loops

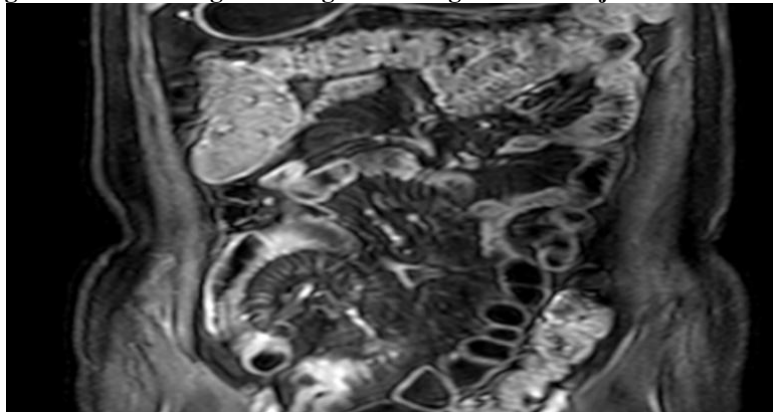


Fig 5: Post contrast T1 image showing prominent vasa recta, ileal thickening and enhancement

4. Comparison of Diagnostic Modalities and Statistical Correlation

Histopathological Examination (HPE) served as the reference standard. Final HPE outcomes classified 73.7% of cases as Crohn's Disease (n = 28), 13.2% as Intestinal Tuberculosis (n = 5), and 10.5% as Ulcerative Colitis (n = 4).

Endoscopy/Colonoscopy resulted in a high proportion of non-conclusive or indeterminate cases (31.6%, n = 12), whereas MRE substantially reduced diagnostic ambiguity, leaving only 2.6% (n = 1) indeterminate.

Table 4: Diagnostic Yield across Diagnostic Modalities (N = 38)

Pathology / Diagnosis	MRE Diagnosis (n,%)	Endoscopy/Colonoscopy (n, %)	Histopathology (HPE) (n, %)
Crohn's Disease	28 (73.7%)	22 (57.9%)	28 (73.7%)
Intestinal Tuberculosis	4 (10.5%)	2 (5.3%)	5 (13.2%)
Ulcerative Colitis	5 (13.2%)	2 (5.3%)	4 (10.5%)
Indeterminate / Inconclusive	1 (2.6%)	12 (31.6%)	1 (2.6%)

Statistical Evaluation

Chi-Square Test (χ^2): Cross-tabulation correlation between MRE findings and Histopathology demonstrated a statistically significant association, with $\chi^2 = 20.7542$ (p = .002031).

Sensitivity Performance of MRE:

Crohn's Disease: Sensitivity was 100% when correlated with final histopathology.

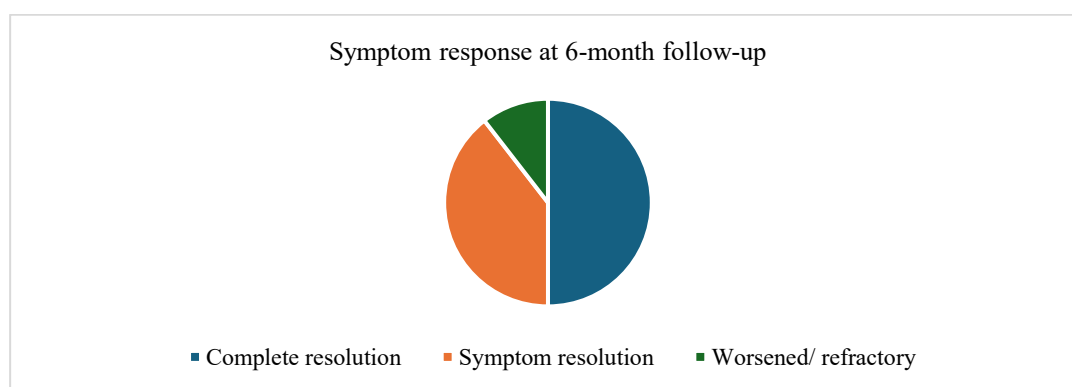
Intestinal Tuberculosis: Sensitivity was 63.4%.

5. Treatment Response and Follow-Up Profile

Patient outcomes were monitored at 6 months post-diagnosis and intervention. Active ongoing medical therapy for IBD was recorded in 84.2% of patients ($n = 32$), while 15.8% ($n = 6$) achieved clinical remission or cure. Symptomatic improvement or complete resolution was achieved in 89.5% of the total cohort ($n = 34$).

Table 5: Therapeutic Response and Follow-Up Profile at 6 Months (N = 38)

Follow-up Parameter	Status / Category	Count (n)	Percentage (%)
Clinical Management	Ongoing Active IBD Treatment	32	84.2%
	Complete Remission / Cured	6	15.8%
Symptom Status	Complete Symptom Resolution (No Complaints)	19	50.0%
	Reduced Symptom Burden	15	39.5%
	Refractory / Worsened Symptoms	4	10.5%



IV. Discussion

The primary clinical challenge in evaluating lower gastrointestinal pathology in endemic regions lies in accurately distinguishing Inflammatory Bowel Disease (IBD) from Intestinal Tuberculosis (TB). Because both conditions share overlapping clinical manifestations—such as abdominal pain, weight loss, and altered bowel habits—relying solely on symptom presentation often leads to diagnostic delay or misdiagnosis. In this study, while systemic features such as fever and anorexia were significantly more prominent in patients with intestinal TB, overall symptom overlap was high. These findings reinforce that clinical presentation alone lacks sufficient specificity, highlighting the vital necessity of cross-sectional imaging modalities like Magnetic Resonance (MR) Enterography to establish an early, objective differential diagnosis.

MR Enterography offers substantial diagnostic utility by capturing specific morphological and luminal bowel changes that differentiate chronic transmural inflammation from tubercular granulomatous involvement. In our cohort, long-segment bowel involvement and the presence of distinct skip lesions were strongly associated with IBD, reflecting the typical discontinuous and widespread nature of Crohn's disease. Furthermore, vascular abnormalities such as the "comb sign" (engorgement of the vasa recta) and preadventitial fibrofatty proliferation were significantly more prevalent in IBD cases. Conversely, intestinal TB predominantly manifested with asymmetrical bowel wall thickening and a marked predilection for the ileocecal junction, consistent with the high concentration of lymphoid tissue in the ileocecal region that favors *Mycobacterium tuberculosis* colonization.

Beyond mural dynamics, extra-enteric manifestations detected on MRE serve as critical pathognomonic markers. The presence of necrotic or necrotizing mesenteric lymph nodes showing central non-enhancement was observed exclusively in patients with intestinal TB, serving as a highly specific radiological hallmark. While both diseases can lead to structural complications such as strictures, fistulae, and local abscesses, the identification of caseating lymphadenopathy on cross-sectional MRI effectively narrows the diagnostic uncertainty. The non-ionizing nature of MRE further enhances its role as a superior imaging modality for young patient populations requiring repeated follow-ups to monitor disease activity or therapeutic response.

Correlating radiological imaging with a robust reference standard—comprising clinical presentation, endoscopic histopathology, and response to specific medical therapy—demonstrated that MRE achieves high

overall diagnostic efficacy. The diagnostic metrics observed in our study align closely with benchmark literature, such as findings by Govind K. Makharia et al., confirming that dedicated MR enterography protocols provide high sensitivity and specificity in distinguishing IBD from TB. Obtaining an accurate non-invasive diagnosis is paramount, as misdiagnosing intestinal TB as IBD can lead to deleterious outcomes if immunosuppressive therapies or biologics are inadvertently initiated in the presence of an active, untreated tubercular infection.

Despite these robust findings, certain limitations must be acknowledged. First, the sample size of 38 patients, while statistically justified based on diagnostic sensitivity parameters, remains relatively modest and reflects single-centre experience. Second, the prospective follow-up of retrospective cases inherently introduces potential selection bias, although newly enrolled prospective cases helped mitigate this risk. Future multi-center studies involving larger patient cohorts are recommended to validate these imaging criteria further and explore the incremental value of advanced functional MRI sequences, such as Diffusion-Weighted Imaging (DWI), in differentiating IBD from intestinal tuberculosis.

V. Conclusion

Magnetic Resonance (MR) Enterography is a highly accurate, reliable, and non-invasive imaging modality for differentiating Inflammatory Bowel Disease (IBD) from Intestinal Tuberculosis (TB). Specific MRE features—such as long-segment involvement, skip lesions, and the comb sign—strongly point toward a diagnosis of IBD, whereas asymmetrical wall thickening, ileocecal valve involvement, and central necrotic mesenteric lymphadenopathy serve as key indicators of Intestinal TB. When correlated with clinical evaluation and histopathological findings, MRE provides high sensitivity and diagnostic precision. Incorporating MRE into routine diagnostic workflows enables timely, targeted therapeutic interventions and prevents the severe complications associated with misdiagnosis or inappropriate immunosuppressive therapy in endemic regions.

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