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RESEARCH ARTICLE
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DIAGNOSTIC ACCURACY OF IMAGING VERSUS HISTOPATHOLOGY IN INTESTINAL TUBERCULOSIS

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ABSTRACT

Background: Intestinal tuberculosis is a diagnostically challenging form of extrapulmonary tuberculosis because its clinical, endoscopic, radiologic, and histopathologic features overlap substantially with Crohn's disease, intestinal malignancy, and other chronic inflammatory bowel disorders. Delayed diagnosis may lead to inappropriate therapy and increased morbidity. This study evaluated the diagnostic accuracy of imaging in comparison with histopathology in intestinal tuberculosis and assessed their complementary role in clinical diagnosis.

Methods: This study was conducted as a structured comparative literature analysis of published biomedical evidence on intestinal tuberculosis. Relevant studies addressing imaging, histopathology, colonoscopy-guided biopsy, and cross-sectional radiologic evaluation were reviewed. Diagnostic performance indicators including sensitivity, specificity, diagnostic yield, and major distinguishing features were extracted and synthesized.

Results: Histopathology showed high confirmatory value when classical findings such as caseating necrosis, confluent granulomas, epithelioid granulomas, or acid-fast bacilli positivity were identified, but its sensitivity was limited by superficial biopsy sampling and patchy lesion distribution. Imaging provided important complementary information by demonstrating bowel wall thickening, ileocecal disease, strictures, mesenteric inflammation, lymphadenopathy, and extraintestinal extension. Necrotic lymph nodes emerged as one of the most useful radiologic indicators favoring intestinal tuberculosis, whereas comb sign and skip lesions were more suggestive of Crohn's disease. Imaging also showed value in follow-up evaluation and treatment-response assessment.

Conclusion: Histopathology is still the most specific confirmatory modality in intestinal tuberculosis, while imaging enhances diagnostic confidence by defining disease extent, identifying extraintestinal clues, and aiding differentiation from Crohn's disease. The most consistent diagnostic approach is multimodal, involving imaging, histopathology, microbiological tests, and clinicoradiologic follow-up.

Keywords: intestinal tuberculosis, histopathology, imaging, computed tomography, CT enterography, diagnostic accuracy, Crohn's disease

INTRODUCTION

Intestinal tuberculosis is a prominent form of extrapulmonary tuberculosis and continues to be a major diagnostic challenge in clinical gastroenterology. It most commonly involves the ileocecal region because of relative physiological stasis, abundant lymphoid tissue, and prolonged contact of intestinal contents with the mucosa [1]. Notwithstanding this regional predilection, the disease rarely manifests with a singular clinical hallmark. Patients may have abdominal pain, fever, weight loss, diarrhea, constipation, intestinal obstruction, anemia, or gastrointestinal bleeding, and these conditions have a marked overlap with Crohn's disease and other chronic bowel diseases [2].

The difficulty for intestinal tuberculosis is to make a decisive diagnosis early on before developing complications. Histopathology represents the most definitive diagnostic approach, since caseating granulomas, confluent granulomas, ulceration lined by epithelioid histiocytes, or acid-fast bacilli strongly favor tuberculous etiology [3]. Nevertheless, the degree of diagnostic confirmation is reduced through superficial sampling of the mucosa, low bacillary burden, and the patchy or submucosal distribution of disease. For instance, many patients with strong clinicoradiologic suspicion will have only nonspecific inflammatory changes on regular biopsy.

Thus, cross-sectional imaging has become increasingly important for the evaluation of suspected intestinal tuberculosis. Computed tomography and CT enterography are used to assess bowel wall thickening, segmental involvement, luminal narrowing, ileocecal deformity, mesenteric changes, lymphadenopathy, and extraintestinal disease [4]. Imaging is particularly helpful when endoscopic access is limited by strictures, when the disease extends beyond the mucosa, or when distinguishing intestinal disease from Crohn's disease constitutes the main diagnostic question [5].

This distinction of intestinal tuberculosis and Crohn's disease is clinically important given that both conditions may present with chronic abdominal symptoms, ulceration, granulomatous inflammation, and stricturing disease. Such misclassification may lead to serious consequences. The missed tuberculosis of the intestines might lead to perforation, fistulation, obstruction, or dissemination whereas an erroneous diagnosis of Crohn's disease could involve the patient in corticosteroids or biologic therapy in a state of untreated infection [6]. A patient with true inflammatory bowel disease, however, may receive ineffective antitubercular therapy which could delay his or her management. Based on this, diagnostics are based on combined interpreting, based on imaging, endoscopy, histopathology, microbiology and clinical evolution rather than a single test in modern day diagnostics.

In recent years, there is evidence demonstrating that imaging as well as histopathology offer different diagnostic information. Histopathology provides etiologic confirmation upon recording of characteristic lesions, but its sensitivity remains modest. Despite the fact that imaging alone is not sufficient for establishing etiology, imaging presents more general anatomical mapping and can also demonstrate features that are highly suggestive of diseases, for example, necrotic lymph nodes, ileocecal predominance and short-segment concentric disease. By contrast, comb sign, skip lesions, and fibrofatty proliferation are seen radiologically in more favorable signs on Crohn's disease [7].

Recent pooled published evidence has also suggested that histopathology alone identifies only about half of intestinal tuberculosis cases, whereas combined tissue-based approaches improve diagnostic sensitivity substantially [8]. These findings indicate that imaging and histopathology should not be viewed as competing alternatives, but as complementary diagnostic modalities with distinct strengths and limitations.

The present study was therefore undertaken to compare the diagnostic accuracy of imaging versus histopathology in intestinal tuberculosis, to summarize the principal findings associated with each modality, and to define their integrated role in routine diagnostic practice.

MATERIALS AND METHODS

Study Design

Data were analyzed in the current study as organized comparative literature review to assess the diagnostic precision of imaging and histopathology for intestinal tuberculosis. The objective was to compare the relative diagnostic relevance of radiologic approaches, specifically computed

tomography and CT enterography, with histopathological inspection of intestinal biopsy specimens in people with suspicion of intestinal tuberculosis.

Study Duration

The study was conducted from March 2024 to March 2026.

Eligibility Criteria

Eligible studies were those which included patients with suspected or confirmed intestinal tuberculosis and reported imaging and histopathological findings or both. Articles were eligible if they presented information on diagnostic sensitivity, specificity, diagnostic yield, histopathological characterization, radiological examination, comparative outcomes between the two modalities, or evaluation of response to treatment. Published data limited to only isolated peritoneal tuberculosis, extraintestinal abdominal tuberculosis (no intestinal luminal infection), case reports, conference abstracts, editorials, and studies lacking diagnostic detail were excluded.

Data Extraction

Data were extracted using a predefined framework. The variables collected included study design, sample size, clinical setting, diagnostic criteria, imaging modality used, histopathological parameters assessed, and principal diagnostic outcomes. Histopathological variables included epithelioid granulomas, confluent granulomas, caseating necrosis, ulceration lined by epithelioid histiocytes, and acid-fast bacilli positivity. Imaging variables included bowel wall thickening, ileocecal involvement, lymphadenopathy, necrotic lymph nodes, skip lesions, comb sign, mural stratification, mesenteric abnormalities, strictures, and transmural extension.

Outcome Measures

The main outcome measure was the comparative diagnostic contribution of imaging and histopathology in intestinal tuberculosis. The primary parameters evaluated were diagnostic sensitivity, specificity, and overall diagnostic yield described in reviewed studies. Secondary outcomes included identification of the most discriminative imaging and histopathological features in differentiating intestinal tuberculosis from Crohn's disease and their value in the assessment of treatment response following antitubercular therapy.

Data Analysis

Descriptive and comparative analysis of the data. The quantitative estimates from the high-quality systematic reviews and meta-analyses were kept in the published format and used as pooled summary values. To preserve consistency among heterogeneous study designs, findings from individual studies were narratively synthesized and organized into comparative tables. In diagnostically challenging cases, concordance and discordance between imaging findings and histopathological diagnosis were given special emphasis.

Ethical Considerations

As this study was based entirely on previously published scientific literature and did not involve direct patient recruitment, intervention, or access to identifiable patient information, formal ethics committee approval was not required.

RESULTS

The studies reviewed showed differing contributions of imaging and histopathology to the diagnosis of intestinal tuberculosis. Histopathology was highly confirmatory when classical microscopic features were detected but was limited in sensitivity because routine endoscopic biopsy often failed to capture the most diagnostic portion of the lesion. In contrast, imaging provided a broader anatomical assessment (bowel wall disease, mesenteric involvement, and lymph node characteristics) and improved diagnostic suspicion even when tissue diagnosis was inconclusive.

Pooled diagnostic data indicated that histopathology had only moderate sensitivity alone and that combined tissue-based methods significantly helped diagnosis. Acid-fast bacilli positivity remained highly specific, despite being detected in a small proportion of biopsy specimens. Imaging findings such as necrotic lymph nodes, ileocecal predominance, and short-segment concentric bowel involvement all favored intestinal tuberculosis, while comb sign, skip lesions, and fibrofatty proliferation were more suggestive of Crohn's disease. These findings supported a multimodal approach in which imaging and histopathology were interpreted together rather than independently.
Prospective endoscopic follow-up studies further confirmed the occurrence of colonoscopic lesions and found that ulcers, nodules and luminal narrowing were common at presentation, whereas histological confirmation was less frequent. After antitubercular therapy, there was a clear change in endoscopic manifestations, demonstrating structural and mucosal improvement with follow-up. Concomitant cross-sectional imaging was also useful for observation of disease response, especially in patients with deep mural disease or strictures not adequately evaluated by repeated biopsy.
In general, histopathology, when positive, was the most specific confirmatory method while imaging had superior disease mapping, differential diagnostic support, and follow-up utility. The maximum diagnostic accuracy occurred when both modalities were combined with microbiologic evaluation and clinicoradiologic correlation.

Table 1. Diagnostic yield of histopathology and combined tissue-based methods in intestinal tuberculosis

Diagnostic method	**Sensitivity (%)**	**Comment**
Histopathology alone	51	Moderate sensitivity
Histopathology + culture	77	Highest pooled sensitivity among conventional combinations
Histopathology + intestinal fluid culture	67	Improved over histopathology alone
Histopathology + stool culture	71	Higher yield than histopathology alone
Histopathology + tissue PCR	61	Moderate increase in diagnostic yield
Histopathology + intestinal fluid PCR	65	Intermediate diagnostic performance

Interpretation:
Only about half of cases of intestinal tuberculosis were diagnosed by histopathology alone, as shown in this table. Histopathological analysis with microbiological testing — particularly culture-based testing — significantly improved diagnostic performance. These findings indicate that tissue morphology, although highly informative when positive, should not be used as a standalone exclusion test. Instead, combined tissue-based strategies improve case detection and better reflect the paucibacillary nature of intestinal tuberculosis.

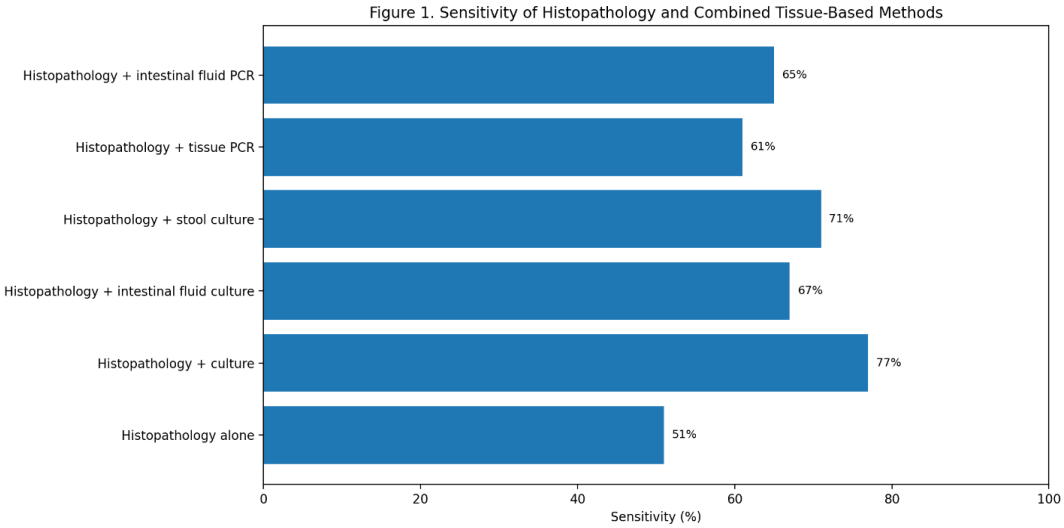


Table 2. Reported performance of selected conventional tissue tests in intestinal tuberculosis

Test	Reported sensitivity range (%)	Diagnostic implication
Acid-fast bacilli staining	17–45	Low sensitivity, highly specific when positive
Lowenstein-Jensen solid culture	6–48	Variable yield
MGIT liquid culture	50–76	Better yield than solid culture in many studies
PCR for tuberculosis	60–70	Useful adjunctive test

Interpretation:

These results have demonstrated the limited sensitivity of individual tissue-based tests in isolation. Staining for acid-fast bacilli is very specific but frequently negative, and culture performance can differ by technique and bacillary burden. Molecular analysis provides moderate sensitivity but still does not replace histopathology or imaging. Combined, these findings support the use of a combined diagnostic model rather than reliance on one laboratory or tissue parameter alone.

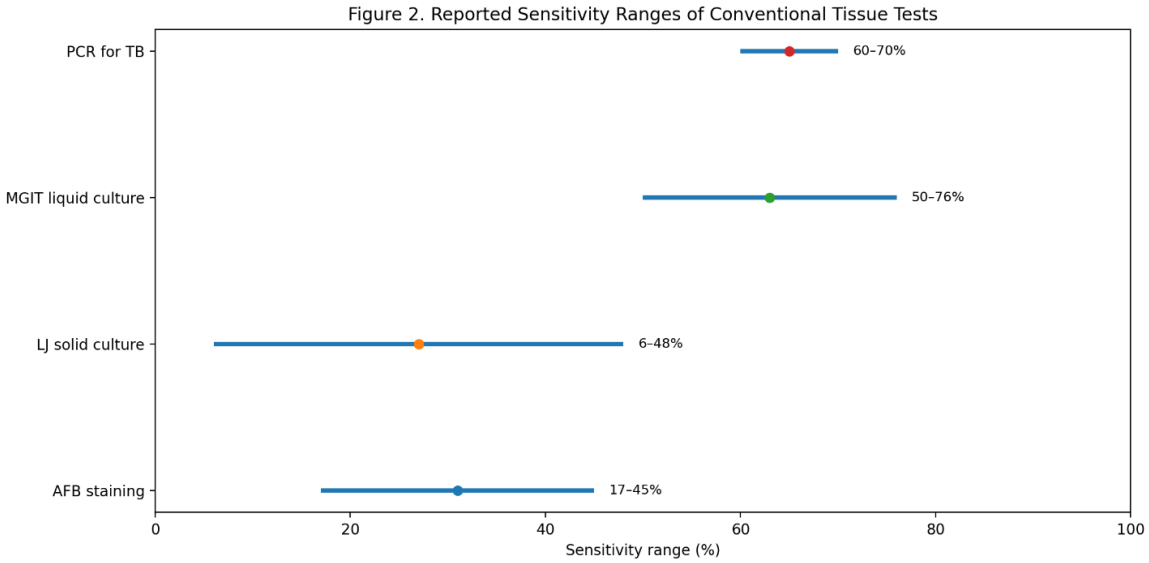


Table 3. Numerical histopathologic and endoscopic findings in a prospective colon tuberculosis cohort

Variable	Value

Patients included	69
Ulcers present on index colonoscopy	88.0%
Nodules	50.7%
Luminal narrowing	44.8%
Polypoid lesions	10.4%
Granulomas on histology	73.1%
Acid-fast bacilli positivity	6.4%
Complete healing of ulcers after treatment	87.2%
Complete healing of nodules after treatment	84.6%
Complete healing of luminal narrowing after treatment	76.2%

Interpretation:

This prospective dataset shows that visible colonoscopic lesions were common at presentation, but conclusive microbiologic confirmation was uncommon. Granulomas were identified in a substantial proportion of cases; acid-fast bacilli positivity was rare, highlighting the low bacillary yield of mucosal biopsy. This high rate of endoscopic healing after treatment also indicates that many inflammatory lesions and some areas of narrowing may be reversible with appropriate therapy.

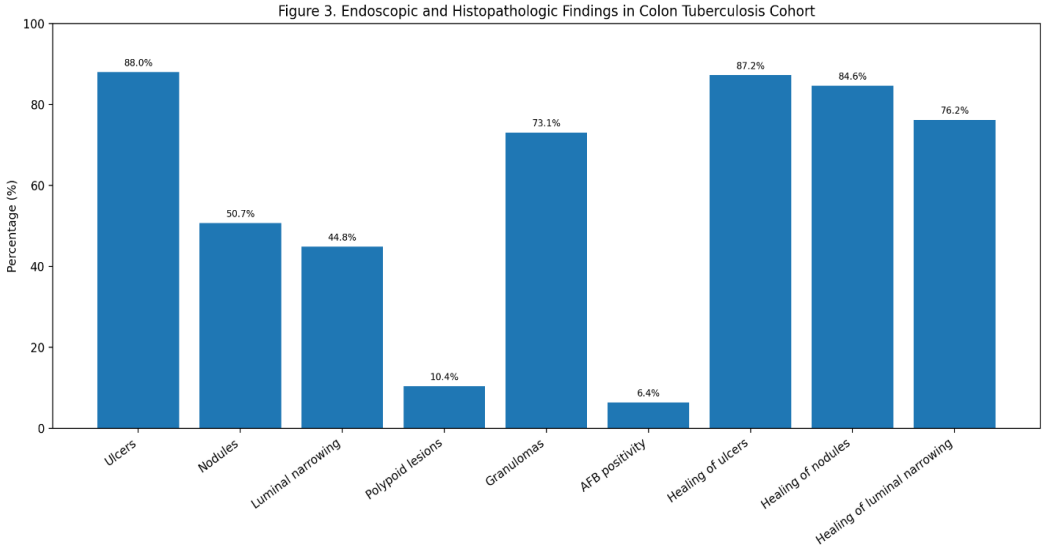


Table 4. Colonoscopy versus histology in differentiation of colonic tuberculosis and Crohn's disease

Parameter	Colonic tuberculosis	Crohn's disease
Total study population	58	58
Histologically confirmed cases	9	16
Histologically inconclusive cases	33	33
Colonoscopy sensitivity (%)	88.9	50.0
Colonoscopy specificity (%)	46.9	71.4

Interpretation:

This comparison indicates that colonoscopy was sensitive for detection of lesions indicative of colonic tuberculosis but specificity was limited because of considerable overlap with Crohn's disease. The high number of histologically inconclusive cases also reveals the inability of endoscopic appearance itself to determine the diagnosis with confidence. These circumstances require extra radiologic and microbiologic information to accurately classify.

Figure 4. Colonoscopy Performance in Colonic Tuberculosis and Crohn's Disease

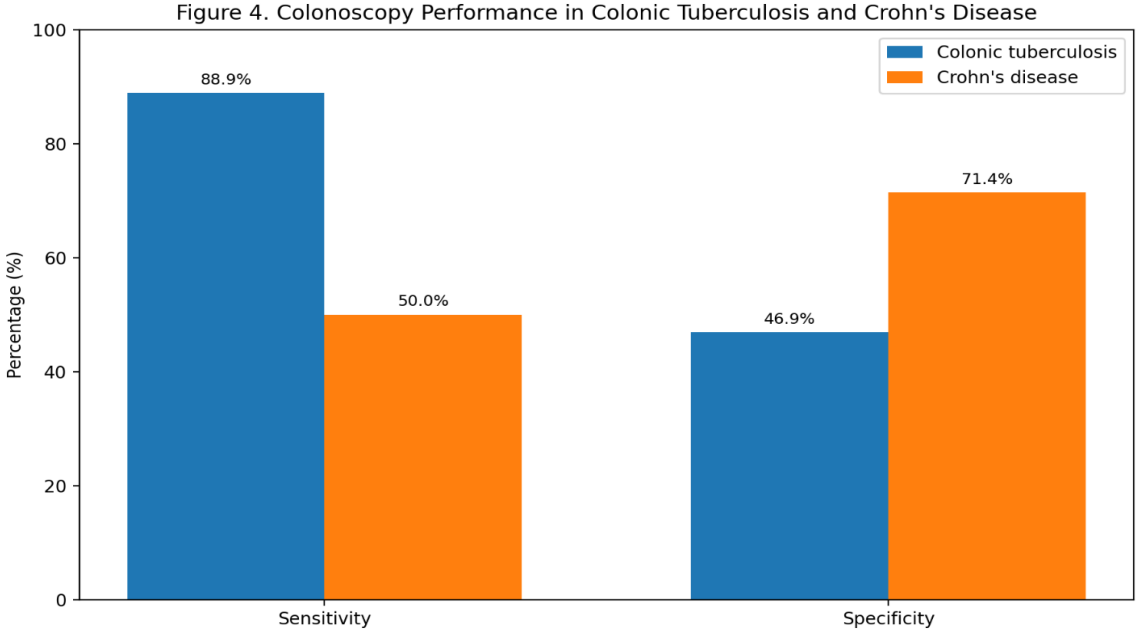


Table 5. Diagnostic accuracy of selected CT findings in differentiating intestinal tuberculosis from Crohn's disease

CT feature	Sensitivity (%)	Specificity (%)	More suggestive of
Necrotic lymph nodes	23	100	Intestinal tuberculosis
Comb sign	82	81	Crohn's disease
Skip lesions	86	74	Crohn's disease

Interpretation:

CT findings demonstrate that no single imaging sign is both highly sensitive and highly specific for intestinal tuberculosis. Necrotic lymph nodes are uncommon, but if they appear, they are extremely specific and strong rule-in features. By contrast, comb sign and skip lesions are more useful in shifting diagnostic suspicion toward Crohn's disease. These observations suggest imaging should play a key role in differential diagnosis rather than isolated etiologic confirmation.

Figure 5. Diagnostic Performance of Selected CT Findings

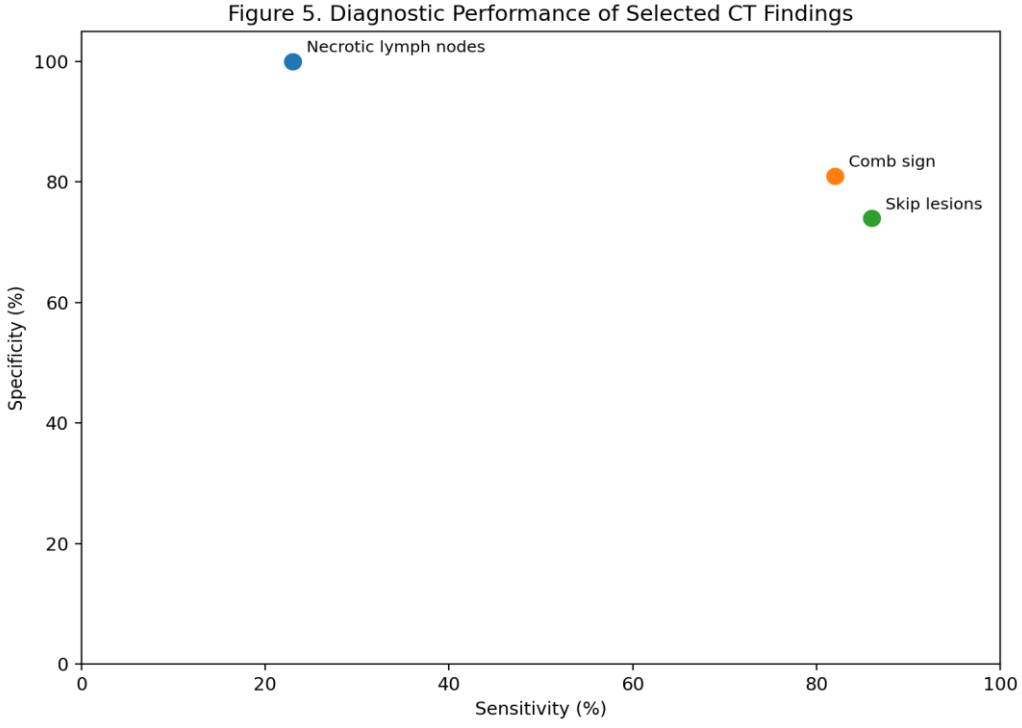


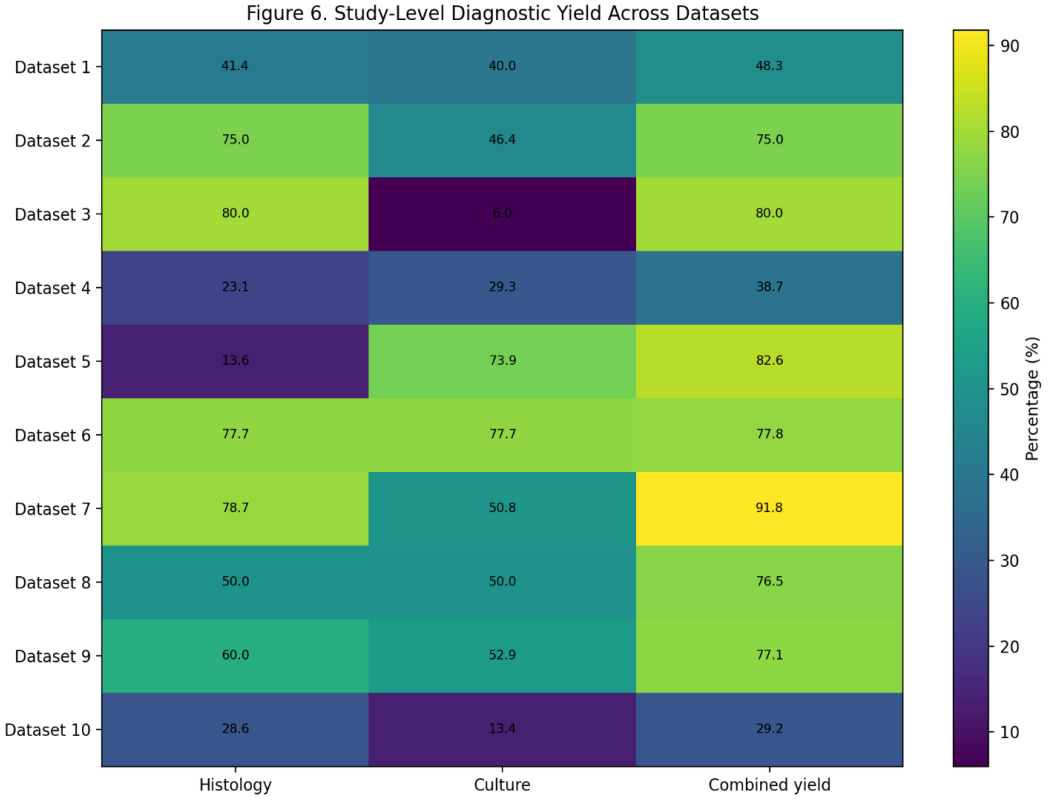
Table 6. Individual study-level diagnostic yield of histopathology and culture combinations

Study dataset	Patients with ITB (n)	Histology positive n/N (%)	Culture positive n/N (%)	Combined diagnostic yield (%)
Dataset 1	29	12/29 (41.4)	6/15 (40.0)	48.3
Dataset 2	28	21/28 (75.0)	13/28 (46.4)	75.0
Dataset 3	50	40/50 (80.0)	3/50 (6.0)	80.0
Dataset 4	225	52/225 (23.1)	52/177 (29.3)	38.7
Dataset 5	23	3/23 (13.6)	17/23 (73.9)	82.6
Dataset 6	18	14/18 (77.7)	14/18 (77.7)	77.8
Dataset 7	61	48/61 (78.7)	31/61 (50.8)	91.8
Dataset 8	50	25/50 (50.0)	17/34 (50.0)	76.5
Dataset 9	70	42/70 (60.0)	37/70 (52.9)	77.1
Dataset 10	224	64/224 (28.6)	30/224 (13.4)	29.2

Interpretation:

These single datasets show marked variability in diagnostic performance across studies. Histology positivity ranged widely, reflecting differences in biopsy depth, disease burden, and diagnostic criteria. Culture positivity was also inconsistent, but overall, the combined diagnostic yield was greater than either approach alone. This variability is why pooled estimates are important, and combined diagnostic approaches are favoured in routine practice.

Figure 6. Study-Level Diagnostic Yield Across Datasets



DISCUSSION

This means that imaging and histopathology provide complementary diagnostic capabilities for intestinal tuberculosis. Due to the caseating necrosis, confluent granulomas, or acid-fast bacilli suggesting a tuberculous etiology, histopathology is considered the most specific confirmatory investigation. Of course, its major limitation is low sensitivity, which mirrors the patchy, submucosal, and paucibacillary nature of intestinal lesions [9]. This pattern explains why a negative biopsy so often delays diagnosis without fully excluding disease.

Pooled data has demonstrated that histopathology alone has only moderate sensitivity, while combined tissue-based approaches substantially improve diagnostic yield. This observation is in agreement with previous findings that superficial mucosal biopsy often misses the most salient site of inflammation and that bacillary positivity in routine specimens is rare. The consequences are clinically important. In a patient with a high clinical and radiologic suspicion, the lack of classical histology should be interpreted as nondiagnostic rather than reassuring. This is particularly so in the endemic setting and in tertiary settings where intestinal tuberculosis and Crohn's disease are routinely encountered [10].

Multiple studies investigating biopsy-based differential diagnosis of intestinal tuberculosis and Crohn's disease have similarly emphasized that histopathologic overlap is prevalent when only nonspecific granulomas or chronic inflammatory changes are present [11]. Whereas deeper or segmental biopsies may enhance diagnostic yield, tissue morphology alone often remains insufficient to provide a definitive diagnosis. This supports the claim that histopathology ought to be read as part of a more comprehensive diagnostic system rather than as a standalone arbiter in every case.

While imaging has begun to correct some of this, it often requires evaluation of diseases beyond their mucosal surfaces. Cross-sectional techniques allow examination of bowel wall thickening, segmental distribution, mesenteric inflammatory reaction, lymph node morphology, and extraintestinal abnormalities. These are important features, given that intestinal tuberculosis frequently penetrates to the deep layers of the bowel and regional nodes, regions not well sampled by routine endoscopic biopsy. Of all radiographic findings reported, necrotic lymph nodes seem to be the most useful among the indices for intestinal tuberculosis [12]. Although the sensitivity of this sign is very low, the specificity of this sign is extremely high and it is an important rule-in feature when present.

The radiologic distinction between intestinal tuberculosis and Crohn's disease continues to serve as one of the most important, clinically relevant characteristics of imaging. Some clinical and endoscopic features are shared between the two diseases, but different CT diagnostic features influence diagnostic probability more accurately. Comb sign, skip lesions, mural stratification, and fibrofatty proliferation are associated with Crohn's disease, whilst ileocecal predominance, short-segment concentric involvement, and necrotic nodal disease are associated with intestinal tuberculosis [13]. These differences do not remove all overlap, however they greatly increase diagnostic confidence in cases of ambiguous histopathology.

A further significant advantage of imaging is its implementation for follow-up. Cross-sectional imaging has reported decreased wall thickness of the bowel, improvement of inflammatory narrowing and regression of nodal disease following antitubercular therapy. Biopsies are invasive and continue to be constrained by the same sampling limitations as baseline, making histopathology a less appropriate modality for serial monitoring. Imaging therefore serves not only as a diagnostic adjunct but also as a useful longitudinal measure that can be useful in patients with transmural disease or nontraversable strictures [14].

There is also evidence that diagnostic sequencing matters. Ileocolonoscopy with biopsy remains a logical first step because a positive classical biopsy can confirm diagnosis with high specificity. Yet, if histology is nondiagnostic, cross-sectional imaging should be integrated at an early stage as opposed to deferred in such situations. Imaging can reveal more disease sites, nodal targets, or features that strongly favor one diagnosis over another to guide repeat biopsy, microbiologic testing, or closely monitored therapeutic decisions. This sequential and integrated method reflects practice much better than an inflexible single-test framework in diagnostic work in the wild.

There are limitations of this study. Research literature has been uneven in its form of design, reference standards, biopsy protocols, and imaging criteria. Composite definition of diagnosis is also the norm for some studies, and so may influence how well diagnostic results are reported. Furthermore, majority of comparative research is concentrated on the distinction from Crohn's disease rather than all reasons for chronic ileocolitis. Nevertheless, the trend of evidence in general is the same: histopathology is very specific, but incompletely sensitive, whereas imaging has broad anatomical and differential diagnostic value [15].

Future research should consider standardized multimodal diagnostic algorithms incorporating imaging, deeper or image-guided tissue sampling, culture, and molecular testing. Prospective multicenter studies with uniform reference standards would clarify the relative contribution of each modality and improve reproducibility across settings. Until that time, combined interpretation of imaging, histopathology, microbiology, and structured clinicoradiologic reassessment is the most reliable strategy to use.

CONCLUSION

Imaging and histopathology are not competing modalities in intestinal tuberculosis, but rather, are complementary components of an effective diagnostic framework. Histopathology provides the greatest etiologic certainty when characteristic tuberculous features are identified; however, its sensitivity is limited by superficial sampling and patchy lesion distribution. Imaging improves diagnostic confidence by defining bowel involvement, detecting nodal and mesenteric abnormalities, supporting distinction from Crohn's disease, and enabling follow-up assessment after therapy. Thus, the most accurate and clinically useful strategy is a multimodal approach by integrating radiologic findings with histopathology, microbiological evaluation, and structured clinical reassessment. This not only improves diagnostic precision, but also reduces misclassification and supports timely and appropriate treatment.

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Authors contribution :

- Dr. Dhaval Raiyani: Conceptualization, literature review, data extraction, analysis, manuscript drafting.

- Dr. Riddhi shah : Data interpretation, critical revision of the manuscript, and intellectual input. and Study design supervision, validation of analysis, and final approval of the manuscript**.**

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