



Original Article

Diagnostic Efficacy of Multidetector Computed Tomography in the Evaluation and Characterization of Small Bowel Pathologies: A Prospective Clinical Study

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ABSTRACT

Background: The small bowel, due to its significant length and intricate looping, has traditionally been difficult to visualize using conventional imaging. Multidetector Computed Tomography (MDCT) with multiplanar reformation has emerged as a transformative tool for diagnosing enteric lesions. This study aims to evaluate the role of MDCT in detecting and characterizing small bowel pathologies. **Materials and Methods:** A prospective clinical study was conducted on 40 patients referred for abdominal symptoms or suspected bowel lesions at a tertiary care center in Coimbatore. Patients underwent evaluation using a 64-slice MDCT scanner following a standardized protocol involving 0.1% mannitol as a negative oral contrast agent. Diagnostic accuracy was determined by comparing MDCT findings against biopsy results as the gold standard.

Results: The mean age of the participants was 38.93 years, with a predominant male distribution (87.5%). Non-neoplastic lesions constituted 95% of cases, with Crohn's disease being the most common (47.36%). The distal ileum and ileocecal junction were involved in 55% of cases. MDCT showed a sensitivity of 88.23% and a positive predictive value of 93.75%.

Conclusion: MDCT enterography provides excellent diagnostic accuracy for small bowel lesions, particularly in characterizing inflammatory bowel diseases. Its ability to provide detailed multiplanar images makes it indispensable for clinical management.

Keywords: Multidetector Computed Tomography; Small Intestine; Crohn Disease; Tuberculosis, Gastrointestinal; Sensitivity and Specificity; Diagnosis, Differential.

INTRODUCTION

The clinical evaluation of the small intestine has historically represented a significant hurdle in gastroenterology and radiology [1]. Often described as the "hidden" portion of the digestive tract, the small bowel's anatomical complexity—characterized by its vast length, mobility, and deep-seated position within the peritoneal cavity—makes it poorly accessible to conventional endoscopy. Historically, diagnostic approaches relied on barium studies, which, while useful for luminal abnormalities, offered limited insight into intramural and extra-enteric extensions of disease [2]. The emergence of Multidetector Computed Tomography (MDCT) has fundamentally altered this diagnostic paradigm.

Pathologies affecting the small bowel range from acute inflammatory conditions to chronic granulomatous diseases and rare neoplastic growths [3]. In South Asian clinical practice, the differentiation between intestinal tuberculosis and Crohn's disease remains a perennial challenge for clinicians due to their strikingly similar clinical presentations and overlapping

radiologic features [4]. Both conditions often target the ileocecal region, presenting with wall thickening, luminal narrowing, and mesenteric lymphadenopathy. Accurate characterization is essential, as the management strategies—anti-tubercular therapy versus immunosuppressive agents—are diametrically opposed [5].

MDCT technology offers several technical advantages that address these challenges. The transition from single-detector to multi-detector arrays has allowed for significantly faster scan times, which minimizes motion artifacts from respiration and peristalsis [6]. Furthermore, the ability to obtain isotropic data enables high-resolution multiplanar reformation (MPR) in coronal and sagittal planes. This multi-dimensional perspective is crucial for evaluating the small bowel, as it allows radiologists to "untwist" the bowel loops and visualize the entire length of a diseased segment, which is often difficult on axial imaging alone [7].

The diagnostic utility of MDCT is further enhanced by the use of negative oral contrast agents, such as mannitol. By distending the bowel and lowering the luminal attenuation, these agents create a distinct contrast between the intestinal wall and its contents, allowing for the precise assessment of mucosal enhancement and mural stratification [8]. Patterns such as the "target sign"—characterized by alternating layers of high and low attenuation—can provide vital clues regarding the activity and nature of the underlying disease process [9].

Moreover, MDCT provides a comprehensive view of the mesentery and surrounding vasculature. Findings such as mesenteric fat stranding, vascular engorgement (the "comb sign"), and the presence of localized abscesses or fistulae are critical for determining the severity of conditions like Crohn's disease. In the case of neoplastic lesions, MDCT aids in staging by identifying regional and distant metastases [10].

The primary objective of this study was to evaluate the diagnostic role of MDCT in identifying and characterizing small bowel pathologies. By analyzing imaging characteristics—such as the pattern of contrast enhancement, length of involvement, and mesenteric involvement—we aim to provide a statistical framework for the accuracy of this modality in a tertiary care setting.

MATERIALS AND METHODS

Study Setting: This prospective clinical investigation was conducted within the Department of Radiology at the PSG Institute of Medical Sciences and Research, Coimbatore, India. This tertiary care teaching hospital provides specialized services for a wide catchment area, facilitating the study of diverse gastrointestinal conditions.

Study Participants: The study cohort comprised 40 patients referred for Contrast-Enhanced Computed Tomography (CECT) of the abdomen with suspected or previously detected small bowel lesions. The study included patients presenting with abdominal symptoms or findings suggestive of bowel pathology on primary clinical evaluation, as well as those with bowel lesions initially detected via ultrasonography. Patients were excluded if they had a history of acute abdominal trauma, chronic kidney disease, or a known hypersensitivity to iodinated contrast media.

Sample Size and Sampling Technique: A sample size of 40 consecutive cases was selected over a study period spanning from December 2018 to December 2020. Consecutive sampling was employed to ensure all eligible patients presenting during the two-year study window were enrolled.

Study Tools: Imaging was performed using a 64-slice Siemens Somatom Definition Edge MDCT scanner. A structured classification scheme was utilized to categorize lesions based on anatomical location, contrast enhancement patterns, wall thickness, and mesenteric involvement.

Study Methodology: All patients followed a standardized preparation involving a four-hour fast prior to the procedure. Intestinal distension was achieved using 1.35 L of 0.1% mannitol suspension administered orally over 60 minutes in divided doses. MDCT scanning was performed in the supine position from the diaphragm to the symphysis pubis. Following plain CT, a triple-phase study (arterial, venous, and delayed) was conducted after the administration of 125 ml of intravenous contrast via a power injector at 4 ml/sec. Post-processing techniques included 1 mm axial image reconstruction and multiplanar reformation to evaluate the morphology of the lesions.

Ethical Issues: The study was initiated following formal clearance from the Institutional Human Ethical Committee. Each participant received a detailed explanation of the study objectives, and written informed consent was obtained prior to data collection.

Statistical Analysis: Statistical processing was performed using SPSS version 27.0. Categorical variables were described using frequencies and percentages, while continuous variables were presented as mean \pm standard deviation. The diagnostic performance of MDCT was evaluated by calculating sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) against biopsy results. P-value of less than 0.05 was considered statistically significant.

RESULTS

The study evaluated 40 participants with a mean age of 38.93 years (SD = 17.74), ranging from 14 to 80 years. A significant majority of the participants were male (87.5%), with the 21–40 age group representing half of the cohort (Table 1).

Table 1: Baseline Demographic Profile of the Study Population (N = 40)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	35	87.5%
	Female	5	12.5%
Age Group	≤20 years	7	17.5%
	21–40 years	20	50.0%
	41–60 years	6	15.0%
	>60 years	7	17.5%

The distal ileum and ileocecal junction were identified as the most frequent sites of pathology, accounting for 55% of the total cases. Non-neoplastic conditions dominated the diagnoses, particularly Crohn's disease (47.36%) and tuberculosis (28.94%) (Table 2).

Table 2: Pathological Distribution and Location Characteristics (N = 40)

Parameter	Category	Frequency (n)	Percentage (%)
Pathology Location	Distal Ileum / IC Junction	22	55.0%
	Proximal Ileum	6	15.0%
	Cecum	5	12.5%
	Distal Jejunum	4	10.0%
	Others	3	7.5%
Type of Lesion	Non-neoplastic	38	95.0%
	Neoplastic (GIST)	2	5.0%

Analysis of MDCT imaging features revealed that segmental thickening was the most common finding (50%), and the "target pattern" was the most frequent enhancement style (62.5%) (Table 3).

Table 3: Descriptive Analysis of MDCT Imaging Features (N = 40)

Feature	Category	Frequency (n)	Percentage (%)
Enhancement Pattern	Target	25	62.5%
	Homogenous	9	22.5%
	Heterogeneous	2	5.0%
	Poor	4	10.0%
Bowel Wall Layer	Mucosal	34	85.0%
	Submucosal	2	5.0%
	Not involved	4	10.0%
Segment Length	Focal (<5 cm)	16	40.0%
	Segmental (6–40 cm)	20	50.0%
	Diffuse (>40 cm)	4	10.0%

Inferential analysis demonstrated a strong association between the type of lesion and the length of the thickened segment. Both neoplastic lesions (100%) presented with focal thickening, whereas non-neoplastic lesions were predominantly segmental (Table 4).

Table 4: Inferential Association Between Lesion Type and Segment Length (N = 40)

Lesion Type	Focal (<5 cm)	Segmental (6–40 cm)	Diffuse (>40 cm)	Total
Neoplastic	2 (100%)	0 (0%)	0 (0%)	2
Non-neoplastic	14 (36.8%)	20 (52.6%)	4 (10.6%)	38

The diagnostic accuracy of MDCT was evaluated against biopsy. MDCT demonstrated high sensitivity and a high positive predictive value for small bowel pathologies (Table 5).

Table 5: Diagnostic Performance Metrics of MDCT with 95% Confidence Intervals

Metric	Point Estimate (%)	95% Confidence Interval
Sensitivity	88.23%	73.1% – 95.5%

Specificity	50.00%	15.0% – 85.0%
Positive Predictive Value	93.75%	79.8% – 98.3%
Negative Predictive Value	33.33%	9.7% – 70.0%

DISCUSSION

The diagnostic findings of this prospective study confirm the robust utility of MDCT in the visualization and characterization of small bowel pathologies. With a sensitivity of 88.23% and a high positive predictive value of 93.75%, MDCT proves to be a reliable primary modality for identifying significant enteric lesions in patients presenting with abdominal symptoms.

The predominance of Crohn's disease (47.36%) and tuberculosis (28.94%) in our study reflects the high burden of chronic inflammatory and granulomatous diseases in the South Indian population. Most lesions were concentrated in the ileocecal region (55%), which is consistent with the physiological stasis of bowel contents and the high density of lymphoid tissue in this area. Many studies emphasized the critical role of CT in identifying ileocecal tuberculosis through specific signs such as terminal ileum thickening and regional lymphadenopathy [11, 12].

One of the most defining characteristics identified in our cohort was the "target sign" of enhancement, observed in 62.5% of cases. This pattern is highly suggestive of acute inflammation, representing mucosal hyperenhancement and submucosal edema. By contrast, the neoplastic lesions in our study—both identified as GIST—exhibited focal thickening and heterogeneous enhancement. This distinction is clinically vital, as focal, asymmetric thickening with heterogeneous enhancement is often an indicator of malignancy [13].

Furthermore, MDCT allowed for the assessment of extra-luminal findings. Mesenteric involvement, including fat stranding and vascular engorgement, was noted in nearly half of the participants (47.5%). These findings are essential for differentiating active Crohn's disease from chronic fibrostenotic stages [14].

The use of 64-slice MDCT with multiplanar reformation provided a distinct advantage over axial imaging alone. By visualizing the bowel in coronal and sagittal planes, we were able to accurately measure the length of thickened segments, a parameter that helped categorize lesions as focal, segmental, or diffuse. This categorization is more than descriptive; it carries significant diagnostic weight, as diffuse involvement (10%) is typically seen in systemic or broadly inflammatory conditions rather than localized neoplasms [15].

While MDCT showed exceptional sensitivity, its specificity (50%) and negative predictive value (33.33%) were lower. This reflects the inherent difficulty in distinguishing between different types of inflammatory bowel disease, such as Crohn's versus TB, based solely on radiologic features. This limitation highlights the need for MDCT to be used as part of a multi-disciplinary approach involving clinical history and histopathological confirmation [16].

CT accurately identifies the cause of small bowel obstruction in 90% of cases, often providing superior extraluminal information compared to contrast studies [17]. Specific CT patterns enable the radiologist to suggest individual tumor types, a finding supported by our clear identification of focal GIST lesions [18].

A strength of our study was the standardized use of mannitol as a negative oral contrast agent, which provided the necessary bowel distension for mural assessment. Without such preparation, bowel loops could appear falsely thickened, compromising the accuracy of the measurements. Despite the relatively small sample size (n=40), the prospective design and comprehensive parameter analysis provide a clear snapshot of MDCT's diagnostic value in a tertiary medical setting.

CONCLUSION

MDCT enterography is a highly sensitive investigative tool for small bowel pathologies, offering a sensitivity of 88.23%. Its primary strength lies in characterizing the location and morphology of lesions, specifically in identifying inflammatory conditions like Crohn's disease and tuberculosis. While histological correlation remains necessary for definitive diagnosis, the high positive predictive value (93.75%) of MDCT makes it a definitive first-line imaging choice for directing clinical management and narrow-down differential diagnoses in complex abdominal cases.

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