

Research Article

ROLE OF MULTIDETECTOR COMPUTED TOMOGRAPHY (MDCT) IN EVALUATION OF SMALL BOWEL DISEASE

¹Dr Manoj kumar meena, ²Dr. Tushar prabha, ³Dr. Neha agrawal, ⁴Dr. Hrishabh Meena, ⁵Dr. Rajat chandak, ⁶Dr. Lokesh belaramani.

¹Junior resident, Department of Radio-Diagnosis Mahatma Gandhi Medical College & hospital, Jaipur (Rajasthan)

² Professor, Department of Radio-Diagnosis Mahatma Gandhi Medical College & Hospital, Jaipur (Rajasthan)

³Professor, Department of Radio-Diagnosis, MGMC&H, Jaipur

^{4,5,6}Resident, Department of Radio-Diagnosis, MGMC&H, Jaipur

*Corresponding Author

Dr Manoj kumar meena.

Email-

Manojdhanawat830@gmail.com

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Abstract: **Introduction:** **Objectives:** To evaluate the role of multidetector computed tomography (MDCT) in the detection, characterization, and differentiation of small bowel diseases and to assess its diagnostic accuracy using clinical, surgical, and histopathological correlation. **Methods:** In this prospective study, 64 patients with suspected small bowel disease underwent contrast-enhanced MDCT. Imaging findings were analyzed and correlated with histopathology, operative findings, or clinical follow-up. Diagnostic performance was calculated. **Results:** Benign lesions predominated (75%), with intestinal tuberculosis (37.5%) and Crohn's disease (25%) being the most common. The ileum was the most frequently involved segment (62.5%). Moderate wall thickening (46.9%) and homogeneous enhancement (40.6%) were the most common findings. Mesenteric fat stranding (43.8%) and lymphadenopathy (34.4%) were frequently observed. MDCT showed high diagnostic performance, with sensitivity of 92%, specificity of 88%, and accuracy of 90%. **Conclusion:** MDCT is a reliable and highly effective imaging modality for the comprehensive evaluation of small bowel diseases. It enables accurate differentiation between inflammatory and malignant lesions and facilitates early diagnosis and appropriate clinical management.

Keywords: Multidetector computed tomography; Small bowel diseases; CT enterography; Bowel wall thickening; Enhancement pattern; Intestinal tuberculosis; Crohn's disease; Small bowel neoplasms; Diagnostic accuracy

INTRODUCTION

Small bowel diseases represent a heterogeneous group of conditions with significant clinical morbidity and diagnostic complexity¹. The small intestine constitutes the largest segment of the gastrointestinal tract, yet remains one of the most challenging regions to evaluate due to its length, mobility, and deep intra-abdominal location². Clinical presentation is frequently non-specific, including abdominal pain, distension, vomiting, anemia, and weight loss, which overlap with other intra-abdominal pathologies and often delay diagnosis³.

Historically, imaging of the small bowel relied on barium-based techniques such as follow-through studies and enteroclysis. Although these methods allowed assessment of mucosal detail and luminal abnormalities, they provided limited information on mural thickness, mesenteric involvement, and extraintestinal disease⁴. Ultrasonography, while useful in selected cases, is operator-dependent and limited by bowel gas and patient habitus⁵. Capsule endoscopy has improved mucosal visualization but lacks the ability

to evaluate transmural and extraluminal pathology and may be contraindicated in suspected obstruction⁶. These limitations have led to the increasing reliance on cross-sectional imaging modalities.

Computed tomography (CT), particularly multidetector computed tomography (MDCT), has transformed the evaluation of small bowel diseases. MDCT enables rapid acquisition of isotropic volumetric data, allowing high-resolution multiplanar and three-dimensional reconstructions of the bowel and surrounding structures^{7,8}. This facilitates simultaneous assessment of the bowel wall, lumen, mesentery, vasculature, and extraintestinal compartments in a single examination. As a result, MDCT has become a key imaging modality in both acute and chronic abdominal conditions.

Advanced techniques such as CT enterography and CT enteroclysis have further enhanced diagnostic performance by improving bowel distension and mucosal visualization⁹. MDCT provides detailed characterization of bowel wall thickening, enhancement patterns, luminal narrowing, mesenteric fat stranding,

lymphadenopathy, and vascular abnormalities¹⁰. Importantly, it also allows detection of complications including abscesses, fistulas, perforation, and ischemia, which are critical for clinical decision-making.

The spectrum of small bowel diseases includes inflammatory and infectious conditions (e.g., Crohn's disease and intestinal tuberculosis), mechanical obstruction, vascular disorders, neoplasms, and traumatic injuries¹¹. MDCT plays a central role across this spectrum. In small bowel obstruction, it demonstrates high diagnostic accuracy for identifying the site, cause, and severity of obstruction, as well as associated complications¹². In inflammatory bowel disease, CT enterography enables evaluation of disease activity and detection of transmural and extraintestinal complications¹³. In mesenteric ischemia, MDCT angiography allows rapid assessment of vascular patency and bowel viability, which is essential for early intervention¹⁴.

MDCT is also valuable in the detection and staging of small bowel neoplasms, providing information on lesion morphology, enhancement characteristics, and metastatic spread¹⁵. In cases of obscure gastrointestinal bleeding, multiphase CT and CT angiography facilitate localization of active bleeding and identification of underlying pathology¹⁶. Furthermore, MDCT is highly sensitive for detecting perforation and traumatic bowel injury, owing to its ability to identify even minimal extraluminal air and associated findings¹⁷.

Compared with magnetic resonance enterography (MRE), MDCT offers advantages including faster acquisition, wider availability, and superior spatial resolution, making it particularly suitable for emergency imaging¹⁸. However, radiation exposure and contrast-related risks remain important limitations, especially in younger patients and those requiring repeated imaging¹⁹. Despite these concerns, MDCT continues to be the primary imaging modality for small bowel evaluation in most clinical settings.

Disease patterns of the small bowel vary geographically. In developing countries, including India, infectious etiologies such as intestinal tuberculosis remain highly prevalent, alongside inflammatory and obstructive conditions²⁰. These differences highlight the importance of region-specific data to evaluate the diagnostic performance of imaging modalities in diverse clinical contexts.

Although the diagnostic utility of MDCT has been well established, there remains a need for studies correlating imaging findings with operative and histopathological outcomes, particularly in mixed disease populations. Additionally, the role of MDCT in differentiating neoplastic from non-neoplastic lesions and in guiding clinical management warrants further evaluation.

The present study, aims to assess the diagnostic performance of MDCT in detecting and characterizing small bowel pathologies. It further seeks to determine the distribution of disease patterns and evaluate the accuracy of MDCT using surgical and histopathological correlation as the reference standard.

MATERIALS AND METHODS

Study design and population: This prospective observational study was conducted in the Department of Radiodiagnosis at Mahatma Gandhi Medical College and Hospital, Jaipur, India, over a period of 18 months. The study protocol was approved by the Institutional Ethics Committee, and all procedures were performed in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to inclusion. Patients presenting with clinical suspicion of small bowel disease, including symptoms such as abdominal pain, vomiting, distension, gastrointestinal bleeding, weight loss, or suspected intestinal obstruction, were considered for inclusion. A total of 78 patients were initially assessed for eligibility during the study period. Of these, 14 patients were excluded due to predefined criteria, including contraindications to iodinated contrast such as severe renal impairment or known contrast allergy, pregnancy, hemodynamic instability precluding CT examination, or incomplete imaging and follow-up data. After applying these criteria, 64 patients underwent contrast-enhanced multidetector computed tomography (MDCT) and were included in the final analysis. Only adult patients aged 18 years and above with adequate imaging and clinical correlation were considered eligible for inclusion in the study.

CT acquisition protocol: All included patients underwent contrast-enhanced MDCT using a multidetector CT scanner. Patients were instructed to fast for 4–6 hours prior to imaging to ensure optimal bowel evaluation. Oral contrast was administered selectively to achieve adequate bowel distension, particularly in patients with suspected inflammatory or neoplastic conditions. Scanning was performed using thin collimation with slice thickness ranging from 0.5 to 1.25 mm, allowing high-resolution image acquisition. Multiplanar reconstructions in axial, coronal, and sagittal planes were generated for detailed assessment. Intravenous non-ionic iodinated contrast (100–120 mL) was administered through a power injector at a rate of 3–

4mL/s. A multiphasic imaging protocol was employed, consisting of a non-contrast phase where indicated, followed by arterial phase imaging at approximately 20–30 seconds, portal venous phase imaging at 45–70 seconds, and delayed phase imaging in selected cases. CT enterography using neutral oral contrast was performed in selected patients to enhance visualization of mucosal and mural abnormalities.

Image interpretation: All MDCT images were independently reviewed by experienced radiologists using a standardized and systematic approach. Imaging analysis focused on identifying the site and extent of bowel involvement, assessing bowel wall thickness and morphological characteristics, and evaluating enhancement patterns, which were categorized as homogeneous, heterogeneous, or stratified. Luminal changes, including dilatation, narrowing, and features of obstruction, were documented. Mesenteric findings such as fat stranding, vascular changes, and lymphadenopathy were evaluated in detail. Extraintestinal findings, including ascites, abscess formation, fistulae, and evidence of perforation, were also recorded. Based on the imaging features, lesions were categorized as neoplastic or non-neoplastic, and a provisional radiological diagnosis was assigned for each patient.

RESULTS

A total of 64 patients with clinically suspected small bowel disease were included in the final analysis. The study population demonstrated a predominance of middle-aged individuals with a higher proportion of male patients, indicating a greater disease burden in this demographic group.

On overall lesion categorization, benign lesions were significantly more common than malignant lesions,

Reference standard: The final diagnosis was established using a composite reference standard that included histopathological examination wherever available, operative findings in surgically managed cases, and clinical follow-up along with laboratory correlation in patients managed conservatively. This approach allowed comprehensive validation of MDCT findings across different categories of small bowel disease.

Outcome measures and statistical analysis: The primary objective of the study was to evaluate the diagnostic performance of MDCT in the detection and characterization of small bowel diseases. Secondary objectives included determining the distribution of neoplastic and non-neoplastic lesions and assessing the correlation between MDCT findings and final diagnosis. Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Continuous variables were expressed as mean with standard deviation, while categorical variables were presented as frequencies and percentages. Diagnostic performance parameters, including sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy, were calculated. Associations between imaging findings and disease categories were evaluated using the Chi-square test or Fisher's exact test, as appropriate, and a p-value of less than 0.05 was considered statistically significant.

accounting for 75% (n = 48) and 25% (n = 16) of cases, respectively. This finding underscores the predominance of non-neoplastic etiologies in patients presenting with small bowel pathology. Further analysis of benign lesions revealed that inflammatory and infectious conditions constituted the majority. Intestinal tuberculosis was the most frequently observed pathology, accounting for 37.5% (n = 24) of cases, followed by Crohn's disease in 25% (n = 16). Other less common conditions included polyposis

Table 1. Distribution of specific small bowel lesions

Disease	Number (n)	Percentage (%)
Tuberculosis	24	37.5
Crohn's disease	16	25.0
Polyposis	4	6.3
Intussusception	2	3.1
Others	2	3.1
Malignant lesions (all)	16	25.0
Total	64	100

(Evaluation of the anatomical distribution of disease demonstrated that the ileum was the most commonly involved segment, accounting for 62.5% (n = 40) of cases, followed by the jejunum (28.1%, n = 18) and duodenum (9.4%, n = 6). This pattern reflects the known predilection of inflammatory conditions for the ileal region. Assessment of CT imaging characteristics demonstrated that bowel wall thickening was a consistent finding across the study population. On quantitative evaluation, moderate bowel wall thickening (6–10 mm) was the most common pattern, observed in 30 (46.9%) patients, followed by mild thickening (3–5 mm) in 18 (28.1%) patients and severe thickening (>10 mm) in 16 (25.0%)

patients. These findings indicate that moderate mural thickening is the predominant imaging manifestation in small bowel diseases.

Table 2. Site of involvement

Site	Number (n)	Percentage (%)
Duodenum	6	9.4
Jejunum	18	28.1
Ileum	40	62.5
Total	64	100

Evaluation of enhancement patterns revealed that homogeneous enhancement was the most frequently observed pattern, present in 26 (40.6%) patients, followed by heterogeneous enhancement in 18 (28.1%) patients, stratified enhancement in 14 (21.9%) patients, and hypo enhancement in 6 (9.4%) patients. Stratified enhancement was predominantly associated with inflammatory conditions, whereas heterogeneous and hypo enhancing patterns were more frequently seen in malignant lesions.

Table 3. CT imaging characteristics

Parameter	Category	Number	%
Wall thickness	Mild	18	28.1
	Moderate	30	46.9
	Severe	16	25.0
Enhancement pattern	Homogeneous	26	40.6
	Heterogeneous	18	28.1
	Stratified	14	21.9
	Hypoenhancing	6	9.4
	Symmetrical thickening	28	43.8
	Asymmetrical thickening	20	31.3
	Polypoidal lesion	10	15.6
	Exophytic mass	6	9.4

Morphological assessment of lesions on MDCT demonstrated that symmetrical bowel wall thickening was the most common morphology, observed in 28 (43.8%) patients, followed by asymmetrical wall thickening in 20 (31.3%) patients, polypoidal lesions in 10 (15.6%) patients, and exophytic masses in 6 (9.4%) patients. Symmetrical thickening was predominantly associated with inflammatory pathologies, while polypoidal and exophytic lesions were more commonly associated with neoplastic conditions. Mesenteric involvement was also a significant finding in the study population. Mesenteric lymphadenopathy was present in 22 (34.4%) patients, while it was absent in 42 (65.6%) patients. The presence of lymphadenopathy was more commonly associated with inflammatory conditions, particularly intestinal tuberculosis.

Table 4. Mesenteric, luminal, and extraintestinal findings on MDCT

Finding	Number (n)	Percentage (%)
Mesenteric findings		
Mesenteric fat stranding	28	43.8
Mesenteric lymphadenopathy	22	34.4
Mesenteric edema	10	15.6
No mesenteric abnormality	4	6.2
Luminal findings		
Luminal narrowing	22	34.4
Luminal dilatation	18	28.1
Obstruction	20	31.3
Normal lumen	4	6.2
Extraintestinal findings		
Ascites	10	15.6
Peritoneal thickening	6	9.4
Abscess	3	4.7
No extraintestinal finding	45	70.3

In addition to mural and mesenteric findings, luminal and extraintestinal abnormalities were also observed. Although present in a smaller proportion of patients, these findings included luminal narrowing, bowel dilatation, ascites, abscess formation, and complications such as perforation and ischemia, highlighting the ability of MDCT to evaluate both intestinal and extraintestinal disease components comprehensively.

Statistical analysis further demonstrated significant associations between imaging characteristics and disease categories. Enhancement patterns showed a significant correlation with disease type, with stratified enhancement being associated with inflammatory lesions and heterogeneous enhancement with malignant lesions. Similarly, severe bowel wall thickening was significantly associated with malignant disease, whereas mild-to-moderate thickening was more commonly observed in inflammatory conditions.

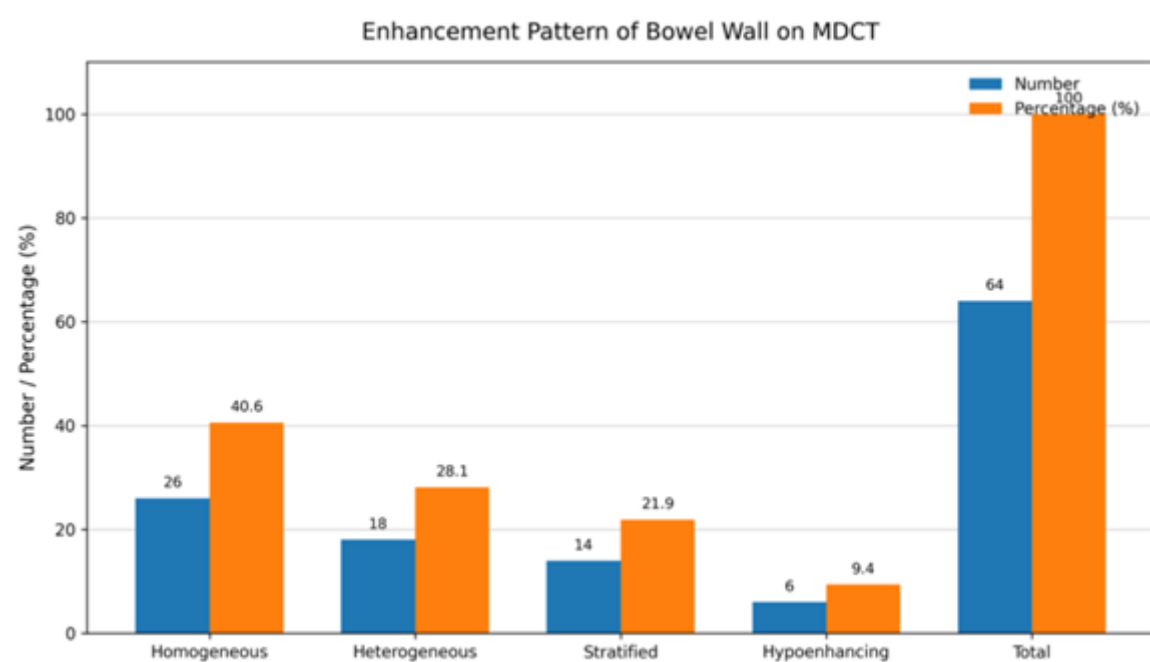


Figure 1. Enhancement pattern of bowel wall on multidetector CT (MDCT).

The diagnostic performance of MDCT was found to be high, with a sensitivity of 92%, specificity of 88%, and overall diagnostic accuracy of approximately 90%. These findings confirm the reliability of MDCT in detecting and characterizing small bowel diseases.

Table 5. Diagnostic performance of MDCT

Parameter	Value (%)
Sensitivity	92
Specificity	88
Diagnostic accuracy	90

Overall, the results demonstrate that MDCT provides detailed and comprehensive evaluation of small bowel pathology, enabling accurate differentiation between inflammatory and malignant conditions and facilitating appropriate clinical management.

DISCUSSION

The present study evaluated the role of multidetector computed tomography (MDCT) in the detection and characterization of small bowel diseases in a cohort of 64 patients. The findings demonstrate that MDCT is a highly effective imaging modality, providing comprehensive evaluation of bowel wall morphology, luminal abnormalities, mesenteric involvement, and extraintestinal complications.

In the current study, benign lesions constituted the majority (75%), with inflammatory conditions such as intestinal tuberculosis and Crohn's disease being the predominant pathologies. This observation is consistent with previous studies conducted in developing countries, where infectious and inflammatory etiologies account for the bulk of small bowel diseases²⁰. Similar findings have been reported by Sharma MP and colleagues, who highlighted the high prevalence of intestinal tuberculosis in the Indian subcontinent²⁰. In contrast, studies from Western populations report a higher proportion of neoplastic lesions, reflecting regional epidemiological differences¹¹. This finding aligns with the known

predilection of both Crohn's disease and intestinal tuberculosis for the terminal ileum¹³. Bruining DH et al. demonstrated that CT enterography reliably identifies ileal involvement and correlates well with disease activity in inflammatory bowel disease¹³. The predominance of ileal involvement in our study further reinforces the diagnostic importance of MDCT in evaluating this region.

Assessment of bowel wall thickening revealed that moderate thickening (46.9%) was the most common finding, followed by mild (28.1%) and severe thickening (25.0%). These findings are comparable to previous imaging studies, which have shown that inflammatory conditions typically present with mild-to-moderate symmetrical thickening, whereas malignant lesions are more likely to demonstrate severe and asymmetrical wall thickening¹⁰. This distinction is clinically important, as it aids in differentiating benign from malignant pathology.

Evaluation of enhancement patterns demonstrated that homogeneous enhancement was the most frequent pattern (40.6%), followed by heterogeneous (28.1%), stratified (21.9%), and hypoenhancing patterns (9.4%). Stratified enhancement was predominantly associated with inflammatory conditions, while heterogeneous and hypoenhancing patterns were more commonly observed in malignant lesions. These findings are consistent with those reported by Wold PB et al., who described stratified enhancement as a characteristic feature of active inflammatory disease, reflecting mucosal hyperemia and submucosal edema¹⁰. Similarly, heterogeneous enhancement has been linked to tumor necrosis and irregular vascularity in malignant lesions¹⁵. Morphological analysis showed that symmetrical wall thickening (43.8%) was the most common pattern, followed by asymmetrical thickening (31.3%), polypoidal lesions (15.6%), and exophytic masses (9.4%). Symmetrical thickening was predominantly associated with inflammatory diseases, whereas polypoidal and exophytic lesions were more frequently seen in neoplastic conditions. These observations are in agreement with previous studies, which emphasize morphological patterns as key discriminators between inflammatory and neoplastic small bowel diseases¹⁵.

Mesenteric involvement was a significant finding in the present study. Mesenteric fat stranding was observed in 43.8% of patients, while lymphadenopathy was present in 34.4% of cases. These findings are consistent with earlier reports, where mesenteric fat stranding and lymphadenopathy are commonly associated with inflammatory conditions, particularly tuberculosis and Crohn's disease⁹. Boudiaf M et al. highlighted the importance of mesenteric changes in improving diagnostic confidence in small bowel diseases⁹.

Luminal abnormalities were also frequently detected, with luminal narrowing (34.4%) and obstruction (31.3%)

being the most common findings. These results are comparable to those reported by Millet I et al., who demonstrated high accuracy of CT in identifying the site and cause of small bowel obstruction¹². The ability of MDCT to identify transition points and associated complications makes it invaluable in acute settings.

Extraintestinal findings were identified in a subset of patients, with ascites (15.6%), peritoneal thickening (9.4%), and abscess formation (4.7%) being the most common. These findings highlight the advantage of MDCT over conventional imaging modalities, as it allows simultaneous evaluation of intra-abdominal structures beyond the bowel wall⁸. Previous studies have similarly emphasized the role of CT in detecting complications such as abscesses and perforation, which are critical for clinical management¹⁷.

Statistical analysis in the present study demonstrated significant associations between imaging findings and disease categories. Stratified enhancement and symmetrical wall thickening were significantly associated with inflammatory lesions, whereas heterogeneous enhancement and severe wall thickening were more commonly associated with malignant disease. These findings are in line with established radiological principles and have been corroborated by multiple studies^{10,15}.

The diagnostic performance of MDCT in the present study was high, with sensitivity of 92%, specificity of 88%, and overall accuracy of 90%. These results are comparable to previous studies, which have reported diagnostic accuracies ranging from 85% to 95% for MDCT in small bowel diseases⁷. Huprich JE et al. demonstrated that MDCT enterography provides excellent diagnostic accuracy in evaluating small bowel pathology, particularly in inflammatory conditions⁷. Similarly, Menke J reported high sensitivity of CT in detecting mesenteric ischemia¹⁴.

Recent advances in CT technology, including improved spatial resolution and faster acquisition times, have further enhanced the role of MDCT in small bowel imaging. Studies by Masselli G et al. and Bruining DH et al. have highlighted the expanding applications of CT enterography in evaluating both inflammatory and neoplastic conditions^{13,15}. Additionally, newer research has emphasized the role of MDCT in guiding management decisions and monitoring treatment response²¹.

Despite its advantages, MDCT has certain limitations, including exposure to ionizing radiation and potential contrast-related adverse effects¹⁹. However, its wide availability, rapid acquisition, and high diagnostic accuracy make it the imaging modality of choice in most clinical scenarios, particularly in emergency settings¹⁸.

The present study has certain limitations that should be considered while interpreting the results. The sample size was relatively small (n = 64), which may limit the generalizability of the findings to a broader population. Being a single-center study, the results may reflect regional disease patterns, particularly the higher prevalence of inflammatory conditions such as intestinal tuberculosis, and may not be directly applicable to other geographic settings. Not all cases had histopathological confirmation, as some diagnoses were based on clinical and radiological follow-up, which may introduce diagnostic bias. Additionally, interobserver variability in image interpretation was not assessed, and advanced imaging techniques such as CT enterography were not uniformly performed in all patients. Finally, the inherent limitations of CT, including radiation exposure and contrast-related risks, remain important considerations, especially in patients requiring repeated imaging.

CONCLUSION

In conclusion, multidetector computed tomography (MDCT) is a reliable, non-invasive, and highly effective imaging modality for the evaluation of small bowel diseases. It provides comprehensive assessment of bowel wall morphology, luminal abnormalities, mesenteric involvement, and extraintestinal findings in a single examination. The present study demonstrates that MDCT has high diagnostic accuracy in differentiating inflammatory and malignant lesions, with characteristic imaging features such as enhancement patterns, degree of wall thickening, and morphological characteristics aiding in diagnosis. The predominance of inflammatory pathologies and ileal involvement observed in this study further highlights the importance of MDCT in early detection and appropriate characterization of small bowel diseases, ultimately facilitating timely and accurate clinical management.

RECOMMENDATIONS

Based on the findings of the present study, MDCT should be considered the primary imaging modality in patients with suspected small bowel pathology, particularly in acute and emergency settings. Routine use of standardized imaging protocols, including multiphasic contrast-enhanced studies, is recommended to improve diagnostic accuracy. Where feasible, advanced techniques such as CT enterography should be utilized for better evaluation of mucosal and mural abnormalities, especially in inflammatory bowel disease. Larger multicentric studies with histopathological correlation are recommended to further validate the diagnostic performance of MDCT. Additionally, future research should focus on reducing radiation exposure through optimized protocols and exploring the role of complementary modalities such as MRI in selected patient populations.

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