ORIGINAL ARTICLE

Intestinal Ultrasound assessment in patients with Inflammatory Bowel Disease remission

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Abstract

Background: ***Inflammatory Bowel Disease (IBD) is a chronic inflammatory condition of the gastrointestinal tract, with Ulcerative Colitis (UC) and Crohn's Disease (CD) being the most common subtypes. Accurate, non-invasive methods for assessing disease remission are essential to reducing the reliance on invasive colonoscopy.***

Aim: ***To evaluate the diagnostic accuracy of intestinal ultrasound (IUS) in detecting bowel wall thickness (BWT) as a predictor of disease remission in IBD patients.***

Methods: ***This study included 50 IBD patients in remission (40 UC, 10 CD). BWT was measured using IUS, and FC levels were assessed. Diagnostic performance was analyzed using sensitivity, specificity, and ROC curves. All patients underwent endoscopic and histopathological assessment for remission status.***

Results: ***BWT at a cutoff of ≤3.6 mm showed 100% sensitivity, specificity, and accuracy in predicting remission. FC at a cutoff of ≤160 µg/g showed 90.91% sensitivity and 66.67% specificity.***

Conclusion: ***IUS-measured BWT is a highly accurate, non-invasive marker for assessing disease remission in IBD patients. FC also provides useful predictive value, but with lower specificity. These findings support the use of IUS as a reliable alternative to colonoscopy for disease monitoring.***

Keywords: Inflammatory bowel disease; IBD remission; bowel wall thickness

1. Introduction

Intestinal ultrasound (IUS) has emerged as a non-invasive, highly effective tool in the management of inflammatory bowel disease (IBD), particularly during remission phases. IUS allows clinicians to monitor disease activity, detect subtle inflammation, and evaluate complications like strictures or fistulas, all without the need for invasive procedures.[1]

In IBD remission, IUS plays a crucial role in assessing the underlying intestinal health, ensuring that inflammation is truly controlled and there is no disease progression, even in the absence of symptoms. By using high-resolution imaging, IUS provides real-time insights into the bowel's structure and function, offering a safer alternative to repeated endoscopic evaluations. Recent studies have highlighted IUS's growing importance in the management of IBD, contributing to better-informed decisions about maintaining remission, adjusting therapies, and preventing relapse. With its high sensitivity and low risk, IUS is becoming an indispensable tool in personalized care for IBD patients.[2-3]

The aim of the study is to use intestinal ultrasound in assessing patients with Inflammatory Bowel Disease in remission.

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2. Patients and methods

This study will include 50 patients diagnosed with Inflammatory Bowel Disease (IBD), comprising 40 patients with Ulcerative Colitis (UC) and 10 patients with another unspecified subtype of IBD. Patient selection will be based on a confirmed clinical diagnosis and laboratory evidence indicating disease remission. The study will be conducted at Al-Azhar University Hospitals. Inclusion criteria include a previously confirmed IBD diagnosis via biopsy and histological and laboratory confirmation of remission. Exclusion criteria include patients under 16 years old, pregnant women, critically ill patients, and obese individuals.

A detailed clinical assessment will be performed to evaluate disease remission. The Simple Clinical Colitis Activity Index (SCCAI) will assess UC activity based on bowel frequency, urgency, stool blood presence, general well-being, and extra-colonic features. For other IBD subtypes, the Crohn's Disease Activity Index (CDAI) will assess stool frequency, abdominal pain, well-being, complications, and opioid use. Bowel wall thickness will be measured using the GE LOGIQ 6 ultrasound machine with a superficial probe. All study procedures comply with ethical standards, with approval from the local Ethics Committee and written informed consent obtained from participants.

3. Results

The study included 50 patients diagnosed with inflammatory bowel disease (IBD), comprising 40 (80%) with ulcerative colitis (UC) and 10 (20%) with Crohn's disease (CD). The mean age of participants was 40.3 ± 7.59 years, ranging from 26 to 55 years. There was an equal gender distribution, with 25 (50%) males and 25 (50%) females.

Table 1. Demographic data of the studied patients.

		(N=50)
AGE (YEARS)	Mean ± SD	40.3 ± 7.59
	Range	26 - 55
GENDER	Male	25 (50%)
	Female	25 (50%)

Clinical and Laboratory Findings

Among the patients, 40 (80%) had a bowel frequency of once daily, while 5 (10%) reported twice daily and another 5 (10%) reported three times daily. No patients exhibited urgency of defecation or blood in stool.

Heart rate at rest ranged from 60 to 80 bpm, with a mean of 61.4 ± 2.81 bpm. Hemoglobin (Hb) levels ranged from 12 to 14.5 g/dL, with a mean of 13.4 ± 0.7 g/dL. Inflammatory markers indicated an erythrocyte sedimentation rate (ESR) of 25.3 ± 9.28 mm/h (range: 11-40 mm/h) and C-reactive protein (CRP) levels averaging 4.4 ± 2.07 mg/L (range: 3.5-10 mg/L). Fecal calprotectin levels varied between 51 and 240 µg/g, with a mean of 89.4 ± 55.46 µg/g.

Table 2. Heart rate and laboratory investigation of the studied patients.

		(N=50)
HEART RATE AT REST (BPM)	Mean ± SD	61.4 ± 2.81
	Range	60 – 80
HB LEVEL (G/DL)	Mean ± SD	13.4 ± 0.7
	Range	12 - 14.5
ESR (MM/H)	Mean ± SD	25.3 ± 9.28
	Range	11 – 40
CRP (MG/L)	Mean ± SD	4.4 ± 2.07
	Range	3.5 – 10
FECAL CALPROTECTIN (MG/G)	Mean ± SD	89.4 ± 55.46
	Range	51 – 240
BOWEL WALL THICKNESS (MM)	Mean ± SD	2.7 ± 0.5
	Range	2.5 – 4

*SD:standard deviation, HB:hemoglobin, ESR:erythrocyte sedimentation rate, CRP:c-reactive protein.

Endoscopic and Histological Remission

All 50 patients (100%) demonstrated endoscopic remission via colonoscopy. However, a histological evaluation revealed that 44 (88%) patients were in complete microscopic remission, while 6 (12%) exhibited some degree of microscopic activity.

Bowel Wall Thickness and Its Diagnostic Performance

Bowel wall thickness (BWT), assessed using intestinal ultrasound (IUS), ranged from 2.5 to 4 mm, with a mean of 2.7 ± 0.5 mm. The study identified a cutoff value of ≤3.6 mm for predicting disease remission, which showed exceptional diagnostic accuracy with 100% sensitivity, 100% specificity, 100% positive predictive value (PPV), and 100% negative predictive value (NPV). The area under the receiver operating characteristic (ROC) curve (AUC) for BWT was 1.0 ($p < 0.001$), indicating perfect diagnostic performance.

Fecal Calprotectin as a Marker of Remission

Fecal calprotectin (FC) was also analyzed as a non-invasive marker for remission. A cutoff value of ≤160 µg/g yielded 90.91% sensitivity and 66.67% specificity, with a PPV of 95.2% and an NPV of 50%. The ROC analysis showed an AUC of 0.951 ($p < 0.001$), confirming its strong but slightly less reliable diagnostic value compared to BWT.

4. Discussion

The aim of this study was to evaluate the sensitivity of intestinal ultrasound (IUS) in detecting bowel wall thickness and its ability to predict disease remission in patients with inflammatory bowel disease (IBD). In this context, the study compared IUS with colonoscopy, histopathology, and inflammatory markers, focusing particularly on the relationship between bowel wall thickness and disease remission, as well as its predictive value when compared with microscopic activity. Our results show that bowel

wall thickness measured by IUS at a cutoff of 3.6 mm can reliably predict disease remission with 100% sensitivity, specificity, and accuracy. Additionally, fecal calprotectin, with a cutoff of 160 µg/g, was found to be a significant marker for predicting remission with high sensitivity and moderate specificity. [4-5]

The study included 50 patients diagnosed with IBD, 80% of whom had ulcerative colitis (UC) and 20% had Crohn's disease (CD). The age range of patients was from 26 to 55 years, with a mean age of 40.3 ± 7.59 years, and there was an equal gender distribution. This demographic information is consistent with previous studies that have reported UC as the most common form of IBD in clinical settings.[6-7]

The absence of significant gender differences in our cohort aligns with existing literature that does not typically demonstrate strong gender predilection in IBD incidence.[8]

The majority of patients in this study (80%) had normal bowel frequency (once daily), with no cases of urgency or blood in stool, which is in line with our selection of patients in remission. These factors reflect the non-severe, stable nature of the cohort, helping minimize bias from active disease manifestations.[9]

Bowel Wall Thickness and Disease Remission

Bowel wall thickness (BWT) has long been recognized as a significant ultrasonographic marker for assessing the severity of inflammation in IBD. In this study, we found that IUS-measured bowel wall thickness with a cutoff value of ≤3.6 mm had a 100% sensitivity and specificity for predicting disease remission. The absence of any complications in this cohort further strengthened the validity of using bowel wall thickness as a marker of remission, given that it accurately reflected the absence of microscopic activity in 88% of the cases.[10-11]

Our findings are in agreement with recent literature that demonstrates the utility of bowel wall thickness as an accurate and non-invasive method for monitoring IBD activity and remission. A recent meta-analysis by Fiocchi et al. showed that a bowel wall thickness cutoff of 3.5 mm had high sensitivity and specificity in distinguishing between active disease and remission in IBD patients. The present study reinforces this finding, emphasizing the reliability of IUS in detecting remission, which is particularly valuable in clinical practice, where non-invasive assessments can reduce the need for more invasive procedures such as colonoscopy.[12-13]

Additionally, the high AUC value of 1 in our study underscores the diagnostic accuracy of bowel wall thickness measurements in predicting disease remission. Similar findings were reported by Liu et al., who found that IUS demonstrated excellent diagnostic performance when compared to colonoscopy in evaluating IBD severity. The advantage of IUS lies in its ability to provide real-time, reproducible measurements without the need for bowel preparation or sedation, making it an ideal tool for routine follow-up in IBD patients.[14]

Fecal Calprotectin as a Marker for Disease Remission

In addition to bowel wall thickness, fecal calprotectin (FC) has been widely used as an inflammatory marker to assess disease activity in IBD. Our study found that fecal calprotectin, with a cutoff value of ≤160 µg/g, could predict remission with a sensitivity of 90.91% and a specificity of 66.67%. Although the specificity was somewhat lower than that of bowel wall thickness, the positive predictive value (PPV) of fecal calprotectin (95.2%) was notably high, making it a reliable marker for confirming remission. The moderate specificity observed in our study is consistent with recent reports that highlight fecal calprotectin's limitations in distinguishing between remission and low-grade inflammation, particularly in the presence of other gastrointestinal disorders. [15]

The sensitivity and PPV of fecal calprotectin reported here align with findings from other studies, such as those by Saha et al. and Armuzzi et al., who demonstrated that FC is highly effective in predicting disease remission in IBD. However, its use as a sole marker for IBD remission is not without challenges, as FC levels can be elevated in other conditions, such as infections or colorectal cancer, which may decrease its specificity. Despite these limitations, FC remains a valuable tool in clinical practice, particularly when used in combination with other markers like bowel wall thickness and histopathological assessments.[16]

Comparison with Colonoscopy and Histopathology

Colonoscopy remains the gold standard for assessing IBD activity and disease remission. In our study, all patients showed endoscopic remission, further corroborating the accuracy of our non-invasive markers (IUS and FC) in predicting disease status. Histopathological evaluation of biopsy samples showed that 88% of patients were in remission, and 12% displayed active microscopic changes, which is consistent with what is seen in clinical practice, where endoscopic remission does not always correlate perfectly with histological remission. [17]

Although colonoscopy provides a detailed visual assessment of the mucosa and is considered the gold standard, it is invasive, expensive, and carries some risks, particularly in patients with comorbidities or those undergoing frequent monitoring. As such, there is growing interest in the use of IUS and fecal calprotectin as

alternatives or adjuncts to colonoscopy for disease monitoring. Both bowel wall thickness and fecal calprotectin provide non-invasive, cost-effective alternatives to colonoscopy and histopathology, offering high diagnostic accuracy for remission status, as shown in our study.[18]

Recent studies by Kopylov et al. and Vavricka et al. have reported that IUS correlates well with both colonoscopy and histopathology, providing an excellent non-invasive alternative for monitoring IBD patients. Our results are consistent with these findings, highlighting that IUS can effectively replace or complement colonoscopy in the routine management of IBD, especially for long-term disease surveillance. [19-20]

4. Conclusion

Intestinal ultrasound (IUS) and fecal calprotectin are effective non-invasive markers for predicting IBD remission. Bowel wall thickness at ≤3.6 mm showed 100% diagnostic accuracy. While fecal calprotectin is slightly less specific, it remains useful. These markers offer reliable alternatives to colonoscopy, enabling frequent monitoring, reducing patient burden, and lowering costs.

Disclosure

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