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Prognostic value of platelet indices and platelet-to-albumin ratio in assessing disease activity in crohn's disease

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Abstract

Objective: *to evaluate the prognostic value of selected platelet indices and platelet-to-albumin ratio in predicting disease activity in Crohn's disease. Subject and method: A cross-sectional descriptive study on 85 patients diagnosed with Crohn's disease at 108 Military Central Hospital from October 2021 to April 2025. Result: The mean age of participants was 37.14 ± 15.15 years; 63.5% were male. The age of disease onset was predominantly between 17 and 39 years (64.7%). The most common clinical symptoms were digestive disorders (89.4%) and abdominal pain (80%). The most frequent complications were fistula (32.9%) and stricture (23.5%). The platelet count (PLT), plateletcrit (PCT), and PLT/ALB ratio were significantly higher in the active Crohn's disease group compared to the remission group ($p < 0.01$). These indices were also significantly correlated with the SES-CD score. PCT and the PLT/ALB ratio were found to be better biomarkers for predicting disease activity. The optimal cut-off value for PCT was 0.244, with a sensitivity of 86.6% and a specificity of 72.2%; the area under the curve (AUC) was 0.797 ($p < 0.01$). For the PLT/ALB ratio, the cut-off value was 7.80, with a sensitivity of 79.3%, specificity of 72.2%, and an AUC of 0.792 ($p < 0.01$). Conclusion: PCT and the PLT/ALB ratio, which depend on platelet count, mean platelet volume (MPV), and albumin levels, may serve as independent indices and sensitive biomarkers for identifying active Crohn's disease.*

Keywords: *Crohn's Disease (CD); platelet count (PLT); mean platelet volume (MPV); plateletcrit (PCT); Simple Endoscopic Score for Crohn Disease (SES-CD), albumin (ALB).*

I. Background

Inflammatory bowel disease (IBD) encompasses both ulcerative colitis (UC) and Crohn's disease (CD). Among these, Crohn's disease is a chronic immune-mediated inflammatory condition of the intestinal mucosa, characterized by transmural inflammation affecting all layers of the gastrointestinal wall, from the mucosa to the serosa. The disease is more commonly seen in Western countries. Although the exact cause of Crohn's disease remains unclear, immunological, genetic, and environmental factors are believed to play significant roles in its pathogenesis.

Currently, there is no gold standard for the definitive diagnosis of Crohn's disease. Diagnosis is primarily based on a combination of clinical symptoms, laboratory findings, imaging studies, gastrointestinal endoscopy, and histopathological evaluation [1].

Regular monitoring of disease activity is crucial for patients with IBD, as it enables timely therapeutic interventions and improves both prognosis and quality of life. Various tools are

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used to assess disease activity, including laboratory markers such as fecal calprotectin, erythrocyte sedimentation rate (ESR), and high-sensitivity C-reactive protein (hs-CRP); clinical indices such as the Crohn's Disease Activity Index (CDAI) and Harvey-Bradshaw Index (HBI); and endoscopic scores such as the Simple Endoscopic Score for Crohn's Disease (SES-CD) and Rutgeerts score. Among these, endoscopy remains one of the most valuable methods; however, it can be invasive, costly, and challenging, especially in patients with significant comorbidities [2,3].

Recent studies have suggested that platelets may play a critical role in the pathogenesis of Crohn's disease. Certain platelet indices, including platelet count (PLT), mean platelet volume (MPV), plateletcrit (PCT), and the platelet-to-albumin (PLT/ALB) ratio, have been proposed as potential non-invasive biomarkers for assessing disease activity [4].

In Vietnam, research on Crohn's disease remains limited. Therefore, we conducted this study with the following objective: "To evaluate the value of selected platelet indices and the platelet-to-albumin ratio in predicting disease activity in Crohn's disease."

2. Subjetc and method

2.1. Study Subjects

* Selection Criteria

Patients were diagnosed with Crohn's disease based on the 2018 guidelines of the American College of Gastroenterology (ACG).

* Exclusion Criteria: Patients were excluded if they had any of the following conditions:

Infectious diseases, severe liver dysfunction or liver failure or hematologic disorders

Malignant diseases, autoimmune diseases, congenital or acquired immunodeficiency.

Refusal to undergo study-related procedures or participate in the study

** Study location and duration*

The study was conducted at the Department of Gastrointestinal Diseases, 108 Military Central Hospital, from October 2021 to April 2025.

2.2. Research Methods

2.2.1. Study Design: This is a cohort study, conducted both retrospectively and prospectively

2.2.2. Sample Selection and Sample Size: A convenience sampling method was used. Patients who met the inclusion criteria were recruited into the study.

The sample size was calculated using a formula appropriate for studies assessing diagnostic accuracy based on the receiver operating characteristic (ROC) curve.

$$n = \frac{(Z\alpha_{/2})^2 \, V(AUC)}{d^2}$$

Where:

n is the required sample size

$Z\alpha_{/2}^{\,2}$ is the confidence coefficient, equal to 1.96

$$V(AUC) = (0.0099 \times e^{\frac{-\alpha^2}{2}}) \times (6\alpha^2 + 16)$$

in $\alpha = \varphi^{-1}(AUC) \times 1{,}414$. Here φ^{-1} denotes the inverse of the cumulative standard normal distribution function.

Based on the study by Jian Tang et al., the PCT index had an AUC-ROC of 0.67 in predicting Crohn's disease activity. With a margin of error (d) less than 0.1, the estimated sample size was greater than 57.4. After accounting for a 10% expected loss to follow-up, the adjusted sample size was greater than 63.1. Therefore, the required sample size was set at 64 patients.

2.2.3. Research Procedures:

- Clinical Evaluation: Demographic and clinical information, including age, sex, and presenting symptoms (e.g., diarrhea, abdominal pain, fever, weight loss, palpable abdominal

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mass), were collected using a standardized patient record form.

- Laboratory Tests:

* *Hematological tests:* Platelet indices including platelet count (PLT, G/L), mean platelet volume (MPV, fL), plateletcrit (PCT, %), hematocrit (HCT, %), and erythrocyte sedimentation rate (ESR, mm/h) were analyzed using the Sysmex XN-9100 hematology analyzer.

* *Biochemical tests:* C-reactive protein (CRP, mg/L) and serum albumin (g/L) were measured using the AU5811 automated biochemistry analyzer.

- Colonoscopy: Assessment of disease activity was performed using the SES-CD (Simple Endoscopic Score for Crohn's Disease) and Rutgeerts scores.

Table 1. SES-CD score

Variable	0	1	2	3
Size of ulcers (cm)	None	Aphthous ulcers (0.1–0.5 cm)	Large ulcers (0.5–2 cm)	Very large ulcers (>2 cm)
Ulcerated surface (%)	None	<10%	10-30%	>30%
Affected surface (%)	Unaffected	<50%	50-70%	>70%
Presence of narrowings	None	Single, can be passed	Multiple, can be passed	Cannot be passed

Each parameter is evaluated in five pre-defined segments of the colon (ileum, ascending colon, transverse colon, descending colon and rectum). The numbers are all added in each segment and divided by the number of segments evaluated .

Remission: 0-2; mild: 3 -6; moderate: 7 – 15; severe: >15.

Table 2. Rutgeerts score for postoperative assessment

Score	Endoscopic description of finding
I0	No lesions in the distal ileum
I1	Not more than 5 anastomotic aphthous lesions in the distal ileum
I2	More than 5 aphthous lesions with normal mucosa between the lesions, or skip areas of large lesions, or ulcers up to 1 cm confined to ileocolonic anastomosis
I3	Diffuse aphthous ileitis with diffusely inflamed mucosa between the multiple aphthae.
I4	Diffuse inflammation, with large lesions: large ulcers and/or nodules/cobble and/or narrowing/stenosis.

Remission: I0 or I1; Relapse: I2 or I3.

2.2.4. Study variable

- Evaluation of age (age at diagnosis and age at the time of study) and gender.

- Assessment of inflammatory severity via endoscopy scores (SES-CD, Rutgeerts) and CDAI score at the time of hospital admission

- Evaluation of clinical symptoms and complications in patients with Crohn's disease

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- Measurement and comparison of ESR, CRP, PLT, MPV, PCT, and PLT/ALB ratio between two groups: remission group (SES-CD ≤ 2 or Rutgeerts I0, I1) and active group (SES-CD > 2 or Rutgeerts I2, I3) at the time of hospital admission.

2.3. Data Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 22.0.

2.5. Ethical Considerations

All study participants were clearly informed about the purpose and significance of the research and participated voluntarily. Collected data were used exclusively for research purposes, kept strictly confidential, and had no impact on the health or rights of the participants.

3. Result

Table 3. General characteristics

Category	Number of patients	Ratio %
Sex		
Male	54	63.5%
Female	31	36.5%
Age of discovery		
< 17 years old	3	3.5%
17-39 years old	55	64.7%
≥ 40 years old	27	31.8%
Average age	37.14 ± 15.15	
Average age of discovery	34.24 ± 14.73	
Clinical symptoms		
Loose/mushy stools	76	89.4%
Abdominal pain	68	80%
Weight loss	45	52.9%
Fever	14	16.5%
Complications		
Fistula	28	32.9%
Stricture	20	23.5%
Perforation	9	10.6%
Abscess	3	3.5%
Gastrointestinal bleeding	1	1.2%
Obstructive, semi-obstructive	2	2.4%
Endoscopic activity level		
Remission	18	21.2%
Active/recurrent	67	78.8%
Total	***n = 85***	

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Table 4. The value of biomarker in assessing Crohn's disease activity

Biomarker	Crohn's disease remission	Active Crohn's disease	P-value
PLT	302 (236.25 - 350)	387 (317 – 477)	0.003
MPV	7.77 ± 1.34	8.28 ± 1.16	0.116
PCT	0.214 (0.182 – 0.278)	0.303 (0.263 – 0.378)	0.000
CRP	3.2 (0.95 – 10.63)	15.7 (4.7 – 45.7)	0.001
ESR	14.5 (11 – 20.25)	27.0 (16 - 58)	0.006
PLT/ALB	6.96 (5.28 – 8.29)	10.19 (8.02 – 13.35)	0.000

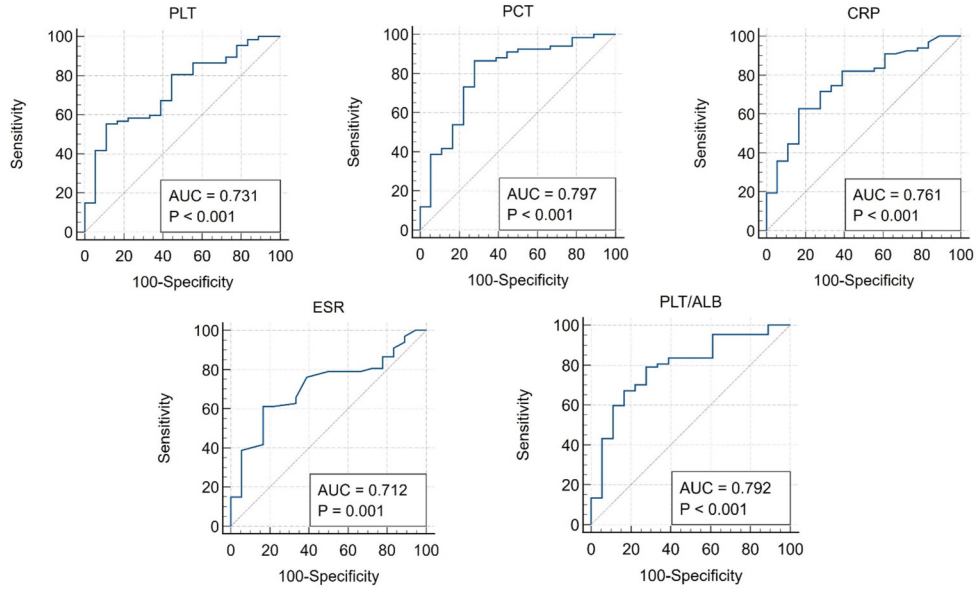

Figure 1. Area Under the Curve (AUC) of the biomarkers

Table 5. Correlation of biomarkers with SES-CD score

Indices	Correlation coefficient (r)	P-value
PLT	0.267	0.022
CRP	0.428	0.000
ESR	0.337	0.004
PLT/ALB	0.415	0.000
CDAI score	0.545	0.000

4. Discussion

The study included 85 patients diagnosed with Crohn's disease based on clinical criteria, endoscopy, and histopathological findings. The mean age at the time of the study was 37.14 ± 15.15 years, which is comparable to the findings of Nguyen Phuong Thuy (35.14 ± 11.7 years) and Nguyen Thi Luan (33.56 ± 11.53 years). The mean age at diagnosis was 34.24 ± 14.73 years, slightly higher than those reported by Nguyen Phuong Thuy (30.46 ± 11.89 years) and Nguyen Thi Luan (30.46 ± 13.1 years). The youngest

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patient in our cohort was 13 years old, and the oldest was 71 years [5,6]. The relatively higher age at diagnosis in our study may be attributed to the prolonged course of disease prior to a definitive diagnosis, as patients often undergo extended treatment at lower-level healthcare facilities before being referred to tertiary hospitals. Additionally, Crohn's disease is inherently challenging to diagnose in its early stages due to nonspecific clinical manifestations and overlapping endoscopic features with other inflammatory bowel diseases.

In our cohort, patients were predominantly diagnosed within two age groups: 17–39 years (64.7%) and over 40 years (31.8%), while only 3.5% were diagnosed before the age of 17. These findings are consistent with international data. For instance, the CONNECT study by Sung Wook Hwang et al. (2017) in South Korea reported that approximately 75% of patients were diagnosed between the ages of 17 and 40 [7]. Although Crohn's disease does not present with age-specific symptoms, elderly patients tend to exhibit features such as anemia, malnutrition, or rectal bleeding, whereas younger individuals are more prone to complications such as fistulas or strictures. Early-onset Crohn's disease has been associated with a poorer prognosis. Several studies have demonstrated that diagnosis before the age of 40 is correlated with increased disease severity and a higher likelihood of requiring corticosteroids, immunosuppressants, hospitalization, or surgery within the initial years post-diagnosis.

In our study, the male-to-female ratio was 1.74:1, with a predominance of male patients. This aligns with findings by Nguyen Thi Luan (1.33:1) [5], and a study by Jong Beom Park et al. in South Korea reporting a ratio of 1.9:1 [8]. Similarly, a study by Keiko Asakura in Japan (2009) found that 70% of Crohn's disease patients were male [9], consistent with epidemiologic trends in Asia. In contrast, studies from Europe and North America have shown either a balanced or female-predominant distribution. It has been hypothesized that genetic differences in sex chromosomes and hormonal factors may influence the pathogenesis of Crohn's disease.

Endoscopic disease activity indices, such as the Simple Endoscopic Score for Crohn's Disease (SES-CD) and Rutgeerts score, are currently the most widely used tools to assess disease severity. At the time of our study, 21.2% of patients were in remission, while 78.8% were in the active stage. During follow-up, most patients remained in the active phase, with the majority exhibiting mild to moderate disease activity.

In addition to CRP and ESR, our study found that PLT, PCT, and the PLT/ALB ratio were significantly elevated in the active disease group compared to the remission group. These findings are consistent with those of Jun Huang et al. and Jian Tang et al. [10,11]. To evaluate the diagnostic performance of these biomarkers, we employed receiver operating characteristic (ROC) curve analysis, using area under the curve (AUC) as the primary indicator.

Our findings showed that PCT (AUC = 0.797) had superior predictive value compared to CRP (AUC = 0.761) and ESR (AUC = 0.712). These results are in line with Jun Huang et al., who reported an AUC of 0.779 for PCT, which was higher than that of PLT (0.728), PLT/ALB (0.694), ESR (0.746), and hs-CRP (0.698) [11]. Interestingly, in our study, the AUC for PLT/ALB was 0.792-higher than that reported by Jun Huang-possibly due to different disease activity classifications (SES-CD $\geq$ 10 in their study vs. active/remission categorization in ours). In contrast, Jian Tang et al. reported a lower AUC for PCT (0.67) compared to hs-CRP (0.83), although it was still higher than that of PLT (0.66). This discrepancy may be due to

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differences in the use of activity indices (CDAI vs. endoscopic scores) and inflammatory marker types (hs-CRP vs. CRP).

Accurate assessment of disease activity is essential in determining disease severity, guiding treatment decisions, and monitoring outcomes in Crohn's disease. Endoscopy, while considered the gold standard, is invasive, expensive, and can be uncomfortable for patients, especially those with comorbidities. Platelets, which play a central role in coagulation, have also been implicated in inflammatory processes. Platelet indices, including PLT, MPV, and PCT, have been shown to vary between active and remission phases. However, MPV has shown limited clinical utility. PCT, which is derived from PLT and MPV, has demonstrated relevance in other diseases such as IBD, coronary artery disease, diabetes, and pulmonary tuberculosis.

In our study, the optimal cut-off value for PCT to predict active Crohn's disease was 0.244, with a sensitivity of 86.6%, specificity of 72.7%, and AUC of 0.797. For the PLT/ALB ratio, the cut-off was 7.80, with a sensitivity of 79.3%, specificity of 72.2%, and AUC of 0.792. Both markers showed moderate positive correlations with the SES-CD score ($r = 0.382$ and $r = 0.415$, respectively; $p < 0.05$), consistent with the findings of Jian Tang et al. Interestingly, commonly used biomarkers such as CRP and ESR have less discriminative value between remission and active Crohn's disease. In contrast, PCT and PLT/ALB could serve as independent and specific biomarkers for identifying active disease

5. Conclusion

PCT and PLT/ALB are valuable biomarkers for diagnosing the activity level of Crohn's disease. These biomarkers can be considered independent indicators for identifying active disease and have a good correlation with the SES-CD score.

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