# Value of Red Cell Distribution Width for Assessing Disease Activity in Crohn's Disease

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**Abstract:** *Background:* Correlation between red cell distribution width (RDW) and chronic inflammation was observed, although studies focused on value of RDW for assessing disease activity in Crohn's disease (CD) are limited. *Methods:* This is a prospective study. RDW, C-reactive protein, erythrocyte sedimentation rate and white blood cell count were measured in 100 patients with CD on admission and 102 age- and gender-matched healthy volunteers. Value of these markers for assessing disease activity in CD was investigated. *Results:* RDW was significantly higher in patients with active CD than in inactive patients ($P < 0.05$). The optimal cutoff value for RDW was 15.6% in differentiating active from inactive disease, with sensitivity and specificity of 94.2% and 56.3%, respectively (area under the curve = 0.743). The overall accuracy of RDW in detecting active CD was 76.0%, which is higher than that of erythrocyte sedimentation rate (68.0%) and white blood cell count (51.0%) but lower than that of C-reactive protein (78.0%). *Conclusions:* RDW was elevated in patients with active CD in comparison with patients in remission. As a cost-effective tool, RDW may assist in determining the disease activity of CD.

**Key Indexing Terms:** Crohn's disease; Red cell distribution width; Disease activity; Inflammatory bowel disease. **[Am J Med Sci 2015;349(1):42–45.]**

Crohn's disease (CD) is characterized by chronic relapsing and remitting inflammation of the bowel.[1] Early detection of disease activity was considered to be able to reduce mortality in CD significantly.[2,3] Procedures such as endoscopic examination and computed tomography are often a burden to the patient because they are either invasive or exposing patients under radiation.[4]

Laboratory markers, such as C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR), have been assessed in previous studies for detection of CD activity.[5–7] However, the sensitivity and specificity of these markers are still far from ideal.[3,8] Therefore, seeking for an affordable, noninvasive and highly specific test was needed for the routine evaluation of disease activity in patients with CD.

Recently, a correlation between red cell distribution width (RDW) and chronic inflammation was observed in several large population studies,[9–11] although there are only several studies concerning the implication of RDW in patients with CD. In this prospective study, we investigated the potential use of RDW as an indicator for the active CD. The ability of RDW in distinguishing patients with CD from healthy controls was also evaluated.

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## MATERIALS AND METHODS

### Study Population

Between January 2012 and July 2013, a total of 100 patients with CD (age range from 16 to 70 years) were included prospectively. The diagnosis of CD was previously made according to conventional clinical, radiologic, endoscopic and histopathologic findings.[12] In addition, 102 age- and gender-matched healthy subjects participated in the study.

The exclusion criteria included (1) hemoglobinopathy or thalassemia trait; (2) history of gastrointestinal bleeding; (3) malignancy, cardiovascular diseases and strokes; (4) renal insufficiency; (5) hematologic, liver or autoimmune disorders; (6) chemotherapy or radiotherapy and (7) received blood transfusion or treatment with iron or erythropoietin during the past 3 months.

### Data Collection

Demographics and disease parameters (including Montreal classification, disease activity, history of surgery and medications and other concomitant diseases) were recorded. Whole blood samples were obtained from all subjects for biochemical assays on admission. Routine hemogram parameters, CRP and ESR levels were assessed. All full blood counts were processed using the COULTER LH780 Hematology Analyzer (Beckman Coulter, Inc, Orange County, CA). Disease activity was determined using Crohn's Disease Activity Index (CDAI),[13] which was calculated at the time of blood collection. A CDAI score >150 in patients with CD was considered to indicate active disease.

### Statistical Analysis

Statistical analyses were performed with SPSS v19 (SPSS, Inc, Chicago, IL). All analysis were 2-tailed and differences were considered statistically significant when $P < 0.05$. Between-group differences in continuous data were compared using Student's *t* test. Receiver operating characteristic curve analysis was performed to identify optimal cutoff values of inflammatory markers.

### Ethical Consideration

This study was approved by the ethics committee of Jinling Hospital. Written informed consent was obtained from all the participants in the study.

## RESULTS

The mean age of enrolled patients with CD was 33.2 ± 0.9 years and the ratio of male to female is 2.03 (67/33). No significant differences were found between the patients with CD compared with the control group subjects in age, gender or smoking history. Demographic and clinical characteristics of patients with CD and healthy controls are shown in Table 1.

### Differentiation of Patients With CD and Healthy Controls

Demographic and clinical characteristics of patients with CD and healthy controls are shown in Table 1. We investigated the ability of RDW in differentiating patients with CD from healthy controls. The optimal cutoff value for RDW was 14.80, with sensitivity and specificity of 84.0% and 94.1%, respectively (area under the curve = 0.933). The overall accuracy of RDW in detecting patients with CD was 89.1% (Table 2 and Figure 1).

### Differentiation of Active and Inactive CD

Significant higher level of RDW, CRP and ESR were observed in patients with active CD compared with those of patients with inactive CD. White blood cell count showed no difference between active and inactive patients (Table 3). In differentiating active from inactive CD, the optimal cutoff value for RDW was 15.6%, with sensitivity and specificity of 94.2% and 56.3%, respectively (area under the curve = 0.743). The overall accuracy of RDW in detecting active CD was 76.0% (Table 4 and Figure 2).

## DISCUSSION

In this study, we observed a significant increase in RDW in the active disease periods of CD compared with patients in remission. Receiver operating characteristic curve analysis showed that RDW may be a sensitive but not a specific marker (sensitivity 94.2%, specificity 56.3%) for determining active CD.

To our knowledge, only few studies investigated RDW in patients with CD.[14–19] Clarke et al[19] published the 1st study related to RDW with inflammatory bowel disease (IBD), which investigated the value of RDW in differentiating CD from ulcerative colitis. However, this study did not evaluate the correlation between RDW and disease activity.

Cakal et al[17] indicated that RDW may serve as an additional inflammatory marker in patients with IBD. They found that RDW at a cutoff of 14.1 showed 78.0% sensitivity and 63.0% specificity for detecting active CD. However, it should be noted that only 22 patients were enrolled in the CD group.

Yeşil et al[15] collected 56 patients with CD and found that RDW (compared with CRP, ESR and platelets) was the most specific test for the determination of patients with active CD. We assume that the few patients with CD might account for the differences observed between their study and ours.

Considering the effect of anemia on RDW level, Song et al[14] investigated the ability of RDW for evaluation of disease activity in patients with IBD without anemia. It showed that an RDW value of 14.1 had a sensitivity of 82% and a specificity of 83% in detecting patients with active CD without anemia. However, because CDAI score is mostly a subjective index and can be affected significantly by the extent of anemia, thus we did not exclude those patients with anemia during this study.

TABLE 1. Demographic and clinical characteristics of patients with CD and healthy controls[a]

| | CD (n = 100) | Controls (n = 102) | *P* |
|---|---|---|---|
| Age (yr) | 33.2 ± 0.9 | 33.2 ± 0.8 | 0.960 |
| Gender (M/F ratio) | 67/33 (2.03) | 67/35 (1.91) | 0.882 |
| Smoking history, n (%) | 26 (26.0) | 21 (20.59) | 0.363 |
| Disease activity, n (%) | | | |
| Active | 48 (48.0) | — | — |
| Inactive | 52 (52.0) | — | — |
| Disease location, n (%) | | | |
| Ileum | 34 (34.0) | — | — |
| Colon | 20 (20.0) | — | — |
| Ileum + colon | 46 (46.0) | — | — |
| Upper GI involvement | 11 (11.0) | — | — |
| Disease behavior, n (%) | | | |
| Stricturing | 28 (28.0) | — | — |
| Penetrating | 18 (18.0) | — | — |
| Inflammatory | 54 (54.0) | — | — |
| Perianal disease | 17 (17.0) | — | — |
| Extraintestinal manifestations | 64 (64.0) | — | — |

[a] CD, Crohn's disease, GI, gastrointestinal.

TABLE 2. Overall accuracy and ROC curve analyses of RDW and other inflammatory markers in differentiating patients with CD and controls[a]

| | Cutoff value | AUC | Sensitivity (%) | Specificity (%) | Overall accuracy (%) |
|---|---|---|---|---|---|
| RDW (%) | 14.8 | 0.933 | 84.0 | 94.1 | 89.1 |
| CRP (mg/dL) | 4.0 | 0.948 | 90.0 | 92.2 | 91.6 |
| ESR (mm/hr) | 6.5 | 0.819 | 79.0 | 77.5 | 78.2 |
| WBC ($10^3/\mu L$) | 5.9 | 0.480 | 81.0 | 25.5 | 53.0 |

[a] AUC, area under the curve; CD, Crohn's disease; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; RDW, red cell distribution width; ROC, receiver operating characteristic; WBC, white blood cell count.

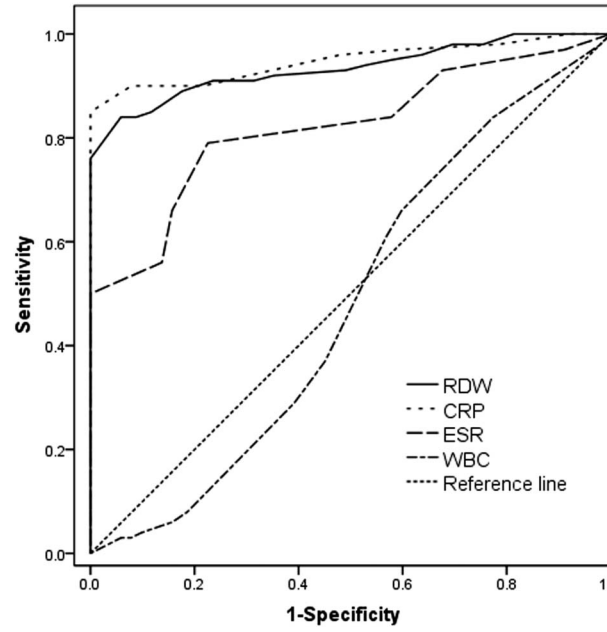


FIGURE 1. ROC curves of RDW and other inflammatory markers in differentiating patients with Crohn's disease and healthy controls. The optimal cutoff value for RDW was 14.8 (sensitivity 84.0%, specificity 94.1%, AUC = 0.933), with 89.11% of overall accuracy. ROC, receiver operating characteristic; RDW, red cell distribution width; AUC, area under the curve.