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# The diagnostic value of hemogram parameters in gastric cancer and intestinal metaplasia

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## ABSTRACT

**Introduction:** Gastric cancer remains a global health issue with high mortality rates. Early diagnosis can significantly affect disease progression; however, current diagnostic methods are often invasive and costly. In recent years, the diagnostic potential of hematological parameters that reflect systemic inflammation has gained attention. This study aimed to evaluate the role of hemogram markers such as RDW, NLR, and MLR in the diagnosis of gastric cancer and intestinal metaplasia.

**Materials and Methods:** A total of 155 patients with a diagnosis of gastric cancer, 200 individuals with biopsy-proven intestinal metaplasia, and 353 healthy controls were retrospectively analyzed. Groups were compared in terms of age, sex, and complete blood count parameters. ROC analysis was performed to evaluate diagnostic performance and determine cut-off values.

**Results:** The mean age was significantly higher in the gastric cancer group ($p<0.001$). Leukocyte count, neutrophils, RDW, NLR, PLR, and MLR were significantly elevated, while hemoglobin and absolute lymphocyte counts were lower ($p<0.001$). RDW demonstrated the highest area under the curve (AUC) in distinguishing gastric cancer patients from healthy individuals (AUC: 0.948, $p<0.001$). In the comparison between intestinal metaplasia and healthy controls, RDW also had the highest AUC value (0.752, $p<0.001$), whereas the diagnostic sensitivity of other hematological parameters was found to be low.

**Conclusion:** Among hematological parameters, RDW, NLR, and MLR may serve as useful auxiliary biomarkers in the diagnosis of gastric cancer. While RDW holds diagnostic significance in identifying intestinal metaplasia, other parameters had limited value. Given their accessibility and low cost, these parameters may hold a valuable place in clinical practice.

**Keywords:** Gastric cancer, intestinal metaplasia, hematological parameters, diagnosis, roc analysis

## Introduction

Gastric cancer is one of the most frequently diagnosed malignancies worldwide and remains a leading cause of cancer-related mortality.[1] Early diagnosis is critical to improving disease prognosis.[2] Although imaging and endoscopic techniques are commonly employed for diagnostic purposes, the increasing interest in laboratory-based

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markers stems from their non-invasive nature and cost-effectiveness.[3] Complete blood count (CBC) parameters have been studied as biomarkers that reflect systemic inflammation in various cancers.[4] Parameters such as neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), monocyte-to-lymphocyte ratio (MLR) and red cell distribution width (RDW) have shown potential diagnostic value.[5] In this study, we aimed to identify potential hematological biomarkers by comparing CBC parameters among three groups patients with gastric cancer, individuals with intestinal metaplasia, and healthy individuals.

## Materials and Methods

This retrospective single-center study was conducted in a tertiary care hospital. Ethical approval was obtained from the Institutional Review Board of Kartal Koşuyolu High Specialization Training and Research Hospital (Date: 18/02/2025, No: 2025/02/1042). This study was conducted in accordance with the principles of the Declaration of Helsinki. A total of 155 patients diagnosed with gastric cancer, 200 individuals diagnosed with intestinal metaplasia by endoscopic biopsy and 353 healthy individuals with normal gastroscopic findings confirmed by gastric biopsy were included in the study. CBC tests were performed within 0–30 days prior to the procedure. Exclusion criteria were active infection, chronic inflammatory disease, liver cirrhosis, hematological and other systemic malignancies, immunosuppressive treatment, use of NSAIDs within 1 week before the procedure, recent surgery or trauma and incomplete data records.

Demographic data including age, sex, and laboratory test results were recorded in a database. Hematological parameters such as hemoglobin (HB), mean corpuscular volume (MCV), red cell distribution width (RDW), platelet count, white blood cell (WBC) count, mean platelet volume (MPV), and absolute neutrophil, lymphocyte, and monocyte counts were measured using the Advia 2120 (Siemens Healthcare Diagnostics). The NLR was calculated by dividing absolute neutrophils by absolute lymphocytes; MLR by dividing absolute monocytes by absolute lymphocytes; PLR by dividing platelet count by absolute lymphocytes. The participants were categorized into three groups: gastric cancer, intestinal metaplasia, and healthy group. These groups were compared based on CBC parameters. ROC analysis was performed to assess diagnostic performance and determine cut-off values.

### Statistical Analysis

Statistical analyses were conducted using IBM SPSS Statistics for Windows, Version 26. The normality of continuous variables was assessed using the Kolmogorov-Smirnov test. Normally distributed variables were expressed as mean ± standard deviation (SD), while non-normally distributed variables were presented as median (minimum–maximum). ANOVA or Kruskal-Wallis tests were used for comparisons among groups, and the chi-square test was used for categorical variables. ROC (Receiver Operating Characteristic) analysis was performed to evaluate diagnostic performance between gastric cancer and control groups, as well as intestinal metaplasia and control groups. A p-value <0.05 was considered statistically significant.

## Results

A total of 708 individuals were included in the study: 155 (21.9%) had gastric cancer, 200 (28.2%) had intestinal metaplasia, and 353 (49.9%) were healthy group. The gastric cancer group was significantly older (mean age 62.7±11.5 years) and age was significantly higher compared to the control group (p<0.001). Sex distribution also differed among the groups (p<0.001) with a higher proportion of males in the gastric cancer group (Table 1). Significant differences were observed among groups in terms of CBC parameters. WBC, neutrophils, monocytes, RDW, NLR, PLR, and MLR were significantly higher in the gastric cancer group (p<0.001). Hemoglobin and absolute lymphocyte counts were significantly lower in the gastric cancer group (p<0.001). Platelet count did not significantly differ between groups (p=0.136) (Table 2). According to ROC analysis, RDW had the highest diagnostic performance in distinguishing gastric cancer from healthy controls (AUC: 0.948; 91.6% sensitivity, 90.4% specificity; p<0.001) (Fig. 1). Other significant parameters included MLR (AUC: 0.778), NLR (AUC: 0.740), and PLR (AUC: 0.704). Platelet count showed a low AUC and was not statistically significant (AUC: 0.545; p=0.112). In the comparison between intestinal metaplasia and healthy group, RDW again had the highest AUC value (0.752; p<0.001) while other parameters showed low AUC values and limited diagnostic utility (Fig. 2) (Table 3).

## Discussion

This study investigated hematological parameters across individuals with gastric cancer, intestinal metaplasia and healthy controls to identify potential non-invasive

**Table 1. Comparison of Clinical Characteristics and Laboratory Parameters of Cases**

| Variable | Gastric cancer group | Intestinal metaplasia group | Healthy group | p |
|---|---|---|---|---|
| n | 155 | 200 | 353 | |
| Age (years) | 62.7±11.5 | 58.5±10.8 | 49.8±13.6 | <0.001 |
| Sex (%) | | | | <0.001 |
| Female | 61 (39.4) | 107 (53.5) | 212 (60.1) | |
| Male | 94 (60.6) | 93 (46.5) | 141 (39.9) | |
| WBC ($10^9$ /L) | 8.3±2.5 | 9.6±3.3 | 7.5±1.5 | <0.001 |
| Neutrophil ($10^9$ /L) | 5.3±2.09 | 6.1±3.05 | 4.3±1.3 | <0.001 |
| Lymphocyte ($10^9$ /L) | 1.9±0.83 | 2.8±1.6 | 2.3±0.62 | <0.001 |
| Monocyte ($10^9$ /L | 0.72±0.3 | 0.61±0.23 | 0.55±0.12 | <0.001 |
| Hemoglobin (g/dl) | 10.3±1.9 | 13.4±2.4 | 14.1±1.08 | <0.001 |
| Platelet ($10^9$ /L) | 310.83±130.62 | 266.7±77.8 | 265.6±67.2 | 0.136 |
| RDW | | | | <0.001 |
| NLR | 3.53±2.6 | 2.30±1.5 | 1.99±0.99 | <0.001 |
| PLR | 213.5 (151.5-381.8) | 129.7 (102.3-377.3) | 124.2 (59.8-169.5) | <0.001 |
| MLR | 0.4061±0.19106 | 0.2581±0.13151 | 0.2473±0.07997 | <0.001 |

**Table 2. Diagnostic Performance of Hematological Parameters in Differentiating Gastric Cancer Patients from Healthy Controls Based on ROC Curve Analysis**

| Variable | Cut Off | AUC | SE | %95 GA | Sensivite | Spesifite | p |
|---|---|---|---|---|---|---|---|
| RDW | 14.2 | 0.948 | 0.0127 | 0.924-0.973 | 91.61 | 90.37 | <0.001 |
| Platelet ($10^9$ /L) | 289.1 | 0.545 | 0.028 | 0.49-0.599 | 57.42 | 63.74 | 0.112 |
| NLR | 2.374 | 0.740 | 0.0253 | 0.691-0.79 | 74.19 | 75.64 | <0.001 |
| PLR | 180.55 | 0.704 | 0.0263 | 0.653-0.756 | 45.16 | 99.72 | <0.001 |
| MLR | 0.394 | 0.778 | 0.024 | 0.731-0.825 | 55.48 | 98.87 | <0.001 |

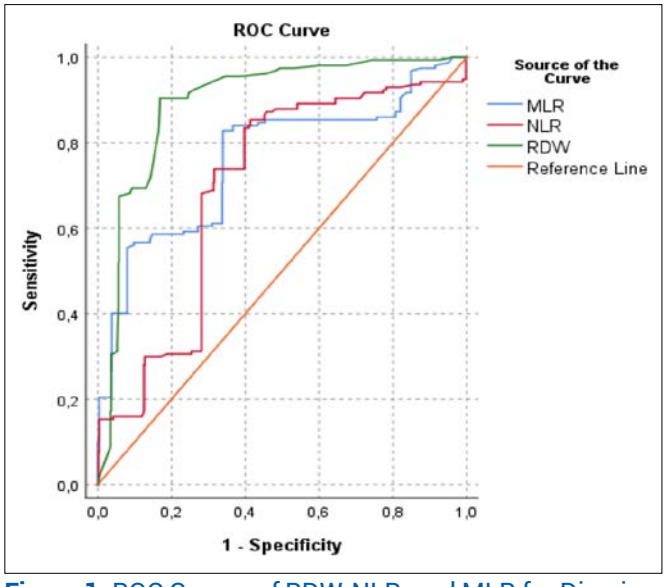


**Figure 1.** ROC Curves of RDW, NLR, and MLR for Discriminating Gastric Cancer Patients from Healthy Controls.

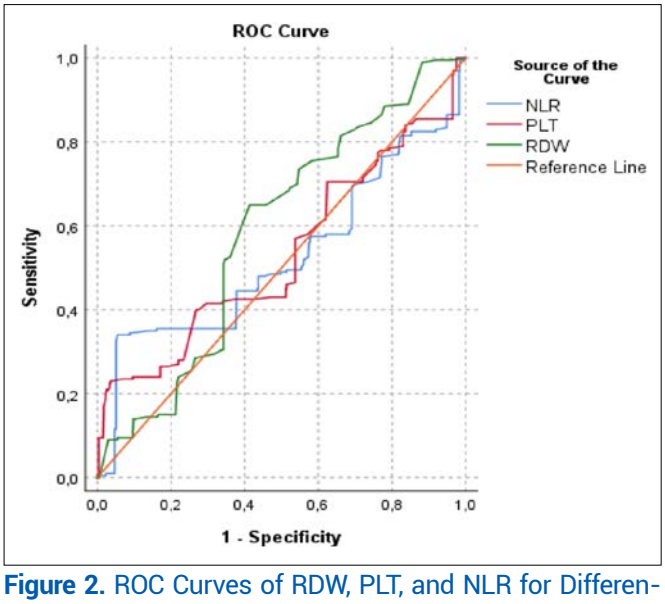


**Figure 2.** ROC Curves of RDW, PLT, and NLR for Differentiating Patients with Intestinal Metaplasia from Healthy Controls.

**Table 3. Diagnostic Performance of Hematological Parameters in Differentiating Patients with Intestinal Metaplasia from Healthy Controls Based on ROC Curve Analysis**

| Variable | Cut Off | AUC | SE | %95 GA | Sensivite | Spesifite | p |
|---|---|---|---|---|---|---|---|
| RDW | 14.0 | 0.752 | 0.0225 | 0.708-0.796 | 65 | 82.44 | <0.001 |
| Platelet ($10^9$ /L) | 342.1 | 0.542 | 0.0257 | 0.492-0.592 | 23 | 97.45 | 0.101 |
| NLR | 3.748 | 0.586 | 0.0255 | 0.536-0.636 | 34.5 | 99.43 | <0.001 |
| PLR | 172.27 | 0.513 | 0.0256 | 0.463-0.563 | 22 | 99.72 | 0.619 |
| MLR | 0.401 | 0.487 | 0.0255 | 0.437-0.537 | 20.5 | 98.87 | 0.613 |

diagnostic biomarkers. Our findings indicate that RDW, NLR, and MLR are significantly associated with gastric cancer, whereas only RDW demonstrated limited but statistically significant diagnostic value in intestinal metaplasia.

Gastric cancer remains a highly lethal disease, and early detection is essential to improving outcomes.[6] The risk of progression from intestinal metaplasia to gastric cancer can increase by up to 30-fold.[7] Prior studies have explored inflammatory markers such as NLR, PLR, MPV, and platelet count in patients with gastric cancer, but few studies have compared these parameters across gastric cancer, intestinal metaplasia, and healthy individuals.[8] Inflammatory markers such as RDW, NLR, and MLR were significantly elevated in the gastric cancer group, while hemoglobin and absolute lymphocyte counts were decreased. These findings align with existing literature indicating systemic inflammation and hematological dysregulation in malignancy.[9] RDW had the highest diagnostic power (AUC: 0.948) supporting previous findings that associate RDW with cellular irregularities and inflammation.[10] Elevated NLR and MLR levels may reflect neutrophilia and suppressed immune response during cancer progression, a phenomenon linked to poor prognosis in many solid tumors.[11]

In the intestinal metaplasia group, hematological changes were less pronounced. RDW alone showed significant diagnostic value (AUC: 0.752), suggesting that even premalignant lesions may exhibit systemic hematological changes. However, the lack of significance in other inflammatory markers implies that intestinal metaplasia may not elicit a strong systemic inflammatory response. A strength of this study lies in its evaluation of both malignant and premalignant conditions, demonstrating how hematological parameters vary across the disease spectrum.[12-14] The consistent performance of RDW highlights its potential as an early, accessible diagnostic tool, particularly in patients where invasive diagnostic procedures are not feasible or in population screening efforts.

## Conclusion

RDW, NLR, and MLR may serve as practical, non-invasive, and low-cost biomarkers in the diagnosis of gastric cancer. RDW may also have value in detecting intestinal metaplasia, a premalignant condition. These findings underscore the clinical utility of hematological markers in early detection and suggest the need for prospective studies to validate their use in routine screening.

### Limitations of the Study

This study has several limitations. Its retrospective design prevents the establishment of causal relationships. Additionally, some confounding factors that may influence hematological parameters such as subclinical inflammation or unreported medication use could not be fully excluded. Prospective studies are needed to validate these findings in broader populations.

### Disclosures

**Ethics Committee Approval:** Ethical approval was obtained from the Institutional Review Board of Kartal Koşuyolu High Specialization Training and Research Hospital (Date: 18/02/2025, No: 2025/02/1042).

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**Conflict of Interest:** None declared.

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