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# The importance of inflammatory parameters in the management of adhesive small bowel obstructions



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**Abstract**
Aim: In the present study, we aimed to examine the role of the Neutrophil-lymphocyte ratio (NLR) and Platelet-Lymphocyte ratio (PLR), which are cheap and easy-to-calculate markers, in surgical treatment decisions for patients with ASBO.
Material and Methods: A total of 103 patients with ileus or similar diagnosis in system records and who underwent bridectomy due to brid ileus, as stated in the surgery notes, were included. The age of patients at the time of application, gender, previous abdominal surgeries, whether they had previous surgery due to ileus, and duration of hospitalization were recorded. NLR and PLR ratios were obtained using a simple calculation model.
Results: According to the data obtained, the sensitivity and specificity values of WBC at 11.10 cut-off value were found to be 72.34% and 85.71%, while the sensitivity and specificity values of CRP at 2.13 were found to be 59.57% and 85.71%. The same values were found to be 82.98% and 85.71%, and 61.70% and 100% for NLR and PLR, respectively. The Youden Index was used to compare the accuracy rates, and NLR with a value of 0.68 was found to be the best parameter.
Discussion: In conclusion, various studies examining the estimation of the need for surgical treatment in patients with ASBO and emphasizing mostly radiological results have been published. Although the present study was not designed to evaluate all radiological, biochemical, and clinical parameters regarding the decision of surgical treatment for the patients, it provides evidence that NLR can be a critical indicator in this matter.

**Keywords**
Bowel Obstruction, Neutrophil-Lymphocyte Ratio, Platelet-Lymphocyte Ratio, Inflammatory Markers, CRP, Blood Count

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## Introduction

Adhesive small bowel obstruction (ASBO) is one of the common causes of particular conditions requiring emergency surgery. In a study examining 87 studies including a total of 110076 patients, the incidence of ASBO following all abdominal surgeries was calculated as 2.4% [1]. The first step in the diagnosis of ASBO is a detailed anamnesis and physical examination. These patients may generally complain of a variety of symptoms such as colicky abdominal pain, nausea, and vomiting in relation to a history of previous abdominal surgery.

Although abdominal X-ray is the primary imaging method used in suspected intestinal obstruction, it is not sufficient to determine the etiology of the obstruction. Computed tomography is the most convenient imaging method to determine the underlying causes of obstruction [2]. If there is no objective evidence such as strangulation, peritonitis, and intestinal ischemia leading to urgent surgical intervention, the choice of non-operative management or surgical treatment depends on the physician's experience [3].

The non-operative management duration is a topic of discussion, and surgery delays have been shown to increase morbidity and mortality [4]. Nevertheless, it is stated that the time taken to wait for the ASBO to heal spontaneously may lead to additional morbidity, because this approach leads to unnecessary delays for patients in need of surgery [5].

The definitive diagnosis of ASBO is determined through a holistic evaluation of the patient's clinical condition, medical history, physical examination results, hematological and biochemical parameters, and radiological imaging studies. There is no generally recognized standard treatment approach among surgeons. Laboratory tests might be useful to estimate the degree of systemic disease, and various biochemical indicators have been tried in planning the treatment of ASBO [6]. Nevertheless, typical markers of inflammation such as WBC count and CPR levels are not able to distinguish between inflammation due to ASBO and inflammation caused by other inflammatory conditions.

Neutrophil-lymphocyte ratio (NLR) and Platelet-Lymphocyte ratio (PLR) taken from complete blood count parameters are signs of the inflammatory response [7]. These parameters might be useful to guide clinicians regarding the inflammatory process and clinical outcomes of ASBO. Rapid medical or surgical treatment decision for ASBO might reduce mortality and morbidity rates. In the present study, we aimed to examine the role of NLR and PLR, which are cheap and easy-to-calculate markers, in surgical treatment decisions for patients with ASBO.

## Material and Methods

### *Study Groups and Study Design*

The present retrospective study was conducted in a multi-centered setting after obtaining ethics committee approval. Patients who were considered to have adhesive small bowel obstruction were included in the study between January 01, 2015 and December 31, 2020. Patient data were derived from archive records and hospital automation systems. A total of 103 patients with small bowel obstruction or a similar diagnosis in the system records and who underwent adhesiolysis due to adhesive bowel obstruction as stated in the surgery notes were included in the present study. Seven patients with cancer and/or foreign body-associated obstruction, six patients with peritoneal carcinomatosis, six patients with mesenteric ischemia associated obstruction, 11 patients with obstruction due to incarcerated hernia, and five patients who underwent surgery for other reasons and bridectomy incidentally were excluded from the study. Moreover, patients under 18 years of age, pregnant patients, and those without abdominal tomography were not included in the study. Eventually, 68 patients with adhesive small bowel obstruction were included in the study. The patients were divided into two groups as surgical treatment group (n = 21) and medical treatment group (n = 47). The age of patients at the time of application, gender, previous abdominal surgeries, whether they had previous surgery due to bowel obstruction, and duration of hospitalization were recorded.

### *Treatment Planning*

Patients with suspected ASBO were detected by evaluating the clinical status, medical history, physical examination results, hematological and biochemical parameters, and radiological imaging of patients. In detailed evaluations, urgent surgical exploration was performed objectively in patients with signs of strangulation, bowel ischemia, or peritonitis. Other patients were followed up for nonoperative treatment. Intestinal decompression was achieved by inserting a nasogastric tube, and a long nasointestinal tube was not used. Patients who were scheduled for nonoperative treatment were administered water-soluble contrast agents, and whether there was a transition to the colon was followed up using direct abdominal radiography. Non-operative follow-up lasted for 72 hours. Patients whose obstruction continued after 72 hours, nasogastric tube drained more than 500 cc daily, and patients with developing signs of peritonitis and intestinal ischemia such as increased abdominal pain, WBC (WBC > 10000/mm$^3$) and CRP (CRP > 75 mg/l) were operated. Treatment of the patients whose abdominal pain regressed, who had no signs of ischemia and peritonitis, and whose contrast agent advanced to the colon, was terminated.

CBC and CRP analyses were performed on venous blood samples obtained from patients. NLR and PLR ratios were obtained using a simple calculation model.

### *Statistical Analyses*

All statistical analyses were performed using SPSS version 18.0 software (SPSS Inc., Chicago, IL, USA). Data distribution was evaluated using the Kolmogorov-Smirnov test. Continuous variables were presented as mean ± standard derivation (SD), and categorical variables were presented as frequencies (n/percentages). The significance of each difference between continuous variables was examined using the Independent Samples t-test or the Mann-Whitney U-test. The significance of each difference between categorical variables was compared using Pearson's Chi-squared test. Receiver Operating Characteristic (ROC) curve analysis was used to define the optimal cut-offs of the diagnostic tests, for which sensitivities, specificities, positive and negative predictive values, and area under the curve (AUC) were calculated. Youden's index was used to optimize the accuracies of all calculations. A p-value <0.05

was considered to reflect statistical significance.

## Results

In the present study, 21 patients who underwent surgical treatment and 47 patients who received medical treatment for ASBO were examined. The demographic data of the patients in each group are summarized in Table 1. According to the results, the average age of the patients in the surgical treatment group was 62.33 ± 18.39 years, and the mean age of the patients in the medical treatment group was 58.21 ± 16.48 years. There was no difference between the groups in terms of mean age (p = 0.081). The hospitalization duration of the patients in the surgical treatment group was statistically higher than in the medical treatment group (p < 0.001). Gastrointestinal surgery was the most common type of surgery that led to small bowel obstruction in both groups. Furthermore, the number of patients who were previously operated for small bowel obstruction was higher in the surgical group (p = 0.014).

**Table 1.** Comparison of the groups according to general demographic data

| Data | Operated Group (n=21) | Non-operated Group (n=47) | "p" |
|---|---|---|---|
| Age (years) | 62.33 ± 18.39 | 58.21 ± 16.48 | 0.081 |
| Gender | | | 0.256 |
| Male | 17 (80.9%) | 30 (63.8%) | |
| Female | 4 (19.1%) | 17 (36.2%) | |
| Affected small bowel segment | | | 0.099 |
| Jejunal | 3 (14.3%) | 12 (25.5%) | |
| Ileal | 12 (57.1%) | 14 (29.8%) | |
| Jejuno-ileal | 6 (28.6%) | 21 (44.7%) | |
| Length of hospitalization (days) | 4.28 ± 2.17 | 2.87 ± 0.74 | <0.001 |
| Previous surgery | | | |
| Colorectal | 0 | 13 (27.6%) | |
| Gastrointestinal | 19 (90.6%) | 20 (42.5%) | |
| Appendectomy | 1 (4.7%) | 6 (12.8%) | |
| Hepatobiliary | 0 | 3 (6.4%) | |
| Transplant surgery | 0 | 1 (2.1%) | |
| Gynecological | 0 | 3 (6.4%) | |
| Urinary | 1 (4.7%) | 1 (2.1%) | |
| Presence of previous ileus surgery | 10 (47.6%) | 3 (6.4%) | <0.001 |

**Table 2.** Table 2. Distribution of biochemical and inflammatory parameters by groups

| Parameters | Operated Group (n=14) | Non-operated Group (n=43) | "p" |
|---|---|---|---|
| WBC (x109/L) | 13.48 ± 2.69 | 10.41 ± 2.88 | <0.001 |
| CRP (mg/L) | 20.44 ± 26.84 | 7.56 ± 9.48 | 0.002 |
| Potassium (mmol/L) | 4.07 ± 0.31 | 4.49 ± 0.56 | 0.002 |
| Sodium (mmol/L) | 136.90 ± 2.14 | 137.63 ± 2.64 | 0.113 |
| Urea (mg/dL) | 40.57 ± 17.89 | 39.80 ± 17.98 | 0.735 |
| Creatinine (mg/dL) | 1.34 ± 0.93 | 0.94 ± 0.32 | 0.057 |
| Hematocrit (%) | 43.04 ± 8.25 | 42.61 ± 5.96 | 0.765 |
| NLR | 15.96 ± 9.48 | 5.60 ± 4.58 | <0.001 |
| PLR | 310.86 ± 120.26 | 198.02 ± 141.72 | <0.001 |

The distribution of biochemical and inflammatory markers of the groups is presented in Table 2. According to the results, the mean WBC, CRP, NLR, and PLR were statistically higher in the surgical treatment group (p-values <0.001, 0.002, <0.001, and <0.001, respectively). Mean potassium values were lower in the surgical treatment group (p = 0.002)

When the patients' responses to the water-soluble contrast agent therapy administered for treatment during hospitalization were evaluated, the decision on urgent surgery decision was made for five (23.8%) patients in the surgical treatment group according to their results at the time of application without any treatment. The remaining 16 (76.2%) patients received medical treatment, and no opaque transition to the cecum was observed at the 24th and 48th hours. In the medical treatment group, eight patients (17%) had an improvement in terms of the small bowel obstruction in the early stage without any contrast agent therapy. Contrast agent transition to the cecum was observed at the 24th hour in 30 (63.8%) of the remaining patients and at the 48th hour in five (10.6%) patients.

The general accuracy rates of inflammatory markers, which might be used to determine patients who would be healed through medical treatment and those who would require surgical treatment are presented in Table 3. ROC curves are presented in Figure 1. According to the data obtained, the sensitivity and specificity values of WBC at 11.10 cut-off value were found to be 72.34% and 85.71%, while the sensitivity and specificity values of CRP at 2.13 were found to be 59.57% and 85.71%, respectively. The same values were found to be 82.98% and 85.71%, and 61.70% and 100% for NLR and PLR, respectively. The Youden Index was used to compare accuracy rates, and NLR with a value of 0.68 was found to be the best parameter.

## Discussion

Intestinal obstruction is the partial or complete obstruction in the advancement of intestinal contents in the gastrointestinal tract for any reason. Most of the time, it can be difficult for surgeons to decide which patient is to be followed up non-operatively and which patient should be operated. We considered that calculating the NRL value might be a guide for surgical treatment decisions in these patients. We aimed to compare these parameters with the classical inflammation

**Table 3.** Overall accuracies afforded by laboratory parameters used to identify patients who will respond to medical therapy (%)

| | Sensitivity | Specificity | PPD | NPD | Cut-off | AUC | Youden's index |
|---|---|---|---|---|---|---|---|
| WBC | 72.34 | 85.71 | 91.90 | 58.10 | 11.10 | 0.786 | 0.58 |
| CRP | 59.57 | 85.71 | 90.30 | 48.60 | 2.13 | 0.732 | 0.45 |
| NLR | 82.98 | 85.71 | 92.90 | 69.20 | 7.95 | 0.899 | 0.68 |
| PLR | 61.70 | 100 | 100 | 53.80 | 178.98 | 0.831 | 0.62 |

markers, WBC count, and CRP value. In our study, the sensitivity and specificity values of the patients operated for adhesive small bowel obstruction were found to be 72.34% and 85.71% for WBC, 59.57% and 85.71% for CRP, 82.98% and 85.71% for NLR, and 61.70% and 100% for PRL, respectively. NLR was found to be the best parameter in terms of comparing the accuracy ratios with each other.

The World Society of Emergency Surgery revised and updated the protocol that was published in 2013 for ASBO treatment in 2017. In a condition where it is observed that the water-soluble contrast agent does not transmit into the colon within 24–36 hours, surgical treatment is recommended. On the other hand, it has been stated that patients who do not have strangulation and peritonitis results and elevated levels of CRP and WBC can be followed up to 72 hours nonoperatively [1].

Pedro et al. stated that 61% of surgical interventions were performed later than 24 hours after hospitalization in their study evaluating 4163 patients who underwent laparotomy for ASBO. When they classified mortality and complication development in 24-hour increments according to the time from hospitalization to surgery, they found that patients who were operated after 72 hours of follow-up had a 3-fold increase in mortality and a 2-fold increase in the incidence of systemic infectious complications in contrast with those who were operated within 24 hours [5]. Some studies have shown that operation of patients who are followed up for ASBO within 24 hours decreases recurrence rates and provides a long-term cost advantage.[8]. Moreover, patients may be discharged early. This situation reveals the need to investigate many parameters that can enable an early decision to perform surgical treatment for patients with ASBO. Young et al. stated in their study that the number of operations, WBC count, CRP level, and BMI before ASBO are statistically significant factors that aid in early selection of patients requiring surgery [9]. As a result of our study, we believe that NLR and PRL (p:0,001, p:0,001) may show systemic inflammation and infection in the early period and contribute to early surgical decision in ASBO cases

The reason for using NLR and PLR as diagnostic markers is due to neutrophilia and lymphopenia that develop as a result of the systemic inflammatory immune response [10]. NLR and PLR are used as auxiliary markers in the diagnosis and prognosis of diseases leading to systemic inflammation and infection, such as malignancy, mesentery artery disease, acute appendicitis, acute cholecystitis, acute pancreatitis, and community-acquired infections [11]. Kaplan et al. examined the combination of NLR and PLR in patients with pancreatitis in 2018 and stated that it can be used as a diagnostic marker for pancreatic abscesses [12].

Although some studies in the literature state that NLR can be an indicator in determining the prognosis of ASBO, there is no study comparing the effectiveness of NLR, PLR, WBC, and CRP values in terms of making surgical treatment decisions for these patients [13]. However, there are some studies revealing the contribution of CRP and WBC values to the diagnosis and treatment of patients with intestinal obstruction. Costa et al. recommend surgery when the WBC count in patients diagnosed with intestinal obstruction is above 18 x 109/L [14]. Even though there is an increase in biomarkers such as WBC, urea, and creatinine due to dehydration in intestinal obstruction, the diagnostic value of CRP is also quite limited [15]. Fujii et al. have stated that CRP has no value in terms of estimating the development of postoperative intestinal obstruction [16]. In our study, WBC ($p < 0.001$) and CRP ($p = 0.002$) values were significantly higher (statistically) in the group that underwent the operation, and their sensitivity and specificity were found to be 72.34% and 85.71%, and 59.57% and 85.71%, respectively. On the contrary, Lapsekili et al. did not find any statistically significant difference in WBC and CRP values between the patients who were provided with surgical and non-operative management ($p = 0.225$ for WBC, $p = 0.67$ for CRP). Alternatively, in the stated study, they evaluated all cases with intestinal obstruction and did not study ASBO cases separately. In correlation with our study, they found that NLR value was significantly higher (statistically) in cases who were treated surgically (p: 0.023). In our study, sensitivity and specificity values for NLR and PLR were 58.14% and 100%, and 62.79% and 92.86%, respectively. Lapsekili et al. found the sensitivity and specificity for NRO as 43% and 78%, respectively. Even though there was no statistically significant difference in CRP levels and WBC, neutrophil, and lymphocyte counts between the two groups, they stated that the high NLR value in intestinal obstruction cases who underwent surgical treatment could be a useful reference for future studies [17].

As a result of our study, we believe that NLR (EF: 0.68) with the highest Youden index value may show systemic inflammation and infection in the early period in ASBO cases when comparing accuracy rates. Bacterial translocation is defined as the passage of viable bacteria from the intestinal intraluminal segment to mesenteric lymph nodes and distant organs [18]. In intestinal obstruction, intestinal peristalsis is disrupted, and bacterial overgrowth triggers and accelerates translocation [19]. Deitch et al. showed that the incidence of this phenomenon was significantly higher in patients who underwent laparotomy for intestinal obstruction, in contrast to the control group, by isolating viable bacteria from mesenteric lymph nodes (59% vs 4%; $p < 0.001$) [20]. In conclusion, various studies examining the estimation of the need for surgical treatment in patients with ASBO and emphasizing mostly radiological results were published [21]. But also there are many studies in the literature that evaluated the changes in NLR and PLR values, which are considered cheap and easily calculated parameters capable of detecting systemic immune response [22,23].

## *Conclusion*

The present study was not designed to evaluate all radiological, biochemical, and clinical parameters regarding the decision of surgical treatment for the patients, it provides evidence that NLR can be a critical indicator in this matter. However, we still believe that more comprehensive and prospective studies should be carried out.

***Scientific Responsibility Statement***

*The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.*

***Animal and human rights statement***

*All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with*

*the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.*

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***Conflict of interest***

*None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.*

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