

Contribution of neutrophil-to-lymphocyte ratio to decisions regarding surgical therapy in patients diagnosed with intestinal obstruction

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Abstract

Background: Neutrophil-to-lymphocyte ratio (NLR) has been reported to be a valuable diagnostic tool in the decision-making process for surgical procedures in cases requiring urgent intervention. It was also reported that NLR could be used as an independent predictor of septic shock, hospitalization in the intensive care unit, and death in patients with a liver abscess. This study aimed to investigate the contribution of the NLR, which is a cheap and easily calculable marker, to decisions regarding surgical therapy in patients with intestinal obstruction (IO).

Methods: Ninety-one patients hospitalized with IO were enrolled in this retrospective study. There were two groups: a surgical therapy group and a conservative therapy group. Complete blood count (CBC) parameters and NLR values were statistically evaluated to determine whether there was any difference between the groups.

Results: The results obtained from the initial CBC tests were compared between the patients receiving surgical therapy (n =30) and conservative therapy (n =61). There was no statistically significant difference in white blood cell counts between the groups (p =0.225). However, there was a statistically significant difference in NLR values between the patients receiving surgical and conservative therapy (p =0.023).

Conclusion: Similar to previous studies investigating other inflammation criteria, we found that high NLR values were statistically significant in favor of the surgical therapy group in determining the need for surgery in ileus cases. The data obtained in our study demonstrate that the NLR measurement contributes to early decision-making concerning surgical therapy in patients with IO at the time of their initial admission to the emergency department. HIPPOKRATIA 2019, 23(4): 160-164.

Keywords: C-reactive protein, intestinal obstruction, neutrophil-to-lymphocyte ratio, white blood cells

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Introduction

Intestinal obstruction (IO) is the partial or complete blockage of the intestinal content's distal progression in the gastrointestinal tract¹. Its etiology may include mechanical obstructions caused by adhesions, malignancy, gallstones, and bezoars, as well as paralytic ileus and peristaltic disorders, such as volvulus and pseudo-obstruction. IO is one of the major indications requiring emergency abdominal surgery, and it has a high morbidity and mortality rate when not treated properly^{2,3}.

Despite insufficient country-based data on IO cases presenting to the emergency department (ED), data from the United States suggest that 15 % of such cases presenting with abdominal pain are diagnosed with IO, and account for approximately 300,000 admissions annually^{4,5}. For IO, it is crucial that definitive diagnosis, treatment decisions, and processes are performed rapidly in the ED. Effective diagnostic processes include rapid evaluation of the diagnostic modalities available to the ED physi-

cian and definitive diagnosis and initiation of appropriate treatment with surgical consultation for surgical cases. Patient medical history and physical examination are the initial and most important steps in establishing a diagnosis. However, the evaluation of laboratory results will help the ED physician to make an appropriate decision in the consultation process. Although abdominal X-ray (AXR) is the first imaging modality in suspected IO, it is insufficient to determine the etiology of obstruction. Computed tomography (CT) is the most suitable imaging method to ascertain the underlying causes of obstruction and colonic dilatation^{4,6}. The definitive diagnosis of IO is established through a holistic evaluation of the patient's clinical status, medical history, physical examination findings, hematological and biochemical parameters, and radiological imaging studies.

There is no standardized approach among surgeons in routine clinical practice for the treatment of IO. The choice of conservative versus surgical therapy for pa-

tients with IO and particularly for patients with adhesions, depends on physicians' experiences if there is no objective evidence of mechanical obstruction in the surgeon's view^{3,4,7}.

An increase in white blood cell (WBC) count and blood urea nitrogen and creatinine levels can be observed in IO as a result of the left shift, but such an increase may also be attributed to concomitant vomiting and dehydration. The diagnostic values of biomarkers, such as C-reactive protein (CRP), are limited in IO^{7,8}. The neutrophil-to-lymphocyte ratio (NLR) obtained from the complete blood count (CBC) parameters is a measure of the inflammatory response, and high NLR values are associated with poor clinical outcomes⁹⁻¹⁴. In cases followed with a high index of suspicion for IO in the ED that are still anticipating a definitive diagnosis, CBC parameters can be utilized to guide clinicians in the inflammatory process and clinical outcome of IO. Rapid decision-making for medical or surgical therapy of IO may improve mortality and morbidity rates and save the institution from excess expenditure. In our study, we aimed to evaluate the contribution of NLR, which is a cheap and easily calculable marker, to the decision of surgical therapy in patients diagnosed with IO.

Material and methods

This retrospective study was approved by the University of Health Sciences Gulhane Non-Interventional Research Ethics Committee (decision No 18/185, date: 26/6/2018). Patients pre-diagnosed with IO in the ED of Gulhane Training and Research Hospital between 1/10/2016, and 1/4/2018, were retrospectively reviewed by entering the International Classification of Diseases (ICD) diagnostic codes in the hospital electronic information management system (FONET[®], Information technology incorporation, Ankara, Turkey). All patients for whom a consultation with a general surgeon was requested because of suspected IO after admission to the ED were acknowledged. Based on previous study findings, NLR value for surgical treatment group of 5.15 and a standard deviation of 4.01¹¹, and assuming the NLR value for the group of patients receiving surgical treatment of 8.50 with an 80 % power and a two-sided error margin of 0.05, a sample of 22 patients were calculated as statistically suitable for each group (surgical and conservative treatment). We finally included more than the required sample of 22 patients in each investigated group as we aimed to have a minimum of 22 patients allocated in each group according to our sample size calculation.

We identified 237 patients consulted to our ED for pre-diagnosis of ileus according to the hospital's patient records. We intended to include patients hospitalized in the general surgery department with a definitive diagnosis of IO. Thus, patients' inclusion criteria were being examined by a consultant general surgery physician and diagnosed and hospitalized with ileus/IO after clinical examination, laboratory, and radiology investigations. Patients evaluated for suspected IO in the ED and found

not to have IO based on laboratory, imaging, and surgical consultation results were excluded from the study. Therefore, patients diagnosed with ileus/IO due to peritonitis, electrolyte imbalance, early postoperative ileus, as well as patients diagnosed with ileus/IO and treated with medical treatment as outpatients, were excluded from the study. A total of 146 patients were excluded from the study, and 91 patients were finally included. All patients' records were retrospectively reviewed, and CBC parameters, CRP and NLR values, imaging outcomes (AXR and contrast-enhanced CT), and general surgery consultation reports were evaluated.

Patients hospitalized with a definitive diagnosis of IO were classified into two groups: a conservative therapy group (CTG) and a surgical therapy group (STG). Demographic data, such as age and gender, and CBC parameters, such as neutrophil, lymphocyte, WBC, CRP, and NLR values, of the hospitalized patients were statistically evaluated to determine whether there was any difference between the groups. Blood samples taken for CBC analysis were studied using the Sysmex XN-1000 (Sysmex America Inc., Lincolnshire, IL, USA) and Beckman Coulter UniCel DxH800 (Beckman Coulter, Miami, FL, USA) instruments in the biochemistry laboratory.

All statistical analyses were performed using SPSS Statistics for Windows, Version 17.0 (SPSS Inc., Chicago, IL, USA). Demographic data were analyzed; descriptive statistics were obtained from laboratory results; means and standard deviations were calculated. The Kolmogorov-Smirnov test was utilized to assess whether data were normally distributed. The Student's t-test was used to compare normally distributed data, and the Mann-Whitney U test was used for data that were not normally distributed. A p value of <0.05 was considered statistically significant.

Results

During the examined period, consultation requests for 237 patients presented in ED with a preliminary diagnosis of IO were assessed by the department of general surgery. A total of 91 patients were subsequently admitted to the general surgery department for further evaluation and treatment. Thirty (32.97 %) of the hospitalized patients were treated surgically (STG), and sixty-one (67.03 %) were treated conservatively (CTG). Of the 91 hospitalized ileus cases, 41 (40.5 %) were male, and 50 were female (59.5 %). There was no statistically significant difference in gender between the groups ($p = 0.259$, chi-square test). The mean age of all patients was 60.87 ± 15.25 , and no significant difference was found regarding age between the groups ($p = 0.581$, Student's t-test).

A significant proportion (70 %) of the 30 patients in the STG had previously undergone abdominal surgery ($n = 21$) and were hospitalized due to IO associated with previous surgery. Of these 21 patients followed for IO, eight had previously undergone colon surgery, ten had undergone gynecological surgery and retroperitoneal lymph node dissection, and three had undergone

urological surgery. According to the surgical notes, all 21 patients had adhesiolysis performed during the surgical management of the ileus. Three patients underwent surgery for strangulated inguinal hernias, and the cause of ileus was obstruction by a previously unknown tumor in four patients. According to their records, upon definite diagnosis, these patients were directly taken to surgery after intravenous fluid replacement and preoperative preparation. The three patients underwent anterior resection for rectosigmoid tumors, and one patient underwent right hemicolectomy for right colonic tumor and left lateral segmentectomy in the same session due to liver metastases. Two of these patients who underwent surgery for tumors had colostomy performed, and two underwent primary anastomosis. Finally, one patient underwent surgery for internal herniation, and one patient underwent surgery for small bowel obstruction due to endometriosis.

All CTG patients (n =61) were discharged after observing restoration of bowel movement and stool passage, and resolution of abdominal distension within 24–48 hours following nasogastric decompression, intravenous fluid replacement, and oral administration of 50 ml Urografin 76 % (40 mg sodium amidotrizoate and 260 mg meglumine amidotrizoate per ml; Bayer AG, Germany).

No statistically significant difference in WBC counts was found between STG and CTG ($p=0.225$). The mean CRP levels were 59.59 ± 70.91 mg/L in the STG and 54.54 ± 68.89 mg/L in the CTG. There was no statistically significant difference between the groups in terms of CRP levels ($p=0.67$). The mean NLR values were 8.03 ± 2.89 in the STG, and 7.21 ± 5.60 in the CTG. Thus, the NLR values were higher in the STG, and there was a statistically significant difference between the groups ($p=0.023$) (Table 1). Receiver-operating characteristic (ROC) curve analysis was performed to determine a cut-off value for NLR at the 95 % confidence interval, and a cutoff value of 8.8 yielded a sensitivity of 43 % and a specificity of 78 % (Figure 1).

Discussion

IO, which constitutes 15 % of all ED admissions, is a leading cause of mortality and morbidity. The detailed diagnostic approach in suspected patients depends on patient density in the ED, physicians' experience, and hos-

pital's laboratory and imaging facilities. To the best of our knowledge, only a few studies in the literature have reported the contribution of CRP to IO diagnosis and treatment modalities. Fujii et al indicate that CRP does not have any value in predicting the development of post-operative IO¹⁵. Similarly, in another study investigating the value of CRP, which is an acute-phase protein used as an inflammation marker, it was reported that a change in CRP levels during the early period had a moderate diagnostic value in clinically suspected cases of acute appendicitis, which is a surgical emergency¹⁶. In another study, Sushruth et al¹⁷ reported that CRP was not useful in diagnosing acute appendicitis due to low sensitivity (44 %) and specificity (80 %). In our study, we found that CRP alone was insufficient for deciding whether surgical or conservative therapy should be administered in patients with diagnosed IO (Table 1).

We were unable to find any study in the literature reporting on whether WBC counts alone were sufficient in deciding regarding surgery for IO. Costa et al recommended surgery when the WBC count was above 18×10^9 cells/L in patients diagnosed with IO¹⁸. In our study, there was no statistically significant difference in WBC counts between the two groups (STG and CTG). Therefore, we consider that the WBC count alone is insufficient in establishing a decision regarding surgery versus conservative treatment in patients diagnosed with IO.

NLR has been reported to be a valuable diagnostic tool in the decision-making process for surgical procedures in cases requiring urgent intervention, such as acute appendicitis, acute cholecystitis, and incarcerated hernia^{11,14,19,20}. In their study, Lee et al²⁰ reported that high NLR values could be utilized to predict prolonged hospitalization of patients operated on for severe cholecystitis. Xie et al¹⁴ emphasized that NLR can be applied to predict intestinal resection due to ischemia in incarcerated inguinal hernias. Ortiz-Reyes et al²¹ reported that early enteral nutrition in critically ill patients improves the patients' clinical condition. It was found that early enteral nutrition reduces inflammation through interaction with the gut-associated lymphoid tissue and that NLR levels were low in these patients. In cases of infected diabetic feet, high NLR values were associated with peripheral arterial disease, high platelet-to-lymphocyte ratio (PLR) values

Table 1: Comparison of laboratory parameters of surgical and conservative therapy groups.

	Surgically Therapy Group (OG)		Conservative Therapy Group (NOG)		p value
	Mean \pm SD	95 % CI	Mean \pm SD	95 % CI	
Neutrophil ($\times 10^9$ cells/L)	12.0 \pm 4.60	4.58-10.68	9.06 \pm 4.83	7.45-10.68	0.101*
Lymphocyte ($\times 10^9$ cells/L)	1.5 \pm 0.56	1.25-1.85	1.6 \pm 0.87	1.31-1.90	0.701**
WBC ($\times 10^9$ cells/L)	14.04 \pm 6.58	5.58-35.17	12.45 \pm 5.68	3.54-32.12	0.225**
CRP (mg/L)	54.54 \pm 68.89	17.82-91.25	59.59 \pm 70.91	35.94-83.23	0.670**
NLR	8.03 \pm 2.89	6.49-9.58	7.21 \pm 5.60	5.38-9.08	0.023**

OG: operated case group, NOG: Non-operatively treated case group, SD: standard deviation, CI: confidence interval, WBC: white blood cell, CRP: C-reactive protein, NLR: neutrophil-to-lymphocyte ratio, *: t-test, **: Mann-Whitney U test.

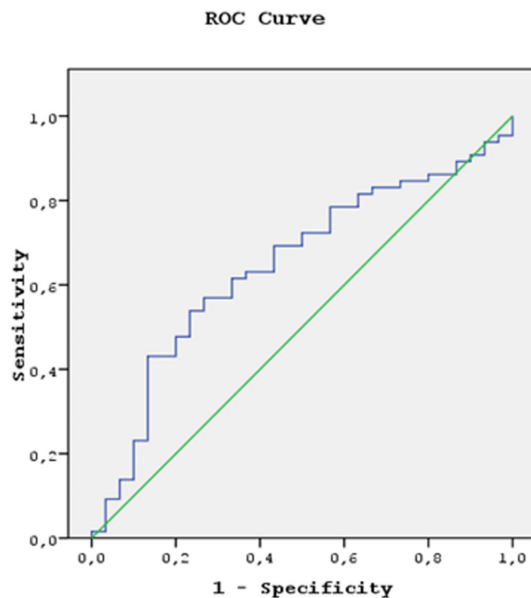


Figure 1: Receiver-operating characteristic (ROC) curve for the neutrophil lymphocyte ratio; 8.8 is the cutoff value for the neutrophil lymphocyte ratio with 43 % sensitivity and 78 % specificity.

were associated with osteomyelitis, and high NLR, PLR, and lymphocyte-to-monocyte ratio (LMR) values were associated with the patients scheduled for surgical amputation¹⁰.

In an ED-based study, it was reported that NLR could be used as an independent predictor of septic shock, hospitalization in the intensive care unit, and death in patients with liver abscess¹². In crowded EDs, in processes where resources should be used efficiently, it is essential to clarify prognostic indicators to be valuable to the ED physicians and consulting general surgeons in treating IO cases that exhibit high mortality and morbidity. Similar to other studies investigating different inflammation markers, we found that high NLR values were statistically significant in favor of STG, thus determining the need for surgery in ileus cases (Table 1). Evaluation of data obtained in our study revealed that although there was no statistically significant difference in CRP levels and WBC, neutrophil, and lymphocyte counts between the two groups, the fact that the NLR value was significant for IO cases receiving surgical therapy would be a useful reference for future studies within the same scope.

To the best of our knowledge, no previous studies investigated the relationship between NLR and decisions regarding surgical treatment in ED patients with a pre-diagnosis of IO. NLR, which was the primary focus of the current study, is a measure of the inflammatory response, and high NLR values are associated with poor clinical outcomes. Hematological indices, such as NLR, PLR, LMR, and CRP levels, are used to evaluate the inflammatory response in patients with cancer during clinical decision-making, such as the clinical course or recurrence^{9,13,15,22,23}. In our study, 13.3 % (n =4) of STG

patients underwent surgery for tumor-related ileus, and it should be noted that the high NLR in these cases would be useful in addition to clinical findings in making decisions regarding surgical therapy.

The main limitation of this retrospective study is the lack of data on proinflammatory cytokines and/or inflammation markers except for CRP, which possibly play a key role in the inflammation process in IO. Another limitation is the relatively small sample size. The present data should, therefore, be interpreted with caution and needs reconfirmation in a larger cohort.

In conclusion, the data obtained in the current study demonstrate that the NLR measurement, which is a simple and low-cost measurement that can be obtained from CBC parameters, contributes to early decision-making regarding surgical therapy in patients with IO, on initial admission to the ED. The effect of appropriate decision for early surgical intervention on mortality and morbidity is also believed to ensure that NLR's diagnostic value is more meaningful.

Conflict of interest

Authors declare no conflicts of interest in connection with this paper.

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