ORIGINAL ARTICLE

Are the systemic immune-inflammation index and pan-immune-inflammation value predictive indicators for the decision of operative treatment in adhesive small bowel obstruction?

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ABSTRACT

BACKGROUND: Emergency surgical pathologies constitute a significant portion of general surgery practice. Small bowel obstructions are a common cause of surgical emergencies in general surgical practice. This study aimed to investigate the predictive role of the Systemic Immune-Inflammation Index and Pan-Immune-Inflammation Value in determining the need for operative treatment in adhesive small bowel obstructions. These obstructions are significant in general surgery, yet clinicians lack consensus on treatment selection and clinical follow-up. This study also seeks to address controversial questions surrounding this topic.

METHODS: The study included patients with small bowel obstruction caused by adhesions during the postoperative period who were treated and followed up in our General Surgery Clinic. Patients' age, demographic information, and clinical data from January 2017 to January 2024 were retrospectively reviewed and recorded using the hospital information management system (HIMS) and patient records. Statistical analyses were performed using SPSS version 22.0.

RESULTS: A total of 341 patients with postoperative adhesive small bowel obstruction were included in the study. The mean age was 59.6±17.4 years (range: 18-93 years), with a male-to-female ratio of 1.4:1. The median duration of symptoms was 2 days (range: 1-30 days). Operative treatment was performed in 19.6% of cases. The most frequently used operative technique was explorative laparotomy and bridectomy (70.1%). Intensive care unit (ICU) admission was required for 16.1% of patients, and the in-hospital mortality rate was 4.1%. The predictive roles of the Systemic Immune-Inflammation Index (SII), Pan-Immune-Inflammation Value (PIV), and other markers for operative treatment were evaluated. Receiver operating characteristic (ROC) analysis revealed that SII (area under the curve [AUC]=0.601, p=0.009) and PIV (AUC=0.596, p=0.010) were determinants for operative treatment.

CONCLUSION: SII and PIV values may assist in determining the need for operative treatment or non-operative follow-up in patients with adhesive small bowel obstruction (ASBO). By utilizing these markers, unnecessary operative interventions may be avoided. The management strategies for ASBO, a significant component of general surgical emergency practice, remain to be fully clarified. There are ongoing debates in the literature on this subject. We believe further studies with prospective, homogeneous, and broader populations should be conducted to address this issue.

Keywords: Systemic immune-inflammation index; pan-immune-inflammation value; small intestine obstruction; non-operative treatment.

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INTRODUCTION

Emergency surgical pathologies constitute a significant portion of general surgical practice. Small bowel obstructions are a common cause of surgical emergencies in this field. Studies indicate that approximately 20% of emergency operations in general surgery are performed on patients with small bowel obstruction.[1,2] Postoperative adhesions resulting from abdominal surgeries are the leading cause of small bowel obstruction. Other causes include hernias, tumoral lesions, and Crohn's disease.[3] A history of previous surgery is the most common risk factor (96%) for adhesive small bowel obstructions (ASBO). Common etiologies of ASBO include colorectal interventions, gynecologic procedures, hernia repairs, and appendectomies.[4, 5]

The clinical follow-up and treatment of patients with ASBO may be managed using a non-operative approach, although operative treatment may be necessary in certain cases. However, no consensus exists among surgeons regarding the decision-making process for non-operative versus operative treatment for each patient.[6,7]

The systemic immune-inflammation index (SII) and the pan-immune-inflammation value (PIV) are two significant biomarkers that have gained widespread attention in recent years. Several studies have documented the use of SII in predicting patient survival in pancreatic cancer, assessing prognosis in colorectal cancers, and monitoring patient outcomes.[8,9] Similarly, studies in the literature have investigated the association between PIV and gastrointestinal system cancers.[10,11] However, a review of the literature reveals that no studies have utilized SII and PIV as predictors for treatment options in ASBO, such as non-operative versus operative management.

This study aimed to investigate the predictive role of SII and PIV in determining the need for operative treatment in ASBO. These obstructions are a critical concern in general surgery, and clinicians have yet to reach a consensus on treatment selection and clinical follow-up.

MATERIALS AND METHODS

This study was approved by the local ethics committee under decision no. 14/10, dated July 10, 2024. It was conducted in compliance with the World Medical Association Declaration of Helsinki - Ethical Principles for Medical Research Involving Human Subjects. The study included patients who were hospitalized and treated in our general surgery clinic for small intestine obstruction due to postoperative adhesions. Patients' age, gender, American Society of Anesthesiologists (ASA) score, body mass index (BMI), smoking history, duration of obstruction-related symptoms, complete blood count, routine biochemical parameters, SII, PIV, length of hospital stay, intensive care unit stay, Charlson Comorbidity Index (CCI), Clavien-Dindo Classification score, type of treatment (non-operative or operative), type of operative treatment, and mortality status between January 2017 and January 2024 were retrospectively reviewed and recorded through the hospital information management system (HIMS) and patient records. The The SII was calculated using the formula:

(Platelet Count x Neutrophil Count) / Lymphocyte Count.

The PIV was calculated using the formula:

(Neutrophil Count x Platelet Count x Monocyte Count) / Lymphocyte Count.

Patients diagnosed with small bowel obstruction due to adhesions and with a history of abdominal surgery performed at least six months prior were included in the study. The patients were diagnosed with small bowel obstruction secondary to adhesions using an abdominopelvic computed tomography (CT) scan with intravenous and oral contrast. Patients treated non-operatively and subsequently discharged were contacted by phone at least six months post-discharge and asked about any repeated hospital admissions with similar symptoms. Patients with repeated hospital admissions were excluded from the study. Patients under 18 years of age, those with colonic-level obstruction, obstruction due to tumor compression or metastasis, or small bowel obstruction from causes other than postoperative adhesion were excluded from the study. Additionally, patients who underwent diagnostic laparoscopy followed by conversion to open surgery were excluded due to the rarity of such cases.

All patients received nasogastric (NG) decompression upon hospitalization. Operative treatments were classified as follows:

1. Explorative laparotomy and bridectomy,
2. Explorative laparotomy and resection with anastomosis,
3. Explorative laparotomy and small bowel diversion.

Patients treated non-operatively were managed with NG decompression, antibiotic therapy, daily complete blood count monitoring, standing direct abdominal radiography, and routine biochemical tests.

Statistical Methods

Statistical analyses were performed using SPSS version 22.0. Descriptive statistics were presented as count, percentage, mean, standard deviation, and median. The conformity of variables to a normal distribution was analyzed. Numerical variables with a normal distribution were tested between the two groups using the Independent Groups T-test, while those with an abnormal distribution were tested using the Mann-Whitney U test. Chi-square analysis and Fisher's Exact test were used to compare nominal data. Receiver operating characteristic (ROC) analyses are presented as the area under the curve and p-value at a 95% confidence interval. After

ROC analysis, sensitivity, specificity, and positive and negative predictive values for the optimal cut-off were calculated using the Youden Index. Binary logistic regression was applied to include clinically essential variables associated with mortality identified in univariate analyses. Correlations between variables were analyzed prior to their inclusion in the model. Regression analyses were performed using two models (Model 1 and Model 2) to account for the high correlation between SII and PIV. Comparisons with p-values below 0.05 were considered statistically significant.

RESULTS

The mean age of the 341 patients with postoperative ASBO included in the study was 59.6±17.4 years (range: 18-93 years). The male-to-female ratio was 1.4:1. The median duration of symptoms was 2 days (range: 1-30 days). Operative treatment was performed in 19.6% of cases, with the most frequently used operative technique being explorative laparotomy and bridectomy (70.1%). Intensive care unit (ICU) admission was required for 16.1% of patients, and the overall in-hospital mortality rate was 4.1%.

Table 1. Comparison of descriptive characteristics by treatment type

	Non-operative (n=274) Number (Percentage)	**Operative (n=67) Number (Percentage)**	**p value**
Age*	58.4±17.2	64.3±17.9	0.014
Gender			0.455
Female	113 (41.2)	31 (46.3)	
Male	161 (58.8)	36 (53.7)	
BMI (kg/m^2)*	26.2±4.6	24.5±4.4	0.010
Smoking (+)	100 (36.5)	17 (25.4)	0.086
ASA Score			0.004
I	48 (17.5)	7 (10.4)	
II	124 (45.3)	22 (32.8)	
III	87 (31.8)	27 (40.3)	
IV	15 (5.5)	11 (16.4)	
CCI*	2.9±2.5	4.0±2.3	0.003
Symptom Duration (days)**	2 (1-30)	3 (1-30)	<0.001
Laboratory Results			
Hemoglobin (g/dL)*	14.0±2.1	13.8±2.0	0.559
BUN (mg/dL)**	37 (5-181)	49 (19-182)	<0.001
Creatinine (mg/dL)*	1.15±0.70	1.44±1.02	0.029
LDH (U/L)**	236 (115-893)	296 (148-778)	<0.001
Platelet (x109/L)**	274 (46-730)	274 (65-594)	0.916
Lymphocyte (x109/L)*	1.7±0.9	1.3±0.6	<0.001
Neutrophil (x109/L)**	8.5 (0.5-28.2)	9.8 (0.8-25.6)	0.110
Monocyte (x109/L)**	0.7 (0.1-4.0)	0.8 (0.3-2.5)	0.430
WBC (x109/L)*	11.8±4.4	12.7±4.9	0.154
SII**	1606 (40-20266)	1939 (49-17640)	0.010
PIV**	1178 (26-13976)	1493 (49-17640)	0.015
Length of Hospital Stay (days)**	3 (1-84)	11 (2-69)	<0.001
ICU Admission (+)	11 (4.0)	44 (65.7)	<0.001
ICU Stay (days)**	2 (1-36)	2 (1-67)	0.582
Mortality	7 (2.6)	7 (10.4)	0.009

*Mean±SD, **Median (min-max); BMI: Body Mass Index; ASA: American Society of Anesthesiologists; CCI: Charlson Comorbidity Index; LDH: Lactate Dehydrogenase; WBC: White Blood Cell Count; ICU: Intensive Care Unit; SII: Systemic Immune-Inflammation Index; PIV: Pan-Immune Inflammation Value; BUN: Blood Urea Nitrogen.

Descriptive characteristics were analyzed based on treatment modality. The operative and non-operative treatment groups showed significant differences in several parameters: age (p=0.014), BMI (p=0.010), ASA score (p=0.004), CCI (p=0.003), symptom duration (p=0.003), blood urea nitrogen (p<0.001), creatinine (p=0.029), lactate dehydrogenase (LDH) (p<0.001), lymphocyte count (p<0.001), length of hospital stay (p<0.001), ICU admissions (p<0.001), and mortality rates (p=0.009). Patients treated operatively had higher SII (p=0.010) and PIV (p=0.015) levels compared to those treated non-operatively (Table 1).

The predictive roles of the SII, PIV, and other markers in operative treatment were evaluated. ROC analyses revealed that SII (area under the curve [AUC]=0.601, p=0.009) and PIV (AUC=0.596, p=0.010) were determinants for operative treatment (Table 2, Fig. 1).

The sensitivity and specificity of SII (>2706) for predicting operative treatment were 41.7% and 78.1%, respectively. For PIV (>1249), the sensitivity and specificity were 62.6% and 54.3%, respectively (Table 3).

Multivariate analyses were conducted to evaluate variables associated with operative treatment identified in univariate analyses. Clinically significant variables from the univariate analyses were included in the regression model. Laboratory values such as hemoglobin, creatinine, PIV, and SII were incorporated due to collinearity. Two regression models (Model 1 and Model 2) were constructed to account for the high correlation between PIV and SII values. The final model included age, hemoglobin, creatinine, length of hospital stay, and either SII or PIV value. Only the length of hospital stay (odds ratio [OR]: 1.35, 95% confidence interval [CI]: 1.24-1.47, p<0.001) was identified as an independent predictor for operative treatment in Model 1, which included the PIV. However, PIV alone was not a significant predictor (Table 4). Similarly, in Model 2, which incorporated the SII, only the length of hospital stay (OR: 1.35, 95% CI: 1.24-1.47, p<0.001) was found to be an independent predictor of operative treatment (Table 5).

Table 2. Determination of the systemic immune-inflammation index (SII), pan-immune inflammation value (PIV), and other markers in operative treatment

	AUC	95% CI	p value
Age	0.617	0.563-0.669	0.002
BMI	0.585	0.531-0.638	0.028
CCI	0.632	0.579-0.684	<0.001
Symptom duration	0.653	0.600-0.704	<0.001
Hemoglobin	0.522	0.467-0.576	0.565
BUN	0.679	0.627-0.728	<0.001
Creatinine	0.623	0.570-0.675	0.001
LDH	0.669	0.617-0.719	<0.001
Platelet	0.504	0.450-0.558	0.913
Lymphocyte	0.626	0.572-0.677	<0.001
Neutrophil	0.563	0.508-0.616	0.117
Monocyte	0.531	0.476-0.585	0.417
WBC	0.545	0.491-0.599	0.251
SII	0.601	0.547-0.653	0.009
PIV	0.596	0.541-0.648	0.010
Length of hospital stay	0.939	0.908-0.962	<0.001

BMI: Body Mass Index; CCI: Charlson Comorbidity Index; BUN: Blood Urea Nitrogen; LDH: Lactate Dehydrogenase; WBC: White Blood Cell Count; SII: Systemic Immune-Inflammation Index; PIV: Pan-Immune Inflammation Value.

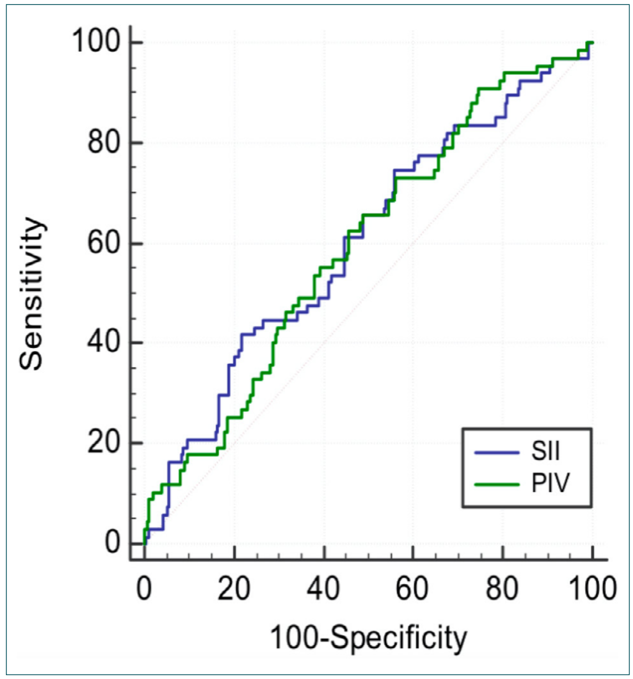

Figure 1. ROC plots of SII and PIV values for surgical treatment.

DISCUSSION

Surgical pathologies requiring urgent intervention are a critical aspect of general surgical practice. Among the most common emergency surgical conditions is acute mechanical intestinal obstruction. ASBO is one of the leading causes of obstruction in patients admitted to hospitals with acute mechanical intestinal obstruction. ASBO may be managed through both non-operative and operative approaches. However, when examining follow-up and treatment protocols, it becomes evident that there is still a lack of agreement and consensus in the literature.[12,13]

SII and PIV are two biological indices that have seen a rapid rise in usage across various medical fields in recent years. Recent studies on these two indices have become increasingly prevalent in the literature. A study by Chen et al.[14] in China examined the risk of bowel resection in incarcerated inguinal hernias using the SII and reported significant find-

Table 3. Diagnostic performance of the systemic immune-inflammation index (SII), pan-immune inflammation value (PIV), and other markers in operative treatment

	Cut-off	Sensitivity	Specificity	PPD	NPD
Age	>62	68.6	56.9	28.0	88.1
BMI	≤24.5	59.7	55.1	24.5	84.8
CCI	>3	65.6	61.6	2.5	88.0
Symptom duration	>2	50.7	72.9	31.5	85.8
Hemoglobin	≤15	77.6	35.0	22.6	86.5
BUN	>33	89.5	41.6	27.3	94.2
Creatinine	>1.03	64.1	59.1	27.7	87.1
LDH	>246	71.6	62.0	31.6	89.9
Platelet	≤345	83.5	25.9	21.6	86.6
Lymphocyte	≤1.4	68.6	55.8	27.5	87.9
Neutrophil	>9	59.7	55.8	24.8	85.0
Monocyte	>0.8	46.2	64.2	24.0	83.0
WBC	>11.6	58.2	56.2	24.5	84.6
SII	>2706	41.7	78.1	31.8	84.6
PIV	>1249	62.6	54.3	25.1	85.6
Length of hospital stay	>5	94.0	83.5	58.3	98.3

BMI: Body Mass Index; CCI: Charlson Comorbidity Index; BUN: Blood Urea Nitrogen; LDH: Lactate Dehydrogenase; WBC: White Blood Cell Count; SII: Systemic Immune-Inflammation Index; PIV: Pan-Immune Inflammation Value.

Table 4. Multivariate analysis of the pan-immune inflammation value (PIV) and other markers in operative treatment

Model 1	OR	95% CI	p value
Age	1.00	0.98-1.03	0.439
Hemoglobin	1.04	0.88-1.23	0.578
Creatinine	0.89	0.56-1.39	0.613
Length of hospital stay	>5	1.24-1.47	<0.001
PIV	1.00	1.00-1.01	0.055

PIV: Pan-Immune Inflammation Value.

Table 5. Multivariate analysis of the systemic immune-inflammation index (SII) and other markers in operative treatment

Model 2	OR	95% CI	p value
Age	1.00	0.98-102	0.497
Hemoglobin	1.06	0.90-1.24	0.485
Creatinine	0.92	0.59-1.43	0.726
Length of hospital stay	1.35	1.24-1.47	<0.001
SII	1.00	1.00-1.01	0.226

SII: Systemic Immune-Inflammation Index.

ings. In a meta-analysis by Yang et al.[15], which included a total of 1,879 colorectal cancer patients, a significant relationship was identified between PIV and disease prognosis, concluding that patients with higher PIV values had lower survival rates. Similarly, a study conducted in Türkiye involving 4,942 patients reported higher mortality rates among cancer patients with elevated PIV values compared to those with lower PIV values.[16]

The literature presents varying perspectives on this subject. A study conducted by Coco et al.[17] in Italy suggested the use of a prognostic score index for guiding operative treatment in patients with ASBO and reported that it could assist surgeons in making treatment decisions. Similarly, a study by Zins et al.[18] in France emphasized that computed tomography imaging provides valuable insights for operative treatment decisions, helping to avoid unnecessary surgeries.

The results of our study indicate that approximately 80% of patients with ASBO were discharged following non-operative management. A study by Maienza et al.[19] reported that patients undergoing non-operative management accounted for approximately 70% of the total patient group. Likewise, Köstenbauer et al.[20] observed that most patients were treated with non-operative management and recommended this approach to avoid unnecessary surgical interventions in appropriate patient groups.

The significance of non-operative follow-up for eligible patients is evident, as demonstrated in the cited studies. Our study presents findings on the effectiveness of SII and PIV in guiding decisions regarding operative treatment, contributing novel data to the literature. We observed that the need for operative treatment was significantly higher in patients with elevated SII (p=0.010) and PIV (p=0.015) values. Moreover, a threshold SII value of >2706 and a PIV cut-off value of >1249 were identified as critical markers for determining the necessity of surgical intervention. Additionally, patients with high SII and PIV values experienced significantly longer hospital stays, as shown by multivariate analyses.

The limitations of our study include its retrospective design, the interpretation of computed tomography images by a single radiologist, and the fact that the same surgical team did not perform the operations.

CONCLUSION

SII and PIV values may serve as valuable tools in deciding between operative treatment and non-operative follow-up for patients with ASBO. These indices could help prevent unnecessary surgical interventions. However, the optimal treatment modalities for patients with ASBO, a critical component of general surgical emergency practice, still need to be clarified, with ongoing debates in the literature on the subject. We believe further studies should be conducted using prospective, homogeneous, and broader patient populations.

Ethics Committee Approval: This study was approved by the University of Health Sciences Gulhane Health Application and Research Center Ethics Committee (decision no. 14/10, dated July 10, 2024).

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ORİJİNAL ÇALIŞMA - ÖZ

Adheziv ince bağırsak obstrüksiyonlarında operatif tedavi kararının alınmasında Sistemik immün-inflamasyon indeksi ve Pan-immün-inflamasyon değeri prediktör müdür?

AMAÇ: Acil cerrahi patolojiler genel cerrahi pratiğinin çok önemli bir kısmını oluşturmaktadır. İnce bağırsak obstruksiyonları da genel cerrahi pratiğinde yeri olan acil cerrahi patolojilerin önemli bir sebebidir. Bu çalışma ile birlikte; genel cerrahi pratiğinde önemli yeri olan ve klinisyenlerin tedavi seçimi ve klinik takip hususunda net bir fikir birliğine varamadığı adheziv ince bağırsak obstrüksiyonlarında; Sistemik immün inflamasyon indeksi ve Pan immün inflamasyon değeri'nin operatif tedavi kararının alınmasında prediktör rolünü araştırmayı ve konu ile ilgili tartışmalı sorulara cevap bulmayı amaçladık.

GEREÇ VE YÖNTEM: Çalışmaya; Genel Cerrahi Kliniğimizde postoperatif dönemdeki adezyona bağlı ince bağırsak obstrüksiyonu olan ve klinik takip ve tedavisi yapılan hastalar dahil edildi. Ocak 2017 ile Ocak 2024 yılları arasındaki hastalara ait; yaş, demografik ve klinik veriler hastane bilgi yönetim sistemi (HBYS) üzerinden ve hasta kayıtları üzerinden geriye dönük olarak tarandı ve kaydedildi. İstatistiksel analizlerde SPSS versiyon 22.0 kullanıldı.

BULGULAR: Çalışmaya dahil edilen postoperatif adheziv ince bağırsak obstrüksiyonu olan 341 hastanın yaş ortalaması 59.6±17.4 idi (18-93 yaş). Erkek/kadın oranı 1.4/1 idi. Median semptom süresi 2 gündü (1-30 gün aralığında). Olguların %19.6'sı operatif olarak tedavi edildi. En sık tercih edilen operatif teknik eksploratif laparotomi+bridektomi (%70.1) idi. Hastaların %16.1'i yoğun bakım ünitesine (YBÜ) kabul edildi. Hastane içi mortalite oranı %4.1 idi. Operatif tedavide SII, PIV ve diğer belirteçlerin belirleyiciliği değerlendirildi. ROC analizlerinde, SII (AUC=0.601, p=0.009) ve PIV (AUC=0.596, p=0.010) değerlerinin operatif tedavide belirleyici olduğu izlendi.

SONUÇ: Bu çalışma ile; SII ve PIV değerlerinin AİBO tanılı hastalarda operatif tedavi veya non-operatif takip kararının alınmasında faydalı olabileceği ve bu sayede gereksiz operatif yaklaşımların önüne geçilebileceğini düşünmekteyiz. Genel cerrahi acil pratiğinde çok önemli yeri olan AİBO'da hastalara uygulanacak tedavi modaliteleri hala net değildir ve literatürde konu ile ilgili tartışmalar sürmektedir. Konu ile ilgili prospektif, homojen ve daha geniş polülasyonlu çalışmaların yapılması gerektiğini düşünmekteyiz.

Anahtar sözcükler: İnce bağırsak obstrüksiyonu; non-operatif tedavi; Pan-immün-inflamasyon değeri; sistemik immün-inflamasyon indeksi.

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