ARAŞTIRMA MAKALESİ/ORIGINAL RESEARCH

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Comparison of the Systemic Immune Inflammatory Index with the Neutrophil Lymphocyte and Platelet Lymphocyte Ratio in terms of Success in Predicting Appendicitis. Single Center Experience

Apandisit Öngörme Başarısı Açısından Nötrofil/Lenfosit, Trombosit/Lenfosit Oranı ile Sistemik İmmün İnflamatuar İndeksin Karşılaştırılması. Tek Merkez Deneyimi

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ABSTRACT

Introduction: Appendicitis is one of the most common causes of acute abdomen in General Surgery practice. Although ultrasonography and abdominal tomography have high sensitivity and specificity for Appendicitis, their use may not be appropriate in all cases. Neutrophil/lymphocyte ratio and platelet/lymphocyte ratio can be used to predict Appendicitis. This study aims to compare the less studied novel Systemic immune-inflammatory index's success in predicting Appendicitis with the neutrophil/lymphocyte and Platelet/lymphocyte ratios.
Method: The data of patients who were operated on for Appendicitis in our clinic between 2005-2021 were reviewed retrospectively. We divided the patients into two groups regarding the histopathologic examinations as those with Appendicitis or not. Neutrophil/lymphocyte, Platelet/lymphocyte ratio, Systemic inflammatory index were calculated for each patient. Receiver operator characteristic curve analysis was used to assess the performances of the test scores for Appendicitis..
Results: A total of 205 patients were included in the study. There were 105 patients in the appendicitis group and 100 patients in the non-appendicitis group. SII (AUC: 0.713) and NLR (AUC: 0.764) were found to be valuable for predicting Appendicitis, but PLR (AUC: 0.442) was not.
Discussion and Conclusion: NLR and SII are valuable markers that can assist physical examination in predicting Appendicitis in cases where imaging methods cannot be used.
Keywords: neutrophil to lymphocyte ratio, platelet to lymphocyte ratio, systemic immune inflammatory index, appendicitis

ÖZ

Giriş ve Amaç: Apandisit, Genel Cerrahi pratiğinde en sık görülen akut karın nedenlerinden biridir. Ultrasonografi ve karın tomografisi, Apandisit için yüksek duyarlılık ve özgüllüğe sahip olmasına rağmen, her durumda kullanımları uygun olmayabilir. Apandisit tahmininde nötrofil/lenfosit oranı ve trombosit/lenfosit oranı kullanılabilir. Bu çalışma, daha az çalışılan yeni Sistemik immün- inflamatuar indeksin Apandisit öngörmedeki başarısını nötrofil/lenfosit ve Trombosit/lenfosit oranları ile karşılaştırmayı amaçlamaktadır.
Yöntem ve Gereçler: 2005-2021 yılları arasında kliniğimizde Apandisit nedeniyle ameliyat edilen hastaların verileri geriye dönük olarak incelendi. Hastaları histopatolojik inceleme sonuçlarına göre apandisit saptanan ve sapanmayan hastalar olarak iki gruba ayırdık. Her hasta için nötrofil/lenfosit, Trombosit/lenfosit oranı, Sistemik inflamatuar indeks hesaplandı. Apandisit test puanlarının performanslarını değerlendirmek için alıcı Receiver operator characteristic curve analysis kullanıldı.
Bulgular: Toplam 205 çalışmaya dahil edilmiştir. Apandisit grubunda 105, apandisit olmayan grupta 100 hasta vardı. SII (AUC: 0.713) ve NLR (AUC: 0.764) Apandisit öngörmede değerli bulundu, ancak PLR (AUC: 0.442) değildi.
Tartışma ve Sonuç: CNLR ve SII, görüntüleme yöntemlerinin kullanılamadığı durumlarda Apandisit tahmininde fizik muayeneye yardımcıolabilecek değerli belirteçlerdir.
Anahtar Kelimeler: nötrofill lenfosit oranı, platelet-lenfosit oranı, sistemik immün inflamatuar indeks, apandisit

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INTRODUCTION

Appendicitis is one of the most common causes of acute abdomen in General Surgery practice and can affect 7% of the society throughout life (1). Meanwhile, there are challenges in its diagnosis even by experienced surgeons due to the absence of pathognomonic signs and symptoms; thus, negative appendectomy rates can reach up to 20%-30%(2,3). Although not pathognomonic, the most prominent physical examination findings are tenderness, defense, and rebound detection in the right lower quadrant, fever higher than 38 degrees, and inability to hear bowel sounds in auscultation (4). When the physical examination findings are evaluated together with the complaints of patients such as loss of appetite, abdominal pain that starts in the midline of the abdomen and then localizes to the right lower quadrant of the abdomen, which are frequently present in the patients, the diagnosis of acute appendicitis can be made with 75% certainty (5).

In addition to evaluating symptoms and examination findings mentioned above, imaging methods bring the clinician closer to the correct diagnosis but increase the cost (6). Although abdominal ultrasonographic examination (USG) should be the first choice among imaging methods, it may mislead the clinician and cause overtreatment or inadequate (undertreatment) treatment when it is not performed under appropriate conditions (such as an experienced radiologist, USG performed in working hours, USG performed by a radiologist with low patient burden) (7). The sensitivity and the specificity of computed tomography (CT) in the diagnosis of appendicitis are higher than USG (respectively 96.40% vs. 79%, 92.17% vs. 87%), but radiation exposure and non-cost effectiveness may be encountered as disadvantages of CT (8,9).

Since imaging methods are high-cost, diagnostic accuracy is related to the radiologist's experience and not constantly accessible; the reason is that various clinical scoring systems have been formed to be applied in the differential diagnosis of appendicitis (10-12). Besides clinical scoring systems, there are various studies proposing the use of hematological parameters, such as neutrophil/lymphocyte ratio (NLR) and platelet/lymphocyte ratio (PLR), which are known to be increased in inflammation, for predicting acute appendicitis (13,14). The Systemic Immune Inflammation Index (SII) is calculated by multiplying the platelet and NLR and tends to be higher in cases of increased inflammation such as NLR and PLR (15).

In this study, we aimed to retrospectively analyze patients operated on with a pre-diagnosis of appendicitis in our clinic and evaluate the success of NLR, PLR, and SII in predicting appendicitis.

MATERIAL AND METHOD

The records of patients who were operated on with a pre-diagnosis of appendicitis between January 2015 and January 2021, were retrospectively analyzed. By assigning a sequence number to each patient, the patients' demographic data,' complaints and physical examination findings of the patients, the blood parameters at the time of admission, the results of radiological imaging, and the histopathological examination results of the appendectomy specimens were recorded in a database. The patients were divided into two groups as those with and without appendicitis according to histopathological examination results. Patients included in both groups were randomly selected. NLR, PLR, SII ratios were calculated for each patient.

Statistical Analysis

Descriptive analyses were performed to provide information on the general characteristics of the study population. Kolmogorov-Smirnov test was used to evaluate whether the distributions of numerical variables were normal. Accordingly, the independent sample Mann-Whitney U test was used to compare the numeric variables between groups. The numeric variables were presented as mean ± standard deviation or median-minimum/maximum. Categorical variables were compared by the Chi-Square test. Categorical variables were presented as a count and percentage. A p-value <0.05 was considered significant. Receiver operator characteristic (ROC) curve analysis was used to identify the best cut-off value and assess the performance of

the test score for appendicitis. Analyses were performed using SPSS statistical software (IBM SPSS Statistics, Version 25.0. Armonk, NY: IBM Corp.)

RESULTS

One hundred five patients (51.2%) who were found to have appendicitis and 100 patients (48.8%) who were found to have not appendicitis were included in the study. In addition, 99 (48.3%) of the patients were female, and 106 (51.7%) were male. The rate of appendicitis in the male gender was higher than the female gender (68/64.2%, 37/37.4%, respectively). This difference was found to be statistically significant (p=0.00). The median age of the patients was 33 (17-83) in the group with Appendicitis (AG), while it was 34 (18-79) in the group without appendicitis (wAG). This difference was notstatistically significant (p=0.56) (Table 1).

Table 1: Demographic Variables, Complaints on Admission

		Appendicitis	Normal Appendix	p- Value
Population		105 (51.2%)	100 (48.8%)	
Age		33 (17-83)	34 (18-79)	0.56
Gender				
	Female	37 (37.4%)	62 (62.6%)	**0.00**
	Male	68 (64.2%)	38 (35.8%)	
Loss of appetite				
	No	27 (40.3%)	40 (59.7%)	**0.02**
	Yes	78 (56.5%)	60 (43.5%)	
Duration of symptoms				
	<24 hours	46 (43%)	44 (44%)	**0.01**
	24 -48 hours	31 (29.5%)	44 (44%)	
	>48 hours	28 (26.7%)	12 (12%)	
Increasing Pain				
	No	71 (87.7%)	10 (12.3%)	**0.00**
	Yes	34 (27.4%)	90 (72.6%)	
Increasing pain with cough				
	No	35 (60.3%)	23 (39.7%)	0.10
	Yes	70 (47.6%)	77 (52.4%)	
Relocation of pain				
	No	53 (55.2%)	43 (44.8%)	0.28
	Yes	52 (47.7%)	57 (52.3%)	
Pain in Right Lower Quadrant				
	No	4(14.8%)	23(85.2%)	**0.00**
	Yes	101(56%)	77 (43.3%)	
Pain except for Right Lower Quadrant				
	No	74 (54%)	63 (46%)	0.25
	Yes	31 (45.6%)	37 (54.4%)	

Complaints of the patients at admission to the hospital were analyzed; It was determined that loss ofappetite was seen at a higher rate in the AG group than in the wAG group (78/56.5% vs. 60 /43.5%). This difference was evaluated as statistically significant (p=0.02). When the duration between the onset of pain and admission to the hospital was analyzed, it was seen that the patients in the AG group applied to the hospital later at a higher ratethan the patients in the wAG group (28/26.7% vs. 12 12%). This difference was evaluated as statistically significant (p=0.01). While right lower qu-adrant pain was significantly higher in AG than wAG (101/56% vs. 77 / 43.3%, p=0.00), there was no significant difference between the groupsin terms of pain in sites other than the right lower quadrant (p =0.25). The increase in pain severity during the observation was higher in wAG than in AG (90/72.6%, 34/27.4%, p=0.00). There were no significant differences between the two groups regarding increased pain intensity with coughing and displacement of pain from the umbilicus to the right lower quadrant (p=0.10, p=0.28, respectively).

Table 2: Laboratory tests, Computerized Tomography results, Surgical Technique

		Appendicitis	Normal Appendix	p-Value
Lymphocyte count		2.127 ± 1.03	2.15 ± 0.97	0.88
Platelet count		229.6 ±4.32	260.2 ± 57.69	**0.00**
Neutrophil count		10.7 ± 8.04	5.21 ± 2.50	**0.00**
CRP		69.86 ±6.21	35.37 ± 31.06	0.06
Leukocyte count		19154.20 ±22658.2	9814 ± 18808.9	**0.00**
SII		1507.1 ±1432.7	732.6 ± 536.2	**0.00**
NLR		6.63 ± 5.9	2.8 ± 2.02	**0.00**
PLR		138.4 ± 90.9	142.6 ± 70.1	0.15
Negative Urine examination				
	No	7 (13.7%)	44 (86.3%)	**0.00**
	Yes	98 (64.5%)	54 (35.5%)	
Appendicitis on Computerised Tomography screening				
	No	9 (9.3%)	88 (90.7%)	**0.00**
	Yes	96 (89.7%)	11 (10.3%)	
Surgical Technique				
	Laparoscopic	102 (75%)	34 (25%)	**0.00**
	Conventional	3 (4.3%)	66 (95.7%)	

Physical examination findings of the patients at the time of admission were analyzed; While no significant difference was found between the groups in terms of fever (p=0.14), it was found that the

rates of detection tenderness, rigidity, rebound, and rovsing sign on physical examination were significantly higher in AG than in wAG (p=00, p=00, p=00, p=00. respectively).

Blood parameters of the patients at admission were analyzed; While no significant difference was found between AG and wAG, in terms of Lymphocyte count (Leu) (2.127 ± 1.03 vs. 2.15 ± 0.97, p=0.88) and C-reactive protein (CRP) (69.86 ± 76.21 vs. 35.37 ± 31.06, p=0.06), platelet count was found to be significantly higher in wAG than in AG (229.6 ± 54.32 vs. 260.2 ± 57.69, p=0.00). Neutrophil count (10.7 ± 8.04 vs. 5.21 ± 2.50, p=00) and Leucocyte count (19154.20 ± 22658.2 vs. 9814 ± 18808.9, p=0.00) were significantly higher in AG. Negative Urine analysis was found to be higher in AG than in wAG (98/64.5% vs. 54/35.5%, p=0.00) (Table 2).

Although SII (1507.1 ± 1432.7 vs. 732.6 ± 536.2, p=0.00) and NLR (6.63 ± 5.9 vs. 2.8 ± 2.02, p=0.00) were significantly higher in AG, there was no significant difference between AG and wAG in the term of PLR (138.4 ± 90.9 vs. 142.6 ± 70.1, p=0.15). ROC analysis revealed that NLR is the most valuable ratio in predicting appendicitis with 0.70 sensitivity and 0.69 specificity (AUC:0.764, cut-off value:2.93). However, SII was also valuable for predicting appendicitis with 0.676 sensitivity and 0.677 specificity (AUC:0.713, cut-off:702.89), PLR was not successful in predicting appendicitis (AUC:0.44, Sensitivity:0.46, specificity:0.46) (Table 3, Figure 1).

Table 3: ROC analysis of SII, NLR, PLR

Variable(s)	AUC (95%)	P	Sensitivity	Specificity	Cut Off
SII	0.713 (0.64-0.78)	0.00	0.676	0.677	702.89
NLR	0.764 (0.69-0.83)	0.00	0.70	0.69	2.93
PLR	0.442 (0.36-0.52)	0.15	0.46	0.46	121.2

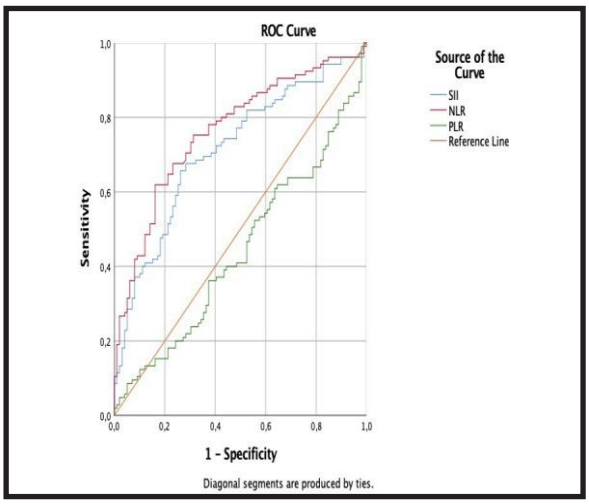

Figure 1: ROC analysis of SII, NLR, PLR

DISCUSSION

Leukocyte count (WBC) and C-reactive protein (CRP) levels are frequently elevated in acute appendicitis. Furthermore, It has been reported in various publications that WBC is the first parameter to rise in acute appendicitis with 82-96% sensitivity (16). Although increased WBC levels are not pathognomonic for appendicitis, there is a direct proportion between WBC and the severity of inflammation in appendix (17,18). Furthermore, a high C-reactive protein (CRP) level could be a predictor of appendix perforation in acute appendicitis (19). In our study, although we found no significant difference in CRP between AG and wAG, which is contraryto the literature, WBC was found to be significantlyhigher in AG.

The neutrophil count is an indicator of ongoing inflammation, while the lymphocyte count is an indicator of the regulatory pathway (20). Numerous studies have proposed that low lymphocyte levels may be used to predict inflammation in patients who underwent surgery (21,22). The increased neutrophil-lymphocyte ratio has been used as

a predictive ratio for the prognosis of colorectal cancer and cardiovascular diseases (23,24). Furthermore, NLR may be a valuable tool for either predicting appendicitis or determining the severity of the disease (18,25). In our study, we found that NLR was more valuable in predicting appendicitisthan SII and PLR.

Various studies are proposing that the number of PLT decreases in appendicitis (3,26). Thus besides neutrophils and lymphocytes, the platelet count can also be used to predict appendicitis (14). Ozkan A et al., In their study, found that PLR was more successful than NLR and WBC in determi- ning the severity of inflammation and detecting perforation in appendicitis (5,14). However, we ascertained that PLR failed to predict appendicitis. The results we obtained were compatible with studies claiming that none-sense of PLT count between patients with and without appendicitis (27,28).

Bacterial infections increase neutrophil count (29). SII which is obtained by multiplying PLT count with the ratio of neutrophil count to lymphocyte count, is being used for predicting the severity of heart diseases and the prognosis of various malignancies (30,31). This current study ascertained that the SII index is a relevant parameter following NLR in predicting appendicitis.

CONCLUSION

In conclusion, although CT and USG have high sensitivity and specificity for diagnosing appendicitis, NLR and SII are worthy markers that can assist physical examination in predicting appendicitis, even if imaging methods cannot be utilizedor accessed

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