



The Role of Platelet Indices, Red Cell Distribution Width and the Ratios of Neutrophil to Lymphocyte, Platelet to Lymphocyte and Lymphocyte to C-reactive Protein as Markers for the Diagnosis of Acute Appendicitis in Children

Çocuklardaki Akut Apandisit Tanısında Trombosit İndeksleri ve Kırmızı Hücre Dağılım Genişliği ile Nötrofil/Lenfosit, Trombosit/Lenfosit ve Lenfosit/C-reaktif Protein Oranlarının Rolü

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ABSTRACT

Objective: To determine the role of mean platelet volume (MPV), platelet distribution width (PDW), red cell distribution width (RDW), neutrophil to lymphocyte ratio (NLR), platelet to lymphocyte ratio (PLR) and lymphocyte to C-reactive protein ratio (LCR) for the diagnosis of complicated and uncomplicated acute appendicitis (AA) in children admitted to the hospital with right lower quadrant pain.

Methods: The patients presented with right lower quadrant abdominal pain were grouped as acute uncomplicated appendicitis (Group 1), acute complicated appendicitis (Group 2) and right lower quadrant abdominal pain-other than appendicitis (Group 3) groups.

Results: In this retrospective study, 1,050 patients were included. There was not a statistically significant difference regarding age and gender between groups ($p=0.555$ and $p=0.641$, respectively). No significant difference was observed in the comparison of all groups and between-groups in terms of all laboratory parameters (MPV, $p=0.528$; PDW, $p=0.181$; RDW, $p=0.479$; NLR, $p=0.953$; PLR, $p=0.848$; LCR, $p=0.535$)

Conclusion: It was shown that MPV, PDW, RDW, NLR, PLR and LCR aided neither in the differential diagnosis of patients with

ÖZ

Amaç: Sağ alt kadranda ağrısı ile hastaneye başvuran hastalarda komplike olan ve olmayan akut apandisit (AA) tanısını koymada ortalama trombosit hacmi (MPV), trombosit dağılım genişliği (PDW), kırmızı hücre dağılım genişliği (RDW), nötrofil/lenfosit oranı (NLR), trombosit/lenfosit oranı (PLR) ve lenfosit/C-reaktif protein (LCR) oranının rolünü belirlemek.

Yöntemler: Sağ alt kadranda ağrısı ile başvuran hastalar akut komplike olmayan apandisit (Grup 1), akut komplike apandisit (Grup 2) ve apandisit dışında sağ alt kadranda karın ağrısı olanlar (Grup 3) şeklinde gruplandırıldı.

Bulgular: Bu retrospektif çalışmaya sağ alt kadranda karın ağrısı nedeniyle başvuran ardışık 1.050 hasta dahil edildi. Gruplar arasında yaş ve cinsiyet açısından istatistiksel olarak anlamlı bir fark yoktu (sırasıyla; $p=0,555$ ve $p=0,641$). Tüm laboratuvar parametreleri açısından tüm gruplar arasında ve gruplar ikiye bölünmüş karşılaştırıldığında anlamlı farklılık gözlenmedi (MPV, $p=0,528$; PDW, $p=0,181$; RDW, $p=0,479$; NLR, $p=0,953$; PLR, $p=0,848$; LCR, $p=0,535$).

Sonuç: Bu çalışmada; MPV, PDW, RDW, NLR, PLR ve LCR'nin hem sağ alt kadranda ağrısı olan olgularının ayırıcı tanısına hem de pediatrik akut komplike ve komplike olmayan apandisit olgularının ayırt edilmesine yardımcı olmadığı gösterilmiştir. Bunun nedeni,

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right lower quadrant pain nor in the discrimination of pediatric acute complicated and uncomplicated appendicitis patients. The explanation for this might be that complete blood cell count could be affected by an inflammatory process other than AA and other characteristics such as anemia, age and sex. Clinical observation and diagnostic imaging modalities should still be the most reliable diagnostic methods in acute appendicitis. The roles of these parameters in the diagnosis of AA can be understood more clearly with multi-center prospective studies with larger sample sizes.

Keywords: Mean platelet volume, platelet distribution width, red cell distribution width, acute appendicitis, children, right lower quadrant pain

tam kan sayımının AA dışındaki bir enflamatuvar süreçten veya anemi, yaş ve cinsiyet gibi diğer bozukluk ve özelliklerden etkilenmiş olması olabilir. AA'da klinik gözlem ve tanısal görüntüleme yöntemleri hala en güvenilir tanı yöntemleri olmalıdır. AA tanısında bu parametrelerin rolleri, daha geniş örneklem büyüklüğüne sahip çok merkezli prospektif çalışmalarla daha net anlaşılabilir.

Anahtar Sözcükler: Ortalama trombosit hacmi, trombosit dağılım genişliği, kırmızı hücre dağılım genişliği, akut apandisit, çocuklar, sağ alt kadran ağrısı

Introduction

Acute appendicitis (AA) is one of the most common causes of acute abdomen. Mostly, the diagnosis is easy due to well-known typical symptoms and clinical findings of AA. However, sometimes these symptoms and clinical findings are not clear. A number of diseases mimic AA and misdiagnosis can lead to negative appendectomy at a rate of 5-42% (1). On the other hand, it is important to diagnose AA rapidly and accurately because diagnostic delay is associated with perforation and increased complication rate (2,3).

In recent years, radiological imaging methods such as ultrasound, computerized tomography and magnetic resonance imaging have been used frequently in diagnosis to improve diagnostic accuracy in patients with suspected AA, but they are not completely sufficient (2,3). Moreover, these methods can be expensive and sometimes not available in emergency departments. Also, the patients are exposed to radiation and contrast allergy may occur in computed tomography (3).

Increased white blood cell and neutrophil counts are the earliest indicators of inflammation in AA with low sensitivity and specificity (2,3). Therefore, new biomarkers are needed for diagnosis. Mean platelet volume (MPV), platelet distribution width (PDW) and red cell distribution width (RDW) are the parameters of complete blood cell count (CBC) calculated automatically. MPV, PDW and RDW have been shown as markers of many inflammatory conditions such as inflammatory bowel disease, celiac disease, acute pancreatitis, rheumatoid arthritis, ankylosing spondylitis, and familial Mediterranean fever (4-7). Neutrophil to lymphocyte ratio (NLR), platelet to lymphocyte ratio (PLR) and lymphocyte to C-reactive protein (CRP) ratio (LCR) are parameters that have been studied as the predictive factors of AA in several articles and can be determined simply by using CBC and CRP (8-10).

In this study, it was aimed to determine the roles of all these laboratory parameters for the diagnosis of complicated and uncomplicated AA in children admitted to the hospital with right lower quadrant pain.

Methods

This retrospective study was conducted on children who were admitted to Muğla Sıtkı Koçman University Training and

Research Hospital, Muğla, Turkey with right lower quadrant pain between January 2018 and December 2019. The study was approved by the local ethics committee on 23.07.2020 with the decision number 160.

The participants were divided into three groups as:

Group 1: Patients with acute uncomplicated appendicitis

Group 2: Patients with acute complicated appendicitis (patients with perforated or gangrenous appendix)

Group 3: Patients with right lower quadrant pain- other than AA

The patients with a history of peripheral vascular disease, hematological disease, acute or chronic infection, and anticoagulant or steroid usage were excluded from the study.

Venous blood samples of the children were collected during admission using the Standard venipuncture technique to analyze CBC and CRP. The Cell-Dyn 3700 Haematology analyzer (Abbott Diagnostics, USA) was used to assess CBC measurements. The reference intervals of MPV, PDW and RDW levels were accepted as 9.4-12.3 fL, 9.9-15.4 fL and 36.4-46.3 fL, respectively. CRP concentrations were quantified with a dual-radius enhanced latex technology (Cobas C 501 Roche Diagnostics, Rotkreuz, Switzerland).

Statistical Analysis

The SPSS (SPSS Inc, version 22.0 software, Chicago, Illinois, USA) was used for statistical analysis. The results were expressed as mean \pm standard deviation. One-Way analysis of variance (ANOVA) was performed to compare age, levels and ratios of parameters which were normally distributed among groups. Kruskal-Wallis test was used to compare levels and ratios of parameters which were not normally distributed among groups. χ^2 test was performed to compare gender. For comparison of groups with each other, post-hoc tests were performed. $p < 0.05$ was considered statistically significant.

Results

Records of 1,050 patients were evaluated. Of these, 110 (10.48%) had uncomplicated AA, 37 (3.52%) had complicated AA, and 903 (86%) did not have AA. The demographic features

of the groups are presented in Table 1 and the comparisons of laboratory parameters of all groups are shown in Table 2. There was not a statistically significant difference regarding age and gender between groups. No significant difference was observed in the comparison of all groups and between-groups in terms of all laboratory parameters.

Discussion

Although AA is one of the most common causes of abdominal pain that requires surgical interventions in childhood, the diagnosis still remains a challenge despite clinical examination, laboratory tests and radiological studies (1-3). The need for a novel, widely-available and inexpensive laboratory marker is obvious to decrease morbidity rates due to either negative appendectomies or complications such as perforation, wound infection, bowel obstruction, abdominal abscess and sepsis. Inexpensive, readily available and convenient inflammatory markers presented in CBC have good potential for the differential diagnosis of AA with these properties. On the other hand, numerous conflicting results have been reported about various inflammatory markers and ratios determined simply by using CBC and CRP in the diagnosis of AA. This is the first study comparing all these parameters in the diagnosis of AA.

In this study investigating the diagnostic value of MPV, PDW, RDW, NLR, PLR and LCR in complicated and uncomplicated AA, we did not determine the role of these parameters in diagnosis. Although MPV, PDW and RDW levels were higher in complicated and uncomplicated appendicitis groups, the difference between groups was not statistically significant.

Furthermore, in patients with right lower quadrant pain but not having AA, LCR was higher than complicated and uncomplicated AA groups. This was not statistically significant either.

The MPV is a measurement of the average size of platelets in the blood, whereas the PDW is a measurement of platelet anisocytosis. Numerous contradictory results have been observed about the diagnostic roles of MPV and PDW in patients with right lower quadrant pain. Some studies reported that MPV increased in AA, while others found that MPV was lower (11-16). Meanwhile, Uyanik et al. (3) suggested that MPV had no diagnostic value in children with AA. Also, Yigit et al. (2) and Ceylan et al. (15) found no difference in terms of PDW between patients with and without AA. Similarly, in the present study, there were no statistically significant differences between the groups in terms of MPV and PDW.

The RDW is an automated measure of the heterogeneity of red blood cell size. Alteration of RDW level has been found in some inflammatory disorders and infections (5,6). Daldal and Dagmura (17) reported that RDW level was significantly lower in patients with AA. On the other hand, Boshnak et al. (8) and Tanrikulu et al. (13) did not find any significant diagnostic value of RDW in AA, similar to our result.

The role of NLR in AA was examined in a few studies. Daldal and Dagmura (17) found that NLR was significantly higher in patients with AA than patients without AA. Khan et al. (18) suggested NLR was a predictor of severity of AA. On the other hand, there was no statistically significant difference between the studied groups with respect to NLR in the current study.

Table 1. Summary of patients' characteristics

	Uncomplicated appendicitis (n=110)	Complicated appendicitis (n=37)	Non-appendicitis (n=903)	p
Age (mean ± SD)	12.03±4.92 years	11.73±5.06 years	11.49±5.03 years	0.555
Gender (M/F) (%)	46/64 (41.8/58.2)	15/22 (40.5/59.5)	412/491 (45.6/54.4)	0.641

F: Female, M: Male, SD: Standard deviation

Table 2. Comparison of groups regarding the parameters (mean ± SD)

Parameter	Uncomplicated appendicitis n=110	Complicated appendicitis n=37	Non-appendicitis n=903	p	p1	p2	p3
MPV (fL)	10.03±0.99	10.22±1.22	10.02±1.06	0.528	1	0.778	1
PDW (fL)	11.71±3.20	12.22±3.13	11.51±2.32	0.181	1	0.262	0.845
RDW (fL)	38.07±6.61	39.4±7.31	37.72±3.73	0.479	1	0.058	0.305
NLR	4.03±7.25	3.82±4.02	3.85±5.67	0.953	1	1	1
PLR	148.03±68.31	157.54±99.23	151.71±92.9	0.848	1	1	1
LCR	1.82±2.77	1.91±4.22	2.46±6.45	0.535	0.914	1	1

p= Comparison of all groups

p1= Comparison between acute appendicitis and non appendicitis

p2= Comparison between perforated appendicitis and non-appendicitis

p3= Comparison between acute appendicitis and perforated appendicitis

MPV: Mean platelet volume, PDW: Platelet distribution width, RDW: Red cell distribution width, NLR: Neutrophile-to-lympocyte ratio, PLR: Platelet to lymphocyte ratio, LCR: lymphocyte to C-reactive protein ratio, SD: Standard deviation

The findings of studies examining the association between the PLR and AA have been controversial. Liu et al. (9) systematically reviewed the literature and found a significant increase in PLR levels in adults with AA with age ≥ 30 years compared to those in adults with AA with age < 30 years or in children with AA. This is consistent with our result.

The ratio of lymphocyte to CRP has recently been introduced as a new parameter in differentiating AA (10). We didn't find a significant diagnostic value of LCR, similar to the result of Daldal and Dagmura (17).

Study Limitations

This was a retrospective study. The roles of these parameters in the diagnosis of AA could be understood more clearly with multi-center prospective studies with larger sample sizes.

Conclusion

The MPV, PDW, RDW, NLR, PLR and LCR are far from being significant predictors in the differential diagnosis of AA. The explanation for this might be that CBC could be affected by an inflammatory process other than AA and other disorders and characteristics such as anemia, diet, age and sex. Clinical observation and diagnostic imaging modalities should still be the most reliable diagnostic methods in AA.

Ethics

Ethics Committee Approval: The study was approved by the local ethics committee on 23.07.2020 with the decision number 160.

Informed Consent: Retrospective study.

Peer-review: Externally peer reviewed.

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