

## **The role of neutrophils/lymphocyte ratio, platelet/lymphocyte ratio and platelet distribution width values in acute appendicitis diseases.**

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### **Abstract**

**Objective:** Laboratory parameters like NLR, PLR and PDW *via* using Alvarado scoring we aimed to predict and question the valuability these in the acute appendicitis diagnosis and acute appendicitis pathological subtype.

**Materials and methods:** Between January 2013 and June 2015, 455 patients that their acute appendicitis diagnosis has been identified as a result of the pathological report and taken to operation with the suspicion of acute appendicitis and applied to Dicle University Medical Faculty. 114 patients that apply to our emergency service with other complaints excluding abdominal pain and who do not possess acute appendicitis have been registered as the control group. Regarding the NLR, PLR and PDW value both patient and control groups and patient group subtypes have been compared among each other.

**Results:** In our patient group according to the control group WBC, neutrophil, NLR and PLR average values have been considered significantly high. Lymphocyte and PDW average values in the control group according to the patient group were significantly high. When compared regarding acute appendicitis types and control group NLR and PLR average values: in the perforated appendicitis group, when compared with both the control group and the other two appendicitis types a significantly high values have been detected.

**Conclusion:** We will consider NLR, PLR and PDW values significant to diagnose acute appendicitis and to predict NLR and PLR value's acute appendicitis pathological subtype.

**Keywords:** Acute appendicitis, Neutrophil/lymphocyte ratio (NLR), Platelet/lymphocyte ratio (PLR), Platelet distribution width (PDW).

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### **Introduction**

Acute appendicitis is acute inflammation of any or all of the appendicitis and consists of 10% of patients presenting emergency service with abdominal pain [1]. Acute appendicitis is a condition in which patients are admitted to the emergency service with abdominal pain and often require a surgical intervention [2,3]. 8% of the total population is affected by this disease [4]. The development of diagnostic devices and surgical techniques in current years has reduced the mortality rates in general population in a rate of 1%. However the mortality rate in the old population based on the acute appendicitis may increase up to 50% [5,6].

In the diagnosis of acute appendicitis excluding the anamnesis and physical examination findings it is also known that laboratory values are supportive, but it is not sufficient. It is known that increased leucocyte values are expressive but they are not diagnostic [7,8]. That's why for the acute appendicitis diagnosis researchers are in pursuit of meaningful parameters [8]. During the inflammatory response, the ratio of leucocytes

in circulatory system changes. Relative lymphopenia is associated with an increase in neutrophil. Neutrophil/Lymphocyte Ratio (NLR) can be claimed as a simple reagent of the inflammatory response [9]. Platelet/Lymphocyte Ratio (PLR) is a new reagent of an inflammation and thrombotic activity that can be observed in cheap and simple hemogram examination [10]. The changes in thrombocyte functions and dimensions are related to the systematical inflammation and that's why it is thought that Platelet Distribution Width (PDW) may be valuable in prediction of some diseases [11,12].

In our study with laboratory parameters like NLR, PLR and PDW *via* using Alvarado scoring we aimed to predict and question the valuability these in the acute appendicitis diagnosis and acute appendicitis pathological subtype.

### **Materials and Methods**

Our study was approved by Dicle University Faculty of Medicine Ethics Committee for a retrospective analysis of the medical information of patients presenting to Dicle University

Faculty of Medicine Emergency Department with acute appendicitis between January 2013 and June 2015. 455 patients were diagnosed with acute appendicitis and were identified as a result of the pathological report and surgically treated with the suspicion of acute appendicitis. 114 patients that apply to our emergency service with other complaints excluding abdominal pain and who do not possess acute appendicitis have been registered as the control group. Patients younger than the age of 18, patients who are not surgically treated but examined medically, patients with diagnostic idiopathic thrombocytopenic purpura, thrombotic thrombocytopenic purpura and essential thrombocytosis, patients with the story of using medicines that lead to thrombocyte structure and functional disorder and last but not least the ones to possess lack of knowledge have been excluded out of the patient group and control group.

Age, gender, application complaint, accompanying system anomaly, accompanying diseases, symptoms and findings during the application to the emergency service (sensitivity at the abdomen-rebound-defence, nausea-vomiting, high fever, anorexia, the position of the pain and its spread), laboratory results, radiological results, post operational biopsy results of the patients to be included in the study have been recorded to the standard work sheets that their operation notes have been prepared. The patients Alvarado scores have been calculated and the patients with scores of 7 and above have been classified as high risk and the patients who have scores of less than 7 have been classified as low risk [13]. Also after the results of the patient's pathology results another classification as phlegmon, perforated and catarrhal have been executed. Regarding the NLR, PLR and PDW values both patient and control groups and patient group subtypes have been compared among each other.

### Statistical analysis

The results have been given as mean standard deviation. Univariate statistical analysis for categorical variables for chi-square test and continuous variables has been executed using student-t test.  $P < 0.05$  value has been assessed statistically significant. In group intern comparisons, since groups do not reflect normal distribution and in groups experiment numbers are not equal, as Kruskal Wallis single sided variance analysis and multiple comparison method Mann-Whitney U test has been used. In comparisons among the groups  $p < 0.01$ , and in other comparisons  $p < 0.05$  values have been considered statistically significant.

### Results

Four hundred fifty five patients to be included into the study consist of 261 male and 194 female patients, average age is  $32.38 \pm 14.67$  y and the control group consists of 54 male and 60 female, average age was  $30.32 \pm 8.75$ . Regarding the age and gender among the patient group and control group there

was no difference statistically significant (respectively  $p = 0.055$  and  $p = 0.058$ ).

When patient and control groups have been compared regarding WBC, platelet, neutrophil, lymphocyte, NLR, PLR and PDW values; in our patient group according to the control group WBC, neutrophil, NLR and PLR average values have been considered significantly high ( $p < 0.001$ ). Lymphocyte and PDW average values in the control group according to the patient group was significantly high (respectively  $p = 0.004$  and  $p < 0.001$ ). Regarding the platelet average value among the patient and control groups no statistical significance has been detected ( $p = 0.057$ ). Laboratory parameters of patient and control group have been given in Table 1.

**Table 1.** Comparison of laboratory findings of patient group and control group.

	Patient group	Control group	P Value
WBC (K/uL; Mean $\pm$ SD)	15.03 $\pm$ 4.21	7.65 $\pm$ 1.32	<0.001
Platelet (K/uL; Mean $\pm$ SD)	255.05 $\pm$ 64.23	242.81 $\pm$ 60.12	0.057
Neutrophil ( $10^3$ /uL; Mean $\pm$ SD)	12.01 $\pm$ 4.14	4.72 $\pm$ 1.20	<0.001
Lymphocyte ( $10^3$ /uL; Mean $\pm$ SD)	1.93 $\pm$ 0.86	2.12 $\pm$ 0.55	0.004
NLR (Mean $\pm$ SD)	8.06 $\pm$ 5.97	2.46 $\pm$ 1.22	<0.001
PLR (Mean $\pm$ SD)	162.6 $\pm$ 97.3	120.7 $\pm$ 36.4	<0.001
PDW (10 (GSD); Mean $\pm$ SD)	19.01 $\pm$ 1.68	16.77 $\pm$ 1.81	<0.001

When compared regarding acute appendicitis types and control group NLR average values: in phlegmon appendicitis group have been detected at significant high level when compared to the control group ( $p < 0.001$ ). In the perforated appendicitis group, when compared with both the control group and the other two appendicitis types a significantly high values have been detected ( $p < 0.001$ ). Also when compared concerning the PLR average values. In the perforated appendicitis group a significantly high values have been detected when compared to both the control group and other two appendicitis groups ( $p < 0.001$ ). In phlegmon appendicitis group a significantly high values have been detected according to the control group ( $p = 0.004$ ). When compared concerning acute appendicitis types and control group PDW average values, in control group PDW average values have been detected significantly high compared to three appendicitis types ( $p < 0.001$ ). The comparison of our patients regarding the acute appendicitis types and control group's NLR, PLR and PDW average values have been given in Table 2.

When Alvarado high risk patients and Alvarado low risk patients are compared concerning the NLR, PLR and PDW values. In our Alvarado high risk patients compared to Alvarado low risk patients, NLR and PLR average values have been detected significantly high (respectively  $p < 0.001$  and  $p = 0.003$ ). Concerning the PDW average values among the

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Alvarado high risk patients and Alvarado low risk patients, no statistically significant values have been detected (p=0.806).

**Table 2.** Comparison of acute appendicitis types regarding the NLR, PLR and PDW values.

Parameter	Groups		P value
NLR (Mean ± SD)	Control (2.46 ± 1.22)	Phlegmon (7.62 ± 5.43)	<0.001
		Perforated (11.02 ± 7.67)	<0.001
		Catarrhal (4.73 ± 2.81)	0.253
	Phlegmon (7.62 ± 5.43)	Perforated (11.02 ± 7.67)	<0.001
		Catarrhal (4.73 ± 2.81)	0.034
		Perforated (11.02 ± 7.67)	<0.001
PLR (Mean ± SD)	Control (120.70 ± 36.45)	Phlegmon (151.94 ± 84.14)	0.004
		Perforated (220.69 ± 133.13)	<0.001
		Catarrhal (126.09 ± 56.13)	1
	Phlegmon (151.94 ± 84.14)	Perforated (220.69 ± 133.13)	<0.001
		Catarrhal (126.09 ± 56.13)	0.776
		Perforated (220.69 ± 133.13)	<0.001
PDW (10 (GSD); Mean ± SD)	Control (16.77 ± 1.81)	Phlegmon (19.12 ± 1.67)	<0.001
		Perforated (18.59 ± 1.74)	<0.001
		Catarrhal (18.93 ± 1.40)	<0.001
	Phlegmon (19.12 ± 1.67)	Perforated (18.59 ± 1.74)	0.076
		Catarrhal (18.93 ± 1.40)	1
		Perforated (18.59 ± 1.74)	1

Laboratory values of Alvarado high risk patients and Alvarado low risk patients have been given in Table 3.

**Table 3.** Comparison of laboratory values of Alvarado high risk patients and Alvarado low risk patients.

	Alvarado risk n=219	high Alvarado risk n=236	low P value
NLR (Mean ± SD)	9.47 ± 5.84	6.74 ± 5.80	<0.001
PLR (Mean ± SD)	176.5 ± 96.8	149.7 ± 96.1	0.003
PDW (10 (GSD); Mean ± SD)	19.03 ± 1.64	19.00 ± 1.71	0.806

**Discussion**

Acute appendicitis is the most frequent surgical abdominal reason for the patients to apply emergency services with the complaint of abdominal pain [14]. In males when compared to female patients it is seen more frequent and the ratio of male to females has been detected as 1.4:1 [15]. In our study as well the ratio of male to female patients was 1.3:1 and it was rather close to the value within the literature frame. In our study we have detected the most frequently seen age interval as the 2<sup>nd</sup>

or the 3<sup>rd</sup> decade. This was as well consistent with the literature expressions [14,16,17].

Since the physiological response of leucocytes against stress is increase in neutrophil numbers and decrease in lymphocyte numbers, the ratio of these two subgroups to each other is used as the reagent of inflammation [18]. During the inflammatory response the ratio of the leucocytes in circulatory system changes. Relative lymphopenia accompanies the increase of neutrophils. NLR can be claimed as a simple reagent of inflammatory response [9]. In the studies executed it has been indicated that NLR can be relevant in various clinical situations and in the diagnosis of acute appendicitis it has been detected that it is a strong reagent [7,8]. In recent times NLR has been started to be examined more and for acute appendicitis, it has been emphasized that it can be a better reagent solely than CRP, leucocyte and neutrophil [7,8]. According to the studies executed by Acar et al. in patients that acute appendicitis has been detected compared to the control group, it has been reported that NLR average values are significantly high [19,20]. In our study we have detected significantly high values in acute appendicitis group compared to the control group which is consistent with the literature. Within the study that has been executed by Ishizuka et al. when acute appendicitis subtypes are compared among each other.

Within the perforated appendicitis group when compared to both phlegmon and catarrhal appendicitis groups NLR ratio has been detected more significantly high [21]. Similarly in the study that we have executed consistent with the literature in perforated appendicitis group compared to both phlegmon and the catarrhal group significantly high values have been detected. After the study that we have executed, we as well consistently with the literature presume and think that NLR value is a valuable reagent in both acute appendicitis diagnosis and in the prediction of perforated appendicitis.

Examination of the ratio of PLR is a new reagent of the inflammation and thrombotic activity that shall be observed in cheap and simple hemogram examination [10]. PLR value has been indicated related to bad prognosis in some peripheral coronary diseases, coronary arterial diseases, in some gynaecologic malignancy and hepatobiliary malignancies [22]. PLR value in recent times has been started to be investigated as a new inflammation reagent in acute appendicitis as well. In the study of Acar et al. the PLR value has been detected in the acute appendicitis group more significantly high when compared to the control group [19]. The author and friends have detected the PLR value significantly high in their study at acute appendicitis detected pregnant patients compared to control group [23]. In our study we have detected in the perforated appendicitis subtype, the PLR value significantly high and we have detected no difference in phlegmon and catarrhal appendicitis subtypes compared to the control group. We think that concerning the importance of PLR value in prognosis of acute appendicitis more research is required to be done and especially in the prognosis of the perforated appendicitis it can be a valuable reagent.

Variations in thrombocyte scale indicate the changes in thrombocyte functions. The changes in the thrombocyte functions and dimensions are related to systemic inflammation and that's why it has been thought that PDW shall be valuable in prognosis of some diseases [11,12]. In recent years studies have been executed with the possibility that PDW value shall be used as a reagent in prognosis of acute appendicitis. In studies that Aydogan et al. executed PDW value has been detected significantly high in acute appendicitis [24,25]. Also Fan et al. in the study that they have executed have detected the PDW value in acute gangrenous appendicitis significantly high compared to the control group [26]. Our study was consistent with the literature and we have detected PDW value was significantly high and we presume and think that it can be used as a reagent in the prognosis of acute appendicitis.

Alvarado scoring system that has been developed by Alvarado in 1986 in acute appendicitis prognosis is a scoring system that has been applied in decisive processes of acute appendicitis surgery based on symptom, clinical findings and laboratory results. When used alone without imaging methods in detecting the acute appendicitis, it has been identified that it leads to successful prognosis results in rate of 70% in the executed studies [27]. We have found statistically significant WBC and neutrophil values consistent with the scoring in Alvarado high risk patients. Again as a result of our study, since we have

found PLR value and the decrease in lymphocyte numbers statistically more significant in Alvarado high risk patients, we think about the fact that lymphocyte value can be added to Alvarado scoring system as a parameter and may increase the specificity of the scoring system.

## Conclusion

After the study, we will evaluate NLR, PLR and PDW values significant to diagnose acute appendicitis and to predict NLR and PLR value's acute appendicitis pathological subtype.

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The authors declared that this study has received no financial support.

## Author's Contribution

Each of the authors contributed to the research, data analyses and writing. All authors read and approved the final manuscript.

## Conflicts of Interest

The authors declare that they have no competing interests.

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