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Evaluation of descriptive performances of platelet indices, neutrophil/lymphocyte ratio, and platelet/lymphocyte ratio in aortic dissections

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SUMMARY

OBJECTIVE: Mechanical damage resulting from aortic dissection creates a thrombus in the false lumen, in which platelets are involved. Platelet index is useful for the function and activation of platelets. The aim of this study was to show the clinical relevance of the platelet index of aortic dissection.

METHODS: A total of 88 patients diagnosed with aortic dissection were included in this retrospective study. Demographic data and hemogram and biochemistry results of the patients were determined. Patients were divided into two groups: deceased and surviving patients. The data obtained were compared with 30-day mortality. The primary outcome was the relationship of platelet index with mortality.

RESULTS: A total of 88 patients, 22 of whom were female (25.0%), diagnosed with aortic dissection, were included in the study. It was determined that 27 (30.7%) of the patients were mortal. The mean age of the entire patient group was 58±13 years. According to the DeBakey classification of aortic dissection of the patients, the percentages of the 1-2-3 type were determined as 61.4, 8.0, and 30.7%, respectively. Platelet index was not found to be directly related to mortality. Increase in age, decrease in bicarbonate value, and presence of diabetes mellitus were associated with mortality.

CONCLUSION: Although there were no significant changes in platelet index in aortic dissection, neutrophil/lymphocyte ratio and platelet/lymphocyte ratio were found to be high in line with the literature. In particular, the presence of advanced age diabetes mellitus and decrease in bicarbonate are associated with mortality.

KEYWORDS: Aortic dissection. Lymphocytes. Neutrophils. Platelet activation.

INTRODUCTION

Aortic dissection (AD) is a highly mortal clinical condition that is most commonly seen in the seventh decade[1,2]. According to the DeBakey classification, 75% of them are types 1 and 2[3]. Partial thrombosis in the false lumen is an independent predictor of mortality in patients[3]. Platelets are also blood components that play an active role in the thrombosis process, and it has been observed that platelets are activated in dissection patients[4,5]. The association of PLT decrease and D-dimer elevation with in-hospital mortality in AD has been reported[5-7]. Tests evaluating platelet function and activation are both difficult and expensive. Values such as mean platelet volume (MPV), platelet distribution width (PDW), platelet-large cell ratio, and platelet crit also provide information about platelet functions and are useful markers that can be accessed quickly and easily[5,8].

Budak et al. stated that C-reactive protein, known as an inflammatory marker, is parallel and related to dissection[9]. In addition, leukocytes (WBC) in the blood are above normal values in AD and correlate with mortality, and the neutrophil/lymphocyte ratio (NLR) has been reported to be significantly higher in AD[10]. In the active disease phase of ulcerative colitis, in the impaired glucose metabolism of diabetic patients, and in autoimmune inflammatory diseases such as Hashimoto's thyroiditis and euthyroid chronic autoimmune thyroiditis, the NLR value is high and correlated with the severity of the disease[11-14]. The platelet/lymphocyte ratio (PLR) is an inflammatory index associated with poor outcomes and integrates risk estimation of PLTs and lymphocytes, reflecting the activation of both hemostatic and inflammatory pathways[15,16]. The PLR value is higher in patients with hepatitis B-associated liver fibrosis and type 2 diabetes compared to healthy individuals[17,18]. PLR and NLR values are increased in SARS-CoV-2-positive patients, patients with irritable bowel syndrome, and patients with malignant thyroid nodules compared to those with benign thyroid nodules[19-22].

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In line with the current information, the aim of this study was to evaluate the relationship between PI, NLR, and PLR values, which are available in the routine complete blood count, with mortality and morbidity in AD.

METHODS

This observational study was initiated after approval by the ethics committee of Ankara City Hospital No. 2 (E2-22-1693-13.04.2022). The study was carried out with the patients diagnosed for AD who were admitted to the emergency department between May 2019 and December 2021.

A form was prepared to collect the data from the patients. Data such as age, gender, comorbidities (diabetes mellitus [DM], hypertension [HT], and coronary artery disease [CAD]), and smoking history of the patients were recorded. Patients were divided into two groups: deceased and survivors.

Hemogram, biochemistry, and blood gas values were determined from intravenous blood samples taken from the patients. Hemogram results were studied on the Advia 2120 (Simens/Germany) device. Blood analyses were performed with Siemens atellica solution device (Simens/Germany). The blood gas parameters of the patients were analyzed using RAPIDLAB 1200 Series (Simens/Germany). Coagulation parameters were analyzed using the Sysmex cs-5100 (Simens/Germany) instrument. AD diagnoses of the patients were made with a contrast-enhanced thoracoabdominal computed angiography 64-slide spiral GE/Revolution CT (General Electric/USA) tomography device in the aortic phase. DeBakey criteria were used for AD classification.

The data of the patients were compared with their 30-day mortality. All parameters were compared in two groups: mortal (group 1) and nonmortal (group 2). Hospital automation system (HiCamp) and examination forms were used for the data acquisition.

The primary outcome of the study was the association of PI values with mortality. Another outcome was the association of NLR and PLR values with mortality.

Statistical analysis

Analysis was carried out with IBM SPSS Statistics 20.0 for Windows. The Shapiro-Wilk test was used for normality analysis. The non-normally distributed data were expressed with median and 25–75% quartiles, and normally distributed data were expressed as mean and standard deviation. The comparisons between the two groups were made using the independent samples t-test and the Mann-Whitney U test. Ratio comparisons in categorical data were performed using chi-square tests. Logistic regression analysis was used to determine mortality predictors. The $p<0.200$ level was used for the parameters to be included in the multiple logistic regression analysis. In the final step, age, DM, and HCO3 parameters were included in the analysis with the backward elimination method. A ROC analysis was then performed for age and HCO3. A p-value of <0.05 was accepted as statistically significant.

RESULTS

Out of 113 patients, 25 were excluded from the study due to a lack of data. A total of 88 patients diagnosed with AD, of whom 22 (25.0%) were female, were included. It was determined that 27 (30.7%) of the patients were mortal. Demographic characteristics, laboratory parameters, and the AD classification of the patients were compared between the two groups formed according to the 30-day mortality data (Table 1). Age, diabetes, creatinine, INR, HCO3, and the DeBakey class were found to be associated with mortality in terms of the $p<0.05$ level. No difference was observed in other parameters in the mortal group (Table 1).

In univariate analysis, parameters with p-values <0.200 were determined as age, gender, presence of diabetes, GFR, potassium, AST, ALT, amylase, lipase, pH, HCO3, troponin, fibrinogen, and DeBakey type. Troponin and fibrinogen parameters were not included in the continuation of the analysis, as there were intolerably missing data. In summary, it was determined that parameters of age, presence of diabetes, and HCO3 were found to be independent predictors for mortality (Table 2).

In ROC analysis, the area under the curve was found to be 0.726 (0.572–0.841; p=0.001) for age and 0.707 (0.621–0.830; p=0.003) for HCO3. For individuals aged 52 years, sensitivity and specificity were 92.59 and 44.26%, respectively. For individuals aged 57 years, sensitivity and specificity were 81.48 and 54.10%, respectively. At the level of 21.4 in the HCO3 parameter, sensitivity and specificity were detected as 64.00 and 79.31%, respectively. ROC curves for "age" and "HCO3" are shown in Figure 1.

DISCUSSION

It has been reported that predictors such as advanced age, female gender, smoking, renal dysfunction, and hypotension are associated with increased mortality and morbidity in terms of poor clinical outcomes in AD patients[3]. In this study, we concluded that advanced age, low HCO3,

Table 1. All parameters in two groups.

Parameters	Groups (30-day mortality)				p-value
	Survival		Mortal		
	Mean±SD or Median (25–75%)	n (%)	Mean±SD or Median (25–75%)	n (%)	
Age (years)	55±12		65±10		<0.001*
Gender					
Male		49 (74.2)		17 (25.8)	0.083†
Female		12 (54.5)		10 (45.5)	
DM		5 (35.7)		9 (64.3)	0.009‡
HT		44 (69.8)		19 (30.2)	0.866†
CAD		24 (64.9)		13 (35.1)	0.440†
Smoker		24 (70.6)		10 (29.4)	0.838†
WBC	12.47 (9.43–14.85)		11.65 (8.96–15.92)		0.762§
Hb	13.4 (12.1–15.1)		14.3 (11.9–15.5)		0.450§
Hct	40.8±6.1		41.8±6.5		0.478*
Neu	8.75 (6.92–10.82)		8.92 (5.55–13.41)		0.978§
Lymphocyte	1.7 (1.19–2.53)		1.82 (0.98–2.38)		0.697§
PLT	234 (188–304)		252 (153–317)		0.717§
NLR	4.83 (3.24–8.05)		6.03 (2.15–10.46)		0.776§
PLR	136.9 (91.4–205.1)		143.4 (75.4–182.1)		0.741§
MPV	8.1 (7.4–8.9)		8.1 (7.5–8.5)		0.807§
Urea	35 (30–45)		41 (34–57)		0.185§
Creatinine	0.92 (0.8–1.12)		1.11 (0.9–1.43)		0.016§
GFR	90 (67–99)		64 (40–80)		<0.001§
Na	139.4±3.4		139±2.9		0.603*
K	3.9 (3.7–4.5)		4.2 (3.8–4.9)		0.128§
Cl	106 (102–108)		106 (104–109)		0.438§
AST	26 (19–40)		28 (19–58)		0.180§
ALT	27 (17–35)		22 (17–48)		0.835§
LDH	292 (233–345)		308 (245–427)		0.375§
Amylase	56 (46–69)		65 (47–80)		0.172§
Lipase	31 (25–39)		32.5 (27–45)		0.278§
pH	7.401 (7.36–7.458)		7.37 (7.334–7.42)		0.090§
HCO3	24.12±3.86		20.46±5.28		0.001*
Lactate	2.36 (1.4–3.79)		2.76 (1.86–4.68)		0.274§
Blood group					
A		26 (68.4)		12 (31.6)	0.834‡
B		9 (69.2)		4 (30.8)	
0		17 (65.4)		9 (34.6)	
AB		9 (81.8)		2 (18.2)	
Rh					
+		54 (69.2)		24 (30.8)	1.000‡
–		6 (66.7)		3 (33.3)	
INR	1.1 (1.1–1.2)		1.2 (1.1–1.4)		0.039§
aPTT	26.4 (23.9–30.2)		28.5 (24.5–31.4)		0.338§
D-dimer	5.56 (2.11–23.54)		11.03 (7.26–23.06)		0.296§
Troponin	18.03 (6–37)		10 (5–115)		0.772§
Fibrinogen	3.75±1.75		2.68±1.72		0.063*
CRP	0.037 (0.010–0.114)		0.020 (0.006–0.069)		0.450§
DeBakey					
1		36 (66.7)		18 (33.3)	0.012‡
2		2 (28.6)		5 (71.4)	
3		23 (85.2)		4 (14.8)	

*Independent samples t-test; mean±standard deviation. †Pearson chi-square test; n (%). ‡Fisher's exact test; n (%). §Mann-Whitney U test; median (25–75% quartiles).

and the presence of diabetes are independent predictors of mortality.

It has been previously reported that platelets are activated as a result of thrombosis occurring in the false lumen in dissections[5,6]. MPV and PDW are also platelet activation markers[23]. In our study, we could not detect a statistically significant relationship on mortality in AD. However, it was drawing an upward graph in both values close to the reference upper limits. The reason for this is that platelet agglutination is caused by waiting for blood in hemogram tubes with EDTA. Since this is a retrospective study and the study period of blood may be long, our PI may have been affected. This may have caused the PIs to be monitored within normal reference ranges. In addition, we may not have seen dramatic increases in PDW and MPV values because AD is an acute and rapidly developing clinical condition and there is no enough time for new platelet production.

In AD patients, CRP increases with inflammation and correlates with Ischemia markers. In addition, WBC values in AD patients are higher than normal, and this has been reported to be associated with increased mortality[24]. Our CRP and WBC values were similarly high, but were relatively lower in the mortal group, although not statistically significant.

In a study by Bedel et al., including 96 patients with type A AD, NLR and PLR values were significantly increased in patients with type A AAD, and the best NLR threshold value to predict in-hospital mortality was 9.74 with 70.6% sensitivity and 76.8% specificity. They reported that the PLR threshold value was 195.8 with a sensitivity of 76.5% and a specificity of 78.1%[25]. As it is known, WBC subtypes and NLR are frequently compared and evaluated in many clinical situations. It has been previously reported that the NLR value is significantly higher in AD patients. In our study, the rate of NLR increased in mortality and surviving groups, but this difference was not statistically significant and was incompatible with the literature[26].

Sbarouni et al., like Bedel et al., have reported that the PLR rate is significantly higher in ADs. It has a significantly specific and low sensitivity in estimating AD and can be used in the exclusion of AD[11]. The fact that PLR is both inexpensive and easily available makes it more useful. In our study, PLR values did not show a statistically significant relationship between the mortal and nonmortal groups. It was also found in other studies that the PLR value increased with adverse events associated with negative outcomes in the hospital[11,23]. In our study, it was observed that the PLR values were increasing, but we concluded that there was no statistically significant difference between the mortal and the nonmortal groups.

The most important limitations are that it is a retrospective study, and the conditions under which the blood was taken

Table 2. Multiple logistic regression analysis for 30-day mortality.

		B	Sig.	Exp(B)
Step 10[a]	Age	0.099	0.006	1.104 (1.029–1.184)
	DM (if yes)	2.118	0.010	8.316 (1.646–42.016)
	HCO3	-0.260	0.001	0.771 (0.659–0.902)
	Constant	-0.327	0.898	0.721

[a]Variable(s) entered on step 1: Age, gender, DM, GFR, K, AST, ALT, amylase, lipase, pH, HCO3, DeBakey.

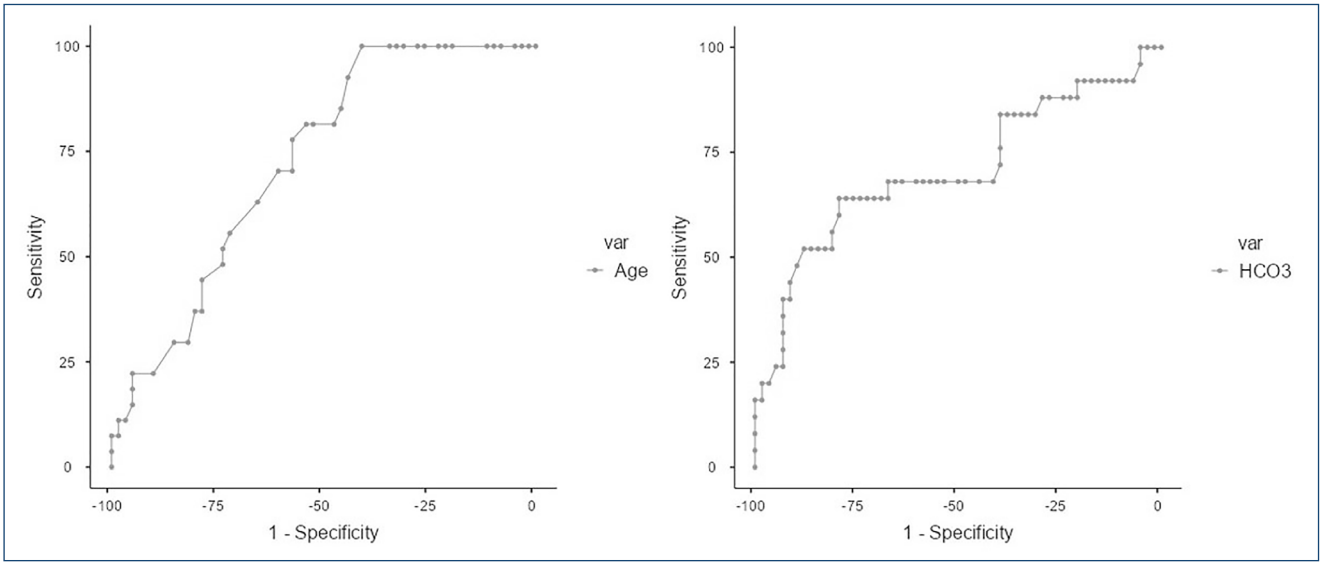

Figure 1. ROC curves for age and HCO3.

from the patients and the laboratory admission and procedure times are not standard.

CONCLUSION

No statistically significant changes were observed in PI, NLR, and PLR values in the mortal group of AD patients, which is not compatible with the literature. However, age, presence of diabetes, and HCO3 were determined as independent mortality predictors for AD. More robust results can be obtained with prospective studies with a larger sample.

AUTHORS' CONTRIBUTIONS

SD: Conceptualization, Data curation, Formal Analysis, Writing – original draft. **ABE:** Formal Analysis. **AŞ:** Formal Analysis. **GKÇ:** Formal Analysis. **SÖ:** Formal Analysis. **ST:** Formal Analysis.

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