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The C-Reactive Protein/Albumin Ratio and Complete Blood Count Parameters as Indicators of Disease Activity in Patients with Takayasu Arteritis

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ACDEF 1 Nurten Seringec Akkececi
BDE 2 Gozde Yildirim Cetin
BDE 2 Hasan Gogebakan
BDE 3 Can Acipayam

1 Department of Physiology, Faculty of Medicine, Kahramanmaras Sutcu Imam University, Kahramanmaras, Turkey
2 Department of Internal Medicine, Division of Rheumatology, Faculty of Medicine, Kahramanmaras Sutcu Imam University, Kahramanmaras, Turkey
3 Department of Pediatrics, Division of Pediatric Hematology and Oncology, Faculty of Medicine, Kahramanmaras Sutcu Imam University, Kahramanmaras, Turkey

Corresponding Author: Nurten Seringec Akkececi, e-mail: seringec@hotmail.com
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Background: This study aimed to evaluate the ratio of C-reactive protein (CRP) to albumin, inflammatory markers, and parameters from the complete blood count (CBC) in patients with Takayasu arteritis and the association with disease activity.

Material/Methods: A retrospective study included thirty-two patients with Takayasu arteritis and 32 healthy controls. Clinical and demographic characteristics of patients with Takayasu arteritis were recorded at baseline, before medication and on remission. Similar data were obtained for the controls at recruitment. Remission was defined as more than six months of stable disease without new vascular lesions in patients who previously had active disease. Kerr's criteria were used to define active Takayasu arteritis.

Results: In patients with Takayasu arteritis, the erythrocyte sedimentation rate (ESR), CRP, CRP/albumin ratio, red cell distribution width (RDW), neutrophil-lymphocyte ratio (NLR), platelet-lymphocyte ratio (PLR), and monocyte-lymphocyte ratio (MLR) were significantly higher, and albumin and MPV were significantly lower compared with controls. The ESR, CRP, CRP/albumin ratio, NLR, PLR, and MLR were decreased in remission, whereas MPV was increased. CRP and the CRP/albumin ratio were positively correlated and albumin and MPV were negatively correlated with disease activity. The CRP/albumin ratio had the highest correlation with disease activity in Takayasu arteritis. The CRP/albumin ratio, RDW, NLR, PLR, and MLR were positively correlated with CRP and ESR.

Conclusions: The CRP/albumin ratio, RDW, NLR, PLR, MLR, and MPV were markers of remission of active disease, and the CRP/albumin ratio, total albumin, and MPV were markers of disease activity in Takayasu arteritis.

MeSH Keywords: C-Reactive Protein • Erythrocyte Indices • Mean Platelet Volume • Takayasu Arteritis

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Background

Takayasu arteritis is a rare progressive inflammatory disease that involves large arteries and the aorta [1]. Takayasu arteritis mainly affects young women and has an annual incidence of 1.1 per million, with a female to male ratio of 8.2/1 in Turkey [2,3]. Monitoring of disease activity is of great importance because Takayasu arteritis is a clinically progressive disease that can cause end-organ ischemia. Despite the frequent use of erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) in assessing disease activity, these assays are neither sensitive nor specific [4].

Recently, new markers which are obtained from complete blood count have been reported that are associated with the inflammatory process and disease activity in many diseases. It has been shown that the monocyte/lymphocyte ratio (MLR), the platelet/lymphocyte ratio (PLR), and the neutrophil/lymphocyte ratio (NLR) are associated with many autoimmune and rheumatic diseases [5], and the PLR and NLR can be used for assessing inflammatory response and monitoring disease activity in patients with systemic lupus erythematosus (SLE) [6] and also in assessing disease activity in patients with rheumatoid arthritis (RA) [7]. Also, the MLR can be used to evaluate disease severity in axial spondyloarthritis [8]. Sahin et al. [9] reported that the mean platelet volume (MPV) was negatively correlated with ESR and CRP in some rheumatic diseases and negatively correlated with disease activity in ankylosing spondylitis and rheumatoid arthritis. A recent study showed that the red blood cell distribution width (RDW) was increased in patients with primary Sjögren's syndrome and was positively correlated with disease activity [10]. There have been few previous studies on blood count (CBC) parameters in patients with Takayasu arteritis.

C-reactive protein (CRP) and albumin are commonly used parameters for the measurement of the activity of inflammatory conditions and are known as positive and negative acute phase reactants (APRs). The CRP/albumin ratio is determined by dividing the CRP by the albumin measurement and is an established scoring system used to determine the degree and activity of inflammatory disease, which is considered to be a more useful indicator of the status of inflammation than CRP or albumin alone [11]. It has been recently shown that the CRP/albumin ratio can be used for monitoring disease activity in patients with RA [12], and as a biomarker of the degree of activity of inflammation in Crohn's disease activity [13]. However, there have been no previous studies that have reported the association between the CRP/albumin ratio with disease activity in patients with Takayasu arteritis.

Therefore, this study aimed to evaluate the CRP/albumin ratio, inflammatory markers, and parameters from the complete blood count (CBC) in patients with Takayasu arteritis and the association with disease activity.

Material and Methods

Ethical approval

This study was approved by the Clinical Research Ethics Committee of Kahramanmaras Sütcü Imam University (No. 2017/20-05), Kahramanmaras, Turkey. Written informed consent was obtained from all participants and the study was performed in accordance with the Declaration of Helsinki.

Patients studied and the diagnosis of Takayasu arteritis

From April 2008 to October 2017, 40 had newly diagnosed Takayasu arteritis according to the 1990 American College of Rheumatology (ACR) criteria in our rheumatology clinic at Kahramanmaras Sütcü Imam University, Turkey. Disease activity was defined by Kerr's criteria [14]. Kerr's criteria were used to define active disease when at least two of the following criteria are positive: systemic symptoms with no other cause; an elevated ESR; signs of the effects of vascular inflammation resulting in ischemia, including claudication, diminished or absent pulses, a bruit, vascular tenderness or pain, and asymmetric peripheral blood pressure; or typical angiographic features, including any imaging method in addition to conventional angiography [14].

In this retrospective study, 32 patients with Takayasu arteritis who had active disease at baseline before medication, and achieved remission after treatment were included. Thirty-two age-matched and sex-matched healthy participants who underwent routine physical examination in our hospital were enrolled as controls. Patients who had other autoimmune diseases, liver or kidney disease, hematologic disease, diabetes, cancer, acute or chronic infections were excluded from the study.

Treatment of patients with Takayasu arteritis

At the baseline visit, there were 35 patients with active disease and five patients with inactive disease. After diagnosis, all patients were treated with corticosteroids. Patients with active Takayasu arteritis received prednisone at a median starting dose of 60 mg/day (range, 20–100 mg/day) and then the prednisone dose was reduced to <5 mg/day in patients with stabilized disease. Disease-modifying antirheumatic drugs (DMARDs) were used and four patients received leflunomide (20 mg/day) and 18 patients received methotrexate (15–25 mg/week). During follow-up, the treatment of 13 patients who did not achieve remission with corticosteroids and DMARDs was replaced by biological drugs, and seven patients were treated

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with the anti-interleukin (IL)-6 antibody, tocilizumab, and treatment with monoclonal antibodies to tumor necrosis factor (TNF)-alpha blocker included one patient who was treated with adalimumab and five patients who were treated with infliximab. There were 32 patients who achieved remission after treatment. Remission was defined as more than six months of stabilized disease without new vascular lesions in patients while undergoing a treatment regimen that included less than 5 mg/day of prednisone, who previously had active disease.

Clinical, demographic, and laboratory data

Clinical, laboratory and demographic characteristics of patients with Takayasu arteritis were recorded at baseline, before medication, and when the patients achieved remission. The findings from imaging studies of patients with Takayasu arteritis at diagnosis and during follow-up were obtained from the medical records. For patients with Takayasu arteritis and controls, the CRP/albumin ratio was calculated and the neutrophil/lymphocyte ratio (NLR), the platelet/lymphocyte ratio (PLR), the monocyte/lymphocyte ratio (MLR), the eosinophil/lymphocyte ratio (ELR), and the basophil/lymphocyte ratio (BLR) were calculated.

Statistical analysis

Statistical analysis was performed with SPSS version 15.0 software (IBM, Chicago, IL, USA). The normality of variable distribution was determined by the Kolmogorov–Smirnov test. If variables were normally distributed, Student's t-test or the Mann-Whitney U test were used to compare parameters between the patients with Takayasu disease and the control group. If variables were normally distributed, the Paired t-test was used, otherwise, the Wilcoxon test was used. The chi-squared (χ^2) test was used to compare gender between the groups. Correlations between the variables were determined by Spearman's correlation coefficient. The area under the curve (AUC), sensitivity, specificity, and cut-off values were compared using the receiver operating characteristic (ROC) curve. $P < 0.05$ was considered as statistically significant. Categorical variables were shown as percentages and continuous variables were presented as mean ± standard deviation (SD).

Results

The clinical, laboratory, and demographic characteristics of the groups are shown in Table 1. There were no significant differences in age and gender between patients with Takayasu arteritis and healthy controls. In patients with active Takayasu arteritis, the erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), white blood cell (WBC) count, neutrophil count, platelet count, red cell distribution width (RDW), the CRP/albumin ratio, the neutrophil/lymphocyte ratio (NLR), the platelet/lymphocyte ratio (PLR), and the monocyte/lymphocyte ratio (MLR) levels were significantly higher, whereas the albumin and the mean platelet volume (MPV) were significantly lower when compared with the healthy controls (Table 1).

Imaging findings at diagnosis in the 32 patients with Takayasu arteritis are shown in Table 2. Imaging studies included computed tomographic angiography (CTA) in 29 patients (90.6%), ultrasonography in 25 patients (78.1%), conventional angiography in 10 patients (31.3%), and magnetic resonance angiography (MRA) in four patients (12.5%).

When the patients achieved remission, the ESR, CRP, NLR, PLR, MLR, and the CRP/albumin ratio were significantly decreased, whereas the lymphocyte count, eosinophil count, and MPV were significantly increased (Table 3). The suppression of CRP levels was found in the seven patients who were treated with tocilizumab. Comparison between CRP levels and the CRP/albumin ratio in patients with active and remission phases are shown in Table 3.

The correlation between laboratory parameters with disease activity, using Kerr's score, and the CRP and ESR in patients with active Takayasu arteritis are shown in Table 3. The CRP levels, the CRP/albumin ratio, WBC, and neutrophil count were significantly positively correlated with disease activity, while albumin and MPV were negatively correlated with disease activity. The CRP/albumin ratio was most significantly correlated with disease activity in Takayasu arteritis (Table 4). As shown in Table 4, the CRP/albumin ratio, WBC, the neutrophil count, the RDW, the platelet count, the NLR, PLR, and MLR were significantly correlated with the CRP and ESR, while albumin and MPV were negatively correlated with CRP and ESR.

The predictive values of ESR, CRP, CRP/albumin ratio, albumin, RDW, MPV, NLR, PLR and MLR for differentiating Takayasu arteritis from healthy controls were investigated by the receiver operating characteristic (ROC) curve analysis. The results of this analysis are shown in Table 5. The area under the curve (AUC) for the CRP/albumin ratio was 0.999 (sensitivity 96.9%; specificity 96.9%), at a cut-off value of 1.14. The AUC for the NLR was 0.869 (sensitivity 84.4%; specificity 68.7%), at a cut-off value of 1.99. The cut-off value for albumin was <4.15 with an AUC of 0.815 (sensitivity 84.4%; specificity 71.9%). The cut-off value for the MPV was <9.25 with AUC of 0.800 (sensitivity 93.8%; specificity 68.7%). For the RDW, the AUC was 0.701 (sensitivity 78.3%; specificity 64.5%), at a cut-off value of 14.35. For the MLR, the AUC was 0.677, at a cut-off value of 0.24, with sensitivity and specificity of 65.6% and 65.6%, respectively. The cut-off value for the PLR was >132.1 with an AUC of 0.652 (sensitivity 71.9%; specificity 65.6%).

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Table 1. Demographic characteristics and laboratory parameters of patients with Takayasu arteritis and healthy controls.

Parameters	TA patients (n=32)	Controls (n=32)	p-value
Age	39.28±14.91	38.19±13.71	NS
Gender: F/M (%)	81.3%/18.8%	84.4%/15.6%	NS
Kerr's score	2.56±0.67	–	–
ESR (mm/h)	49.00±27.61	10.75±6.14	<0.001
CRP (mg/dl)	47.32±45.34	3.16±0.42	<0.001
Albumin (g/L)	3.90±0.46	4.34±0.23	<0.001
CRP/albumin ratio	13.20±13.68	0.73±0.13	<0.001
WBC (10^9/L)	9.88±2.57	7.34±1.48	<0.001
Neutrophil (10^9/L)	6.79±2.09	4.13±1.05	<0.001
Lymphocyte (10^9/L)	2.23±0.80	2.40±0.55	NS
Monocyte (10^9/L)	0.60±0.22	0.53±0.16	NS
Eosinophil (10^9/L)	0.13±0.05	0.14±0.08	NS
Basophil (10^9/L)	0.06±0.07	0.04±0.02	NS
RBC (10^9/L)	4.48±0.49	4.90±0.41	<0.001
Hemoglobin	11.60±2.37	13.42±1.35	<0.001
Hematocrit (%)	36.15±4.93	39.69±2.90	0.001
MCV	80.77±9.95	81.14±6.39	NS
RDW (%)	16.06±2.61	14.79±3.62	0.012
Platelet (10^9/L)	344.3±147.7	285.9±61.41	0.045
MPV (fL)	8.93±1.49	10.40±0.86	<0.001
PDW (fL)	12.03±2.12	12.44±2.05	NS
NLR	3.31±1.38	1.76±0.44	<0.001
PLR	167.5±88.3	123.2±30.8	0.036
MLR	0.30±0.13	0.23±0.06	0.009
ELR	0.06±0.04	0.06±0.03	NS
BLR	0.03±0.04	0.02±0.01	NS

TA patients – patients with Takayasu arteritis; ESR – erythrocyte sedimentation rate; CRP – C-reactive protein; WBC – white blood cell; RBC – red blood cell; MCV – mean corpuscular volume; RDW – red cell distribution width; MPV – mean platelet volume; PDW – platelet distribution width; NRL – neutrophil/lymphocyte ratio; PLR – platelet/lymphocyte ratio; MLR – monocyte/lymphocyte ratio; LMR – lymphocyte/monocyte ratio; MER – monocyte/eosinophil ratio; ELR – eosinophil/lymphocyte ratio; BLR – basophil/lymphocyte ratio; NS – not significant. Data are presented as the mean ± standard deviation.

Discussion

In this study, serological and complete blood count (CBC) parameters, including the C-reactive protein/albumin ratio, were compared between patients with Takayasu arteritis and normal controls. In patients with Takayasu arteritis, the levels of these parameters were correlated with disease activity. The findings showed that in patients with Takayasu arteritis, the C-reactive protein (CRP) to albumin ratio, the neutrophil/lymphocyte ratio (NLR), the platelet/lymphocyte ratio (PLR), the monocyte/lymphocyte ratio (MLR), and the red cell distribution width (RDW) were significantly higher, and the mean platelet volume (MPV) and albumin were significantly lower when compared with healthy controls. Among these parameters, the

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Table 2. Distribution and pattern of arterial lesions at presentation in 32 patients with Takayasu arteritis.

Site of vascular involvement	No. of patients with imaging	No (%) of any lesion**	No (%) of patients with arterial stenosis	No (%) of patients* with arterial occlusion	No (%) of patients with arterial aneurysm
Ascending aorta	32	1 (3)	1 (3)	0	0
Aortic arch	32	2 (6)	1 (3)	0	1 (3)
Descending aorta	32	2 (6)	2 (6)	0	0
Suprarenal aorta	32	1 (3)	1 (3)	0	0
Infrarenal aorta	32	0	0	0	0
Right carotid artery	32	9 (28)	7 (22)	2 (6)	0
Left carotid artery	32	13 (40)	9 (28)	4 (13)	0
Right vertebral artery	32	6 (19)	5 (15)	1 (3)	0
Left vertebral artery	32	7 (22)	6 (19)	1 (3)	0
Innominate artery	32	1 (3)	1 (3)	0	0
Right subclavian artery	32	3 (9)	3 (9)	0	0
Left subclavian artery	32	18 (56)	15 (47)	3 (9)	0
Right axillary artery	15	2 (13)	2 (13)	0	0
Left axillary artery	15	9 (60)	7 (47)	2 (13)	0
Celiac artery	20	3 (15)	3 (15)	0	0
Superior mesenteric artery	20	2 (10)	2 (10)	0	0
Inferior mesenteric artery	20	0	0	0	0
Right renal artery	30	1 (3)	1 (3)	0	0
Left renal artery	30	3 (10)	3 (10)	0	0
Right iliac artery	10	0	0	0	0
Left iliac artery	10	0	0	0	0
Right femoral artery	10	1 (10)	1 (10)	0	0
Left femoral artery	10	2 (20)	2 (20)	0	0
Coronary artery	6	2 (33)	2 (33)	0	0
Pulmonary artery	3	1 (33)	1 (33)	0	0

* Percentages calculated as number with abnormality divided by total number following imaging of the vessel; ** stenosis, occlusion, or aneurysm.

CRP/albumin ratio, albumin, and the MPV were associated with disease activity. Also, the CRP/albumin ratio, RDW, NLR, PLR, and MLR were positively correlated with CRP and ESR levels, whereas albumin levels and the MPV were negatively correlated with CRP and ESR levels. To our knowledge, the present study is the first to investigate the CRP/albumin ratio and the MLR in Takayasu arteritis.

Takayasu arteritis is a chronic, progressive, inflammatory disease, and monitoring of disease activity is of great importance. However, currently, there are no reliable laboratory biomarkers to monitor disease activity. Recent studies have shown that levels of the interleukins, IL-6, IL-8, and IL-18, and levels of serum amyloid A (SAA) were significantly increased in patients with Takayasu arteritis and could be used to monitor disease activity [15,16]. Misra et al. [17] recently showed that serum IL-17 and IL-23 levels were also increased in patients with Takayasu arteritis. However, the measurement of these biomarkers is too costly to use in routine clinical practice.

Analysis of components of the CBC is a simple and inexpensive method and includes important parameters of inflammation in many diseases and can be used to assess disease activity [6, 9, 10]. The association between CBC parameters and disease activity in Takayasu arteritis has not previously been studied. However, it has previously been shown that in patients with Takayasu arteritis, the RDW, the NLR, and the PLR were increased, the MPV was decreased, and also the RDW,

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Table 3. Clinical and laboratory parameters of patients with active Takayasu arteritis and patients in remission.

Parameters	Active TA (n=32)	Remission (n=32)	p-value
Kerr's score	2.56±0.67	1.00±1.00	<0.001
ESR (mm/h)	49.00±27.61	16.12±14.59	<0.001
CRP (mg/dl)	40.32±37.58	5.30±4.64	<0.001
Albumin	3.90±0.46	4.05±0.22	NS
CRP/albumin ratio	11.26±11.43	1.34±1.21	<0.001
WBC (10^9/L)	9.88±2.57	8.77±2.57	NS
Neutrophil (10^9/L)	6.79±2.09	5.12±1.73	0.001
Lymphocyte (10^9/L)	2.23±0.80	2.77±1.04	0.010
Monocyte (10^9/L)	0.60±0.22	0.67±0.28	NS
Eosinophil (10^9/L)	0.13±0.05	0.18±0.10	0.001
Basophil (10^9/L)	0.06±0.07	0.09±0.18	NS
RBC (10^9/L)	4.48±0.49	4.72±0.50	<0.001
Hemoglobin	11.60±2.37	12.45±1.83	0.026
Hematocrit	36.15±4.93	37.96±4.00	0.006
MCV	80.77±9.95	80.71±8.33	NS
RDW (%)	16.06±2.61	16.27±2.96	NS
Platelet (10^9/L)	344.3±147.7	303.9±98.1	NS
MPV (fL)	8.93±1.49	10.23±0.96	<0.001
PDW (fL)	12.03±2.12	11.98±2.15	NS
NLR	3.31±1.38	2.02±0.78	<0.001
PLR	167.5±88.3	120.6±47.8	0.009
MLR	0.30±0.13	0.24±0.08	0.028
ELR	0.06±0.04	0.07±0.04	NS
BLR	0.03±0.04	0.04±0.10	NS

TA patients – patients with Takayasu arteritis; ESR – erythrocyte sedimentation rate; CRP – C-reactive protein; WBC – white blood cell; RBC – red blood cell; MCV – mean corpuscular volume; RDW – red cell distribution width; MPV – mean platelet volume; PDW – platelet distribution width; NRL – neutrophil/lymphocyte ratio; PLR – platelet/lymphocyte ratio; MLR – monocyte/lymphocyte ratio; LMR – lymphocyte/monocyte ratio; MER – monocyte/eosinophil ratio; ELR – eosinophil/lymphocyte ratio; BLR – basophil/lymphocyte ratio; NS – not significant. Data are presented as the mean ± standard deviation.

NLR, and PLR were shown to be positively correlated with CRP and ESR, and the MPV was negatively correlated with CRP and ESR [18–20]. Also, the NLR, PLR, RDW, and MPV have been reported to be associated with disease activity in these studies [18–20]. These previous findings support the results of the present study, but this study also showed that the MPV values were correlated with disease activity.

The interleukins, IL-6 and IL-17, which are increased in patients with Takayasu arteritis, have an active role in inflammatory diseases [21,22]. IL-23 regulates IL-17 production and also has a role in the regulation of neutrophil homeostasis [22,23]. IL-17, which released from T helper (Th) 17 lymphocytes, triggers neutrophil activation, accumulation, chemotaxis, and migration and also induces IL-6 [22]. IL-6 inhibits erythrocyte maturation, leading to an increase in RDW [24]. A positive correlation between IL-6 and RDW has previously been reported [25]. Senchenkova et al. [26] showed that IL-6 was associated with thrombocytosis. Neutrophils and platelets are actively involved in the inflammatory response [27,28]. The NLR was determined

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Table 4. Baseline correlation between laboratory parameters with disease activity (Kerr's score), C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) in patients with Takayasu arteritis.

Parameter	Kerr's r-value	Score p-value	CRP r-value	p-value	ESR r-value	p-value
ESR	0.264	NS	0.844	<0.001	–	–
CRP	0.623	<0.001	–	–	0.844	<0.001
CRP/Alb	0.624	<0.001	0.970	<0.001	0.826	<0.001
Albumin	–0.421	0.016	–0.680	<0.001	–0.549	<0.001
WBC	0.469	0.007	0.606	0.007	0.522	<0.001
Neutrophil	0.414	0.018	0.673	<0.001	0.582	<0.001
RBC	–0.330	NS	–0.484	<0.001	–0.497	<0.001
Hemoglobin	–0.337	NS	–0.461	<0.001	–0.460	<0.001
Hemotocrit	–0.384	0.030	–0.423	<0.001	–0.463	<0.001
RDW (%)	0.069	NS	0.337	0.013	0.251	0.048
Platelet	0.340	NS	0.331	0.007	0.305	0.014
MPV	–0.397	0.025	–0.608	<0.001	–0.517	<0.001
NLR	0.170	NS	0.615	<0.001	0.591	<0.001
PLR	0.232	NS	0.299	0.016	0.326	0.009
MLR	0.295	NS	0.304	0.015	0.257	0.041

TA patients – patients with Takayasu arteritis; ESR – erythrocyte sedimentation rate; CRP – C-reactive protein; WBC – white blood cell; RBC – red blood cell; MCV – mean corpuscular volume; RDW – red cell distribution width; MPV – mean platelet volume; PDW – platelet distribution width; NRL – neutrophil/lymphocyte ratio; PLR – platelet/lymphocyte ratio; MLR – monocyte/lymphocyte ratio; LMR – lymphocyte/monocyte ratio; MER – monocyte/eosinophil ratio; ELR – eosinophil/lymphocyte ratio; BLR – basophil/lymphocyte ratio; NS – not significant.

Table 5. The results of the receiver operating characteristic (ROC) curve analysis of the parameters used in the diagnosis of Takayasu arteritis.

	AUC	SE	95% CI	Cut-off	Sensitivity (%)	Specificity (%)	p-value
ESR	0.960	0.021	0.920–1.001	16.0	93.8	75.0	<0.001
CRP	0.998	0.003	0.993–1.003	4.60	96.9	96.9	<0.001
CRP/Alb	0.999	0.002	0.996–1.002	1.14	96.9	96.9	<0.001
Albumin	0.815	0.054	0.711–0.920	4.15	84.4	71.9	<0.001
RDW	0.701	0.073	0.559–0.843	14.35	78.3	64.5	0.012
MPV	0.800	0.058	0.686–0.915	9.25	93.8	68.7	<0.001
NLR	0.869	0.047	0.776–0.962	1.99	84.4	68.7	<0.001
PLR	0.652	0.070	0.514–0.790	132.1	71.9	65.6	0.036
MLR	0.677	0.068	0.543–0.811	0.24	65.6	65.6	0.015

ROC – receiver-operating characteristic; CI – confidence interval; AUC – area under the curve; SE – standard error; CRP/Alb – C-reactive protein/albumin ratio; ESR ,– erythrocyte sedimentation rate; CRP – C-reactive protein; RDW – red cell distribution width; MPV – mean platelet volume; NRL – neutrophil/lymphocyte ratio; PLR – platelet/lymphocyte ratio; MLR – monocyte/lymphocyte ratio.

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by dividing the absolute neutrophil count by the absolute lymphocyte count, and the PLR was determined by dividing the absolute platelet count by the absolute lymphocyte count. The NLR and PLR increase if the number of neutrophils and platelets increases, even if the lymphocyte count does not change. In the present study, an increased NLR, PLR, RDW, neutrophil and platelet count in patients with Takayasu arteritis might be explained by the increased level of IL-17, IL-23, and IL-6 in Takayasu arteritis.

Currently, the MLR, basophil/lymphocyte ratio (BLR), and eosinophil/lymphocyte ratio (ELR) have been shown to novel markers of inflammation in many systemic autoimmune rheumatic diseases (SARDs). The MLR and ELR have previously been shown to increase, and the BLR decreased in nearly all SARDs, and the MLR has been shown to be positively correlated with ESR and CRP in almost all SARDs [5]. However, there have been no previous studies on the roles of the MLR, BLR, and ELR in patients with Takayasu arteritis. In the present study, the findings showed that the MLR was significantly higher in patients with Takayasu arteritis and the MLR decreased when the patients achieved remission. Also, the MLR was positively correlated with the CRP and ESR. There were no statistically significant differences between the study groups in terms of the BLR and ELR. To our knowledge, the present study is the first to investigate all these complete blood count parameters in Takayasu arteritis.

Acute phase reactants (APRs) can be used to measure inflammatory status. CRP and albumin are commonly used parameters and are known as positive and negative APRs, respectively. The novel inflammation-based score, the CRP/albumin ratio is believed to be a more useful indicator of the inflammatory status than CRP or albumin alone [11]. The CRP/albumin ratio has previously been shown to be a useful biomarker of the activity of Crohn's disease [13]. The findings of the present study showed that CRP and the CRP/albumin ratio were increased and the albumin levels were decreased in patients with Takayasu arteritis. Also, the CRP/albumin ratio showed an increased correlation with disease activity in Takayasu arteritis than CRP, ESR, and albumin alone (Table 4). The receiver operating characteristic (ROC) curve analysis showed that the optimal cut-off value of the CRP/albumin ratio for Takayasu arteritis was 1.14 and the area under the curve (AUC) for the CRP/albumin ratio was 0.999 (sensitivity 96.9%; specificity of 96.9%), which was higher than the AUC for CRP, albumin, ESR, NLR, MPV, RDW, MLR, and PLR. The present study confirmed the potential for the measurement of the CRP/albumin ratio in Takayasu arteritis and its correlation with disease activity.

Conclusions

The findings from this study showed that in patients with Takayasu arteritis, the C-reactive protein (CRP) to albumin ratio, the red cell distribution width (RDW), the neutrophil/lymphocyte ratio (NLR), the platelet/lymphocyte ratio (PLR), the monocyte/lymphocyte ratio (MLR), and the mean platelet volume (MPV) could be potential parameters for indicating inflammation in patients with Takayasu arteritis and may help to determine remission of active disease. The CRP/albumin ratio, albumin, and MPV may be useful markers for evaluating disease activity of Takayasu arteritis.

Conflict of interest

None.

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