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ARTYKUŁ ORYGINALNY / *ORIGINAL ARTICLE*

The role of the neutrophil/lymphocyte ratio in patients with rheumatic mitral stenosis as an indicator of spontaneous echocardiographic contrast

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Abstract

Background: Although it has declined in developed countries, mitral valve stenosis is problematic in developing countries; its main cause is rheumatic fever. In patients with rheumatic mitral stenosis (RMS), ongoing chronic inflammation may result in the progression of valvular damage and the formation of spontaneous echocardiographic contrast (SEC).

Aim: We investigated the role of the neutrophil/lymphocyte ratio (NLR) as an indicator of ongoing inflammation and independent predictive risk factor for SEC in RMS patients.

Methods: A total of 112 patients (mean age 46 ± 10.6; 73.2% female) with RMS who underwent both transthoracic echocardiography and transoesophageal echocardiography were enrolled; the control group comprised 100 healthy volunteers (mean age 44 ± 9.1; 62% female). Patients were divided into two subgroups according to the formation of SEC in the left atrium and appendage. Haematological and biochemical indices were measured in all patients and controls.

Result: NLR was higher in the patients than controls (2.6 ± 1.15 vs. 1.71 ± 0.53, $p < 0.001$). In addition, it was higher in the SEC-positive group (mean age 47 ± 10.3; 68.4% female) compared to the SEC-negative group (mean age 44 ± 10.7; 78.2% female; 3.21 ± 1.25 vs. 1.97 ± 0.55, $p < 0.001$). In multivariate analysis, NLR (odds ratio [OR] 20.602, 95% confidence interval [CI] 4.678–90.731; $p < 0.001$) and left atrial diameter (OR 5.966, 95% CI 2.166–16.429; $p = 0.01$) were found to be independent predictors of SEC in RMS patients.

Conclusions: RMS patients exhibit on-going inflammation; NLR is a good marker of this. The formation of SEC is associated with inflammation and NLR is an independent predictive risk factor for SEC.

Key words: neutrophil/lymphocyte ratio, spontaneous echocardiographic contrast, rheumatic mitral stenosis, inflammation

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INTRODUCTION

Despite a decline in developed countries, mitral valve stenosis (MS) continues to be a problem in developing countries. Its main cause is rheumatic fever — a systemic autoimmune disorder stemming from a prior group A streptococcal infection [1]. It is generally believed that in the early phase of rheumatic valvular heart disease, group A streptococcal infection results in an autoimmune reaction in the patients, and as a result, valvular damage occurs [2]. In addition, previous studies have demonstrated that in the chronic phase of the disease, chronic inflammation is ongoing, and this may be responsible for the progression of valvular damage [3, 4].

One of the significant causes of mortality and morbidity in patients with MS is thrombus and spontaneous echocardiographic contrast (SEC) formation within the left atrium (LA), and subsequent embolisation into the systemic circulation. Whether or not atrial fibrillation (AF) is present, it has been reported that patients with MS have a hypercoagulable

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condition [5]. Some previous studies have also reported that in addition to AF and blood stasis in the LA, the pathophysiology of LA thrombus and SEC occurring in patients with MS exhibits some other mechanisms, such as inflammation and abnormal platelet size and activation [6–10].

The significance of the neutrophil/lymphocyte ratio (NLR) as a marker of inflammation in cardiovascular disease (CVD) has been revealed by recent studies [11, 12]. In addition, in CVDs such as ST-segment elevation, myocardial infarction, and acute decompensated heart disease, there is a positive correlation between long-term mortality and NLR [13, 14].

In this study, we aimed to determine the role of NLR as an indicator of ongoing inflammation which may cause the progression of rheumatic mitral stenosis (RMS). We also aimed to investigate the role of NLR as an independent risk factor for SEC in patients with RMS.

METHODS

Patient selection

In this study, a total of 112 (mean age 46 ± 11; 73% female) consecutive patients with RMS were enrolled. The control group consisted of 100 age- and sex-matched healthy volunteers (mean age 44 ± 9; 62% female). Informed consent was obtained from all patients. This study complies with the Declaration of Helsinki and the trial protocol was approved by the local ethics committee.

Patients with chronic RMS (mitral valve area [MVA] planimetric < 2 cm^2), who underwent both transthoracic and transoesophageal echocardiography (TEE) for diagnosis or to investigate the presence of SEC and thrombus in the LA and appendage, were enrolled in the study. The exclusion criteria for this study were a finding of thrombus within LA or appendage, heart failure, renal failure, acute rheumatic fever, acute infection, inflammatory disease, malignancy and a history of anti-inflammatory drug use. After the initial evaluation, the patients with RMS were divided into two subgroups in terms of the presence of SEC in the LA and appendage. The SEC-positive group (mean age 47 ± 10.3; 68.4% female) included patients with SEC within the LA, while the SEC-negative group (mean age 44 ± 10.7; 78.2%) represented those without SEC. Past medical history was taken from all patients. All patients' electrocardiograms were evaluated for AF.

Blood samples

Blood samples were drawn from the antecubital vein for determination of biochemical and haemostatic parameters after overnight fasting. EDTA tubes were used for automatic blood count. The blood counts were measured by laser procedure (Mindray BC 5800, China). The high-sensitivity C-reactive protein (hs-CRP) level was immunologically determined using the immunoturbidimetric method (Abbott Aeroset 1600 autoanalyser, Abbott Reagents, Germany).The baseline NLR was measured by dividing the neutrophil count by the lymphocyte count.

Echocardiographic assessment

Transthoracic two-dimensional and Doppler echocardiographic assessments were performed using a Vivid S6 with a 3.5 MHz phased array transducer (GE Medical System, Horten, Norway). Two-dimensional and pulsed wave Doppler echocardiographic studies were performed in the left lateral decubitus position with the conventional views (parasternal long- and short-axis, apical four-chamber views). LA diameter, left ventricular (LV) end-diastolic diameter and LV end-systolic diameter were measured by M-mode echocardiography. The LV ejection fraction was assessed from apical two- and four-chamber views, using the modified Simpson method. The MVA was measured using the planimetric method. The tricuspid regurgitation's maximum velocity was measured, and the pressure gradient was calculated. To estimate systolic pulmonary artery pressure, assumed right atrial pressure (10 mm Hg) was added to the gradient. M-mode measurements and conventional Doppler echocardiographic examinations were performed based on the criteria given in the American and European Societies of Echocardiography guidelines [15].

TEE was performed using a commercially available echocardiography machine (VIVID 6, GE Medical) with the use of a multiplane TEE probe and a 5 MHz phased array transducer. After administering topical anaesthesia using lidocaine, the TEE probe was advanced and echocardiographic images were obtained. The images were then evaluated for the presence or absence of SEC in the LA and appendix. LA SEC was diagnosed according to the presence of dynamic smoke-like echoes within the atrial cavity, with a characteristic swirling motion distinct from white noise artefacts [16]. Gain settings were adjusted as required to distinguish SEC from echoes due to excessive gain. All images were recorded while zooming the LA appendage and optimising gain settings and post processing to minimise grey noise artefacts. Artefact images were considered to be present when location and echogenicity suggestive of reverberations were obtained at different TEE rotational angles. The presence or absence of SEC was evaluated independently by two observers, and any discrepancy was resolved by consensus.

Statistical analysis

The variables were investigated using visual and analytical methods to determine whether they were normally distributed. The continuous data was determined as the mean ± standard deviation and categorical variables were expressed as absolute numbers or percentages and compared using the χ^2 test. The continuous variables between two groups were compared using the student's t test or Mann-Whitney U test. The degree of association between two groups in term of the continuous variable was investigated by applying Spearman's correlation. In patients with MS, the effects of different variables from SEC were calculated using univariate analysis of

Table 1. Baseline characteristics of patients and controls

Variable	Controls (n = 100)	Patients (n = 112)	P
Age [years]	44 ± 9	46 ± 11	0.217
Female	62 (62%)	82 (73.2%)	0.081
Hypertension	19 (19.6%)	33 (29.5%)	0.077
Diabetes mellitus	9 (9%)	18 (16.1%)	0.123
Coronary artery disease	7 (7%)	11 (9.8%)	0.462
Triglyceride [mg/dL]	142 ± 76	127 ± 58	0.240
Low-density lipoprotein cholesterol [mg/dL]	119 ± 32	121 ± 38	0.832
Total cholesterol [mg/dL]	182 ± 39	191 ± 48	0.644
Haemoglobin [g/dL]	12.8 ± 1.3	12.7 ± 1.4	0.853
Platelets [10^3/mm^3]	269 ± 63	259 ± 77	0.193
White blood cell [× 10^9/L]	7.2 ± 1.7	8.1 ± 1.1	0.001
Neutrophils [× 10^9/L]	4.1 ± 1.1	5.1 ± 1.3	< 0.001
Lymphocytes [× 10^9/L]	2.5 ± 0.7	2.1 ± 0.6	< 0.001
Neutrophil/lymphocyte ratio	1.7 ± 0.5	2.6 ± 1.2	< 0.001
High-sensitive C-reactive protein [mg/L]	1.1 ± 0.5	1.7 ± 0.7	< 0.001

each variable. The variables for which the unadjusted p value was < 0.10 on logistic regression analysis were identified as potential risk markers and included in the full model, and the confidence interval (CI) was 95%. The receiver operating characteristics curve was used to demonstrate the sensitivity and specificity of the NLR and optimal cut-off value for predicting SEC in patients with MS. A p value < 0.05 was considered to be statistically significant. All statistical analyses were carried out using statistical software (SPSS, version 17.0 for Windows; Chicago, IL, USA).

RESULTS

There were no significant differences between patients and controls in terms of age, gender, diabetes mellitus, coronary artery disease, hypertension or lipid profile. The baseline characteristics of the two groups are shown in Table 1. In patients with RMS, the levels of hs-CRP were significantly higher than controls (1.69 ± 0.70 vs. 1.06 ± 0.51, p < 0.001). Patients had significantly increased mean values of white blood cell (WBC) counts compared to controls (8.08 ± 1.1 vs. 7.2 ± 1.7, p = 0.001). NLR was also significantly greater in patients than controls (2.6 ± 1.15 vs. 1.71 ± 0.53, p < 0.001). A significant correlation was shown between the LA diameter and NLR (r = 0.362, p < 0.001) and between AF and NLR (r = 0.441, p = 0.001). In addition, it was also determined that there was a significant correlation between NLR and hs-CRP (r = 0.345, p < 0.001).

When the patients with chronic RMS were divided into two subgroups according to the presence of SEC within the LA, there was no significant difference between the subgroups in terms of gender, diabetes mellitus, coronary artery disease, hypertension or lipid profile. The patients in the SEC-positive group were older on average, but this difference was not statistically significant (47 ± 10.3 vs. 44 ± 10.7, p = 0.062; Table 2). The levels of hs-CRP were significantly higher in the SEC-positive group than in the SEC-negative group (1.89 ± 0.71 vs. 1.48 ± 0.63, p = 0.003). When the AF rates were compared between the two subgroups, 32 (56.1%) patients had AF in the SEC-positive group and 21 (38.2%) patients had AF in the SEC-negative group (p = 0.057). Acetylsalicylic acid and warfarin use was also higher in the SEC-positive than in the SEC-negative group (p < 0.001).

In terms of echocardiographic parameters, there were no differences between the two subgroups according to the LV ejection fraction (p = 0.180). The systolic pulmonary artery pressure was slightly higher in the SEC-positive group, but this difference were not statistically significant (48 ± 16 vs. 42 ± 12, p = 0.095). The mean gradient measured to the mitral valve was considerably higher in the SEC-positive than in the SEC-negative group (12 ± 4.4 vs. 10.4 ± 4.2, p = 0.027). The LA diameter was also significantly greater in the SEC-positive group than in the SEC-negative one (5.5 ± 0.68 vs. 4.4 ± 0.46, p < 0.001), and similarly, the planimetric MVA was smaller in the SEC-positive group (1.18 ± 0.35 vs. 1.33 ± 0.36, p = 0.013).

An increased WBC count was found in the SEC-positive group compared to the SEC-negative group (8.4 ± 1.7 vs. 7.6 ± 1.6, p = 0.01). Similarly, NLR was statistically significantly higher in the SEC-positive group (3.21 ± 1.25 vs. 1.97 ± 0.55, p < 0.001; Table 3). The receiver operating characteristic curve of NLR is presented in Figure 1. NLR > 2.2 had a 79% sensitivity and 80% specificity in predicting SEC in patients with chronic RMS . The positive and negative predictive values in detecting SEC formation within the LA in the patients with RMS were 77.6% and 77.8%, respectively.

Table 2. Comparison of baseline characteristics among patients with or without spontaneous echocardiographic contrast (SEC)

Variable	SEC		P
	Negative (n = 55)	Positive (n = 57)	
Age [years]	44 ± 11	47 ± 10	0.062
Female	43 (78.2%)	39 (68.4%)	0.244
Hypertension	14 (25.5%)	19 (33.3%)	0.361
Diabetes mellitus	8 (14.5%)	10 (17.5%)	0.666
Coronary artery disease	7 (12.7%)	4 (7%)	0.310
Triglyceride [mg/dL]	123 ± 67	131 ± 50	0.074
Total cholesterol [mg/dL]	187 ± 50	196 ± 46	0.099
Low-density lipoprotein cholesterol [mg/dL]	119 ± 45	123 ± 29	0.106
History of drug use:			< 0.001
Aspirin	9 (16.4%)	10 (17.5%)	
Warfarin	10 (18.2%)	33 (57.9%)	
Atrial fibrillation (%)	21 (38.2%)	32 (56.1%)	0.057
Left ventricular ejection fraction [%]	61 ± 4	60 ± 4	0.180
Pulmonary artery pressure [mm Hg]	42 ± 12	48 ± 16	0.095
Mitral valve area [cm^2]	1.3 ± 0.4	1.2 ± 0.4	0.013
Left atrial diameter [cm]	4.4 ± 0.5	5.5 ± 0.7	< 0.001
Mean gradient [mm Hg]	10 ± 4	12 ± 4	0.027
High-sensitive C-reactive protein [mg/L]	1.5 ± 0.6	1.9 ± 0.7	0.003

Table 3. Comparison of laboratory parameters among patients with or without spontaneous echocardiographic contrast (SEC)

Variable	SEC negative	SEC positive	P
Haemoglobin [g/dL]	12.7 ± 1.4	12.8 ± 1.5	0.907
Platelets [10^3/mm^3]	240 ± 69	278 ± 81	0.012
White blood cell [× 10^9/L]	7.6 ± 1.6	8.4 ± 1.7	0.01
Neutrophils [× 10^9/L]	4.5 ± 1.0	5.7 ± 1.4	< 0.001
Lymphocytes [× 10^9/L]	2.3 ± 0.6	1.9 ± 0.6	< 0.001
Neutrophil/lymphocyte ratio	1.9 ± 0.5	3.2 ± 1.2	< 0.001

Variables which were found to be statistically significant in univariate analyses were entered into multivariate stepwise logistic regression analysis (Table 4). In multivariate analysis, NLR (odds ratio [OR] 20.602, 95% CI 4.678–90.731; $p < 0.001$) and LA diameter (OR 5.966, 95% CI 2.166–16.429; $p = 0.01$) were found to be independent predictors of the presence of SEC in patients with RMS (Table 5).

DISCUSSION

Chronic RMS is a late effect of rheumatic fever which results in continuing damage to the heart valves. According to one current hypothesis, the valvular damage in acute rheumatic fever is a consequence of an autoimmune process stemming from an antigenic similarity between the human heart valves and group A streptococci [1, 17]. However, in terms of the chronic phase of the disease, some investigators have reported that patients have ongoing chronic subclinical inflammation, and this may be responsible for the progression of the disease. Yetkin et al. [18] showed that plasma-soluble adhesion molecules (ICAM, VCAM-1 and E-selectin) were higher in patients with RMS than in healthy control subjects. Furthermore, according to Alyan et al.'s [19] and Golbasi et al.'s [3] studies, patients with RMS have higher hs-CRP levels compared to controls. As signs of systemic inflammation and oxidative stress, hs-CRP and advanced oxidation protein products (AOPPs) have been found to be increased in patients with RMS by Chiu-Braga et al. [4]. In this study, the levels of hs-CRP were also found to be greater in patients with RMS than in healthy control subjects.

Nowadays, it is known that WBC count and NLR are indicators of inflammation in CVD. Secondary to a situation that causes stress, corticosteroid levels increase and, as a consequence, lymphopenia occurs [20]. In the inflammatory state,

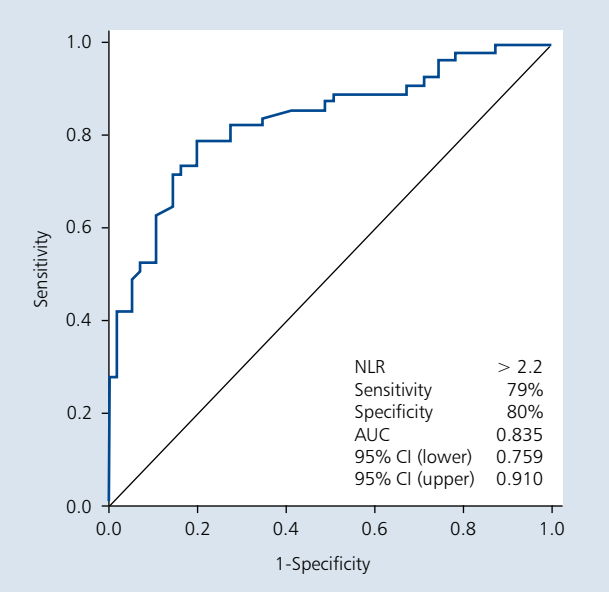

Figure 1. Receiver operating characteristic curve of neutrophil/lymphocyte ratio (NLR) for predicting spontaneous echocardiographic contrast in patients with chronic rheumatic mitral stenosis; CI — confidence interval; AUC — area under curve

lymphopenia arises due to increased lymphocyte apoptosis [21]. Moreover, recent studies have reported that, in patients with acute decompensated heart failure and ST-segment elevation myocardial infarction NLR has been associated with long term mortality [13, 14]. It has also been demonstrated that there is a positive correlation between hs-CRP and NLR [22]. In the present study, this positive correlation was also demonstrated. In this study, the role of NLR as a sign of inflammatory status in patients with RMS was also investigated. As a result, NLR was found to be higher in patients with RMS than in healthy subjects.

Alyan et al. [18] showed that there is an inverse correlation between hs-CRP and MVA. On the other hand, Chiu-Braga et al. [4] observed no correlation between the levels of AOPP and hs-CRP with the degree of MS. Likewise, in this study, no correlation was found between NLR and MVA or mean gradient. However, it was determined that there is a significant correlation between NLR and increased LA diameter or the presence of AF. It was also shown that there is a significant relation between AF, inflammation and structural remodelling. Hence, all these data have demonstrated that in patients with MS, chronic subclinical inflammation was ongoing, and rather than MVA and mean gradient, this inflammation may relate to AF and structural remodelling of the LA.

In patients with RMS, a significant cause of mortality and morbidity is thrombus formation within the LA and embolisation into the systemic circulation. Left atrial SEC, or 'smoke', is a frequent finding characterised by dynamic smoke-like echoes with a swirling motion within the LA cavity or appendage. SEC is frequently seen in patients with MS, atrial arrhythmias or mitral valve prosthesis [23]. Previous studies have shown that there is a relationship between SEC and LA thrombus [24, 25]. Although intra-atrial stasis and a low velocity of blood are the major factors in the formation of SEC, there are other explanations for the mechanism of its formation. It has been demonstrated that there are relations between SEC and fibrinogen and haematocrit and blood viscosity, as well as that LA SEC is a sign of the hypercoagulable state [24, 25].

Table 4. Effects of variables on spontaneous echocardiographic contrast on univariate logistic regression analyses

Variable	Unadjusted odds ratio	95% confidence interval	P
Female	1.654	0.707–3.867	0.246
Age	1.035	0.998–1.073	0.065
Hypertension	1.464	0.645–3.323	0.362
Diabetes mellitus	1.250	0.454–3.445	0.666
Coronary artery disease	0.518	0.974–1.878	0.317
Atrial fibrillation	2.072	0.974–4.408	0.058
Mean gradient	1.096	1.01–1.999	0.046
Mitral valve area	0.312	1.102– 0.954	0.041
Pulmonary artery pressure	1.030	1.01–1.060	0.040
Left ventricular ejection fraction	0.949	0.872–1.033	0.229
Left atrial diameter	17.248	6.421–46.33	< 0.001
White blood cell	1.335	1.066–1.722	0.013
Platelets	1.007	1.002–1.012	0.012
Neutrophil/lymphocyte ratio	6.119	2.894–12.940	< 0.001
High-sensitive C-reactive protein	2.497	1.364–4.572	0.003

Table 5. Effects of variables on spontaneous echocardiographic contrast on multivariate logistic regression analyses

Variable	Adjusted odds ratio	95% confidence interval	P
Age	1.028	0.951–1.111	0.493
Atrial fibrillation	1.437	0.299–6.911	0.651
Mean gradient	0.919	0.741–1.140	0.440
Mitral valve area	0.422	0.022–8.004	0.566
Pulmonary artery pressure	1.017	0.957–1.081	0.586
Left atrial diameter	24.254	4.287–137.224	< 0.001
White blood cell	1.034	0.621–1.723	0.897
Platelet	1.002	0.992–1.012	0.687
Neutrophil/lymphocyte ratio	4.705	2.638–13.511	0.004
High-sensitive C-reactive protein	2.145	0.674–6.824	0.196

In addition, Apek et al. [6] showed that platelet indices such as mean platelet volume and plateletcrit have an important role in the pathophysiology of SEC; they also showed that high mean platelet volume and plateletcrit levels are independent risk factors of SEC. Furthermore, some studies have demonstrated that inflammation plays an important role in the formation of SEC and thromboemboli; for instance, Licata et al. [26] reported in their study that higher immune-inflammatory activation exists in patients with cardioembolic strokes than those with other types of ischaemic strokes. Additionally, the abnormal inflammatory state may lead to the prothrombotic state and this can result in thromboembolism in patients with AF [27]. Recently, Kaya et al. [22] demonstrated that independently of AF, NLR and hs-CRP are associated with LA SEC. They also found that NLR, hs-CRP, MVA and LA diameter are independent risk factors of SEC. Moreover, Karthikeyan et al. [28] showed that independent of the severity of MS, there was a relationship between elevated hs-CRP levels and LA thrombus. In accordance with this, in the present study, the hs-CRP levels and NLR were found to be higher in the SEC-positive group than in the SEC-negative group. Furthermore, it was found that independently of AF, NLR and LA diameter are independently associated with SEC in patients with chronic RMS. It was also found in this study that the MVA is smaller and the mean gradient is higher in patients with SEC, but these are not independent risk factors of SEC. However, hs-CRP and the MVA were found to be independent risk factors in the study conducted by Kaya et al. [22]. This may have been related to the patient populations in the studies. While the patient population in our study consisted of patients with mild, moderate and severe RMS, the previous study included only patients with severe MS who were undergoing mitral balloon valvuloplasty.

SEC correlates with the degree of emptying of LA appendage, paroxysmal AF and fibrinogen level. The limitations of this study were that LA flow velocities and fibrinogen levels of patients were not studied, and we did not have records of 24-h Holter monitoring of patients, so patients with paroxysmal AF might have been overlooked.

CONCLUSIONS

This study showed that in patients with RMS, chronic subclinical inflammation persists and NLR is a good marker of this inflammation. In addition, the data showed that the inflammatory process is associated with the formation of SEC in patients with RMS, and that NLR is an independent predictive risk factor for SEC. According to this study, NLR is an inexpensively and easily found inflammatory marker which is related to SEC in this disease.

Conflict of interest: *none declared*

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Znaczenie stosunku liczby neutrofili do limfocytów u chorych z reumatyczną stenozą mitralną jako wskaźnika ryzyka powstania spontanicznego kontrastu w echokardiografii

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Streszczenie

Wstęp: Mimo że stenoza zastawki mitralnej coraz rzadziej występuje w krajach rozwiniętych, wada ta nadal stanowi problem. Jej główną przyczyną jest gorączka reumatyczna U pacjentów z reumatyczną stenozą mitralną (RMS) przewlekły proces zapalny może spowodować progresję uszkodzenia zastawki i pojawienie się spontanicznego kontrastu w echokardiografii (SEC).

Cel: Celem pracy była ocena znaczenia stosunku liczby neutrofili do limfocytów (NLR) jako wskaźnika toczącego się procesu zapalnego i niezależnego czynnika ryzyka powstania SEC u chorych z RMS.

Metody: Do badania włączono 112 pacjentów (średnia wieku 46 ± 10,6 roku; 73,2% kobiet) z RMS, u których wykonano zarówno przezklatkowe, jak i przezprzełykowe badanie echokardiograficzne; grupa kontrolna obejmowała 100 zdrowych ochotników (średnia wieku 44 ± 9,1 roku; 62% kobiet). Chorych podzielono na dwie podgrupy w zależności od obecności SEC w lewym przedsionku i w jego uszku. U wszystkich pacjentów i u osób z grupy kontrolnej zmierzono parametry hematologiczne i biochemiczne.

Wyniki: Współczynnik NLR był wyższy w grupie chorych niż w grupie kontrolnej (2,6 ± 1,15 *vs*. 1,71 ± 0,53; $p < 0,001$). Współczynnik ten był wyższy w SEC-dodatniej grupie (średnia wieku 47 ± 10,3; 68,4% kobiet) niż w grupie SEC-ujemnej (średnia wieku 44 ± 10,7; 78,2% kobiet; 3,21 ± 1,25 *vs*. 1,97 ± 0,55; $p < 0,001$). W analizie wieloczynnikowej współczynnik NLR (iloraz szans [OR] 20,602; 95% przedział ufności [CI] 4,678–90,731; $p < 0,001$) i średnica lewego przedsionka (OR 5,966; 95% CI 2,166–16,429; $p = 0,01$) były niezależnymi czynnikami predykcyjnymi powstania SEC u chorych z RMS.

Wnioski: Współczynnik NLR jest dobrym markerem stanu zapalnego toczącego się u chorych z RMS. Powstawanie SEC wiąże się z procesem zapalnym, a NLR jest niezależnym czynnikiem ryzyka SEC.

Słowa kluczowe: współczynnik neutrofile/limfocyty, spontaniczny kontrast w echokardiografii, reumatyczna stenoza mitralna, zapalenie

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