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CLINICAL STUDY

Measurement of epicardial fatty tissue thickness has a diagnostic value in lichen planus patients and is associated with fibrinogen to albumin ratio and neutrophil to lymphocyte ratio

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ABSTRACT
OBJECTIVE: Lichen planus (LP) is one of the chronic inflammatory diseases. Epicardial fatty tissue (EFT) is the adipose tissue in which pro-inflammatory and pro-atherogenic hormones and cytokines are secreted. We planned to investigate the predictive value of EFT in LP patients by evaluating together with Fibrinogen to albumin ratio (FAR) other inflammation markers.
MATERIALS AND METHODS: A total of 53 consecutive LP patients and 57 healthy controls were enrolled in this single-center, prospective, case-control study. Demographic data were recorded; blood tests were obtained from both groups. Then, EFT thickness was measured by echocardiography.
RESULTS: Fibrinogen, FAR, neutrophil to lymphocyte ratio (NLR), platelet to lymphocyte ratio, and EFT thickness were higher in LP patients ($p < 0.05$, for all). EFT was positively correlated with FAR ($r = 0.306$, $p = 0.001$), NLR ($r = 0.240$, $p = 0.011$), and PLR ($r = 0.297$, $p = 0.002$). ROC analysis indicated that FAR could predict LP with a sensitivity of 83 % and a specificity of 44 %; NLR could predict LP with a sensitivity of 80 % and a specificity of 46 %; EFT could predict LP with a sensitivity of 79 % and a specificity of 54 %. In the binary logistic regression analysis NLR, FAR, and EFT were found to be independent predictors of LP.
CONCLUSION: We found a relationship between LP and FAR together with other inflammation parameters NLR, and PLR. We demonstrated for the first time that FAR, NLR and EFT were independent predictors of LP. Also, there was a significant relationship between these parameters and EFT *(Tab. 4, Fig. 1, Ref. 30)*.
Text in PDF *www.elis.sk*
KEY WORDS: lichen planus, epicardial fatty tissue, fibrinogen, albumin, neutrophil, lymphocyte.

Introduction

Cutaneous lichen planus (LP) is a comparatively infrequent dermatosis that affects < 1 % of the population. It is a heterogeneous papulosquamous explosion that consists of pruritic, polygonal, and planar papules or plaques. Infectious and immune dysregulation, genetic and, environmental factors may play a role in its pathophysiology (1, 2). Whereby it is a chronic disease with an inflammatory process, and it is associated with lipid disorders and cardiovascular diseases (3, 4). As inflammation is the major contributor to atherosclerosis, the measurement of inflammatory markers may have an important role in the risk assessment and management of LP patients.

Epicardial fatty tissue (EFT) is localized between the myocardium and the visceral leaflet of the pericardium. An increase in the thickness and volume of EFT affects T, B, and macrophage cells. After that an increase in the secretion of cytokines and hormones such as interleukin 6 (IL-6), tumor necrosis factor alfa (TNFα), leptin, and a decrease in the secretion of hormones such as adiponectin and omentin are observed (5, 7). It has now been proven by many previous studies that there is a relationship between EFT and inflammatory process, insulin resistance and diabetes mellitus, and cardiovascular disease (7–11).

The systemic inflammation response-based indexes, such as neutrophil-to-lymphocyte ratio (NLR), and platelet-to-lymphocyte ratio (PLR), were defined as an indicator for lichen planus (12, 13). Recently, the fibrinogen to albumin ratio (FAR) has been studied as an effective indicator for some cardiovascular diseases, inflammatory diseases, and malignancies (14–16). Based on all this, we aimed to investigate whether EFT may be associated with LP together with FAR, NLR, and PLR as a marker of inflammation in this study.

Materials and methods

Study population

A total of 53 consecutive LP patients who were followed up in our dermatology department and 57 healthy controls were enrolled

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in this single-center, prospective, case-control study between the January 2022 and September 2022. Patients who met the diagnostic criteria of LP established by the World Health Organization were included. Patients were examined by an experienced physician, involving in all parts of the body including skin, nails, and scalp. Healthy controls were randomly selected from the dermatology and cardiology department who had been admitted with nonspecific complaints and had no other disease. Hypertension, severe renal and hepatic failure, cardiovascular and cerebrovascular disease, malignancy and other inflammatory, rheumatic and connective tissue diseases were excluded from the study. Patients under the treatment with immunosuppressive therapy, systemic steroid therapy, anti-lipid, antihypertensive, antiplatelet, and anticoagulant treatments were also excluded from the study. The study was designed and conducted with the approval of the local ethics review committee and in accordance with the Declaration of Helsinki. Informed consent forms were obtained from both, patients and control groups.

Clinical and laboratory data

After physical examination of the patients and controls, brachial systolic and diastolic blood pressures were measured with a standard sphygmomanometer. Body mass index was calculated from the anthropometric measurements. Duration of the disease, history of smoking, and the existence of diabetes mellitus were recorded. Routine biochemistry, complete blood count, C-reactive protein, lipid parameters, and fibrinogen were recorded during admission after 12-hour overnight fasting. Total cholesterol, TG, and HDL were measured by an auto-analyzer. LDL cholesterol was calculated by the Friedewald formula. The albumin concentration and fibrinogen levels were measured from blood samples at the same time. The NLR was defined as the ratio of neutrophil to lymphocyte count; PLR was defined as the ratio of neutrophil to lymphocyte count; the FAR was defined as the ratio of fibrinogen to albumin level.

Echocardiographic evaluation and epicardial adipose tissue measurement

Transthoracic echocardiography was performed in both, patients and controls in the left lateral decubital position, with a VIVID S60 (General Electric, Horton, Norway) with a 3 MHz transducer, by an experienced cardiologist who was blinded to the clinical data. EFT thickness was measured on the right ventricle from the parasternal long-axis view, apical 4 chamber view, and subcostal view at the end-diastole for three cardiac cycles. EFT was identified as an echo-free space in the pericardial layers on the 2-dimensional echocardiography.

Statistical analysis

Statistical analysis was performed by using the 20.0 SPSS for Windows (SPSS Inc., Chicago, Illinois, USA). Categorical variables are presented as counts and percentages. Continuous variables were evaluated for normal distribution using the Kolmogorov-Smirnov test and presented as mean ± standard deviation or median with interquartile range. To assess the differentiation between the groups, Students't-test was used for normally distributed variables, the Mann-Whitney U test for non-normally distributed variables, and the chi-square test for categorical variables. Pearson correlation test was used for correlation analysis between FAR, EFT, and other variables. Receiver operating characteristics (ROC) were generated to determine cut-off values of EFT, and FAR for the LP. In addition, univariate and multivariate binary regression analyses were used to define independent predictors of LP. Variables with a p-value less than 0.10 in univariate analysis were included in the multivariate analysis. A p-value less than 0.5 was accepted as statistically significant.

Results

A total of 53 LP patients and 57 healthy controls were enrolled in the study. The baseline demographic, clinical, and laboratory characteristics of the patient and control group are summarized in Table 1. LP patients were older, as well as had higher fibrinogen, FAR, NLR, PLR, and EFT values ($p < 0.05$, for all). The mean

Tab. 1. Baseline demographic, clinical and laboratory characteristics of patient and control group.

Variables	LP patients (n = 53)	Control group (n = 57)	p
Age (year)	43.0±13.1	37.7±9.8	**0.018**
Male (n, %)	36 (32.7)	33 (30.0)	0.277
BMI (kg/m^2)	29.2±5.8	27.4±5.0	0.091
SBP (mmHg)	119.9±14.3	119.0±16.9	0.773
DBP (mmHg)	74.2±10.1	75.1±13.2	0.711
DM (n, %)	4 (3.6)	5 (4.5)	0.815
Smoking (n, %)	21 (19.1)	18 (16.4)	0.428
HPL (n, %)	3 (2.7)	4 (3.6)	0.770
Duration of LP (month)	21.9±8.2	0	–
Multiple region (n, %)	30 (56.3)	0	–
LDL (mg/dL)	97.3±27.9	94.7±30.1	0.649
HDL (mg/dL)	41.6±10.5	43.9±8.9	0.208
TG (mg/dL)	126.7 (113.0–265.5)	130.0 (89.5–271.5)	0.191
Creatinine (mg/dL)	0.78±0.16	0.79±0.17	0.854
Glucose (mg/dL)	110.5±41.3	99.6±13.3	0.276
Hgb (g/dL)	14.3±2.0	14.2±2.1	0.838
Neutrophil (10^3/μL)	4.73±1.4	4.29±1.2	0.092
Lymphocyte (10^3/μL)	2.67±0.6	2.66±0.6	0.822
Platelet (10^3/μL)	280±70	265±66	0.201
MPV (fL)	10.01±0.7	9.8±0.9	0.088
CRP (mg/L)	1.97 (0.91–4.24)	1.33 (0.77–2.11)	0.126
Fibrinogen (g/L)	3.15±0.65	2.69±0.60	**0.001**
Albumin (g/L)	4.57±0.35	4.53±0.26	0.501
FAR	0.69±0.16	0.59±0.14	**0.001**
NLR	1.86±0.57	1.65±0.46	**0.001**
PLR	115.2±31.7	102.6±24.8	**0.022**
EFT, PLAX (mm)	0.69±0.21	0.61±0.14	**0.021**
EFT, A4C (mm)	0.67±0.23	0.55±0.13	**0.002**
EFT, subcostal (mm)	0.65±0.14	0.54±0.11	**0.031**
EFT, mean (mm)	0.67±0.18	0.57±0.11	**0.007**

LP = lichen planus; BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure; DM = diabetes mellitus; LDL = low-density lipoprotein; HDL = high-density lipoprotein; TG = triglyceride; Hgb = haemoglobin; MPV = mean platelet volume; CRP = C-reactive protein; FAR = fibrinogen to albumin ratio; CAR = CRP to albumin ratio; NLR = neutrophil to lymphocyte ratio; PLR = platelet to lymphocyte ratio; EFT = epicardial fatty tissue; PLAX = parasternal long axis; A4C = apical 4-chamber. Bold fonts indicate a p <0.05

duration of the LP disease was 21.9 ± 8.2 months, and most of the patients had cutaneous LP. Multiple regional involvements were present in 30 (56.3 %) patients. EFT was positively correlated with FAR (r = 0.306, p = 0.001), NLR (r = 0.240, p = 0.011), and PLR (r = 0.297, p = 0.002). Other positively correlated parameters are presented in Table 2.

ROC analysis indicated that a cut-off value of 0.60 for FAR could predict LP with a sensitivity of 83 % and a specificity of 44 % (AUC: 0.675, 95% CI: 0.574–0.775, p = 0.002); a cut-off value of 0.65 for NLR could predict LP with a sensitivity of 80 % and a specificity of 46 % (AUC: 0.655, 95% CI: 0.554–0.757, p = 0.005); a cut-off value of 0.46 for EFT could predict LP with a sensitivity of 79 % and a specificity of 54 % (AUC: 0.718, 95% CI: 0.623–0.813, p < 0.001) (Fig. 1, Tab. 3).

Univariate and multivariate binary logistic regression analyses were performed to investigate independent predictors of LP in the study population (Tab. 4). In the multivariate regression analysis NLR, FAR, and EFT (mean) were found to be independent predictors of LP (Tab. 4).

Tab. 2. Correlation analysis of EFT and other parameters.

	r	P
FAR	0.306	**0.001**
Fibrinogen	0.212	**0.026**
Age	0.292	**0.002**
Duration of LP	0.341	**< 0.001**
Neutrophil	0.203	**0.033**
NLR	0.240	**0.011**
PLR	0.297	**0.002**

EFT = epicardial fatty tissue; FAR = fibrinogen to albumin ratio; LP = lichen planus; NLR = neutrophil to lymphocyte ratio; PLR = platelet to lymphocyte ratio. Bold fonts indicate a P value lower than 0.05

Tab. 3. Cut-off, sensitivity, and specificity values of FAR, NLR, and EFT in receiver operating characteristic (ROC) curve analysis to identify LP.

	AUC (95% CI)	Cut-off	Sensitivity (%)	Specificity (%)	p
FAR	0.675 (0.574–0.775)	0.60	83	44	**0.002**
NLR	0.655 (0.554–0.757)	0.65	80	46	**0.005**
EFT (mean)	0.718 (0.623–0.813)	0.46	79	54	**< 0.001**

FAR = fibrinogen to albumin ratio; NLR = neutrophil to lymphocyte ratio; EFT = epicardial fatty tissue; LP = lichen planus; AUC = area under curve; CI = confidence intervals. Bold fonts indicate a p < 0.05

Tab. 4. The predictors of LP in binary logistic regression analysis.

Variables	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)	p
Age	1.04 (1.006–1.078)	0.022	1.02 (0.973–1.061)	0.470
BMI	1.06 (0.990–1.143)	0.085	1.04 (0.941–1.142)	0.468
Neutrophil	1.00 (1.000–1.001)	0.088	1.00 (0.999–1.002)	0.637
NLR	3.75 (1.620–8.709)	0.002	4.33 (1.358–13.805)	**0.013**
PLR	1.01 (1.002–1.031)	0.026	1.01 (0.986–1.024)	0.597
CRP	1.18 (1.003–1.407)	0.047	0.96 (0.772–1.206)	0.755
Fibrinogen	3.33 (1.674–6.639)	0.001	0.031 (0.000–31.346)	0.188
FAR	76.81 (4.487–1217.17)	0.002	15.83 (1.155–217.166)	**0.039**
EFT mean	84.05 (5.026–1405.615)	0.002	27.65 (0.888–861.773)	**0.038**

LP = lichen planus; BMI = body mass index; NLR = neutrophil to lymphocyte ratio; PLR = platelet to lymphocyte ratio; CRP = C-reactive protein; FAR = fibrinogen to albumin ratio; EFT = epicardial fatty tissue
Bold fonts indicate a p < 0.05

Discussion

The main purpose of the present study was to investigate the predictive value of EFT in LP patients by evaluating it together with FAR, NLR, and PLR. We found that EFT thickness was increased and FAR, NLR, and PLR values were higher in LP patients compared to controls. Additionally, FAR, NLR, and PLR had a significant positive correlation with EFT. In the ROC analysis, FAR, NLR and EFT had a good sensitivity value in predicting LP disease and they were independent predictors of LP in multivariate regression analysis.

LP is a chronic immune-mediated inflammatory disease that affects the skin, mucous membranes, genitalia, and appendages (17). T-cell-mediated inflammatory tissue reaction results in a cytotoxic reaction against epithelial basal cells (18). Upregulation of intercellular adhesion molecule-1 (ICAM-1) and T helper immune response which is associated with cytokines such as interferon-γ, tumor necrosis factor-α (TNF-α), interleukin (IL)-1, IL-6, IL-8, IL-22 are related with the pathogenesis of LP (19, 20). Matrix metalloproteinase upregulation, pro-inflammatory mediators, proteases of mast cells, and toll-like receptors are other factors that have been proposed as contributors to LP (18, 21). It was shown in the previous studies that cardiovascular risk factors such as dyslipidemia, diabetes mellitus, and increased oxidative stress were associated with LP (3, 4, 22). Chronic inflammation, endothelial dysfunction, and increased oxidative stress are major mechanisms that play role in cardiovascular events including atherosclerosis, hypertension, insulin resistance, dyslipidemia, and arrhythmias (23).

EFT exhibits embryological and morphological similarities with visceral fat and is mainly located on the right ventricle surface and anterior wall of the left ventricle (7). Histological analysis of EFT reveals abundant and smaller adipocyte stromal cells, and a large amount of resident inflammatory cells such as lymphocytes, macrophages, and mast cells (5). It also serves as paracrine/endocrine organ with a key role in lipid and glucose homeostasis. It affects pro-inflammatory cascades through the release of adipocytokine (5). Pathological stressful conditions (obesity, insulin resistance, diabetes, and vascular damage may promote the shift of EFT towards a pro-inflammatory and profibrotic phenotype. Impressive changes in EFT finally lead to inflammation by secreting hormones, inflammatory cytokines, and chemokines such as monocyte chemotactic protein-1 (MCP-1), IL-1β, IL-6, TNF-α, and plasminogen activator inhibitor-1 (PAI-1) (5). In our study, we investigated whether there is an increase in EFT thickness, which is an inflammatory indicator of cardiovascular disease, in LP, which is an inflammatory disease. We found only one important study that investigated this before (12). In

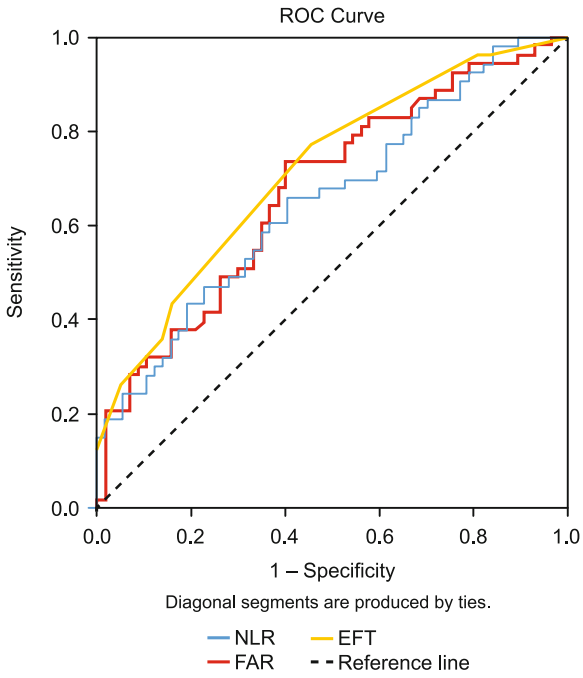

Fig. 1. ROC analysis of NLR, FAR and EFT.

our study, we found that EFT thickness was increased in LP patients, which was consistent with that study.

Noninvasive, simple, inexpensive inflammatory parameters calculated from the complete blood test, NLR, and PLR are widely used and have been evaluated for diagnosis and follow-up of inflammatory diseases such as LP, psoriasis, and Behçet's disease. There are studies showing that NLR and PLR are higher in LP patients compared with healthy controls. In a study comparing LP patients with healthy controls, it was observed that NLR was higher in LP patients and EFT thickness was also increased. Similar results were obtained in our study as well.

Fibrinogen is a serum glycoprotein and plays a role in the regulation of macrophage adhesion (by stimulating IL-1β and TNF-α), activation of cytokine/chemokine production, stimulation of smooth muscle proliferation, enhancing the release of endothelial cell growth factors, indicating the role as an inflammatory marker (24). Furthermore, it is important for the aggregation of thrombocytes (25). Accumulating studies have proposed a combining indicator FAR that can reflect the state of inflammation and demonstrated that it is an important prognostic predictor in various cancers (26, 27), coronary artery disease, contrast-induced nephropathy, and retinal vein occlusion (28–30). In the literature, no data are currently available regarding FAR levels and LP disease. And, no study has compared the diagnostic values of inflammatory markers with each other and EFT in LP patients. We investigated the association between LP and FAR together with other inflammation parameters NLR, and PLR. We have demonstrated for the first time that FAR, NLR and EFT were independent predictors of LP. Additionally, we showed a significant relationship between these parameters and EFT.

There are several limitations of our study. Firstly, our study was single center with a limited number of participants, and a cross-sectional study. Secondly, consecutive measurements of inflammatory parameters were not evaluated. It would be better to compare inflammatory parameters in terms of long-term effects in LP patients and to compare the values before and after the treatment of LP disease. Thirdly, EFT thickness on the right ventricular free wall does not show the total amount of epicardial adiposity. Additionally, further investigations with larger populations might be necessary to clarify threshold values of FAR, NLR, PLR, and EFT thickness.

Conclusion

High levels of FAR, NLR, and PLR with an increased EFT thickness can support the inflammatory process in LP disease. Increase in FAR, NLR and PLR were related to an increase in EFT in our study. Our study showed that FAR, NLR and EFT can be used for predicting inflammatory status in LP. We think, it is important to understand the relationship between FAR, NLR, PLR, and EFT in LP patients, so that physicians can be able to instantly quantitatively evaluate clinical follow-up and inflammation in LP patients admitted to outpatient clinics.

References

1. Le Cleach L, Chosidow O. Clinical practice. Lichen planus. N Engl J Med 2012; 366 (8): 723–732.

2. Tziotzios C, Lee JYW, Brier T, Saito R, Hsu CK, Bhargava K et al. Lichen planus and lichenoid dermatoses: Clinical overview and molecular basis. J Am Acad Dermatol 2018; 79 (5): 789–804.

3. Dreiher J, Shapiro J, Cohen AD. Lichen planus and dyslipidaemia: a case-control study. Br J Dermatol 2009; 161 (3): 626–629.

4. Fedele S, Sabbah W, Donos N, Porter S, D'Aiuto F. Common oral mucosal diseases, systemic inflammation, and cardiovascular diseases in a large cross-sectional US survey. Am Heart J 2011; 161 (2): 344–350.

5. Mazurek T, Zhang L, Zalewski A, Mannion JD, Diehl JT, Arafat H et al. Human epicardial adipose tissue is a source of inflammatory mediators. Circulation 2003; 108 (20): 2460–2466.

6. Gollasch M, Dubrovska G. Paracrine role for periadventitial adipose tissue in the regulation of arterial tone. Trends Pharmacol Sci 2004; 25 (12): 647–653.

7. Ansaldo AM, Montecucco F, Sahebkar A, Dallegri F, Carbone F. Epicardial adipose tissue and cardiovascular diseases. Int J Cardiol 2019; 278: 254–260.

8. Iacobellis G, Leonetti F. Epicardial adipose tissue and insulin resistance in obese subjects. J Clin Endocrinol Metab 2005; 90 (11): 6300–6302.

9. Liu J, Fox CS, Hickson D, Sarpong D, Ekunwe L, May WD et al. Pericardial adipose tissue, atherosclerosis, and cardiovascular disease risk factors: the Jackson heart study. Diabetes Care 2010; 33 (7): 1635–1639.

10. Cheng KH, Chu CS, Lee KT, Lin TH, Hsieh CC, Chiu CC et al. Adipocytokines and proinflammatory mediators from abdominal and epicardial adipose tissue in patients with coronary artery disease. Int J Obes (Lond) 2008; 32 (2): 268–724.

11. Iacobellis G, Lonn E, Lamy A, Singh N, Sharma AM. Epicardial fat thickness and coronary artery disease correlate independently of obesity. Int J Cardiol 2011; 146 (3): 452–454.

12. Ertem AG, Erdogan M, Koseoglu C, Akoglu G, Ozdemir E, Koseoglu G et al. Epicardial fat tissue thickness is increased in patients with lichen planus and is linked to inflammation and dyslipidemia. Rev Port Cardiol 2016; 35 (10): 525–530.

13. AtaS H, Cemil BÇ, KurmuS GI, Gönül M. Assessment of systemic inflammation with neutrophil-lymphocyte ratio in lichen planus. Postepy Dermatol Alergol 2016; 33 (3): 188–192.

14. Çetin M, Erdoğan T, KiriS T, Özer S, Yilmaz AS, Durak H et al. Predictive value of fibrinogen-to-albumin ratio in acute coronary syndrome. Herz 2020; 45 (Suppl 1): 145–151.

15. Duan Z, Luo C, Fu B, Han D. Association between fibrinogen-to-albumin ratio and the presence and severity of coronary artery disease in patients with acute coronary syndrome. BMC Cardiovasc Disord 2021; 21 (1): 588.

16. Liang Y, Wang W, Que Y, Guan Y, Xiao W, Fang C et al. Prognostic value of the fibrinogen/albumin ratio (FAR) in patients with operable soft tissue sarcoma. BMC Cancer 2018; 18 (1): 942.

17. Arias-Santiago S, Buendía-Eisman A, Aneiros-Fernández J, Girón-Prieto MS, Gutiérrez-Salmerón MT, García-Mellado V et al. Lipid levels in patients with lichen planus: a case-control study. J Eur Acad Dermatol Venereol 2011; 25 (12): 1398–1401.

18. Roopashree MR, Gondhalekar RV, Shashikanth MC, George J, Thippeswamy SH, Shukla A. Pathogenesis of oral lichen planus – a review. J Oral Pathol Med 2010; 39 (10): 729–734.

19. Chen X, Liu Z, Yue Q. The expression of TNF-alpha and ICAM-1 in lesions of lichen planus and its implication. J Huazhong Univ Sci Technolog Med Sci 2007; 27 (6): 739–741.

20. Rhodus NL, Cheng B, Ondrey F. Th1/Th2 cytokine ratio in tissue transudates from patients with oral lichen planus. Mediators Inflamm 2007; 2007: 19854.

21. El Tawdy A, Rashed L. Downregulation of TLR-7 receptor in hepatic and non-hepatic patients with lichen planus. Int J Dermatol 2012; 51 (7): 785–789.

22. Aly DG, Shahin RS. Oxidative stress in lichen planus. Acta Dermatovenerol Alp Pannonica Adriat 2010; 19 (1): 3–11.

23. Flammer AJ, Ruschitzka F. Psoriasis and atherosclerosis: two plaques, one syndrome? Eur Heart J 2012; 33 (16): 1989–1991.

24. Szaba FM, Smiley ST. Roles for thrombin and fibrinogen in cytokine/chemokine production and macrophage adhesion in vivo. Blood 2002; 99 (3): 1053–1059.

25. Mosesson MW. Fibrinogen and fibrin structure and functions. J Thromb Haemost 2005; 3 (8): 1894–1904.

26. Xu WY, Zhang HH, Xiong JP, Yang XB, Bai Y, Lin JZ et al. Prognostic significance of the fibrinogen-to-albumin ratio in gallbladder cancer patients. World J Gastroenterol 2018; 24 (29): 3281–3292.

27. Xu Q, Yan Y, Gu S, Mao K, Zhang J, Huang P et al. A Novel Inflammation-Based Prognostic Score: The Fibrinogen/Albumin Ratio Predicts Prognoses of Patients after Curative Resection for Hepatocellular Carcinoma. J Immunol Res 2018; 2018: 4925498.

28. Ertas F, Avci E, Kiris T. The Ratio of Fibrinogen to Albumin as a Predictor of Contrast-Induced Nephropathy After Carotid Angiography. Angiology 2019; 70 (5): 458–464.

29. Guclu H, Ozal SA, Pelitli Gurlu V, Özgün GS, Özgün E. Increased Fibrinogen to Albumin Ratio in Ischemic Retinal Vein Occlusions. Eur J Ophthalmol 2017; 27 (6): 735–739.

30. Karahan O, Acet H, ErtaS F, Tezcan O, ÇaliSkan A, Demir M et al. The relationship between fibrinogen to albumin ratio and severity of coronary artery disease in patients with STEMI. Am J Emerg Med 2016; 34 (6): 1037–1042.

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