Anti-dsDNA, Anti-Nucleosome and Anti-C1q Antibodies as Disease Activity Markers in Patients with Systemic Lupus Erythematosus

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SUMMARY

Introduction In spite of the growing number of reports on the study of anti-nucleosome and anti-C1q antibodies, there are still controversies on their significance as disease activity markers in patients with systemic lupus erythematosus (SLE) and their use in everyday clinical practice.

Objective Our aim was to assess the presence of anti-dsDNA, anti-nucleosome and anti-C1q antibodies in SLE patients, as well as to establish their sensitivity, specificity, positive and negative predictive value, and their correlation with SLE and lupus nephritis clinical activity.

Methods The study enrolled 85 patients aged 45.3±9.7 years on the average, with SLE of average duration 10.37±7.99 years, hospitalized at the Institute„Niška Banja" during 2011, and 30 healthy individuals as controls. Disease activity was assessed using Systemic Lupus Erythematosus Disease Activity Index (SLEDAI). In all examinees the levels of anti-dsDNA, anti-nucleosome and anti-C1q antibodies were measured using the ELISA method with Alegria Test Strips Orgentec (Germany).

Results Patients with active lupus nephritis had a higher presence of anti-C1q antibodies and higher co-positivity of anti-dsDNA, anti-nucleosome, and anti-C1q antibodies compared to those with inactive lupus nephritis (77.77% vs. 21.74%; p<0.01). SLE patients with SLEDAI ≥11 had a higher presence of anti-nucleosome (93.75% vs. 64.15%; p<0.01) and anti-C1q antibodies (46.87% vs. 22.64%; p<0.05), as well as a higher mean level of anti-nucleosome antibodies (107.79±83.46 U/ml vs. 57.81±63.15 U/ml; p<0.05), compared to those with SLEDAI of 0-10. There was a positive correlation between the SLEDAI and the level of anti-dsDNA (r=0.290; p<0.01), anti-nucleosome (r=0.443; p<0.001), and anti-C1q antibodies (r=0.382; p<0.001). Only anti-C1q antibodies demonstrated correlation with proteinuria (r=0.445; p<0.001).

Conclusion Anti-nucleosome and anti-C1q antibodies demonstrated association with SLE and lupus nephritis activity, suggesting their potential usefulness in making predictions about lupus nephritis and assessment of disease activity.

Keywords: systemic lupus erythematosus; anti-dsDNA antibodies; anti-nucleosome antibodies; anti-C1q antibodies; lupus nephritis; SLEDAI

INTRODUCTION

Systemic lupus erythematosus (SLE) is a chronic inflammatory autoimmune disease characterized by multisystem clinical presentation and serologic findings of various antibodies [1, 2]. It has been shown that conventional parameters such as anti-dsDNA antibodies, complement level, proteinuria, creatinine clearance and urine sediment are not specific enough to detect disease activity in renal involvement and nephritis relapse [3]. In recent years, new biomarkers have been intensely studied, which could mark renal involvement before clinical manifestations, i.e. indicate subclinical disease forms. Among them, a significant place is reserved for anti-nucleosome [4, 5, 6] and anti-C1q antibodies [7, 8, 9], which have been extensively studied. Anti-nucleosome antibodies are highly correlated with anti-dsDNA antibodies and are considered sensitive SLE markers, but their correlation with disease activity and renal involvement remains controversial. There are opinions that anti-C1q surveillance would be important in the clinical monitoring of SLE patients, as a non-invasive biologic marker of renal involvement, both for early detection of nephritis and for prediction of exacerbations [10-14]. In some reports, the authors have stated that anti-dsDNA antibodies are necessary but not sufficient for the development of lupus nephritis exacerbations, and that anti-dsDNA antibodies and anti-nucleosome antibodies, with elevated levels of anti-C1q antibodies, are associated with renal disease [15, 16, 17].

In spite of a growing number of reports on the study of anti-nucleosome and anti-C1q antibodies, there are still controversies regarding their significance as disease activity markers in SLE patients and their use in everyday clinical practice.

OBJECTIVE

Our aim in this study was to examine the presence of anti-dsDNA, anti-nucleosome and anti-C1q antibodies in SLE patients, and to establish their sensitivity, specificity, and positive and

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negative predictive value. We also attempted to establish their possible association with clinical activity of SLE and lupus nephritis activity.

METHODS

The study enrolled 85 patients with SLE, hospitalized at the Clinic of Rheumatology of the Institute „Niška Banja" in 2011, in whom the diagnosis was made based on the criteria of the American College of Rheumatology revised in 1997. Thirty healthy individuals made up the control group. The study was also performed at the Center of Medical Biochemistry of the Clinical Centre in Niš. All patients were carefully considered and examined using the same methodology. Prior to inclusion, all patients were first informed about study aims, signing after that the informed consent to be enrolled in the study. The Ethics Committee of the Faculty of Medicine in Niš also gave their consent for the study to be carried out. Inclusion criteria for the study were as follows: age above 18, definitive diagnosis of SLE, made according to the criteria of the American College of Rheumatology revised in 1997, with present at least 4 of 11 criteria in total.

In addition to clinical examination and supplemental diagnostic methods, disease activity was assessed in all patients using Systemic Lupus Erythematosus Disease Activity Index (SLEDAI), based on a standardized questionnaire. The SLEDAI evaluates the activity of 9 organ systems based on the presence or absence of 24 variables during the examination. The value range was 0-105. Based on the total sum, the disease was classified as follows: without activity 0, low activity 1-5, moderate activity 6-10, high activity 11-19, and very high activity ≥20. The examinees were divided into 2 groups; the first group consisted of those without disease activity, with low or moderate activity (SLEDAI 0-10), and the second consisted of those with high and very high disease activity (SLEDAI ≥11).

Involvement of different organs and systems was determined in accordance to the current criteria. For the diagnosis of lupus nephritis, the presence of proteinuria 0.5 g/24h was necessary, and/or the finding of pathologic urine sediment. Glomerular filtration assessment was performed in all examinees using the Modification of Diet Renal Disease (MDRD) formula.

Simultaneously with clinical examination and disease activity assessment, the samples of blood were taken and centrifuged, and serum samples were frozen at -70°C up to the moment of determination of the studied antibodies. In addition to the standard lab and immunologic analyses, the levels of anti-dsDNA, anti-nucleosome antibodies, and anti-C1q antibodies were measured in SLE patients and controls. The presence of these antibodies was determined using the ELISA test on the automatic ELISA reader Alegria (Organtec, Germany). Autoantibodies were determined on the Alegria Test Strips (Organtec, Germany), barcoded per each antibody, using the technique of indirect immunologic reaction. The Anti-C1q ELISA is a test for the quantitative detection of class IgG antibodies against the C1q complement component. Positivity cut-offs for the examined antibodies were set in compliance with the manufacturer's instructions, being ≥25 U/ml for anti-dsDNA, ≥20 U/ml for anti-nucleosome, and ≥10 U/ml for anti-C1q antibodies. Maximal possible antibody values were 200 U/ml for anti-dsDNA, 200 U/ml for anti-nucleosome, and 100 U/ml for anti-C1q antibodies. The assays were performed at the Center of Medical Biochemistry, Clinical Center Niš.

The Sigmastat 3.5 program was used for statistical data processing. The following tests were employed: descriptive statistics, Student's t-test, Mann-Whitney test, and Chi-square test.

RESULTS

Average age of SLE patients was 45.3±9.7 years. Average age of control group examinees was 44.7±9.5 years. There were 78 (91.77%) women and 7 (8.23%) men in the SLE group, and among controls there were 27 (90%) women and 3 (10%) men. Both groups were homogenous related to age. Average disease duration in the studied group was 10.37±7.99 years (from 1 month, to 29 years), and average age at diagnosis was 35.88±9.66 years. The median for the number of diagnostic criteria was 5 (minimum 4, maximum 9). The frequency of individual clinical manifestations at the time of examination was for arthritis/arthralgias 69.41%, skin changes 65.88%, serositis 24.70%, hematologic manifestations 24.70%, lupus nephritis 37.56%, and neuropsychic manifestations 18.82%. Out of 32 patients with lupus nephritis, 9 (28.12%) had active nephritis, and 23 (71.88%) inactive lupus nephritis; 53 (62.35%) patients had SLEDAI from 0 to 10, and 32 (37.65%) had SLEDAI score ≥11. The average SLEDAI value in all SLE patients was 11.38±7.55.

Positive anti-dsDNA antibodies were found in 59 (69.41%) patients, anti-nucleosome antibodies in 64 (75.29%), and anti-C1q antibodies in 27 (31.76%) SLE patients (Table 1). All control group subjects were negative for antibodies. There were no significant differences in the positivity of studied antibodies between the groups with and without nephritis. Moreover, there were no differences in the simultaneous positivity of all three antibodies, and simultaneous positivity of two antibodies between nephritis

Table 1. Frequency of positive anti-dsDNA, anti-nucleosome and anti-C1q in SLE patients

Antibodies	SLE (n=85; 100%)	LN (n=32; 37.64%)	SLE without LN (n=53; 62.36%)
Anti-dsDNA	59 (69.41%)	26 (81.25%)	33 (62.26%)
Anti-nucleosome	64 (75.29%)	26 (81.25%)	38 (71.70%)
Anti-C1q	27 (31.76%)	12 (37.50%)	15 (28.30%)
Anti-dsDNA, C1q, Nucl.	24 (28.23%)	12 (37.50%)	12 (22.64%)
Anti-dsDNA, Nucl.	25 (29.41%)	11 (34.37%)	14 (26.41%)
Anti-C1q, Nucl.	2 (2.35%)	-	2 (3.77%)

SLE – systemic lupus erythematosus; LN – lupus nephritis; n – number of patients

and nephritis-free groups (Table 1). When we compared the positivity of studied antibodies between the groups of patients with active and inactive lupus nephritis, we found a significant difference in anti-C1q positivity and simultaneous positivity of all three antibodies, with positive anti-C1q antibodies and co-positive anti-dsDNA, anti-nucleosome, and anti-C1q antibodies found in 5 out of 23 (21.74%) patients with inactive lupus nephritis and in 7 out of 9 (77.77%) patients with active lupus nephritis (p<0.01). In the group with active lupus nephritis, 100% patients had positive anti-nucleosome antibodies (Table 2).

Specificity and sensitivity of the studied antibodies was 100% and 87.06% for anti-dsDNA antibodies for the cut-off >10.6 U/ml, 96.67% and 82.35% for anti-nucleosome antibodies for the cut-off >9.7 U/ml, and 100% and 35.71% for anti-C1q antibodies for the cut-off >9.4 U/ml (Graph 1, Table 3). Positive and negative predictive value for SLE diagnosis was 100% and 74.10% for anti-dsDNA antibodies, 98.59% and 65.92% for anti-nucleosome antibodies, and 100% and 35.50% for anti-C1q antibodies.

Examining antibody positivity in the group with active and very active disease (SLEDAI ≥11), compared to those with SLEDAI from 0 to 10, we found a significant difference in anti-nucleosome and anti-C1q antibodies (Table 4).

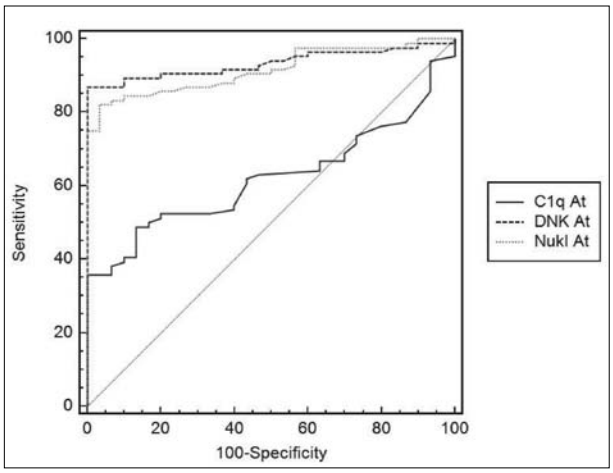
The mean level of anti-dsDNA antibodies in the SLE group was significantly higher – 80.18±74.69 U/ml, compared to controls with 5.97±3.02 U/ml (p<0.001). In the SLE group, the mean level of anti-nucleosome antibodies was 74.38±74.16 U/ml, which was significantly higher than in controls with 6.37±3.01 U/ml (p<0.001). The mean level of anti-C1q in SLE patients was 14.67±23.60 U/ml, and in controls it was 4.29±1.99 U/ml, although without any significant difference.

Examination of the mean levels of antibodies in those with lupus nephritis and those without it did not reveal significant differences for any of the antibodies. In the group with active lupus nephritis, mean levels of all three antibodies were significantly higher compared to those with inactive lupus nephritis (Table 5).

Table 2. Frequency of positive anti-dsDNA, anti-nucleosome and anti C1q antibodies in SLE patients according to lupus nephritis (LN) activity

Antibodies	LN (n=32; 37.64%)		SLE without LN (n=53; 62.36%)
	Active (n=9; 28.12%)	Inactive (n=23; 71.87%)	
Anti-dsDNA	8 (88.88%)	18 (78.26%)	33 (62.26%)
Anti-nukleosome	9 (100.00%)	17 (73.91%)	38 (71.70%)
Anti-C1q	7 (77.77%)	5 (21.74%)[a]	15 (28.30%)[b]
Anti-DNA, C1q, Nucl.	7 (77.77%)	5 (21.74%)[c]	12 (22.64%)[d]
Anti-DNA, Nucl.	1 (11.11%)	10 (43.48%)	14 (26.41%)
Anti-C1q, Nucl.			2 (3.77%)

* p<0.01 vs. Active (a – χ^2=8.67; b – χ^2=7.46; c – χ^2=8.67; d – χ^2=9.04)



Graph 1. Receiver operating characteristic curve for anti-dsDNA, anti-nucleosome, and anti C1q antibodies (ab). Specificity and sensitivity of the studied antibodies was 100% and 87.06% for anti-dsDNA ab, 96.67% and 82.35% for anti-nucleosome ab and 100% and 35.71% for anti-C1q ab.

Table 4. Frequency of positive anti-dsDNA, anti-nucleosome and anti-C1q in SLE patients according to SLEDAI values

Antibodies	SLEDAI		SLEDAI 11.38±7.55 (n=85; 100.00%)
	0–10 (n=53; 62.35%)	≥11 (n=32; 37.64%)	
Anti-DNA	36 (67.92%)	23 (71.87%)	59(69.41%)
Anti-nucleosome	34 (64.15%)	30 (93.75%)*	64 (75.29%)**
Anti-C1q	12 (22.64%)	15 (46.87%)***	27 (31.76%)
Anti-DNA, C1q, Nucl.	12 (22.64%)	12 (37.50%)	24 (28.23%)
Anti-DNA, Nucl.	16 (30.18%)	9 (28.12%)	25 (29.41%)
Anti-C1q, Nucl.	1 (1.88%)	1(3.12%)	2 (2.35%)

* p<0.01 (χ^2=8.52) vs. SLEDAI=0–10;
** p<0.05 (χ^2=5.01) vs. SLEDAI≥11;
*** p<0.05 (χ^2=4.51) vs. SLEDAI=0–10
SLEDAI – Systemic Lupus Erythematosus Disease Activity Index

Table 5. Mean levels of anti-dsDNA, anti-nucleosome and anti-C1q in the group with active and inactive lupus nephritis (LN)

Antibodies	LN (n=32; 37.64%)		LN (n=32; 37.64%)
	Active (n=9; 28.12%)	Inactive (n=23; 71.87%)	
Anti-dsDNA	144.04±75.19	61.59±57.66*	84.78±72.37
Anti-nucleosome	176.59±44.44	39.17±34.10***	77.82±72.63**
Anti-C1q	34.78±39.89	7.87±7.13*	15.44±24.45

* p<0.05 vs. Active; ** p<0.01 vs. Active; *** p<0.001 vs. Active

Table 3. Specificity and sensitivity of anti-dsDNA, anti-nucleosome, and anti-C1q antibodies

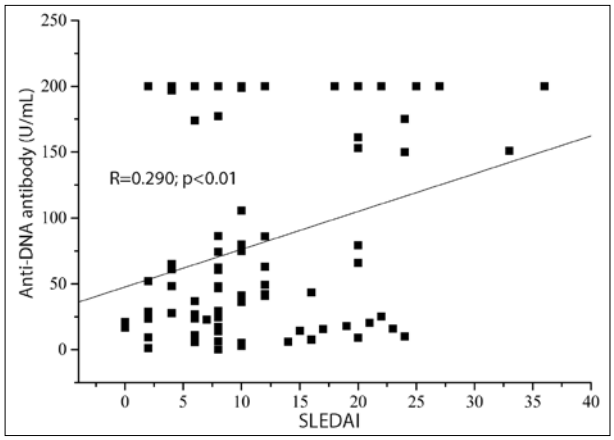
Antibodies	AUC	SE	95% CI	Specificity	Sensitivity	Criterion
Anti-dsDNA	0.934*	0.022	0.871-0.972	100.00	87.06	>10.6
Anti-nucleosome	0.916*	0.025	0.849-0.960	96.67	82.35	>9.7
Anti-C1q	0.621	0.057	0.526-0.710	100.00	35.71	>9.4

* p<0.001 vs. C1q
AUC – area under the curve; SE – statistical error; CI – confidence interval

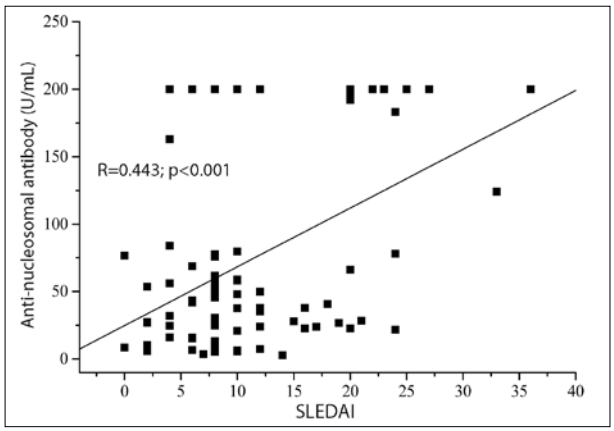
Table 6. Mean levels of anti-dsDNA, anti-nucleosome and anti-C1q in the groups with SLEDAI from 0-10 and SLEDAI ≥11

Antibodies	SLEDAI		SLE 11.38±7.55 (n=85; 100.00%)
	0–10 (n=53; 62.35%)	≥11 (n=32; 37.64%)	
Anti-dsDNA	71.57±71.33	96.54±77.61	80.18±74.69
Anti-nucleosome	57.81±63.15	107.79±83.46*	74.38±74.16
Anti-C1q	10.07±15.89	22.12±31.56	14.67±23.60

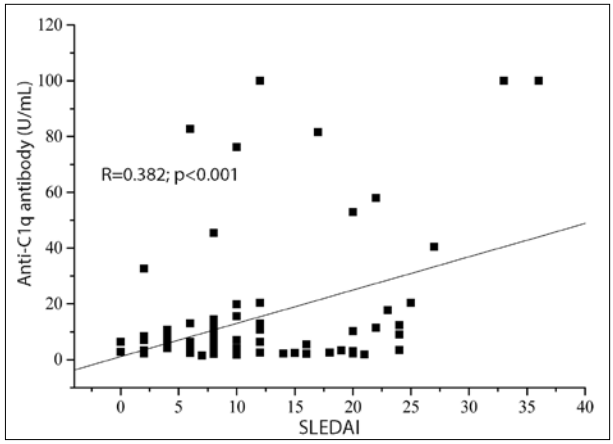
* p<0.05 vs. SLEDAI=0-10



Graph 2. Positive correlation between Systemic Lupus Erythematosus Disease Activity Index (SLEDAI) and anti-dsDNA ab levels



Graph 3. Positive correlation between SLEDAI and anti-nucleosome ab levels



Graph 4. Positive correlation between SLEDAI and anti-C1q ab levels

The mean levels of studied antibodies were higher in the groups with high and very high disease activity (SLEDAI≥11) compared to the group without disease activity, with low and moderate activity (SLEDAI from 0 to 10), but the difference was significant only for anti-nucleosome antibodies (Table 6).

Examining the correlation between the antibodies and SLEDAI-assessed disease activity, we found a positive correlation for all three antibody types. There was a positive correlation between anti-dsDNA antibodies and SLEDAI (r=0.290; p<0.01) (Graph 2). We also found a positive correlation between anti-nucleosome antibodies and SLEDAI (r=0.443; p<0.001) (Graph 3), as well as between anti-C1q antibodies and SLEDAI (r=0.382; p<0.001) (Graph 4).

Examining the intercorrelation between these antibodies the following positive correlations were found: between anti-dsDNA and antinucleosome antibodies it was r=0.561 (p<0.001), between anti-dsDNA and anti-C1q it was r=0.403 (p<0.001), and between anti-nucleosome and anti-C1q antibodies it was r=0.436 (p<0.001). All three antibodies demonstrated negative correlations with C3 complement component, which were r=-0.345 (p<0.01) for anti-dsDNA; r=-0.450 (p<0.001) for anti-nucleosome antibodies; and r=-0.300 (p<0.001) for anti-C1q antibodies.

When the renal function parameters were examined (proteinuria and glomerular filtration assessed using the MDRD formula), out of all three studied parameters only anti-C1q antibodies demonstrated a correlation with proteinuria (r=0.445; p<0.001). There was no correlation between the examined antibodies and glomerular filtration.

DISCUSSION

Studies have shown that anti-nucleosome antibodies are present in 70-100% of SLE patients, and that they demonstrate a high specificity (up to 97%) [4, 5, 18], which agrees with our own results (96.67%). Anti-C1q antibodies have been identified in 30-60% of SLE patients [16], which agrees with our findings (31.76%). Bizzaro et al. [19] have recently published the results of their meta-analysis of 26 studies, comparing the sensitivity, specificity, positive and negative predictive value of anti-dsDNA and anti-nucleosome antibodies. The comparative analysis showed that anti-nucleosome antibodies had higher diagnostic sensitivity (59.9% vs. 52.4%), with specificity slightly higher than anti-dsDNA antibodies (94.9% vs. 94.2%). In the past studies of juvenile SLE, specificity and positive predictive value for anti-nucleosome antibodies were 96-98%, and specificity for anti-C1q was 92-100% [20].

Our results demonstrated that anti-dsDNA and anti-nucleosome had high specificity and positive predictive value for the SLE diagnosis. These results agree with the results published for adults with SLE and for juvenile SLE, so that all three antibody types can be considered reliable markers in the SLE diagnosis [4, 5, 8, 18]. In addition to the reports on the high specificity of anti-C1q antibodies in SLE diagnosis [20], as in our study, there have been many studies suggesting that anti-C1q antibodies are not

specific for SLE and that they can be encountered in other autoimmune (Sjögren's syndrome, hypocomplementemic urticarial vasculitis) and infectious diseases [21]. The prevalence of anti-C1q antibodies in healthy population ranges from 2% to 8%. Our result about high specificity of anti-C1q antibodies in SLE diagnosis can be explained by the fact that there were few healthy controls (n=30) and that all of them had negative anti-C1q antibodies for the cut-off >9.4 U/ml.

In our study, although the prevalence of positive findings of anti-nucleosome antibodies was higher compared to anti-dsDNA antibodies (75.29% vs. 69.41%), the sensitivity of anti-nucleosome antibodies for the diagnosis of SLE was lower compared to the sensitivity of anti-dsDNA antibodies (82.35% vs. 87.06%). This can be explained by the fact that in our study antibody positivity cut-off values according to the ROC curve were lower than that recommended by the ELISA test manufacturer, and were >10.6 U/ml for anti-dsDNA antibodies, and >9.7 U/ml for anti-nucleosome antibodies.

Anti-nucleosome [6, 22-27] and anti-C1q antibodies [7, 10, 11] have been described as indicators of disease activity and lupus nephritis activity in adults, which agrees with our results. There have been reports about anti-nucleosome antibodies being a sensitive marker of renal involvement in the absence of anti-dsDNA antibodies [25, 28]. Katsumata et al. [29] have demonstrated the association of anti-C1q antibodies with global SLE activity, but not with active lupus nephritis. Recently, Tan et al. [30] have reported that in 281 SLE patients with lupus nephritis anti-C1q antibodies have been closely associated with C1q concentrations and glomerular C1q deposition, concluding that the kidney is certainly one of the target organs of C1q antibodies.

Our results demonstrated that the presence of anti-C1q with simultaneous presence of all three antibody types was significantly higher in the group with active compared to the group with inactive lupus nephritis. Simultaneous positivity of anti-dsDNA, anti-nucleosome, and anti-C1q antibodies can be a marker of active lupus nephritis. Sui et al. [31] have recently reported their results concerning a powerful association of simultaneous positivity of anti-dsDNA, anti-nucleosome, and anti-histone antibodies with lupus nephritis activity, especially with proliferative glomerulonephritis.

We demonstrated a high sensitivity of both anti-dsDNA and anti-nucleosome antibodies. Although anti-C1q antibodies had a low level of sensitivity, our results showed them to be a good marker of lupus nephritis activity, being the only ones that correlated with proteinuria, which was in accordance with the results of Akhter et al. [32].

Similar to the results of some studies [4, 6, 8, 11], our results showed a correlation of anti-dsDNA, anti-nucleosome, and anti-C1q antibodies with the SLEDAI activity index. Meyer et al. [7] have shown that anti-C1q can be a good serologic marker of the subsequent development of active proliferative glomerulonephritis in SLE patients, and that patients without anti-C1q are exposed to a very low risk of developing severe proliferative glomerulonephritis forms. Similar results have been reported by Chen et al. [11], concluding that anti-C1q antibodies are a non-invasive biologic marker in the prediction of lupus nephritis histopathology, and that low titers or absence of anti-C1q antibodies may have an impact on therapeutic decision-making in SLE. The same authors have found positive intercorrelations between anti-dsDNA, anti-nucleosome, and anti-C1q, as well as their negative correlation with C3 complement component, which agrees with our own findings.

CONCLUSION

Anti-nucleosome and anti-C1q antibodies demonstrated an association with SLE and lupus nephritis activity, suggesting their potential usefulness in making predictions about lupus nephritis and assessment of disease activity.

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Анти-*dsDNA*, антинуклеозомска и анти-*C1q* антитела као показатељи активности болести код особа са системским еритемским лупусом

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КРАТАК САДРЖАЈ

Увод Упркос бројним саопштењима о испитивању антинуклеозомских и анти-*C1q* антитела, и данас постоје опречна мишљења о њиховом значају као показатељима активности болести код особа са системским еритемским лупусом (СЕЛ) и њиховој примени у свакодневној клиничкој пракси.

Циљ рада Циљ рада је био да се испита постојање анти-*dsDNA*, антинуклеозомских и анти-*C1q* антитела код болесника са СЕЛ, утврде њихова сензитивност, специфичност, позитивна и негативна предиктивна вредност и установи њихова корелација с клиничком активношћу СЕЛ и активношћу лупусног нефритиса (ЛН).

Методе рада Истраживање је обухватило 85 болесника са СЕЛ, просечне старости од 45,3±9,7 година и просечног трајања болести од 10,37±7,99 година, који су болнички лечени 2011. године у Институту за лечење и рехабилитацију „Нишка Бања", и 30 здравих особа које су чиниле контролну групу. Активност болести је процењена коришћењем *Systemic Lupus Erythematosus Disease Activity Index* (*SLEDAI*). Код свих испитаника је методом *ELISA* мерен ниво анти-*dsDNA*, антинуклеозомских и анти-*C1q* антитела коришћењем тест-трака *Alegria*® (*ORGENTEC*, Немачка).

Резултати Код болесника с активним ЛН забележени су веће присуство анти-*C1q* антитела и већа истовремена позитивност анти-*dsDNA*, антинуклеозомских и анти-*C1q* антитела у односу на групу с неактивним ЛН (77,77% према 21,74%; $p<0,01$). Код болесника са СЕЛ и вредношћу *SLEDAI* 11 и већом установљено је веће присуство антинуклеозомских (93,75% према 64,15%; $p<0,01$) и анти-*C1q* антитела (46,87% према 22,64%; $p<0,05$), као и виши средњи ниво антинуклеозомских антитела (107,79±83,46 *U/ml* према 57,81±63,15 *U/ml*; $p<0,05$) у односу на болеснике с вредношћу *SLEDAI* од 0 до 10. Утврђена је позитивна корелација између *SLEDAI* и нивоа анти-*dsDNA* ($r=0,290$; $p<0,01$), антинуклеозомских ($r=0,443$; $p<0,001$) и анти-*C1q* антитела ($r=0,382$; $p<0,001$). Анти-*C1q* антитела су једина показала корелацију с протеинуријом ($r=0,445$; $p<0,001$).

Закључак Антинуклеозомска и анти-*C1q* антитела показују удруженост с активношћу СЕЛ и ЛН, а одређивање ових антитела може бити корисно за предвиђање развоја ЛН и процену активности болести.

Кључне речи: системски еритемски лупус; анти-*dsDNA* антитела; антинуклеозомска антитела; анти-*C1q* антитела; лупусни нефритис; *SLEDAI*

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