DOI: 10.20514/2226-6704-2022-12-4-310-315
EDN: AZTSGS
УДК 616.711-002-097.3+616.711-007.17-097.3

А.П. Ребров[1], И.З. Гайдукова[2], А.В. Апаркина*[1], М.А. Королев[3], К.Н. Сафарова[1], К.Д. Дорогойкина[1], Д.М. Бичурина[4]

[1] — ФГБОУ ВО «Саратовский ГМУ им. В.И. Разумовского» Минздрава России, Саратов, Россия
[2] — ФГБОУ ВО «Северо-Западный государственный медицинский университет им. И.И. Мечникова» Минздрава России, Санкт-Петербург, Россия
[3] — НИИ клинической и экспериментальной лимфологии — филиал ФГБНУ «Федеральный исследовательский центр Институт цитологии и генетики СО РАН», Новосибирск, Россия
[4] — ГУЗ «Областная клиническая больница», Саратов, Россия

УРОВЕНЬ IGA АНТИТЕЛ К CD74 У ПАЦИЕНТОВ СО СПОНДИЛОАРТРИТАМИ И ДЕГЕНЕРАТИВНО-ДИСТРОФИЧЕСКИМИ ЗАБОЛЕВАНИЯМИ ПОЗВОНОЧНИКА

A.P. Rebrov[1], I.Z. Gaydukova[2], A.V. Aparkina*[1], M.A. Korolev[3], K.N. Safarova[1], K.D. Dorogoikina[1], D.M. Bichurina[4]

[1] — Saratov State Medical University named after V.I. Razumovskyy, Saratov, Russia
[2] — North-Western State Medical University named after I.I. Mechnikov, St. Petersburg, Russia
[3] — Research Institute of Clinical and Experimental Lymphology — branch of the Federal State Budgetary Scientific Institution «Federal Research Center Institute of Cytology and Genetics of the Siberian Branch of the Russian Academy of Sciences», Novosibirsk, Russia
[4] — State healthcare institution «Regional Clinical Hospital» Saratov, Russia

The Level of IgA Antibodies to CD74 in Patients with Spondyloarthritis and Degenerative-Dystrophic Diseases of the Spine

Резюме

По данным литературы аутоантитела IgA к антигену CD74 рассматриваются в качестве возможного маркера для диагностики аксиальных спондилоартритов (СпА). У пациентов с болью в спине в связи с дегенеративно-дистрофическими заболеваниями позвоночника (ДДЗП) уровень аутоантител к CD74 не изучался. Представляет интерес сопоставление уровня аутоантитела IgA к антигену CD74 у пациентов с хронической болью в спине при различных заболеваниях. **Цель** настоящего исследования — сравнение уровней аутоантитела IgA к антигену CD74 у пациентов со СпА и ДДЗП. **Материалы и методы.** В исследовании включено 87 пациентов (55 мужчин, средний возраст 41 [29; 49] лет) со СпА, отвечающих критериям аксиального спондилоартрита Assessment of Spondyloarthritis International Society (2009), и 39 пациентов (25 мужчин, средний возраст 45 [34; 53] лет) с ДДЗП, верифицированных неврологом (коды МКБ-Х — M 51.1 и M 54.4). Методом

*Контакты: Алёна Васильевна Апаркина, e-mail: alena437539@yandex.ru
*Contacts: Alena V. Aparkina, e-mail: alena437539@yandex.ru
ORCID ID: https://orcid.org/0000-0001-8463-2379

количественного иммуноферментного анализа измеряли содержание аутоантител IgA к CD74 в образцах сывороток у пациентов со СпА и ДДЗП. **Результаты.** Средний уровень аутоантител IgA к CD74 у пациентов со СпА составил 11,3 [5,4; 19,4] Ед/мл, у пациентов с ДДЗП — 6,9 [4,5; 13,7] Ед/мл (p=0,024). Концентрация аутоантитела IgA к антигену CD74, превышающая пороговое значение, выявлена у 58 (66,7 %) пациентов со СпА и только у 11 (28,2 %) пациентов с ДДЗП (p<0,001). У пациентов с ДДЗП повышение уровня аутоантител IgA к CD74 выявлено у 10 (40 %) из 25 мужчин и у 1 (7,1 %) из 14 женщин (p = 0,029, χ^2 = 4,785). **Выводы.** У 2/3 пациентов со СпА установлено повышение уровня аутоантител IgA к CD74. При этом у пациентов со спондилоартритами значимо повышена концентрация аутоантител IgA к CD74 по сравнению с пациентами с ДДЗП.

Ключевые слова: *IgA антитела к CD74, спондилоартрит, дегенеративно-дистрофические заболевания позвоночника*

Конфликт интересов

Авторы заявляют, что данная работа, её тема, предмет и содержание не затрагивают конкурирующих интересов

Источники финансирования

Авторы заявляют об отсутствии финансирования при проведении исследования

Статья получена 06.12.2021 г.
Принята к публикации 05.05.2022 г.

Для цитирования: Ребров А.П., Гайдукова И.З., Апаркина А.В. и др. УРОВЕНЬ IGA АНТИТЕЛ К CD74 У ПАЦИЕНТОВ СО СПОНДИЛОАРТРИТАМИ И ДЕГЕНЕРАТИВНО-ДИСТРОФИЧЕСКИМИ ЗАБОЛЕВАНИЯМИ ПОЗВОНОЧНИКА. Архивъ внутренней медицины. 2022; 12(4): 310-315. DOI: 10.20514/2226-6704-2022-12-4-310-315. EDN: AZTSGS

Abstract

Background. According to the scientific literature, anti-CD74 IgA antibodies (IgA anti-CD74) are considered as a possible marker for the diagnosis of axial spondyloarthritis (SpA). The level of IgA anti-CD74 in patients with back pain due to degenerative spine disease has not been studied. Therefore, it could be interesting to compare the serum levels of IgA anti-CD74 in patients with chronic back pain in various diseases. **Aim**: to compare the levels of IgA anti-CD74 in patients with SpA and degenerative spine diseases. **Material and methods.** A total of 87 SpA patients (55 male, mean age 41 [29; 49] years) fulfilling the Assessment of Spondyloarthritis International Society (2009) criteria for Axial SpA, and 39 patients (25 male, mean age 45 [34; 53] years) with neurologist-verified degenerative spine diseases (ICD 10 codes — M 51.1 and M 54.4) were enrolled to the study. The serum levels of IgA anti-CD74 were analyzed by enzyme-linked immunosorbent assay (ELISA) in all patients. **Results.** The median levels of IgA anti-CD74 in patients with SpA were 11.3 [5.4; 19.4] U/ml, in patients with degenerative spine disease — 6.9 [4.5; 13.7] U/ml (p=0.024). IgA anti-CD74 serum levels were above the cut-off value in 58 (66.7 %) patients with SpA and only in 11 (28.2 %) patients with degenerative spine disease (p<0,001). The elevated serum levels of IgA anti-CD74 were detected in 10 (40 %) of 25 male patients and in 1 (7.1 %) of 14 female patients (p = 0.029, χ2 = 4.785) with degenerative spine disease. **Conclusion**. Serum levels of IgA anti-CD74 were increased in two-thirds of patients with SpA. IgA anti-CD74 was significantly higher in SpA patients compared to patients with degenerative spine disease.

Key words: *IgA antibodies to CD74, spondyloarthritis, degenerative-dystrophic diseases of the spine*

Conflict of interests

The authors declare no conflict of interests

Sources of funding

The authors declare no funding for this study

Article received on 06.12.2021
Accepted for publication on 05.05.2022

For citation: Rebrov A.P., Gaydukova I.Z., Aparkina A.V. et al. The Level of IgA Antibodies to CD74 in Patients with Spondyloarthritis and Degenerative-Dystrophic Diseases of the Spine. The Russian Archives of Internal Medicine. 2022; 12(4): 310-315. DOI: 10.20514/2226-6704-2022-12-4-310-315. EDN: AZTSGS

ASDAS — the Ankylosing Spondylitis Disease Activity Score, BASDAI — the Bath Ankylosing Spondylitis Disease Activity Index, CRP — C-reactive protein, DDDS — degenerative and dystrophic diseases of the spine, ESR — erythrocyte sedimentation rate, SpA — spondyloarthritis

Introduction

Spondyloarthritis (SpA) is a group of chronic inflammatory diseases of spine, joints, and entheses that are characterized by common clinical, X-ray and/or MRI signs and genetic features [1]. The pathogenesis of SpA is not fully understood. According to current concepts, investigation of the pathogenesis of SpA is based on the theory of the autoimmune nature of this disease, however, no autoantibodies were found that could be used to diagnose this disease, to assess SpA activity, and, in the long term, the effectiveness of ongoing treatment [2]. There are several known types of autoantibodies with not finally determined role in SpA: autoantibodies to beta-2-microglobulin, mutated citrullinated vimentin, sclerostin, CD74, etc. [3]. Over recent years, researchers turned their attention to analysis of the role and diagnostic value of anti-CD74 IgA autoantibodies in patients with SpA. Anti-CD74 autoantibodies that were first identified in 2014 by N.T. Baerlecken et al. [4], are currently considered as a candidate biomarker for the diagnosis of axial SpA, in particular, of non-radiographic axial SpA.

Currently, literature sources have no definitive information about the role and significance of anti-CD74 autoantibodies in the patients with SpA. Thus, a higher diagnostic significance of the combination of HLA-B27 and CD74 for the diagnosis of early axial SpA was observed in the European population compared to the determination of HLA-B27 alone [5]. According to the literature sources, anti-CD74 IgA autoantibodies may become a possible immunological biomarker for the diagnosis of axial spondyloarthritis [6]. However, according to Liu Y. et al., the ambiguity of the data obtained and the discrepancy between the results of studies conducted may be due to ethnic differences in the studied groups of patients, or errors in laboratory tests (perhaps, storage time or the fact of sample freezing) [3]. At the same time, we found no data in available literature on the level of anti-CD74 autoantibodies in patients with back pain caused by degenerative and dystrophic diseases of the spine (DDDS). The use of anti-CD74 IgA autoantibodies level for early diagnosis of SpA, as well as for differential diagnosis of diseases in patients with chronic back pain is of undoubted academic and practical interest. This paper is a pilot study on the comparison of the level of anti-CD74 IgA autoantibodies in the patients with SpA and DDDS.

The objective of this study was to compare the level of anti-CD74 autoantibodies in the patients with SpA and DDDS.

Materials and methods

This study included in total 126 patients aged 28–55, with chronic back pain of different origin. All patients were hospitalized in the Rheumatology or Neurology Department of Saratov Regional Clinical Hospital during the period of 2017–2019 due to persistent intense back pain that could not be managed at the outpatient stage of treatment. All patients signed an informed consent form to enter the study. This study was approved by the Ethics Committee of V.I. Razumovsky Saratov State Medical University of the Ministry of Health of Russia. Patients with oncohematological, rheumatic diseases (except for SpA), acute chronic pathologies, patients with injuries, mental diseases, drug or alcohol abuse, infections (HIV/viral hepatitis), as well as pregnant women were excluded from the study.

The group of patients with SpA included 87 patients (55 men, average age 41 [29; 49]) who were hospitalized in the Rheumatology Department and participated in PROGRESS prospective cohort single-center study (PROGram for monitoRing the activity and functional status of patiEnts with Spondyloarthritis in the Saratov region; registration on the website www.citis.ru, No. 01201376830 from 09 DEC 2013). All patients with SpA met the criteria for axial spondyloarthritis established by the Assessment of Spondyloarthritis International Society (2009). The group of patients with DDDS included 39 patients (25 men, average age 45 [34; 53]); the diagnosis was confirmed by a neurologist (codes M.51.1 and M.54.4 in ICD-10). SpA group included 32 female and 55 male patients; DDDS group — 14 female and 25 male patients. SpA and DDDS groups were comparable in terms of sex, age, and disease duration. SpA activity was assessed by calculating the ASDAS-CRP (Ankylosing Spondylitis Disease Activity Score) and BASDAI (Bath Ankylosing Spondylitis Disease Activity Index) activity scores [7, 8]. Erythrocyte sedimentation rate (ESR) and highly sensitive C-reactive protein (CRP) levels were determined in all patients. To determine the amount of anti-CD74 (IgA) autoantibodies in the obtained serum samples of patients, a quantitative enzyme immunoassay technique was used using AESKULISA® SpAdetect reagents (AESKU, Germany) according to the instructions attached to the kit (threshold value of normal level was 12 U/mL).

Duration of SpA was 10 [7; 20] years; the age of disease onset was 31.5 [27; 42] years. In patients with DDDS, disease duration was 8 [5; 18] years; the age of disease onset was 36.5 [34; 45] years. Description of patients with SpA and DDDS is presented in Table 1; $p \geq 0.05$ for all parameters. Cardiovascular risk was comparable in patients with SpA and with DDDS.

Statistical processing of obtained data was carried out using Microsoft Office Excel 2007 (Microsoft Corp., USA) and STATISTICA 8.0 (StatSoft Inc, USA). The nature of data distribution was assessed by a graphical method and using Shapiro — Wilk test. Descriptions of parameters other than the normal distribution are presented as Me [Q1; Q3], where Me is the median, Q1 and Q3 are the first and third quartiles. If data distribution was other than normal, nonparametric methods were used: Mann-Whitney test, Wald-Wolfowitz runs test, χ^2 test, Fisher's test, Wilcoxon test.

Results

Average ESR in patients with SpA and DDDS was 11 [6; 20] mm/h and 7 [2; 9] mm/h, respectively ($p = 0.0001$). CRP level in patients with SpA was 10.5 [4.0; 20.0] mg/mL, in patients with DDDS — 4.0 [3.4; 6.5] mg/mL ($p = 0.0001$). The average level of anti-CD74 IgA autoantibodies in patients with SpA was 11.3 [5.4; 19.4] U/mL, in patients with DDDS — 6.9 [4.5; 13.7] U/mL ($p = 0.024$). Increased concentration of anti-CD74 IgA autoantibodies above the threshold value was found in 58 (66.7%) patients with SpA and only in 11 (28.2%) patients with DDDS ($p < 0.001$), Fig.1.

Concentration of anti-CD74 IgA autoantibodies exceeded the threshold value with the same frequency in male and female patients with SpA: in 36 (65.5%) male and 22 (68.8%) female patients. Analysis of data revealed a trend towards increased incidence of elevated levels of anti-CD74 IgA autoantibodies in 10 (40%) male patients compared with 1 (7.1%) female patient with

Table 1. *The main clinical and demographic parameters and characteristics of drug treatment in patients with spondyloarthritis and degenerative spine diseases, included in the study*

Parametr	Patients with spondyloarthritis (n = 87) Me [Q1; Q3] / n (%)	Patients with degenerative spine diseases (n = 39) Me [Q1; Q3] / n (%)
Age, years	43 [36; 51]	47 [38; 55]
Age of onset of the disease	31,5 [27; 42]	36,5 [34; 45]
Men	55 (63,2)	25 (64,1)
Women	32 (36,8)	14 (35,9)
Duration of the disease, years	10 [7; 20]	8 [5; 18]
BMI, kg/m^2	24,2 [18; 32]	25,1 [19; 34]
Obesity	14 (16,1)	7 (17,9)
Totalcholesterol, mmol/L	4,8 [4,0; 5,8]	4,9 [4,1; 6,0]
Arterial hypertension	25 (28,7)	11 (28,2)
	Therapy	
NSAIDs	85 (97,7)	39 (100)
Glucocorticoids	12 (13,8)	-
DMARs, including:		-
Methotrexate	2 (2,3)	-
Sulfasalazine	1 (1,1)	-
bDMARDs	2 (2,3 %)	-

Notes: BMI — body mass index, NSAIDs — non-steroidal anti-inflammatory drugs, DMARs — disease-modifying antirheumatic drugs, bDMARDs — biological disease-modifying anti-rheumatic drugs

DDDS (p = 0.070). Men with DDDS and the level of anti-CD74 IgA autoantibodies above the threshold value demonstrated significantly increased concentration of CRP compared to this parameter in men with DDDS and the level of anti-CD74 IgA autoantibodies below the threshold value (5.8 [4.4; 7.5] and 2.4 [2.2; 4.2] mg/mL, respectively, p = 0.038).

Discussion

Differential diagnosis of chronic back pain is a challenge in clinical practice [9]. Insufficient effectiveness of conventional instrumental examinations and laboratory tests for diagnosing SpA, especially at the early stages of this disease, is the reason for searching new immunological markers for differential diagnosis in patients with back pain [10]. According to research findings, anti-CD74 autoantibodies have the highest clinical and diagnostic significance in SpA [11, 12, 13]. At the same time, anti-CD74 IgA autoantibodies were not studied in patients with DDDS and chronic back pain. Interleukin 6 levels, the activity of cathepsin B, and hyaluronic acid in blood serum were studied as biomarkers of inflammation in patients with DDDS [14, 15]. Results of these studies revealed that patients with DDDS have slightly increased levels of interleukins. In our research, we have found that the concentration of anti-CD74 IgA autoantibodies was significantly higher in patients with SpA than in patients with DDDS. These results are comparable with the results obtained by foreign researchers that demonstrated high sensitivity and specificity of anti-CD74 IgG in patients with SpA what confirms clinical, pathogenetic and diagnostic significance of anti-CD74 autoantibodies in this disease.

Besides, a higher level of CRP was observed in men with DDDS and increased concentration of this immunological marker, than in men with DDDS and the level of anti-CD74 IgA autoantibodies below the threshold value. The data obtained raise questions about the reasons for such a combination in patients with DDDS, as well as about the nature and characteristics of the pathological process, and the need for additional special examination in order to exclude or confirm SpA in this group. Unfortunately, so far, SpA is often diagnosed with delay [9]; the patients with early onset of chronic pain are for a long time treated for DDDS by many doctors, whereas SpA is diagnosed with 7-10 years delay or even later. Such patients suffer from chronic pain, lose working capacity; moreover, they have to undergo repeated resultless examinations with different specialists, as well as diagnostic procedures, including computed tomography; however, SpA is diagnosed only by a rheumatologist. One of the most urgent issues of today is the timely diagnosis of SpA to use "the window of opportunity" and provide time therapy. In this regard, the results obtained are of undeniable academic and practical interest. These data certainly do not allow drawing definite and far-reaching conclusions, however, they allow suggesting that the determination of anti-CD74 IgA autoantibodies can be used in the future in differential diagnostics of patients with chronic back pain, if sufficient evidence is collected.

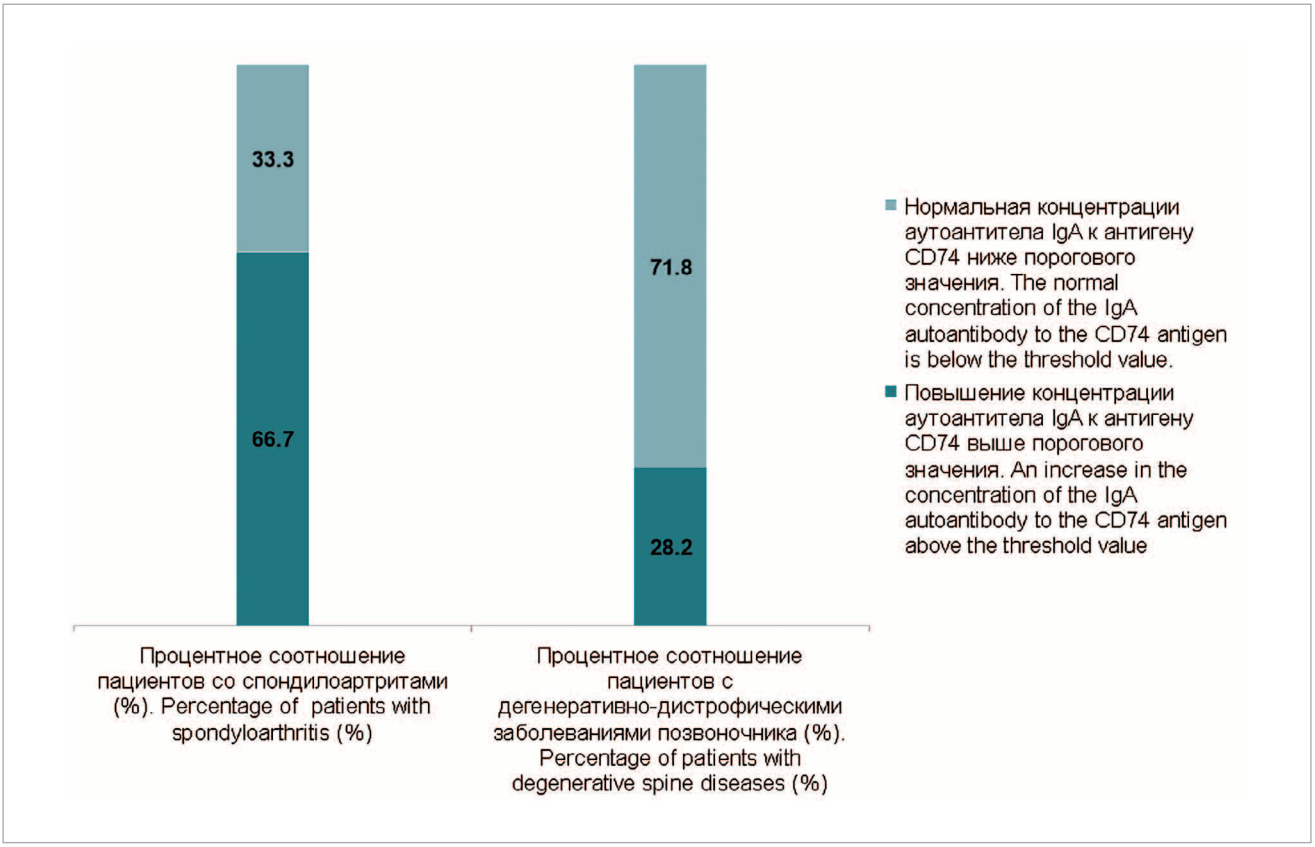

Figure 1. *The patients with spondyloarthritis and degenerative spine diseases with a concentration of IgA to CD74 above and below the threshold level*

Limitations

This study was conducted on a small sample of patients that were included in the study along with different concomitant treatment. Extrapolating the results of this study to all patients with SpA and DDDS should be done with caution.

Conclusion

2/3 of patients with spondyloarthritis demonstrated increased level of anti-CD74 IgA autoantibodies. Moreover, the concentration of anti-CD74 IgA autoantibodies in patients with spondyloarthritis was significantly increased in comparison with patients with DDDS. Determination of the level of anti-CD74 IgA autoantibodies in combination with conventional laboratory tests and instrumental methods of examination seems to be high-perspective for differential diagnosis in patients with chronic back pain; larger studies with specific design are required, with follow-up of patients at the early stages of disease development, i.e. patients with chronic back pain and increased levels of anti-CD74 IgA autoantibodies and CRP.

Вклад авторов:

Все авторы внесли существенный вклад в подготовку работы, прочли и одобрили финальную версию статьи перед публикацией

Ребров А.П. (ORCID: https://orcid.org/0000-0002-3463-7734): концепция и дизайн исследования, анализ и интерпретация данных, написание текста статьи, утверждение итогового варианта текста рукописи.

Гайдукова И.З. (ORCID: https://orcid.org/0000-0003-3500-7256): концепция и дизайн исследования, анализ и интерпретация данных, утверждение итогового варианта текста рукописи.

Апаркина А.В. (ORCID: https://orcid.org/0000-0001-8463-2379): анализ и интерпретация данных, написание текста статьи, утверждение итогового варианта текста рукописи.

Королев М.А. (ORCID: https://orcid.org/0000-0002-4890-0847): получение данных, утверждение итогового варианта текста рукописи.

Сафарова К.Н. (ORCID: https://orcid.org/0000-0002-8989-8405): получение данных, утверждение итогового варианта текста рукописи.

Дорогойкина К.Д. (ORCID: https://orcid.org/0000-0003-1765-2737): получение данных, утверждение итогового варианта текста рукописи.

Бичурина Д.М. (ORCID: https://orcid.org/0000-0003-1745-6285): получение данных, утверждение итогового варианта текста рукописи.

Author Contribution:

All the authors contributed significantly to the study and the article, read and approved the final version of the article before publication

Rebrov A.P. (ORCID: https://orcid.org/0000-0002-3463-7734): research concept and design, analyzing and interpreting data, approving the final version of the publication

Gaydukova I.Z. (ORCID: https://orcid.org/0000-0003-3500-7256): research concept and design, analyzing and interpreting data, approving the final version of the publication

Aparkina A.V. (ORCID: https://orcid.org/0000-0001-8463-2379): analyzing and interpreting data, approving the final version of the publication

Korolev M.A. (ORCID: https://orcid.org/0000-0002-4890-0847): obtaining data, approving the final version of the publication

Safarova K.N. (ORCID: https://orcid.org/0000-0002-8989-8405): obtaining data, approving the final version of the publication

Dorogoykina K.D. (ORCID: https://orcid.org/0000-0003-1765-2737): obtaining data, approving the final version of the publication

Bichurina D.M. (ORCID: https://orcid.org/0000-0003-1745-6285): obtaining data, approving the final version of the publication

Список литературы / References:

1. Эрдес Ш.Ф., Ребров А.П., Дубинина Т.В., и др. Спондилоартриты: современная терминология и определения. Терапевтический архив. 2019; 91(5): 84–8. doi:10.26442/00403660.2019.05.000208
   Erdes S.F., Rebrov A.P., Dubinina T.V. et al. Spondyloarthritis: modern terminology anddefinitions. Ter Arkh. 2019; 91(5): 84–8. doi:10.26442/00403660.2019.05.000208 [in Russian].
2. Abdelaziz M.M., Gamal R.M., Ismail N.M., et al. Diagnostic value of anti-CD74 antibodies in early and late axial spondyloarthritis and its relationship to disease activity. Rheumatology (Oxford). 2021 Jan 5; 60(1): 263-268. doi: 10.1093/rheumatology/keaa292. PMID: 32710117
3. Liu Y., Liao X., Shi G. Autoantibodies in Spondyloarthritis, Focusing on Anti-CD74 Antibodies. Front Immunol. 2019 Jan 22; 10: 5. doi: 10.3389/fimmu.2019.00005
4. Baerlecken N.T., Nothdorft S., Stummvoll G.H., et al. Autoantibodies against CD74 in spondyloarthritis. Ann. Rheum. Dis. 2014; 73(6): 1211-4. doi: 10.1136/annrheumdis-2012-202208.
5. Ziade N.R., Mallak I., Merheb G., et al. Added Value of Anti-CD74 Autoantibodies in Axial SpondyloArthritis in a Population With Low HLA-B27 Prevalence. Front. Immunol. 10: 574. doi: 10.3389/fimmu.2019.00574.
6. Кузнецова Д.А., Лапин С.В., Гайдукова И.З., и др. Клинико-диагностическая значимость аутоантител к CD74 при аксиальных спондилоартритах. Клиническая лабораторная диагностика. 2018; 68 (5): 297-301. doi: 10.18821/0869-2084-2018-63-5-297-301.
   Kuznetsova D.A., Lapin S.V., Gaydukova I.Z., et al. The clinical diagnostic significance of auto antibodies to CD74 at axial spondylarthrosis. Klinicheskaya Laboratornaya Diagnostika (Russian Clinical Laboratory Diagnostics) 2018; 68 (5): 297-301. doi: 10.18821/0869-2084-2018-63-5-297-301. [in Russian].
7. Garrett S., Jenkinson T., Kennedy L.G., et al. A new approach to defining disease status in ankylosing spondylitis: the Bath Ankylosing Spondylitis Disease Activity Index. J Rheumatol. 1994;21(12):2286–2291.
8. Lukas C., Landewé R., Sieper J., et al. Assessmentof Spondylo Arthritis international Society. Developmentof an ASAS-endorsed disease activity score (ASDAS) in patientswith ankylosing spondylitis. Ann Rheum Dis. 2009; 68(1): 18–24. doi: 10.1136/ard.2008.094870
9. Poddubnyy D. Classification vs diagnostic criteria: the challenge of diagnosing axial spondyloarthritis. Rheumatology (Oxford). 2020; 59(Suppl4): iv6-iv17. doi: 10.1093/rheumatology/keaa250.
10. Baerlecken N.T., Witte T. Methods and means for diagnosing spondyloarthritis using autoantibody markers. Patent EP, № 2420834A1; 2010.
11. Baerlecken N.T., Nothdorft S., Stummvoll G.H., et al. Autoantibodies against CD74 in spondyloarthritis. Ann. Rheum. Dis. 2014; 73(6): 1211-4. doi: 10.1136/annrheumdis-2012-202208.
12. Baraliakos X., Baerlecken N., Witte T., et al. High prevalence of anti-CD74 antibodies specific for the HLA class II-associated invariant chain peptide (CLIP) in patients with axial spondyloarthritis. Ann. Rheum. Dis. 2014; 73(6): 1079-82. doi: 10.1136/annrheumdis-2012-202177.
13. Prajzlerová K., Grobelná K., Pavelka K., et al. An update on biomarkers in axial spondyloarthritis. Autoimmun. Rev.2016; 15(6): 501-9. doi: 10.1016/j.autrev.2016.02.002.
14. Weber K.T., Alipui D.O., Sison C.P., et al. Serum levels of the proinflammatory cytokine interleukin-6 vary based on diagnoses in individuals with lumbar intervertebral disc diseases. Arthritis Res Ther. 2016 Jan 7;18:3. doi: 10.1186/s13075-015-0887-8.
15. Rodrigues L.M.R., Oliveira L.Z., Silva M.B.R.D. et al. Share Infla mmatory biomarkers in sera of patients with intervertebral disc degeneration. Einstein (Sao Paulo). 2019 Aug 29; 17(4): eAO4637. doi: 10.31744/einstein_journal/2019AO4637.