Available online at www.ujpronline.com
Universal Journal of Pharmaceutical Research
An International Peer Reviewed Journal
ISSN: 2831-5235 (Print); 2456-8058 (Electronic)

RESEARCH ARTICLE

THE ASSOCIATION OF EPSTEIN-BARR VIRUS ANTIBODIES WITH RHEUMATOID ARTHRITIS AMONG YEMENI PATIENTS IN SANA'A CITY

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Article Info:

Article History:
Received: 24 May 2017
Reviewed: 3 July 2017
Accepted: 20 August 2017
Published: 15 September 2017

Cite this article:
Othman AM, Alyosfi EA, AL-Shamahy HA. The association of EPSTEIN-BARR virus antibodies with rheumatoid arthritis among Yemeni patients in Sana'a city. Universal Journal of Pharmaceutical Research 2017; 2(4): 15-18. ***http://doi.org/10.22270/ujpr.v2i4.R4***

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Abstract

Objectives: Rheumatoid arthritis (RA) is a chronic autoimmune disease that is associated with progressive disability, systemic complications and early death. Etiology of RA is unknown. It is assumed that environmental factors initiate RA development in genetically susceptible individuals. Epstein- Barr Virus (EBV) stimulates polyclonal B cell activation and has been suggested to play a role in RA pathogenesis. Current study aimed to study the association between EBV and RA.
Methods: One hundred and sixty subjects were enrolled in the study. Eighty individuals were clinically diagnosed to have RA and confirmed by anti-CCP3 test. The remaining 80 individuals were healthy controls matched for age and sex. Serum IgG and IgM antibodies against EBV viral capsid antigen (VCA) were tested by an enzyme-linked immunosorbent assay (ELISA).
Results: The crude prevalence rate of EBV-VCA IgM antibodies among patients was (21.2%) while in healthy individuals was (8.7%) with significant OR equals to 2.8 times for RA patient's. The female prevalence rate of EBV-VCA IgM antibodies was (21.8%) higher than of male (18.7%). The female prevalence rate of EBV-VCA IgG antibodies was (95.3%) higher than of male (75%). EBV-VCA IgG and IgM antibodies titers were elevated in RA patients than in healthy controls.
Conclusion: In conclusion, high titers of EBV antibodies are associated with RA. However, the causative relationship between EBV and autoimmune diseases is complex and involves different mechanisms.
Keywords: Anti EBV-VCA IgG antibodies, anti EBV-VCA IgM antibodies, Epstein- Barr Virus, Rheumatoid arthritis, Yemeni.

INTRODUCTION

Rheumatoid arthritis (RA) is a chronic autoimmune disorder which is common among females at an older age. Worldwide prevalence of RA is estimated to be about 0.5%-1%.The cause of RA remains unclear though it has been proposed by previous studies that both genetic and environmental factors play an important role in RA pathogenesis[1-3]. RA genetic susceptibility is carried by HLA-DRB1* alleles containing the QK/RRAA or RRRAA motif in their third hyper variable region. This motif is known as the shared epitope[4]. It is associated with low occurrence of T cells specific for EBV gp110, a replicative phase glycoprotein critical for the control of EBV infection[5]. One environmental trigger may be the Epstein-Barr virus (EBV). EBV is a double-stranded DNA herpes virus that is extremely common worldwide, infecting about 98% of the human population by the age of 40 years[6]. It is transmitted through saliva. It infects and replicates in epithelial cells and B cells. EBV then becomes latent within memory B cells and persists for the lifetime of the host[7]. It causes acute infectious mononucleosis. It also reported to have association with nasopharyngeal carcinoma, Hodgkin and non-Hodgkin lymphomas, gastric carcinoma, Burkitt lymphoma and other lympho-proliferative disorders in immune compromised individuals[8]. For long time, EBV has been suspected as a possible etiology of autoimmune diseases including RA due to its high prevalence in the population and its lifelong infection after primary infection[9,10]. The association between EBV and RA was first reported by Alspaugh and Tan. They reported that sera from RA patients were reactive against a nuclear antigen in EBV-transformed lymphocytes[11]. Association between RA pathogenesis and EBV has been linked to molecular mimicry. Several EBV antigens share similarities with self-antigens; more specifically, glycine/ alanine repeats in EBNA-1 resemble synovial proteins. Antibodies

against this repeat cross-react with a 62kD protein in RA, but not in normal synovium[12,13]. EBV DNA loads are higher in mononuclear cells isolated from active RA patients compared to healthy seropositive individuals as well as EBV serology. Furthermore, antibodies directed against cyclic citrullinated peptides (ACPA) which are used as confirmatory test for RA diagnosis, were found to react with a citrullinated sequence of Epstein-Barr nuclear antigen-1 (EBNA-1),supporting the association between EBV and RA[14]. Current study aimed to investigate the association between EBV and RA via measuring EBV-VCA IgM and IgG in RA patients compared with healthy controls.

SUBJECTS AND METHODS

This study is a case-control study conducted from October 2014 to October 2015. A total number of 160 individuals were included in the study. Eighty persons were clinically diagnosed with RA and confirmed by measuring anti-CCP3. The other 80 were healthy individuals used as controls. A full history from each RA case and healthy control was recorded on a predesigned questionnaire. The study was carried out at Al-Thawra Modern General Hospital and National Center of Central Public Health Laboratories, in Sana'a city, Yemen. Patients with other autoimmune diseases, infectious mononucleosis, Hodgkin's lymphoma, Burkitt's lymphoma, nasopharyngeal carcinoma, or with HIV were excluded from the study. Five ml of venous blood was collected from each individual into plain vacutioner tubes. The specimens were allowed to clot at room temperature and centrifuged at 3500 rpm for five minutes. Serum was separated from each sample into Eppendorf tubes and stored at -20°C until tested. EBV virologic assays to measure IgG and IgM viral capsid antigen (VCA) were performed using NovaLis a EBV ELISA kits provided by (NOVA TEC, Dietzenbach, Germany). The commercially ELISA test for anti-CCP3 was carried out according to the manufactures instructions (INOVA Diagnostics Kits, San Diego, CA-USA). Statistical analysis of data was performed using the Epi Info statistical program version 6 (CDC, Atlanta, USA).

RESULTS

Table 1 shows the characteristics of RA patients and healthy controls. Out of 80 RA cases, 64 (80%) were females while 16 (20%) were males. Their age ranged from 20 to 80 years with mean age 42.3±16.3 years old. Likewise, the control group involved 64 (80%) females and 16 (20%) males. Their age ranged from 20 to 80 years with mean age 39.6±11.2 years old. Most of the cases and controls were at the age group of ≥50 years old.

Table 1: Age and sex of rheumatoid arthritis cases and healthy controls.

Variable Characteristics	Cases (n=80)		Controls(n=80)		Total(n=160)	
	No.	%	No.	%	No.	%
Age/ Years						
20-29	22	27.5	22	27.5	44	27.5
30-39	16	20.0	16	20.0	32	20.0
40-49	10	12.5	10	12.5	20	12.5
≥50	32	40.0	32	40.0	64	40.0
Total	**80**	**100**	**80**	**100**	**160**	**100**
Mean/ Years	42.3		39.6		39.9	
SD/ Years	16.3		11.2		14.5	
Min./ Years	20		20		20	
Max./ Years	80		80		80	
Sex						
Females	64	80.0	64	80.0	128	80
Males	16	20.0	16	20.0	32	20
Total	**80**	**100**	**80**	**100**	**160**	**100**

Table 2 shows the prevalence rate of EBV-VCA IgM antibodies in different sex and age groups for RA patients and healthy controls. EBV-VCA IgM antibodies among RA females, 14 (21.8%), were higher than that of RA males, 3 (18.7%), with an OR equals to 2.7 times for females than males whereas in control females, 6 (9%), and males, 1(6%). As regard to the age, the serum EBV-VCA IgM antibodies in RA patients were highest at the age group of 40-49, years in which the rate was (30%), followed by the age group of ≥50 years (25%), then the age group of 30-39 years (18.7%), and finally the age group of 20-29 years (13.6%). Among the controls corresponding numbers were 1(10%), 3(9.3%), 2(12.5%), and 1(4%), respectively. When we compared the crude prevalence rate of EBV IgM antibodies among cases and controls we found that the crude prevalence rate among RA patients was 21.2% while among controls was 8.7%. OR of EBV infection for RA cases was 2.8 times, and this association was ranged from 1.01 up to 8.1, with significant $\chi 2$ (4.9) and statistically p equals to 0.02. Table 3 demonstrates the prevalence rate of EBV-VCA IgG antibodies in different sex and age groups of RA patients and healthy controls. The EBV-VCA IgG antibodies among females, 61 (95.3%), were higher than that of males, 12 (75%), among cases with an OR equals to 5.2 times for females than males whereas, in control females, 51(79.6%), and males, 10 (62.5%). As regard to the age, the serum EBV-VCA IgG antibodies were highest at the age group of ≥50 years old, in which the rate was (100%), followed by the age group of 40-49 years (90%), then the age group of 30-39

years (87.5%), and finally the age group of 20-29 years (81.8%). Among the controls corresponding numbers were 28(87.5%), 7(70%), 12(75%), and 14(63.6%), respectively. When we compared the crude prevalence rate of EBV IgG antibodies among cases and controls we found that the crude prevalence rate among RA patients was 91.3% while among controls was 76.3%. OR of contract EBV infection for RA cases was 3.2 times, and this association was ranged from 1.2 up to 9.2, with significant χ^2 (6.6) and statistically *p* equals to 0.01.

Table 2: Seropositive for EBV-VCA IgM for RA patients and healthy controls.

Age and Sex groups	Seropositive for EBV-VCA IgM Case		Control		OR	CI	χ^2	*P*
	No.	%	No.	%				
Age/ Years								
20-29	3	13.6	1	4	4	0.26-9.0	1.1	0.29
30-39	3	18.7	2	12.5	1.6	0.17-16.7	0.24	0.62
40-49	3	30	1	10	3.8	0.24-12.1	1.25	0.26
≥50	8	25	3	9.3	3.2	0.66-17.5	2.74	0.09
Sex								
Female **(n=64)**	14	21.8	6	9	2.7	0.8-8.6	3.8	0.05
Males **(n=16)**	3	18.7	1	6	3.46	0.3-9.8	1.14	0.28
Crude rate IgM	17	21.2	7	8.7	2.8	1.01-8.1	4.9	0.02

Table 3: Seropositive for EBV-VCA IgG for RA patients and healthy controls.

Age and Sex groups	Case		Control		OR	CI	χ^2	*P*
	No.	%	No.	%				
Age/ Years								
20-29	18	81.8	14	63.6	2.6	0.54-13	1.8	0.17
30-39	14	87.5	12	75	2.3	0.3-22.7	0.82	0.36
40-49	9	90	7	70	3.86	0.24-121	1.25	0.26
≥50	32	100	28	87.5	Undefined		4.2	0.03
Sex								
Female (n=64)	61	95.3	51	79.6	5.2	1.28-24.4	7.14	0.007
Males (n=16)	12	75	10	62.5	1.8	0.3-10.7	0.58	0.44
Crude rate IgG	73	91.3	61	76.3	3.25	1.2-9.2	6.6	0.01

DISCUSSION

RA is a systemic autoimmune disease of unknown etiology. Both genetic and environmental factors are suggested to contribute to RA pathogenesis[1,15]. Epstein-Barr virus was proposed as an environmental trigger of RA. It causes massive polyclonal expansion of resting lymphocytes and becomes latent within memory B cells for the lifetime of the host[16]. Current study showed a highly significant rate and associated OR of positive EBV-VCA IgM and IgG in RA patients than in healthy controls. Several studies have shown elevation of EBV antibodies in RA patients than healthy controls[14,17,18]. So far, there is no decisive theory to explain how EBV is involved in RA pathogenesis. However, several representative hypotheses on the possible mechanisms of EBV's involvement in autoimmune diseases are described[19]. One mechanism by which EBV can trigger RA is molecular mimicry[20]. Studies found antibodies against EB-encoded proteins cross-react with RA-specific proteins[7,11,21]. This finding supports the molecular mimicry hypothesis in RA pathogenesis either by influencing T cell receptor recognition of the HLA 'shared epitope'[6]. Molecular mimicry between a major EBV epitope and several autoantigens might contribute to a breakdown of tolerance and autoimmunity in patients with RA[22]. It hypothesizes that in patients with certain autoimmune diseases, EBV infects auto reactive B cells leading to auto antibodies production[23,24]. Third mechanism is through the mistaken-self theory[25,26]. EBV-infected B cells together with closely located activated T cells have been demonstrated in the synovial lesions of RA[27,28].

CONCLUSIONS

High titers of EBV antibodies are not attributed to more frequent EBV reactivation in RA patients as a result of immune suppression therapy. Studies monitored EBV viral load in RA patients under TNF blockers for one to five. EBV load was stable over time; even when TNF blockers were associated with methotrexate. In conclusion, high titers of EBV antibodies are associated with RA. However, the causative relationship between EBV and autoimmune diseases is complex and involves different mechanisms.

ACKNOWLEDGEMENTS

The authors thank physicians and specialists at the Department of Rheumatology at Al-Thawra Modern General Hospital and staff at Virology Department at National Center of Central Public Health Laboratories for their great help during study performance.

AUTHOR'S CONTRIBUTION

Othman AM: writing original draft, conceptualization, methodology, investigation. **Alyosfi EA:** writing, review, and editing, supervision, resources. **AL-Shamahy HA:** writing, review, and editing. Final version of manuscript is approved by all authors.

DATA AVAILABILITY

The data and material are available from the corresponding author on reasonable request.

CONFLICT OF INTEREST

There is no conflict of interest to be declared.

REFERENCES

1. McInnes IB, Schett G. The pathogenesis of rheumatoid arthritis, N Engl J Med 2011; 365:2205-2219 *https://doi.org/10.1056/NEJMra1004965*
2. Myasoedova E, Davis JM, Crowson CS, Gabriel SE. Epidemiology of rheumatoid arthritis: Rheumatoid arthritis and mortality, Curr Rheumatol Rep 2010; 12:379-385.*https://doi.org/10.1007/s11926-010-0117-y*
3. Pedersen M, Jacobsen S, Garred P, *et al*. Strong combined gene-environment effects in anti-cyclic citrullinated peptide-positive rheumatoid arthritis: A nationwide case-control study in Denmark, Arthritis Rheum 2007; 56:1446-1453. *https://doi.org/10.1002/art.22597*
4. Winchester R, Dwyer E, Rose S. The genetic basis of rheumatoid arthritis. The shared epitope hypothesis, Rheum Dis Clin North Am 1992; 18:761-783 *https://doi.org/10.1097/BOR.0b013e328336ba63*
5. Arleevskaya MI, OA Kravtsova, J Lemerle, *et al*. How rheumatoid arthritis can result from provocation of the immune system by microorganisms and viruses, Front Microbiol. 2016; 7:1296.*https://doi.org/10.3389/fmicb.2016.01296*
6. Costenbader KH, Karlson EW. Epstein-barr virus and rheumatoid arthritis: Is there a link? Arthritis Res Ther. 2006; 8:204.*https://doi.org/10.1186/ar1893*
7. Niller HH, Wolf H, Ay E, Minarovits J. Epigenetic dysregulation of epstein-barr virus latency and development of autoimmune disease. Adv Exp Med Biol 2011; 711:82-102 *https://doi.org/10.1007/978-1-4419-8216-2_7*
8. Butel J. General properties of viruses. In: KC C, ed. Jawetz, melnick, and adelberg's medical microbiology. New York: McGraw-Hill Education 2013;407–415.
9. Adtani P, Malathi N. Epstein-barr virus and its association with rheumatoid arthritis and oral lichen planus. J Oral Maxillofac Pathol 2015; 19:282-285 *https://doi.org/10.4103/0973-029X.174643*
10. 10 Mahabadi M, Faghihiloo E, Alishiri GH, Ataee MH, Ataee RA. Detection of epstein-barr virus in synovial fluid of rheumatoid arthritis patients. Electron Physician 2016; 8:2181-2186. *https://doi.org/10.19082/2181*
11. Aslpaugh MA, Tan EM. Serum antibody in rheumatoid arthritis reactive with a cell-associated antigen. Demonstration by precipitation and immunofluorescence, Arthritis Rheum. 1976; 19:711-719. *https://doi.org/10.1002/1529-0131(197607/08)19:4<711::aid-art1780190409>3.0.co;2-i*
12. Toussirot E, Roudier J. Pathophysiological links between rheumatoid arthritis and the epstein-barr virus: An update, Joint Bone Spine 2007; 74:418-426. *https://doi.org/10.1016/j.jbspin.2007.05.001*
13. Baboonian C, Halliday D, Venables PJ, *et al*. Antibodies in rheumatoid arthritis react specifically with the glycine alanine repeat sequence of epstein-barr nuclear antigen-1. Rheumatol Int 1989; 9:161-166.*https://doi.org/10.1136/ard.50.11.772*
14. Westergaard MW, Draborg AH, Troelsen L, Jacobsen S, Houen G. Isotypes of epstein-barr virus antibodies in rheumatoid arthritis: Association with rheumatoid factors and citrulline-dependent antibodies. Biomed Res Int 2015; 472174.*https://doi.org/10.1155/2015/472174*
15. Birch JT, Jr., Bhattacharya S. Emerging trends in diagnosis and treatment of rheumatoid arthritis. Prim Care 2010; 37:779-792.PMID: 24024009
16. Balandraud N, Roudier J, Roudier C. Epstein-barr virus and rheumatoid arthritis. Autoimmun Rev 2004; 3:362-367.*https://doi.org/10.1186/ar1893*
17. Alderzi AR AM, Alhadithi HS. Epstein–barr virus antibodies in rheumatoid artheritis iraqi patients. J Fac Med Baghdad. 2013; 55:358-361 *https://doi.org/10.1016/j.autrev.2004.02.002*
18. Ferrell PB, Aitcheson CT, Pearson GR, Tan EM. Seroepidemiological study of relationships between epstein-barr virus and rheumatoid arthritis. J Clin Invest 1981: 67:681-687.PMID: 6259207
19. Shigeyoshi Fujiwara MT. Epstein-barr virus and autoimmune diseases. Clin Exp Neuroimmunol 2015: 6:38-48. *https://doi.org/10.1111/cen3.12263*
20. Cusick MF, Libbey JE, Fujinami RS. Molecular mimicry as a mechanism of autoimmune disease. Clin Rev Allergy Immunol 2012; 42:102-111. *https://doi.org/10.1007/s12016-011-8294-7*
21. Alspaugh MA, Jensen FC, Rabin H, Tan EM. Lymphocytes transformed by epstein-barr virus. Induction of nuclear antigen reactive with antibody in rheumatoid arthritis. J Exp Med 1978: 147:1018-1027. *https://doi.org/10.1084/jem.147.4.1018*
22. Balandraud NRJ. Epstein-barr virus and rheumatoid arthritis. Joint Bone Spine 2017. *https://doi.org/ 10.1186/ar1893*
23. Pender MP. Infection of autoreactive B lymphocytes with EBV, causing chronic autoimmune diseases. Trends Immunol 2003; 24:584-588. *https://doi.org/10.1016/j.it.2003.09.005*
24. Niller HH, Wolf H, Minarovits J. Regulation and dysregulation of epstein-barr virus latency: Implications for the development of autoimmune diseases, Autoimmunity 2008; 41:298-328. *https://doi.org/10.1080/08916930802024772*
25. Scotet E, David-Ameline J, Peyrat MA, *et al*. T cell response to epstein-barr virus transactivators in chronic rheumatoid arthritis. J Exp Med 1996: 184:1791-1800. *https://doi.org/10.1084/jem.184.5.1791*
26. Van Noort JM, Bajramovic JJ, Plomp AC, van Stipdonk MJ. Mistaken self, a novel model that links microbial infections with myelin-directed autoimmunity in multiple sclerosis. J Neuroimmunol 2000; 105:46-57. *https://doi.org/10.1016/S0165-5728(00)00181-8*
27. Miceli-Richard C, Gestermann N, Amiel C, *et al*. Effect of methotrexate and anti-tnf on epstein-barr virus t-cell response and viral load in patients with rheumatoid arthritis or spondylarthropathies. Arthritis Res Ther 2009; 11:R77.*https://doi.org/10.1186/ar2708*
28. Balandraud N, Texier G, EMassy, *et al*. Long term treatment with abatacept or tocilizumab does not increase epstein-barr virus load in patients with rheumatoid arthritis - a three years retrospective study. PLoS One 2017:12:e0171623. *https://doi.org/10.1371/journal.pone.0171623.eCollection 2017*