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Original Article

Early detection of Asymptomatic Myocardial Dysfunctions in Rheumatoid Arthritis Patients: A New Approach

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ABSTRACT

Background: Cases of rheumatoid arthritis [RA] are characterized by a decreased life expectancy, as well as a 50% are at greater risk of developing cardiovascular diseases [CVD] compared to other subjects. Precocious myocardial dysfunction can be detected more accurately and faster with speckle -tracking Echocardiography.

The aim of the work: This study attempts to evaluate the function of myocardial Left ventricular [LV] systole via Speckle Tracking Echocardiography [STE] strain imaging in RA cases with the absence of [CVD] and to correlate the results with the disease features.

Patients and Methods: A case control study, which recruited 60 RA cases [with a median age of 46.22 ± 8.14 years] without known CVD, as well as 60 healthy controls.

Results: Assessment of speckle-tracking for [LV] systolic function revealed diminished Global Longitudinal Strain [GLS] in patient group [-16.80% vs. -22.35%, PP<0.001]. A negative association has been detected between RA as well as GLS duration [r = - 0.301]. Receiver operating characteristics [ROC] curve was utilized to determine the optimal cut-off value GLS value that was -20, with 76.7% sensitivity, 80% specificity, 92% positive predictive value, 63% negative predictive value, as well as with 83.9% diagnostic accuracy.

Conclusion: GLS measurement using STE is valuable in detecting impairment of left ventricle systolic function in RA patients, even in the presence of normal ejection fraction. Not only that but also, the degree of systolic function impairment is correlated to RA disease activity. This raises the concern that inappropriate management of RA activity could lead to development of CVD.

Keywords: Rheumatoid arthritis; Speckle tracking; Cardiovascular disease; Left ventricular longitudinal strain.

INTRODUCTION

It is well known that asymptomatic left ventricular myocardial dysfunction is common, both systolic and diastolic abnormalities at rates of; 45 and 31% respectively [1]. Rheumatoid Arthritis [RA] cases often encounter earlier Cardiovascular [CV] events [2], decreased life expectancy [3] and a greater than 50% higher CV death risk [4] compared to other subjects. Furthermore, these clinical events depend only in part on traditional risk factors of CV [5, 6] possibly in relation to persistent inflammation [7] as well as inflammatory myocardial infiltrates [8-12].

Detection of precocious systolic impairment can be performed by assessing strain [the ratio of myocardial deformation to its original shape] as well as the proportion of strain [how rapidly the deformation takes place] of the global myocardium or pre-selected myocardial

sections in standard planes. Doppler is regarded as an angle-dependent approach and is consequently not appropriate computing strain [deformation] indices. Speckle tracking echocardiography [STE] can be more informational [13-17] as it is an angle independent approach permitting assessing local myocardial strain as well as the rate of strain in pre-selected segments based on detection and tracking of small normal reflex patterns in the ultrasound B- mode image.

THE AIM OF THE WORK

The present study was aimed to evaluate the function of myocardial systole via imaging the STE strain in RA case without any known CVD and to correlate the results with disease characteristics.

PATIENTS AND METHODS

The current case control study involved [60] subjects with confirmed RA without known CVD who presented to the Rheumatology outpatient clinic of Al-Azhar university hospitals, during the period between October 2017 and March 2018, and the control group consisted of [60] healthy persons.

Inclusion criteria: Patients > 18 years old diagnosed as rheumatoid arthritis according to 1987 Revised Classification Criteria.

A full history was obtained from all subjects besides a complete clinical examination, and venous samples were collected for complete blood picture, low density lipoprotein, high density lipoprotein, triglycerides, total cholesterol, urea, creatinine, rheumatoid factor and anti-CCP. Standard echocardiographic screening in addition to spickle-tracking evaluation of LV strains, were performed using Philips IE 33 ultrasonography and was performed by a single investigator in both groups based on the directions of the American Society of Echocardiography. The process of STE analysis involved three or four basic steps. These include [i] the acquisition of optimal 2D images, [ii] image storage, [iii] image transfer to a dedicated workstation, and [iv] post-study analysis. We performed longitudinal strain analysis using a three-plane strain study. After the selection of the stored images and entering the aortic valve closure time, which was measured before, we began placing the tracking points, the annular points were placed at the intersection of the annulus and the LV wall, apical point was placed along the endocardial border of the apical wall.

Exclusion criteria: All cases with a history of ischemic heart diseases, congestive heart failure, stroke, atrial fibrillation, diabetes mellitus, cancer, chronic kidney illness, venous thromboembolism, other rheumatological diseases and valvular heart disease were excluded.

Data Collection and Analysis: The sample size was determined using epi-info Version 7 based on the following prerequisites: Confidence level = 95%, Expected frequency of Rheumatoid Arthritis = 4%, Confidence limit = 5%, population size = 1500. This was given a minimum sample size fifty-seven. So, we took sixty patients to be included in the study as case group and sixty healthy individuals as control group. Independent t-tests were used as we compared Means between the groups

Ethical considerations: All procedures in studies recruiting human subjects are performed based on the ethical standards of the institutional and/or national research committee and according to the 1964 Helsinki declaration and its subsequent amendments or similar ethical standards. The study was approved by the local ethics committee of Al-Azhar University at 2/APR/2017. Prior to Enrolment, all subjects were instructed about the objectives of the study, besides obtaining their informed written consent.

RESULTS

The median age of patients was 46.22 ± 8.14 years, with most patients were females [81.7 %]. The mean BMI was 29.16 ± 4.48. Among the 60 patients, 11.7 % were smokers, The mean systolic and diastolic blood pressure was 119.92 ± 7.51 mmHg and 79.50 ± 5.18 mmHg, respectively; this showed significant difference between patients and the control groups, Also, the mean heart rate among patients was 78.27 ±

8.51 b/pm, indicating that there was no significant difference between patients and control groups [Table 1].

As shown in table [2] the mean total leucocytic count was 7.69±1.75 and this showed a statistically marked difference between the two groups with a p-value of 0.046. With respect to the rheumatoid factor, it was positive in 91.7 % of the patients [n=55]. Whereas Anti- cyclic citrullinated peptide [Anti-CCP] was positive in only 25 % of patients [n=15] [Table 2].

Regarding Conventional echocardiographic examination, there was no statistical difference between study groups in relation to the LV diameter and thickness. The fractional shortening and ejection fraction was also showed no statistical difference between patients and controls. Using the color flow Doppler, we founded that 83.3 % of the examined patients had a normal mitral valve morphology and function and only 16.7 % of them had a trivial mitral regurgitation. Aortic valve was normal in 96.7 % of the patient group and only 3.3 % of them had a mild aortic regurgitation. Mild tricuspid regurgitation was also founded in 16.7 % in the patients group. Whereas the pulmonary valve function was normal in all patients, and the mean PASP was 25.75 ± 4.44 mmHg. There was a marked difference between the study groups in relation to the mitral valve. Assessment of speckle-tracking of left ventricular systolic function demonstrated diminished global longitudinal epicardial strain in the patient group [-16.80% versus -22.35%] with a P- value of less than [0.001]. Also, it showed a decrease in regional longitudinal strain in the following segments: inferior, infero septal, infero lateral, anterior, lateral and antero lateral [Table 3].

As shown in Table [4], there was a marked difference between study groups in relation to the regional longitudinal strain among the mentioned segments.

As shown in Figure [1], the mean global longitudinal strain was -16.51± 3.40 in RF positive patients and -20.0 in RF negative patients and this showed a statistical difference as the p- value =0.028. As regard anti-CCP, the mean global longitudinal strain was -17.93 ± 2.66 in anti-CCP positive patients and -16.42 ± 3.61 in anti-CCP negative patients with no statistical significance as the p-value =0.142.

Receiver operating characteristics [ROC] curve was used to define the best cut off value of GLS which was -20, with sensitivity of 76.7% specificity of 80% positive predictive value of 92%, negative predictive value of 63% with diagnostic accuracy of 83.9%.

Table [1]: Demographic data of participants

Demographic items		Patients (N=60)	Control (N=60)	t/x2#	p-value
Age (years)	Mean±SD Range	46.22±8.14 26-55	42.55±7.59 28-55	3.143	0.080
Gender	Female Male	49 (81.7%) 11 (18.3%)	42 (70.0%) 18 (30.0%)	3.938#	0.095
Weight(kg)	Mean±SD Range	88.75±12.51 64-110	84.85±12.58 64-100	1.552	0.063
Height(cm)	Mean±SD Range	172.68±6.47 155-180	172.40±7.76 155-180	0.026	0.872
BMI [wt/(ht)^2]	Mean±SD Range	29.16±4.48 19.4-36.33	27.57±3.94 19.75-32.65	2.013	0.160
Smoking	No Yes	53 (88.3%) 7 (11.7%)	48 (80.0%) 12 (20.0%)	0.878#	0.349
Duration(years)	<5years >5 years	6 (10.0%) 54 (90%)	--- ---	-	-
SBP (mmHg)	Mean±SD Range	119.92±7.51 110-130	115.50±6.86 100-120	5.409	0.023
DBP (mmHg)	Mean±SD Range	79.50±5.18 70-90	74.00±6.81 60-80	14.358	<0.001
HR (bpm)	Mean±SD Range	78.27±8.51 65-94	79.35±9.24 65-95	0.233	0.631

Table [2]: Comparison between patients and controls according to laboratory investigations

Laboratory investigation		Patients (N=60)	Control (N=60)	t/x2#	p-value
Hb(gm/dl)	Mean±SD Range	11.44±1.43 7.6-14	11.93±1.09 10-14	1.936	0.168
Platelet (* 10^6/mm3)	Mean±SD Range	267.37±83.12 160-400	292.00±86.19 167-411	1.294	0.259
TLC(*10^6/mm3)	Mean±SD Range	7.69±1.75 4-12.6	12.03±16.51 5.8-82	4.122	0.046
Urea(mg/dl)	Mean±SD Range	23.10±12.18 10-46	23.65±9.66 12-42	0.034	0.855
Creatinine(mg/dl)	Mean±SD Range	0.75±0.18 0.5-1.1	0.80±0.23 0.5-1.2	1.088	0.300
GFR (ml/min)	Mean±SD Range	139.92±35.63 76.4-236.11	135.58±53.24 74.72-258.33	0.172	0.680
TC (mg/dl)	Mean±SD Range	186.17±37.31 100-298	178.00±41.57 100-260	0.679	0.412
LDL (mg/dl)	Mean±SD Range	123.69±30.59 64-218	118.67±27.29 69-171	0.425	0.516
HDL (mg/dl)	Mean±SD Range	33.47±12.25 13-90	33.90±16.48 18-90	0.016	0.901
TG (mg/dl)	Mean±SD Range	128.70±38.72 26-256	114.95±31.91 52-178	2.052	0.156
ESR 1st (mm/hr)	Mean±SD Range	28.52±21.10 8-129	18.05±6.75 10-33	4.722	0.033
ESR 2nd (mm/hr)	Mean±SD Range	55.62±32.62 12-159	30.10±10.13 17-50	11.768	<0.001
CRP (mg/dl)	Mean±SD Range	17.24±13.63 1.9-48	5.81±5.48 2.1-20	13.258	<0.001
RF	Negative Positive	5 (8.3%) 55 (91.7%)	60 (100.0%) 0 (0.0%)	58.667#	<0.001
Anti- CCP	Negative Positive	45 (75.0%) 15 (25.0%)	60 (100.0%) 0 (0.0%)	6.154#	0.013

Table [3]: Comparison between patients and control according to ECHO analysis

ECHO analysis		Patients (N=60)	Control (N=60)	t/x2#	p-value
LA (cm)	Mean±SD Range	3.35±0.38 2.5-3.9	3.23±0.39 2.7-3.9	1.545	0.218
Aorta(cm)	Mean±SD Range	2.55±0.22 2.1-3	2.57±0.22 2.2-3	0.087	0.769
LVEDD (cm)	Mean±SD Range	4.64±0.55 3.48-5.65	4.69±0.60 3.48-5.65	0.108	0.743
LVESD (cm)	Mean±SD Range	3.03±0.43 2.02-3.86	2.98±0.44 2.02-3.43	0.189	0.665
IVSD (cm)	Mean±SD Range	0.74±0.17 0.52-1.1	0.71±0.17 0.52-1.1	0.376	0.541
PWD (cm)	Mean±SD Range	0.79±0.07 0.61-0.9	0.79±0.08 0.61-0.9	0.240	0.626
FS%	Mean±SD Range	34.88±4.43 28.96-46.98	35.27±4.23 28.96-46.98	0.117	0.733
EF%	Mean±SD Range	64.62±5.85 55.45-79.1	65.52±6.49 57.5-79.1	0.340	0.562
MV	Normal Trivial MR	50 (83.3%) 10 (16.7%)	60 (100.0%) 0 (0.0%)	6.810#	0.041
AV	Mild AR Normal	2 (3.3%) 58 (96.7%)	0 (0.0%) 60 (100.0%)	0.684#	0.408
TV	Mild TR Normal Trivial TR	10 (16.7%) 39 (65.0%) 11 (18.3%)	6(10.0%) 45 (75.0%) 9 (15.0%)	0.762#	0.683
PV	Normal	60 (100.0%)	60 (100.0%)	0.000	1.000
PASP (mmHg)	Mean±SD Range	25.75±4.44 20-38	24.40±3.50 20-30	1.530	0.220

Table [4]: Comparison between patients and controls according to speckle analysis

Speckle analysis		Patients (N=60)	Control (N=60)	t-test	p-value
Basal Ant	Mean±SD Range	-21.55±6.77 -42_-9	-24.25±5.89 -42_-18	2.538	0.115
Basal AS	Mean±SD Range	-20.22±6.67 -32_-5	-23.10±4.12 -30_-18	3.304	0.073
Basal IS	Mean±SD Range	-14.82±5.86 -24_-6	-22.15±6.19 -32_-9	22.867	<0.001
Basal Inf	Mean±SD Range	-14.42±5.92 -25_-6	-21.75±5.49 -32_-13	23.830	<0.001
Basal IL	Mean±SD Range	-16.27±6.64 -26_-6	-24.10±3.88 -33_-18	24.897	<0.001
Basal AL	Mean±SD Range	-15.85±10.48 -31_9	-23.35±3.47 -31_-18	9.817	0.002
Mid Ant	Mean±SD Range	-16.50±5.63 -27_-6	-21.10±5.01 -32_-14	10.531	0.002
Mid AS	Mean±SD Range	-21.33±5.92 -39_-1	-24.10±6.26 -39_-17	3.184	0.078
Mid IS	Mean±SD Range	-15.20±11.21 -34_12	-23.95±6.07 -34_-15	11.036	<0.001
Mid Inf	Mean±SD Range	-21.10±5.35 -33_-11	-21.85±2.83 -28_-19	0.358	0.552
Mid IL	Mean±SD Range	-20.38±6.45 -35_-9	-23.10±4.09 -30_-16	3.117	0.081
Mid AL	Mean±SD Range	-18.10±6.11 -28_-8	-22.05±4.61 -28_-14	7.009	0.010
Apical Ant	Mean±SD Range	-15.35±5.27 -25_-3	-21.55±4.17 -28_-15	22.869	<0.001
Apical S	Mean±SD Range	-17.57±10.11 -31_10	-22.85±4.59 -32_-18	5.077	0.027
Apical Inf	Mean±SD Range	-23.18±5.15 -32_-9	-22.30±4.54 -32_-17	0.467	0.496
Apical Lat	Mean±SD Range	-17.20±3.93 -28_-5	-22.70±4.80 -28_-13	26.221	<0.001
Apex	Mean±SD Range	-18.02±4.10 -28_-5	-22.40±4.57 -30_-13	16.175	<0.001

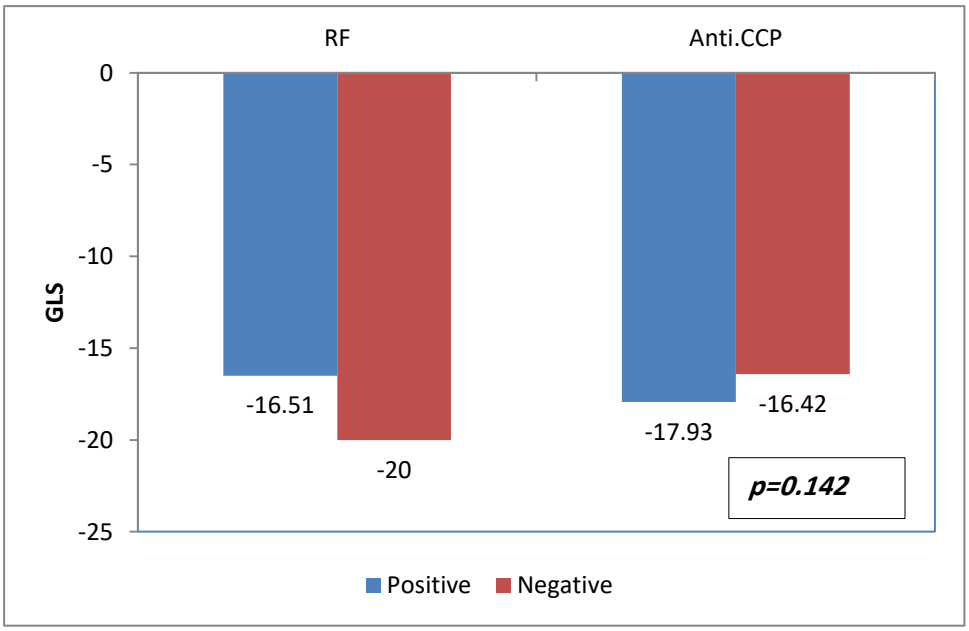

Figure [1]: Bar chart between positive/negative RF(LT) and Positive/negative Anti-CCP (RT) according to GLS

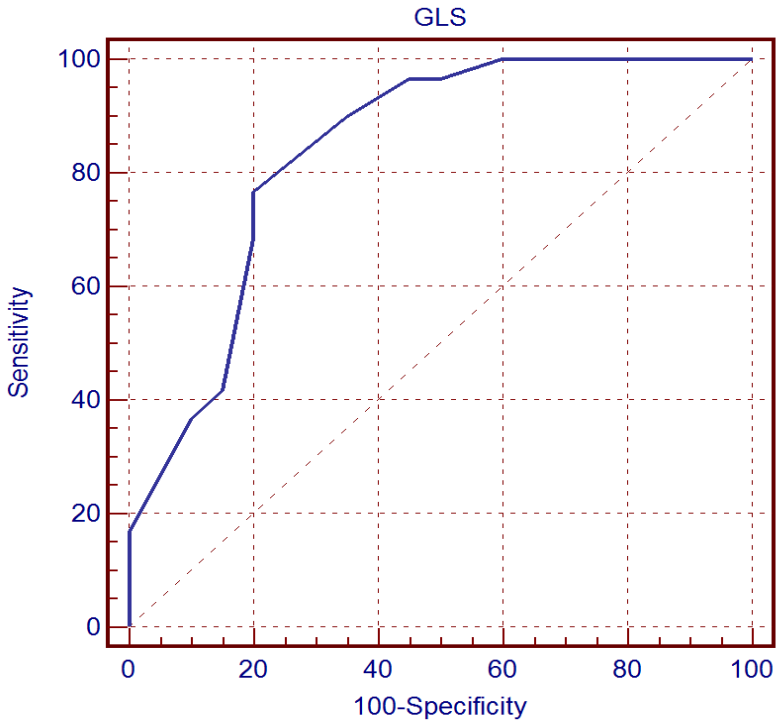

Figure [2]: ROC curve diagnostic Performance of GLS in Discrimination between patients and control

DISCUSSION

The key finding of the present study is that GLS computed via utilizing STE the left was decreased in cases with RA without CVD history as well as normal ejection fraction compared to the normal control groups. Also, GLS is reduced in RA patients with RF +ve more than those with RF -ve. Strain abnormalities were correlated with indices of RA disease acuteness like ESR as well as CRP. Risk factors for traditional CVD like smoking, hypertension, hyperlipidemia, as well as diabetes have not been able to portend abnormal values of strain in RA cases, indicating the strain dysfunction was probably induced by RA. Moreover, systolic strain dysfunction was not associated with diastolic impairment as detected by echocardiography and was impaired in RA cases with no or mild diastolic dysfunction, indicating that strain can be a more accurate non-invasive tool for identifying mechanical LV impairment in RA cases. These results indicate that subclinical myocardial disease can be found in RA cases before developing symptomatic CVD. This can be due to the systemic inflammation in seropositive RA is correlated with increased inflammatory cytokine release such as IL-6 as well as TNF that results in endothelial impairment, which is the 1st phase of atherosclerosis [17]. In the study of Logstrup *et al.* [18], It was demonstrated that in RA cases, elevated baseline anti-CCP was correlated with deterioration of GLS throughout two-year follow-up period compared with cases with normal baseline anti-CCP [0.6 ± 1.8% vs 1 ± 2.8%; p = 0.04] even though there was a non-significant difference in the score of coronary calcium during this period [23.8 ± 40.3 vs 22.6 ± 68.9; p = 0.96]. These results are compatible with those of the present research on seropositive RA, the greater the depression in left ventricular function. Also, Fine *et al.* [16] in their research on 87 RA cases, GLS of decreased left and right ventricle compared with normal individuals [p < 0.001]. Ikonomidis *et al.* [19] investigated interleukin inhibitor impact on the function of blood vessels as well as myocardial deformation in 80 RA cases. They detected a marked GLS improvement following interleukin inhibitor improvement, particularly in coronary artery disease. the left ventricular systolic function detected via echocardiography was almost normal in all groups investigated. In addition, it was not associated with GLS decline in the active RA group, indicating that GLS is an

accurate tool in such cases to detect the precocious phase of myocardial impairment.

All these data support that GLS is a well-proven way to detect any decline in ventricular systolic function even in the existence of a normal ejection fraction [20]. In contrast to our data, Logstrup *et al.* [15] illustrated that reduced anti-CCP antibody level bind to diminished GLS. Additionally, Meune *et al.* [21] in their research on 27 RA cases, they detected a non-significant change in systolic strain between RA subjects as well as the control group. Their results were attributed to method they utilized in the measurement of the strain. They utilized tissue Doppler instead of STE that is more accurate and automated strain measurement technique.

Limitations of the study: This was a single-center study with a modest patient sample size. Strain values of rheumatoid arthritis patients were compared with those of normal patients without a history of cardiovascular disease and with normal ventricular function on clinically indicated transthoracic echocardiography, rather than a prospectively recruited cohort of normal subjects, which may be a potential source of bias. We studied only the systolic function of the left ventricle whereas the diastolic function was not included in our study as it has been studied in many of research.

Conclusion: GLS measurement using STE is valuable in detecting impairment of left ventricle systolic function in RA patients, even in the presence of normal ejection fraction. Not only that but also, the degree of systolic function impairment is correlated to RA disease activity. This raises the concern that inappropriate management of RA activity could lead to development of CVD.

Recommendations and future directions: From this study, we recommend that patients with rheumatoid arthritis should undergo a full comprehensive echocardio-graphic study for assessment of LV systolic function, as well as for cardiac valves. Using the technology of speckle tracking echocardio-graphy for measuring strain in those patients is beneficial as it helps detecting the subclinical LV systolic dysfunction which may affect those patients. We also recommend doing an exercise stress test for those patients with affected strain, if positive stress test we must proceed for a coronary angiography but if the test is negative, a follow- up echocardiography is recommended.

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REFERENCES

1. Cioffi G, Viapiana O, Ognibeni F, Dalbeni A, Gatti D, Adami S, *et al.* Prevalence, and factors related to left ventricular systolic dysfunction in asymptomatic patients with rheumatoid arthritis. A prospective tissue Doppler echocardiography study. Herz. 2015 Nov;40[7]:989-96. DOI: 10.1007/s00059-015-4320-5.

2. Peters MJ, Symmons DP, McCarey D, Dijkmans BA, Nicola P, Kvien TK, *et al.* EULAR evidence-based recommendations for cardiovascular risk management in patients with rheumatoid arthritis and other forms of inflammatory arthritis. Ann Rheum Dis. 2010; 69[2]:325-31. DOI: 10.1136/ard.2009.113696.

3. Wong JB, Ramey DR, Singh G. Long-term morbidity, mortality, and economics of rheumatoid arthritis. Arthritis Rheum. 2010; 44[12]:2746-9. DOI: 10.1002/1529-0131 [200112]44:12<2746::aid-art461>3.0.co;2-z.

4. Curtis JR, Yang S, Singh JA, Xie F, Chen L, Yun H, *et al.* Is Rheumatoid Arthritis a Cardiovascular Risk-Equivalent to Diabetes Mellitus? Arthritis Care Res [Hoboken]. 2018; 70[11]:1694-1699. DOI: 10.1002/acr.23535.

5. Mantel Ä, Holmqvist M, Andersson DC, Lund LH, Askling J. Association Between Rheumatoid Arthritis and Risk of Ischemic and Nonischemic Heart Failure. J Am Coll Cardiol. 2017 Mar 14;69[10]:1275-1285. DOI: 10.1016/j.jacc.2016.12.033.

6. Roman MJ, Moeller E, Davis A, Paget SA, Crow MK, Lockshin MD, *et al.* Preclinical carotid

atherosclerosis in patients with rheumatoid arthritis. Ann Intern Med. 2006 Feb 21; 144[4]:249-56. DOI: 10.7326/0003-4819-144-4-200602210-00006.

7. Solomon DH, Kremer J, Curtis JR, Hochberg MC, Reed G, Tsao P, *et al.* Explaining the cardiovascular risk associated with rheumatoid arthritis: traditional risk factors versus markers of rheumatoid arthritis severity. Ann Rheum Dis. 2010;69[11]:1920-5. DOI: 10.1136/ard. 2009.122226.

8. Solomon DH, Reed GW, Kremer JM, Curtis JR, Farkouh ME, Harrold LR, *et al.* Disease activity in rheumatoid arthritis and the risk of cardiovascular events. Arthritis Rheumatol. 2015;67[6]:1449-55. DOI: 10.1002/art.39098.

9. Rovenský J, Vlcek M, Imrich R. Kardiovaskulárne ochorenia u reumatoidnej artritídy [cardiovascular diseases in rheumatoid arthritis]. Vnitr Lek. 2010 Jul;56[7]:721-3. Slovak. PMID: 20842919.

10. Innala L, Möller B, Ljung L, Magnusson S, Smedby T, Södergren A, *et al.* Cardiovascular events in early RA are a result of inflammatory burden and traditional risk factors: a five-year prospective study. Arthritis Res Ther. 2011 Aug 15;13[4]: R131. DOI: 10.1186/ar3442.

11. Karpouzas GA, Malpeso J, Choi TY, Li D, Munoz S, Budoff MJ. Prevalence, extent, and composition of coronary plaque in patients with rheumatoid arthritis without symptoms or prior diagnosis of coronary artery disease. Ann Rheum Dis. 2014 Oct;73[10]:1797-804. DOI: 10.1136/annrheumdis-2013-203617.

12. Myasoedova E, Davis JM 3rd, Crowson CS, Roger VL, Karon BL, Borgeson DD, *et al.* Brief report: rheumatoid arthritis is associated with left ventricular concentric remodeling: results of a population-based cross-sectional study. Arthritis Rheum. 2013 Jul;65[7]:1713-8. DOI: 10.1002/art.37949.

13. Sitia S, Tomasoni L, Cicala S, Atzeni F, Ricci C, Gaeta M, Sarzi-Puttini P, Turiel M. Detection of preclinical impairment of myocardial function in rheumatoid arthritis patients with short disease duration by speckle tracking echocardiography. Int J Cardiol. 2012 Sep 20;160[1]:8-14. DOI: 10.1016/j.ijcard. 2011.03.012.

14. Baktir AO, Sarli B, Cebicci MA, Saglam H, Dogan Y, Demirbaş M, Sutbeyaz ST, Arinc H. Preclinical impairment of myocardial function in rheumatoid arthritis patients. Detection of myocardial strain by speckle tracking echocardiography. Herz. 2015 Jun;40[4]:669-74. DOI: 10.1007/s00059-014-4068-3.

15. Løgstrup BB, Deibjerg LK, Hedemann-Andersen A, Ellingsen T. Left ventricular function in treatment-naive early rheumatoid arthritis. Am J Cardiovasc Dis. 2014 Jun 28;4[2]:79-86. PMID: 25006535.

16. Fine NM, Crowson CS, Lin G, Oh JK, Villarraga HR, Gabriel SE. Evaluation of myocardial function in patients with rheumatoid arthritis using strain imaging by speckle-tracking echocardiography. Ann Rheum Dis. 2014 Oct;73[10]:1833-9. DOI: 10.1136/annrheumdis-2013-203314.

17. Choy E. Understanding the dynamics: pathways involved in the pathogenesis of rheumatoid arthritis. Rheumatology [Oxford]. 2012 Jul;51 Suppl 5: v3-11. DOI: 10.1093/rheumatology/ kes113.

18. Løgstrup BB, Masic D, Laurbjerg TB, Blegvad J, Herly M, Kristensen LD, *et al.* Left ventricular function at two-year follow-up in treatment-naive rheumatoid arthritis patients is associated with anti-cyclic citrullinated peptide antibody status: a cohort study. Scand J Rheumatol. 2017 Nov;46[6]:432-440. DOI: 10.1080/03009742.2016.1249941.

19. Ikonomidis I, Tzortzis S, Andreadou I, Paraskevaidis I, Katseli C, Katsimbri P, *et al.* Increased benefit of interleukin-1 inhibition on vascular function, myocardial deformation, and twisting in patients with coronary artery disease and coexisting rheumatoid arthritis. Circ Cardiovasc Imaging. 2014 Jul;7[4]:619-28. DOI: 10.1161/CIRCIMAGING.113. 001193.

20. Lang RM, Badano LP, Mor-Avi V, Afilalo J, Armstrong A, Ernande L, *et al.* Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015 Jan;28[1]:1-39. e14. DOI: 10.1016/j.echo.2014.10.003.

21. Meune C, Wahbi K, Assous N, Weber S, Kahan A, Allanore Y. Myocardial dysfunction in rheumatoid arthritis: a controlled tissue-Doppler echocardiography study. J Rheumatol. 2007 Oct;34[10]:2005-9. PMID: 17787044.

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